



Featherflowers and Coppercups

**Spring 2017
Vol 29 No 232**

\$6.⁵⁰

Australian Plants

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This issue has been produced by Hazel Dempster. Layout by Jim Barrow. In each article, all photos are by the author unless otherwise indicated. Front cover: *Verticordia aurea* Photo Sally Page. Back cover *Pileanthus vernicosus* Photo Hazel Dempster

Australian Plants is published quarterly to promote knowledge of Australian native plants. Contributions and offers to produce an issue are welcome. Please contact:

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Australian Plants No. 232 Issue of Volume 29 which comprises issues 230 - 237
Published quarterly and available nationally in 3000 copies by the Australian Plants Society NSW Ltd

© Australian Plants Society NSW Ltd 2017 ABN 87 002 680 408 ISSN 0005-0008
Printed by Elect Printing, Fyshwick, ACT Print post approved 100009857

fungal infections such as botrytis on their foliage, and in sheltered sites with poor air circulation they can rapidly lose most of their foliage and die. It is therefore critical in cooler areas to ensure your *Verticordias* and *Pileanthus* are planted where they will get maximum winter sun and good air circulation.

Another essential element in their successful cultivation is the provision of a gravel or sand mulch over the beds. Organic mulches all contain fungal spores which splash up onto the foliage, resulting in rapid loss of the plants. I find coarse, washed river sand ideal as it is fungus free, and reflects light back up off the ground into the lower foliage of the shrubs, keeping them healthy.

We have a good collection of both grafted and ungrafted plants in a number of beds around the property, and the best of these for us would have to include *Pileanthus aurantiacus*, *P. rubrinitidus*, *Verticordia albida*, *V. chrysostachys*, *V. dichroma*, *V. grandis* which really thrives, *V. insignis*, *V. lepidophylla*, *V. mitchelliana*, *V. muelleriana*, *V. ovalifolia* and *V. pennigera*. The absolute winners in our garden are *Verticordia ovalifolia* — low form, which comes into flower in early December and flowers with massed large pale pink flowers well into summer. I have planted these everywhere in the gardens and they always put on a superb show late in the season, and usually well before all the summer *Verticordia*'s are out.

Verticordia mitchelliana particularly the low form creates a superb display with its massed rich red pendulous flowers on strongly horizontal branches — this makes it a winner for bold landscaping displays! Another winner is *V. grandis*, which grows rapidly for us here in a strong upright habit. All plants are absolutely covered with large red flowers right throughout the long summer months so long as there is sufficient subsoil moisture to allow them to keep forming more flower buds. Our largest plants are now 1.5 m tall and around 1 m wide. Another, which really thrives is the superb hybrid *V. 'Wemm's Find'* which is a natural hybrid between *V. monadelpha* and *V. oculata*.

Verticordias and *Pileanthus* require little maintenance if their requirements for good drainage, air circulation and full sun are observed. Unless you are hoping to collect seed from your plants they should be lightly pruned back soon after flowering. This will allow plenty of time for new growth to establish prior to the next winter. The resultant plants will remain compact and free flowering the following season. If an outbreak of fungal infection begins to result in leaf drop, a broad spectrum, systemic fungicide should be immediately sprayed onto the plants. This may need repeating every few months in cooler climates.

Phillip Vaughan is also now grafting a large range of superb *Pileanthus* and *Verticordia*, so the number of species getting into gardens is gradually growing. I have quite a few friends who see our spectacular summer displays of our *Pileanthus* and *Verticordia* and have begun grafting their own plants which is really great to see. Most grafted species thrive for me on *Chamelaucium uncinatum* 'Purple Pride' rootstocks. Grafted plants perform so much better, being able to withstand cold wet winters far better than plants on their own roots. They have more resistance to disease and survive the long hot summers better too!

I have also been lucky to get a good number of *Verticordias* from a few collectors in South Australia, particularly John Edmonds-Wilson and John and Julie Barrie. As a result, I have around 30-40 species of *Verticordia* and about 4 species of *Pileanthus* growing successfully in our gardens here in western Victoria. With climate change, our annual rainfall has halved from around 700 mm to around 350 mm. As a result, we can now grow WA sandplain plants far easier than we can our

Eastern species — these just cannot survive our now long dry summers.

Our *Verticordias* and *Pileanthus* on the other hand are mostly thriving, so long as they are planted into well prepared, full sun sites with excellent air circulation. We deep rip our granite soils for garden beds, then build them up to at least 30-40 cms high. This ensures perfect drainage over winter, and allows deep root penetration for the long hot summers. Most *Verticordia* and *Pileanthus* seem to be quite frost hardy, although we rarely get many. However both genera are highly prone to



Pileanthus rubrinervis in front of *Grevillea eriostachya*.

Editorial and Introduction

Hazel Dempster

Life member of the WA Wildflower Society, recipient of the Australian Plants Award and Ad Dip Horticulture WA. She is plants advisor to Boxed Green.

My exposure to these two spectacular genera on numerous trips to the Lower Murchison in late spring over the years, with the intrepid plants hunters and horticulturists from the Wildflower Society of WA Northern Suburbs Volunteer Nursery, has been very intense. *Verticordia* and *Pileanthus* are sought because of their outstanding colour and horticultural potential.

Verticordia became more familiar to us all when Elizabeth George set out to find more about them by setting up the *Verticordia* Growing Group from 1980 and, along with Dr Alex George, later accounted for four new taxa bringing numbers to 101 species. The Growing Group including Pat and Norm Moyle and the ASGAP *Verticordia* Study Group made headway with their propagation and cultivation. Elizabeth's book, "*Verticordia*" became a must for all enthusiasts with its detailed explanations, horticultural advice and identification from beautifully detailed coloured artwork of each species by botanical artist Margaret Pieroni.

At the moment, these two genera are on a botanical journey and their final resting place is still to be decided. Jim Barrow describes this well here but like us all must wait for any decision. As both genera have shown the ability to hybridise across specific species within their genera, as well as *Verticordia* intergeneric crossing with *Chamelaucium* species, their new positions will be of interest.

This issue shows progress in horticultural methods to tame these wonderful species. Newcomer, Shaun Tennant, explains how he came to gather the knowledge and successfully propagate and grow *Verticordia*.

Sally Page, daughter of Pat and Norm Moyle, carries on the legacy left to her in the creation of new and delightful *Verticordia* and *Pileanthus* in her garden in Gingin along with many other interesting species.

Greg Keighery, Senior Principal Research Scientist with the W.A. Department of Biodiversity, Conservation and Attractions, reminds us of the Key for the 8 *Pileanthus* species and one sub species of which Jeff Mountstephen, an original member of the *Verticordia* growing group explains his challenges with all the *Pileanthus* species.

To touch on how space-age methods are used to produce generic plants with manipulated colour attributes, Digby Gowns and Tony

Scalzo researchers from Kings Park and Botanic Gardens, are looking at a brave new world in horticulture. We may be introduced to some amazing new manipulated plants in the future. Plants developed across genera will become the floricultural norm.

Bob Dixon retired Horticultural Advisory Officer from Kings Park and Botanic Garden explains his uncanny ability to successfully grow from seed.

Philip Vaughan from Victoria has intrigued us all with his grafting ability and desire to be able to grow many more species on different root stocks to suit specific surrounds.

The final paper from Neil Marriott, well known Australian horticulturalist from Victoria, explains how the two WA genera grow and survive in the conditions in his garden.

The interest in these spectacular genera is widespread. While it is pleasing to see their emergence in horticulture, careful monitoring must occur to ensure that their places in their natural environment remain viable.

Further Reading

Elizabeth A (Berndt) George . Margaret Pieroni Illustrator (2002) *Verticordia The turner of hearts*. Pub University of WA Press Crawley Western Australia 6009.

Acknowledgements

I would sincerely like to thank all the authors of this Featherflowers and Coppercups issue of "Australian Plants" for their generous support with contributions and photographs: Special thanks to Jim Barrow with his expertise to set up the layout and design.

Hazel E Dempster (hazeldempster@bigpond.com).



Hybrid Verticordias from the Moyles' garden (left) and (right) from the garden of their daughter, Sally Page (see page 114).

Pileanthus and Verticordia cultivation in Victoria

Neil Marriott,

Neil Marriott is the former owner of White Gums Nursery in the Grampians region of Western Victoria for 20 years. White Gums rapidly gained the reputation as the place to go for a huge range of Western Australian plants, most of which were growing superbly in large display gardens. Neil has been studying West Australian plants for over 30 years, discovering and describing many plants new to science. He is co-author of the "Grevillea Book" as well as 'Grassland Plants of SE Australia'. He is a life member of APS Victoria. He leads wildflower tours with Birdswing Tours to Western Australia every year.

It often seems to me that over here in the East, there are only a handful of Verticordias that are readily available in native nurseries such as *Verticordia chrysantha*, *V. plumosa* and occasionally *V. chrysanthella* and *V. mitchelliana*.

With *Pileanthus* there is even less knowledge, apart from a handful of collectors' gardens, they are virtually unknown in cultivation. As a result, it is extremely difficult for collectors such as myself to be able to access material for cultivation. When I used to run White Gums Nursery I used to get struck cuttings from that wonderful couple from the West, Pat and Norm Moyle. This allowed me to build up a good collection of species that I have been re-propagating from cuttings. With their sad passing, their daughter Sally Page is now ably filling that gap.



Pileanthus aurantiacus in front of *Verticordia insignis* ssp *eomagis*.

Acknowledgments

I have been extremely fortunate to have been mentored by George Lullfittz, whose generosity and willingness to share his remarkable and dedicated life's work can never be overstated. Sharing the following decades with knowledgeable plantsmen, as friends, such as Peter Olde and Neil Marriott, whose nursery, from that initial period, was full of rare and unusual plants, had such a big influence. I am full of admiration for another mate, Digby Grown, from King's Park, where his work with *Verticordia* and many others, is exposing our flora to the world.



Grafted *V. muelleriana* hybrid..



Part of Vaughan's garden.



Grafted *Verticordia mirabilis*. Photo: Hazel Dempster.

Verts and rels

Jim Barrow

In a former life, Jim was a Chief Research Scientist in CSIRO. He is now an Adjunct Professor at UWA and at 85 still publishing research papers on soil chemistry and plant nutrition — and writing articles for Australian Plants.

Botanists do not always choose an appropriate name for plants. For example, an upright growing *Hakea* is called *Hakea prostrata*. (It was first collected from an exposed ocean-side location.) But they sometimes get it spectacularly right: as in *Verticordia*. The name comes from the Latin “vertere” to turn and “cordia” hearts. So the name means the turner of hearts — which was one of the appellations of the goddess Venus. She was the goddess of beauty and the plant was so named because of the great beauty of flowers. (By the way, she was also the goddess of love, desire, sex, fertility, prosperity and victory. Make of that what you will.)

The name is also appropriate because the genus is, of course, a member of the Myrtaceae (Myrtle) family and myrtle was sacred to Venus. There is another similarity: both the goddess and the plant attract a group of dedicated worshippers. In the case of the plant, we have been fortunate that some of these “worshippers” have provided articles for this issue.

What makes a *Verticordia*?

The most obvious characteristic is that the sepals are mostly multiply divided and coloured to match the petals. Hence the common name “featherflowers”. Notice that “weasel” word: mostly. *Verticordia* is a member of the “*Chamelaucium* alliance”, a group of about 600 closely related plants that are very difficult to shove into nice discrete boxes: there is always something that doesn't quite fit. An example is the plant currently known as *Verticordia verticordina*. It was first described as *Chamelaucium*, then became a *Darwinia* and was then (with some reluctance) put into *Verticordia*. This is perhaps not surprising as these two genera are closely related to *Verticordia*.

The relatives.

One solution to the problem of plants that cannot be fitted into nice neat boxes is to “lump” closely-related genera into one large genus. If this were done for *Verticordia* and its close relatives, the resulting genus would be called *Pileanthus*, because this was the first-named genus (1809). The problem with that solution is that it loses a great deal of information just as putting *Dryandra* into *Banksia* has lost information.

Pileanthus is well dealt with in the rest of this issue. Here we will deal with two close genera: *Darwinia* and *Chamelaucium*.

Darwinia was named after Erasmus Darwin, the grandfather of Charles. It has had more boundary changes than Poland. Blackall and Grieve ("How to know West Australian Wildflowers") separated it from *Chamalaucium* by the length of its style. But, as is usually the case in this group, there were some plants that did not fit. They had long styles, but were otherwise similar to *Chamalaucium*.

The genus is now specified in terms of the bracts that surround the flowering head. These may be large and conspicuous as in the Mountain Bells. There are also some species in which the inflorescence is up turned and sits on the ground outside the canopy of the parent plant (Photo below).



A long-styled *Chamaleucium*, informally known as *C. erythroclorum* rather than *C. sp.* Yoongarillup (G.J. Keighery 3635).



Gillam's Bell. *D. oxylepis*.



Darwinia nieliana.



Albany swamp daisy *Actinodium cunninghamii*.

Of the approximately 70 species names listed in FloraBase, about a quarter are "not current" And there-to hangs a tale. Several years ago, a manuscript was prepared assigning names to several new species in *Darwinia* and *Chamelaucium*. But it was not published. Botanists familiar with these genera often use these names, but in the quaint terminology of FloraBase not published is recorded as "not current".

well for some time. This has meant the need for interstock use, where a second graft is done as a bridge between the preferred rootstock and the desired top. Some very promising results are being seen in both *Verticordia* and *Pileanthus*, with species which have previously shown incompatibility. Plants such as *V. cooloomia* and *V. nitens* are examples of *Verticordia* to be exhibiting promise in this regard. It should be noted that new stock/scion combinations should be trialled for an acceptable time to ensure the new combination is sound.

Soil borne failure of grafted plants is not usually the fault of the combination or incompatibility. Death is more likely due to the rootstock not being happy in a particular soil or other factors such as fungus. *V. grandis* is a great example. Plants thrive through warmer conditions, flowering brilliantly. The plant attempts to continue flowering in the cold, wetter months, with blooms acting like feathery sponges which hold moisture, that turns to fungus, dying back into the stem, often killing the plant. For this reason, regular pruning at this time [autumn] of the year will create a denser plant but also remove flowers from the plant and thus the potential of moulds.

Staking young grafts is often required as increased vigour of grafted plants means denser, heavier growth loads. This can place stress on what are often very thin stems and young graft unions. Stakes can usually be removed once calliper diameter thickens.

Grafting *Verticordia* and *Pileanthus* has meant that over 50 successful and reliable combinations have been achieved. This means that varieties such as *V. mirabilis*, *V. serotina*, *V. oculata* and *P. filifolius*, *P. aurantiacus*, *P. vernicosus* are now available for gardeners to enjoy.

The process of production of *Verticordia* and *Pileanthus* is to use a top wedge graft [or others such as whip if that is preferred by the grafter, as it seems to have no bearing on the outcome], with very small pieces, no larger than 2.5 cm, of scion material, with some active axillary buds. Unions are wrapped with Parafilm tape, or a suitable substitute, and the completed grafts placed in a warm environment until growth of the scion is noticed. There should be no direct sunlight at this time. This graft union forming period usually takes around 3-6 weeks. Plants are then gradually hardened off. Humidity is best avoided during this process, as fungal attack often effects soft, young shoots. It is advisable to remove any flowers, as they attract fungus, and plant energy is best used to promote leaf and stem development. New grafts are best planted out when they have reached a reasonable size [10 cm of scion] with preference being firm, well grown plants suitable for 140 mm pot. This allows for unions to properly form and stems to reach a suitable diameter.

Grafting Verticordia and Pileanthus

Phil Vaughan

Phil is a nurseryman and dedicated collector of Australian plants, who developed the passion from visiting the West, in the early eighties. Grafting began when being constantly told that the showy WA plants cannot be grown in the east.

Verticordia and Pileanthus are amongst the most desirable of all of our native flora. Unfortunately, they are often some of the more fickle plants to cultivate in gardens. With the advent of grafting, many of these have become spectacular garden subjects, with new combinations of stock and scion. The range of successful plants is increasing all the time.

Doug McKenzie was one of the first to delve into producing Verticordias on a larger scale, using the grafting process. His ground work is the basis for what is used today. Seeing his plants enthused me to a great extent, leading me to become an obsessive collector. Today along with Doug's son, Peter, we are endeavouring to introduce a wide range of species and varieties in commercial quantities. This has meant much experimentation with stock/scion combinations, as there is no such thing as a universal rootstock. It also needs to be noted that many plants are susceptible to failure in regions associated with high rainfall or humidity. Grafting can help with increased vigour, which aides in recovery, but death still occurs in many instances.

Rootstocks are chosen for their ability to grow in a wide range of soil types and conditions.

Doug used a basic system, with *Darwinia citriodora* as the stock for "straight leaf" Verticordia i.e. *V. monadelpha*, *V. galeata*, *V. pritzellii* and *V. mitchelliana* being examples. *Chamelaucium uncinatum* or Geraldton wax was and is used for the round leaf species. *V. grandis*, *V. muelleriana*, *V. chrysostachys* and *V. dichroma* are produced using this combination. This is still the standard for today's grafts. Currently dieback resistant clones of *Chamelaucium* are being assessed. A number of intergeneric rootstocks are being trailed with varying degrees of success. Plants of *Homoranthus* sp. for example, are being tested for compatibility and adaptability in a range of soil types and climatic conditions. Intergeneric stock use is particularly the case with *Pileanthus* spp such as *P. bellus*, *P. limaceus* and *P. filifolius*, which all fall off the *Darwinia* and *Chamelaucium* genera, presumably due to incompatibility. In simple terms this means there is a problem between the rootstock and scion. This can be seen as complete failure of the graft to take, a miss match of stem diameter between top and bottom, or a "falling off" when bumped or from excessive wind, even after appearing to be successful, or growing

Much larger changes in *Darwinia* are also possible. Perhaps the Albany Swamp Daisy is just an upturned *Darwinia* and should be included? The splitters axe also hovers. The eastern species are thought to be sufficiently different to be split off to form a separate genus. As the type species is found in the Blue Mountains, the Eastern group would take the name *Darwinia* and the Western group a different name.

Chamelaucium uncinatum, the inappropriately called Geraldton wax, is the best known member of this genus. It occurs in several separate populations and is thought to have been originally confined to the calcareous Quindalup dunes between Perth and Geraldton. The name is inappropriate because the type specimen was collected near the Roundhouse in Fremantle not in Geraldton. The separate populations differ somewhat and this variation has been used in breeding. The species is now well established in horticulture and has been subjected to much selection and cross breeding. This genus is subject to the same problem as *Darwinia* with about 40% of the names listed in FloraBase as "not current".

C. uncinatum has been crossed with other species including the large-leaved wax flower *C. megalopetalum*.



C. uncinatum cultivar "Purple Pride".



A specially red form of *C. megalopetalum*.
Photo: Digby Grows.

Verticordia

One might think that such a well-loved genus, easily recognised by a common characteristic and very popular in horticulture, would be immune from the splitters axe. But one would be wrong! The axe hovers. Studies on chromosome number, ovule number and molecular genetics suggest that the feathery sepals have evolved more than once. To modern systematic botanists, similarity is unimportant and evolutionary sequence is everything. Plants in any kind of group should have a recent common ancestor.

The new genera will be similar to current sub-genera, but with some changes. The names used will probably be those of the current sub

genera but in order to not infringe on priority they will not be used here.

Genus 1

The group contains most of the yellow species. They have fewer than six (mostly 2) ovules, and $n = 6$ to 8 chromosomes



V. chrysantha.

V. galeata.

Genus 2.

This group contains the type species and would therefore be called *Verticordia*. None of the flowers are yellow.. They have fewer than six (mostly 2) ovules, and $n = 6$ to 9 chromosomes.



The marvellous *V. monadelph* (pink and white forms) photographed in Moyles' garden - see article by Sally Page).

Seedlings at the cotyledon stage can also be directly planted into their final growing positions under ideal cool and moist growing conditions in winter. Species successfully transplanted this way include *V. lindleyi* ssp *lindleyi*, *V. densiflora* and *V. roei*. However, they require intensive management to prevent predation, and competition from weeds.



V. roei. Photo Hazel Dempster.



V. paludosa. Photo Sally Page.

Growing on

Grow in full sun and make sure seedlings are not too wet in winter. You may experience yellowing of the foliage. This can indicate the plants are too wet or have a nutrient deficiency. To correct, apply micronutrients; make sure you use a product that has a combination of micronutrients to reduce the risk of making the problem even worse as some deficiencies are difficult to identify.

If you wish to grow on seedlings for a year, most species will be okay in forestry pots but may require a light tip pruning to stop the plants getting too high. Most *Verticordia* seedlings, whether grown in situ or in containers, will produce a few flowers when about 15 months old.

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Personal communications

Growns, D. Senior Plant Breeder, Botanic Gardens and Parks Authority, Perth, Western Australia.

Acknowledgements

Public Transport Authority, for funding Botanic Gardens and Parks Authority project-Translocation of *Verticordia lindleyi* ssp *lindleyi*.



Verticordia grandis, 1 day old seedlings ready for pricking out.

will be shorter, reducing any potential damage to the root. The main root will go down to the bottom of the pot. Hold the seedling between thumb and forefinger. If the root is small you can just make a hole with a special tool for this purpose or just use an inverted pencil. Lightly press the mix around the root but making sure the cotyledons are at the top of the mix.

Long or lanky seedlings can also be pricked out as long as the stem is buried up to the cotyledons. When at the right level touching the mix, the cotyledons will sit just above the mix after watering. Early pricking out also isolates the individual seedlings reducing the risk of fungal infections such as damping off. Some of these diseases can go through a pot full of seedlings within days. After pricking out, water in and place in cool lightly-shaded conditions for one or two days, then gradually harden off into full sunlight.



Verticordia picta, a 3 year old plant grown from seed.

Potting on larger seedlings with long root systems may require trimming of some roots, to prevent them curling around. To produce better root systems, fill the pot with potting mix at an angle creating a triangle, full at the base of the pot and angling towards the top. Place the roots on the angle laying them flat and then continue to fill up the pot whilst holding the seedling but making sure the top of the seedling is upright and in the middle of the pot. Firm down the mix around the seedling carefully to avoid damaging the root system.



V. plumosa, the second species named.



V. huegelii. In common with many plants the old flowers turn red and are then invisible to insects.

Genus 3.

None of the flowers are yellow. They have six or more ovules, and $n=11$ chromosomes.



The appropriately named *V. grandis* flowers through the year.



V. etheliana.



V. cooloomia doesn't seem to fit in with the rest of the yellow-flowered species and might be placed in a genus of its own.

V. cooloomia (Kool-a-MY-a).

A *Verticordia* journey

Shaun Tennant

*Dr Shaun Tennant has a scientific background in organic chemistry and computer science but no prior experience in plants or even gardening for that matter. Yet to avoid spending all his days sitting in front of a computer he decided to try to collect the genus *Verticordia*. With the help of other enthusiasts and experts a collection of approximately 125 species out of 146 has been amassed so far.*

Why *Verticordia*?

If you were going to grow an entire genus how would you choose? My criteria were: greater than 50 species, not too easy, and less than 200 species, not too hard. It had to be Western Australian to avoid biosecurity issues. I have moved often in the past so the collection needed to be in pots so primarily small shrubs with few if any trees being preferred. As an absolute beginner and not even knowing genus names, walks through Kings Park (Perth, W.A.) helped familiarise me with possible candidates. Next ironically, I went to my computer and started searching FloraBase (florabase.dpaw.wa.gov.au) the Department of Parks and Wildlife (DPaW) database of W.A. plants. Early candidates were *Hypocalymma*, too small in number, *Conospermum*, not diverse enough in appearance and *Chamelaucium*, too dominated by commercial hybrids. Both *Hypocalymma* and *Chamelaucium* highlighted a problem I had not anticipated. That of how incomplete was the taxonomy of a genus. Too many “Genus sp. Location” species hinted at work still in progress. Now I also recognised the importance of clear taxonomic descriptions not written in Latin or needing electron microscope photos!

Inspiration came from an unlikely source, having a parent whose birthday is the day after Christmas. This necessitates two presents at this time of the year so it had become a tradition to buy her *Verticordia nitens* (Christmas Morrison) or *Verticordia eriocephala* (Common Cauliflower), which she remembered from growing up. This is the point where the genus *Verticordia* suggested itself. FloraBase revealed it consisting of 145 well defined species in W.A. and later I found only one other species located outside of W.A. in the Northern Territory. The majority were smallish shrubs except for three tropical trees. What solidified choosing the genus *Verticordia* was discovering the late Elizabeth A. George’s book “*Verticordia: The Turner of Hearts*” with illustrations by Margaret Pieroni. Here were clear taxonomic descriptions in English along with exquisite illustrations. Best of all were the small finely detailed black and white drawings of the flower parts that gave

Germination requirements

I prefer to sow seed in autumn and if sowing early e.g. March, I place the containers in my shed in a polythene bag to keep the moisture in. This negates the need to water on a regular basis and enables you to keep the containers in cooler conditions. Seed will not germinate in really high temperatures. (In WA it is common to have temperatures in the low to mid 30’s in March). Early sowing also enables you to produce larger seedlings for planting in late winter or early spring before the onset of hot weather. Having to grow on plants in containers for the following autumn or winter planting is more costly than planting out smaller plants and can restrict ideal root structures. Under ideal growing conditions, if you have large quantities of seed they can be sown *in situ*. I have successfully raised *V. nitens* and *V. densiflora* by this method.



V. nitens. Photo Sally Page.



V. densiflora var. *caespitosum*. Photo Sally Page.

Germination and potting on

Most species will take a minimum of 3 weeks to germinate, I have had some species germinate in 18 days. Therefore, if using the polythene bag method, you should start checking for germinants 18 days after sowing and keep checking every 2 days as seedlings quickly succumb to low light conditions.

As soon as they germinate you must remove them from the polythene bag. If only a few have germinated you can transplant them. Place the container back in the polythene bag and wait for further germinants. When transplanting (pricking out) work in a cool area out of direct sunlight and away from drying wind.

I prefer to use forestry type pots which produce a better root system with no curling of the roots around the bottom of the pot. Always pick up the seedlings by their cotyledons (first seed leaves). Never pick them up by the stem as you will crush it and it will rot. Using small seedlings, one or two days old, makes pricking out easier as the root



Verticordia grandis slightly immature fruit, one round seed per fruit with some of these exposed, like an inverted pyramid. Viable seed have a convex top.

Seed treatment

To improve germination rates, seed is treated with smoke by aerosol smoking for 1 hour or soaking seed in smoke water, (1 part smoke water to 10 parts of water) overnight significantly improves germination rates. Other methods, before smoke treatment was used, include, sowing as soon as the seed is cleaned, and baking the seed pots out in the full sun. This method together with natural wetting and drying cycles in autumn often improves germination rates (1).

Note: success germinating other genera of plants with similar seed using this method may be possible.

Seed sowing

Though most people recommend a seed sowing mix I always use a potting mix: less things to store and it simplifies things. Whichever you prefer to use, make sure it is a premium native plant mix, low in phosphate, and that it is well drained. Adding more coarse sand will improve drainage. A good mix should have a pH of about 6.3 to 6.5 i.e. slightly acidic. Fill up your pot, punnet or tray to the top and scrape off the excess. Then firm up the sowing base, which will give you a level sowing surface and reduces the risk of seed sinking too deeply into air pockets underneath when the mix is watered.

Sow as thinly or thickly as you wish, depending on how/when you prick out (transplant) your seedlings after germination. Seed should not be buried too deeply, usually no more than 2 to 3 times their own depth. The topping I use is a type of coarse river sand, no fines. Similar materials such as crushed granite 2 to 3 mm grit can also be used. This topping holds the seed in place, allows water penetration, and does not attract algal growth (keeps the scene clean). Water the seed container when you wish to start the germination process.

conditions e.g. *V. densiflora* up to 80%. However, under wetter (humid) conditions, some species e.g. *V. eriocephala* are susceptible to fungal diseases which can damage the new growth and flowers leading to very low viability rates. Seed production can also be limited through pests such as webbing caterpillars. A simple way to check seed viability is to do a cut test using a razor blade or scalpel, if the cut seed is white inside it should be viable.

me a fast track into the taxonomic identification of *Verticordia*. I have been told that Elizabeth A. George had to strongly push for inclusion of these drawings so valuable to the amateur taxonomist.



V. brachypoda, one of the first species I found to add to the collection.



V. inclusa: as the name suggests, the style and stamens are enclosed/included within the petals. Normally below 1 m this flower was found at head height chasing the sun.

Where to start?

The *Verticordia* hunt started with visits to the decreasing number of specialist W.A. native plant nurseries. This yielded a single digit number of species the highlight being my first declared rare flora (DRF) namely *V. staminosa* subsp. *staminosa*. I had feared that the DRF species would be unobtainable due to their very strict protection. However, over time I have found they are far more often available than the not threatened common species. This is typified by the quarterly Friends of King Park plant sales, another early source of species, particularly the *V. plumosa* varieties which are DRF. Resorting to searching the web for *Verticordia*, I finally found the phone number for the Wildflower Society of W.A. (WSOWA). Upon calling I asked if they had any *Verticordia* species and if so how many? Jeff Mountstephen replied too many to count. My first visit to the nursery run by the Northern Suburbs Branch of the WSoWA resulted in over 30 additional species. It also resulted in my first meeting with Elizabeth A. George and the other highly skilled volunteers. The offer to join the society and learn how to grow and propagate *Verticordia* was gratefully accepted.

After a year or so at the nursery I realised that to complete my *Verticordia* collection I would have to venture out and collect the missing species. This meant tackling the complexities of a Flora licence. Suffice to say, the restrictions are reasonable but occasionally confounding. Sadly too many times I have seen how road graders have decimated roadside plant populations where collection is not permitted. Happily one exception was watching a road grader carefully miss every pink ribbon adorned *V. fimbrilepis* subsp. *fimbrilepis* (DRF) that grew by the side of the road.

How to find *Verticordia*

To begin with accompanying the more experienced professionals and volunteers of the Northern Suburbs Branch on collection trips was invaluable. Eventually to focus purely on *Verticordia* another approach was developed. NatureMap (naturemap.dpaw.wa.gov.au) and Australia's Virtual Herbarium (AVH, avh.chah.org.au) are publicly accessible online geographic information systems. *Verticordia* location maps from NatureMap or AVH can be captured via the Print Screen Windows' key, pasted into Microsoft Paint and saved as a jpeg file. Next using the Android app "Custom Maps" by Marko Teittinen it is possible to position these location maps by overlaying them onto Google Maps. Now using the "Custom Maps" app and a tablet's GPS it is possible to simply drive and/or walk to the location. Importantly NatureMap's administrative layers feature helps identify the land tenure status of a location to aid in compliance with licence restrictions. This approach proved very successful even though the precision of the technique is not perfect.



LEFT *V. nobilis*, the best specimen I ever found was growing alone on the top of a 5 m pile of gravel in a pit. RIGHT *V. lepidophylla* var. *quantula*, from Dick Mills' garden who was one of a group of early propagators of *Verticordia*. Many thanks go to Sally Page née Moyle for propagating and gifting this plant.

What species is this *Verticordia*?

One of the advantages of choosing the genus *Verticordia* is that they are commonly known as "Featherflowers", part of their appeal. So picking them out in bushland is usually not difficult. The exception is

Propagating *Verticordia* species from seed

Bob Dixon

Bob Dixon, now retired, was employed at Kings Park and Botanic Garden for 35 years. There he specialised in managing natural ecosystems, environmental weed control, growing and translocating declared rare flora back into natural and degraded ecosystems. Bob started growing Verticordia grandis from seed at Perth Zoo in the early 1970's.

Verticordias are normally propagated by softwood (soft tip) cuttings as the cuttings are available, more frequently after flowering with the flush of new growth. However, some species are difficult to strike from cuttings or it may be difficult to obtain good cutting material from stressed, drought-affected, plants. One way to overcome this is to grow plants from seed. However, growing from seed also has its limitations. *Verticordias* are notorious for producing large numbers of non-viable seed and therefore people tend to avoid growing them this way.

Seed collection and cleaning

Seed must be collected when it is fully mature, as slightly immature seed will shrivel up and die. Collect the seed directly off the plant as it is about to naturally fall. You can also bag the flower heads, after pollination, using a fine but open weave cloth which will allow some sunlight and air movement. This seed can then be harvested when it is fully mature. It is a great way of collecting seed from distant locations.

Verticordia grandis (see picture on page 105) is bird pollinated, producing very few viable seeds in natural populations. It flowers for most of the year on new growth with viable pollen only produced during summer. (Pers com. Digby Grown). The best time to harvest the seed is December through to March. The seed is collected by hand. Seed sleeves will only ensure a small quantity can be harvested at one time.

Viable seed are round and contained within a fruit, one seed per fruit, which is similar in shape to an inverted pyramid. Fruit with a convex top indicates the seed inside is viable.

Always try and clean seed, directly after harvesting as this will reduce the risk of storing the seed with pests present.

Seed of many *Verticordia* species stores well in the short term as long as it is cleaned, dried and stored in dry conditions.

Seed quality

Seed collected from wild populations varies considerably, with viability rates of 2% to 3% or up to 64% (personal observations). Good cleaning methods also increase the likelihood of obtaining better seed samples. In cultivation, viability can be much higher due to better growing

division and then plants are regenerated through microcallus, macrocallus and somatic embryo phases. Germinated somatic embryos are then transferred to sterile propagation mixes in tubes in the tissue culture laboratory to grow them onto whole plants for hardening off under nursery conditions.

There are several advantages to the use of somatic hybridisation for producing wide intergeneric crosses. Somatic hybrids are tetraploid ($n = 4$). That is, they have four sets of chromosomes, unlike their diploid parents ($n = 2$). Higher levels of ploidy in hybrids can restore fertility allowing them to be used for further crossing. In addition, tetraploid somatic hybrids will have larger flowers, which is likely to make them horticulturally more desirable.

Somatic fusion has been successfully applied to produce somatic hybrids of a *Chamelaucium* cultivar with *Verticordia etheliana* var. *etheliana*, the latter of which is a donor of bright red. Somatic hybrid plants have been grown up in the nursery and are currently in bud stage. These plants have intermediate characteristics between the two parents. If fertile, we will use these plants for 'sib-crossing' to segregate bright red flower colour into plants with classic waxflower characteristics.

Other plants that have been selected for somatic hybridisation include different species of *Verticordia* and *Pileanthus* which are donors of bright yellow, orange and metallic pink. Future research will target the bell flowered *Darwinia* species and *Actinodium*.

In summary, the pioneering application of somatic fusion to the *Chamelaucium* tribe offers the opportunity to produce novel elite waxflowers with a range of exciting bright colours that reflect the spectacular flora of Western Australia while providing robust plants for ornamental purposes in home gardens, large scale landscapes and for the cutflower industry.



Pileanthus peduncularis var. *filifera*. Photo: Hazel Dempster.

looking for yellow *Verticordia* species at the time when *Acacia* are flowering. The main problem is that of species and infraspecies identification. This was partly solved by the laborious scanning of Elizabeth A. George's book. In doing so I could have the descriptions and finely detailed taxonomic drawings on a tablet in the field. Combining this reference material and a jeweller's loupe with 30x magnification, the majority of species may be identified or at least narrowed down. Also of note is that geographic location is a very powerful filter to eliminate possible species. Although, having recently found *V. paludosa* 100 km out of its known range, means caution is needed.

In many cases a more reliable identification was needed. Initially I had expected an expensive microscope was required. But surprisingly a very cheap, eBay-purchased, USB microscope with 20x and 400x magnification provided impressive photos for identification and recording. Examples of these photos are dispersed throughout this article. Amassing a few thousand microscope photos has made subsequent identification progressively easier. With such a low tech approach



LEFT *V. staminosa* var. *erecta*, and RIGHT *V. luteola* var. *luteola*. Partially dissecting a flower and a cheap USB microscope makes identification very easy.



LEFT *V. huegelii* var. *decumbens* and RIGHT *V. huegelii* var. *huegelii*. When identification of an infraspecies is difficult, I find A/B testing helpful.

LEFT *V. pritzelii* and RIGHT *V. gracilis*. It took me a very long time to differentiate these closely related species. The reflexed fringed auricles of *V. pritzelii* are the easiest difference but are less obvious on older flowers.

possible, it's remarkable there is not a public online photographic taxonomic resource. With progress in light field cameras e.g. Lytro and digital processing even better photos are readily possible.

How to Propagate *Verticordia*

From my experience, propagation of *Verticordia* is most-readily achieved via cuttings. Propagation from seed is hindered by low seed set, seed availability and long timelines. Even so, Bob Dixon, formerly of the Botanic Gardens and Parks Authority, has had success with seeds. My discussion below will focus on cuttings.

Early propagators of *Verticordia* had success with soft tip-cuttings. With the advent of rooting hormone gels e.g. Clonex Purple, this requirement was relaxed and most cutting material is suitable. Indeed this was dramatically illustrated by bush collected *V. interioris* cutting material that looked like “dead twigs”. Yet it struck. If excessive callusing is observed, typically in “round-leaf” species, the lower hormone strength Clonex Green is beneficial. Where species have differing basal, stem or floral leaves basal cutting material is preferred e.g. *V. cooloomia*, *V. insignis* varieties, *V. nitens*, *V. serrata* varieties etc. Note, for *V. serrata* varieties, basal material having new growth shown by a red tinged stem tip is best.

At the Northern Suburbs Branch nursery, cuttings of *Verticordia* are placed in 150mm pots containing 1:1-perlite:Richgro seed raising mix and sprayed with fungicide. These are covered by an uncapped 2 litre clear plastic bottle whose bottom has been removed, placed on a mesh table and left to strike in a polytunnel with overhead watering every 2-3 days. A majority of *Verticordia* may be propagated by this simple technique even at home and without a polytunnel. At first impression, this low-cost approach appears primitive. Nevertheless the plastic bottle not only maintains humidity but more importantly for *Verticordia* species, keeps water off their leaves. Also, the overhead supplied water passes down the sides of the bottle into the cutting mix. I suspect that being placed on a mesh table with the bottle being open topped improves air flow into the cutting mixture and cutting surrounds. Furthermore it allows convection to remove excess heat. It has always greatly surprised me how little attention is given to air flow/ventilation in propagation compared to light, water and temperature.

Personally I have successfully employed a more-elaborate propagation setup over winter using a polystyrene enclosure, bottom heat and thermostat, ultrasonic fogging, computer fan and lighting (again Ebay sourced). The cutting mix used was 1:3-peat:perlite in punnets to allow for better heat transfer. Bottom heat (~25 °C) speeds root formation

many of which have bright flower colours, offers the potential to introduce vivid colours into waxflowers via hybridisation. However, all F1 interspecific and intergeneric *Chamelaucium* hybrids are functionally sterile. On very rare occasions, as with ‘My Sweet Sixteen’, and on two occasions within the Kings Park breeding program, progeny from these F1 hybrids can be produced.

To capture the bright colours in genera such as *Verticordia* and *Pileanthus* a large number of second generation hybrids need to be produced. This is because these colours are recessive to the colours produced in *C. uncinatum*, which is via the anthocyanin pathway. The presence of the enzyme 3'5' hydroxylase in *Chamelaucium* drives the colour pathway to produce purple/pink/magenta colours in first generation



V. etheliana var. *etheliana*, the *Verticordia* parent of the fused hybrid.

hybrids. When 3'5' hydroxylase is not present, as in some species of *Verticordia*, the colour pathway produces reds.

The functional infertility of the intergeneric hybrids is a significant further barrier to subsequent breeding and selection of plants with elite horticultural merit. To produce the red colour in hybrids fertility therefore needs to be restored so that

the hybrid genome can resegment, thus allowing some progeny in the second generation to express the red colour.

To restore fertility in F1 hybrids the Kings Park breeding program is applying the technique of somatic fusion in tissue culture. Somatic fusion involves the merging of plant protoplasts which are cells that have had their cell walls removed. The removal of plant cell walls is achieved by enzymatic digestion using a cocktail of enzymes that digest distinct cell wall components.

Following cell wall removal, the plant protoplasts are purified to homogeneity. Protoplasts from two different species are then mixed together in a 1:1 ratio. These are then fused together to produce hybrids using electrofusion, where low voltage AC and DC currents are applied to align cells in a ‘chain-of-beads’ to allow adjacent cells to fuse or coalesce. Fused cells contain the genomes from both parents.

Fused hybrid cells are incubated in cell growth media to promote cell

long vase-life makes *Chamelaucium* cultivars a popular filler for floral arrangements and they represent the most important native cutflower grown in Australia. *C. uncinatum* has been cultivated as a garden plant for about 100 years and as a cut flower for at least 40 years. It is now grown worldwide, with major cut flower production regions in Australia, USA, Peru, South Africa, and Israel. Recently hybrids between this species and *C. megalopetalum* have become very popular due to their enhanced vase life and terminal flowering. Examples are 'Madonna', 'Blondie', 'Moonlight Delight', 'Ruby's Delight' and the Pearlflower series.

A number of other hybrids within *Chamelaucium* are well known. The cultivars 'Lady Stephanie' and 'Wanneroo' are hybrids between *C. uncinatum* and *C. floriferum*, 'White Surprise' is a hybrid between *C. uncinatum* and *C. axillare*. Hybrids between *C. uncinatum* and *C. micranthum* include 'Plum White', 'Moonstar', 'Supernova', 'Sweet Georgia' and 'White Fire'.

'My Sweet Sixteen' is a rare three parent hybrid between *C. uncinatum*, *C. floriferum* and *C. axillare* developed by the pioneer breeder Brian Jack.

Intergeneric hybrids are rare in the plant world; however hybrids between *C. uncinatum* and *Verticordia plumosa* are grown as cut flowers and garden plants. Cultivars such as 'Paddy's Pink', 'Eric John,' 'Southern Stars' and 'Jasper' are chance intergeneric hybrids between these two species. Hybrids between *C. uncinatum* and *V. grandis*, and between *C. uncinatum* and *V. hughanii* have also been produced in controlled hybridisation programs.

Kings Park has produced a number of hybrids through controlled hybridisation in *Chamelaucium* including *C. uncinatum* X *C. megalopetalum*, *C. uncinatum* X *C. lullfitzii*, *C. megalopetalum* X *C. lullfitzii* and *C. uncinatum* X *C. ciliatum*.

A limitation of existing waxflowers is that most have pastel flower colours. The close relationship of *Chamelaucium* with other genera in the *Chamelaucium* tribe,



The bright colours of *Pileanthus filifolius*.

and ultrasonic fogging prevents water collection on "round-leaf" species' leaves. This combined with Clonex Green enabled a 70% strike rate for the problematic *V. argentea*.

The degree of difficulty of propagation of various species of *Verticordia* from cuttings is summarised in Table 1. For ease of discussion they have been grouped. The "Easy - Group 1" species with somewhat linear leaves typified by *V. chrysantha*, *V. densiflora*, *V. monadelphica* and *V. plumosa* varieties readily strike and grown on. Similarly "Easy - Group 2" species with generally small narrowly elliptic leaves propagate with no trouble. The "Easy - Group 3" species with mostly triquetrous leaves strike well particularly from basal cuttings but once potted up care must be taken. They are sensitive to excessive watering and humidity that can result in leaf drop and death.

The "Moderate" of this group of species have diverse reasons for their difficulty rating. Fungal susceptibility occurs for example with *V. patens*, *V. nobilis* and *V. rutilastra*. Slow growth rates of the likes of *V. dasystylis* subsp. *oestopoia*, *V. multiflora* subsp. *solox* and *V. picta* hinder their propagation. Nonetheless successful propagation of this group is achievable with care and patience.

Many of the "Hard" group of species exhibit difficulty in root formation. The reasons are unclear but may be due to the nature of the species and/or scarcity of quality cutting material. Two species in particular have consistently resisted numerous attempts at propagation even with good material, namely *V. aereiflora* and *V. etheliana* var. *formosa*. Plants of this pair were finally attained by grafting.

The "Round-Leaf" group deserves special mention. Most are typically hard to strike with the exception of *V. fragrans*. Excessive callousing is common requiring lower strength root hormone. Furthermore if water is applied from above it collects on their leaves leading to cuttings and recently potted-up plants defoliating. Fogging or the plastic bottle setup helps avoid these problems. Cutting material taken from younger plants usually performs better. In the case of the popular but hard *V. grandis*, cuttings taken from new growth coming out of its tuber after a fire can have a >90% strike rate. There also appears to be a lot of variation in strike rate within a species. David Pike, another experienced volunteer at the Northern Suburbs Branch, has a plant of *V. dichroma* var. *syntoma* that strikes well compare to other plants of the same species.

A general observation applicable to all *Verticordia* is to move them to an open area as soon as the potted-up cuttings have stabilised. The humidity of an enclosed space makes watering complicated whereas outside it is more forgiving.

Table 1 *Verticordia* grouped by propagation difficulty.

Easy - Group 1

V. acerosa var. *acerosa*
V. acerosa var. *preissii*
V. amphigia
V. brevifolia subsp. *brevifolia*
V. chrysanthra
V. chrysanthella
V. citrella
V. densiflora var. *cespitosa*
V. densiflora var. *densiflora*
V. densiflora var. *roseostella*
V. densiflora var. *stelluligera*
V. endlicheriana var. *angustifolia*
V. fastigiata
V. galeata
V. helichrysantha
V. huegelii var. *decumbens*
V. huegelii var. *huegelii*
V. huegelii var. *stylosa*
V. huegelii var. *tridens*
V. longistylis
V. minutiflora
V. mitchelliana subsp. *implexior*
V. mitchelliana subsp. *mitchelliana*
V. monadelphra var. *callitricha*
V. monadelphra var. *monadelphra*
V. nitens
V. penicillaris
V. pennigera
V. pityrhopis
V. plumosa var. *ananeotes*
V. plumosa var. *brachyphylla*
V. plumosa var. *grandiflora*
V. plumosa var. *incrassata*
V. plumosa var. *plumosa*
V. plumosa var. *vassensis*
V. staminosa subsp. *staminosa*
V. staminosa var. *cylindracea*
V. staminosa var. *erecta*
V. vicinella

Easy - Group 3

V. habrantha
V. inclusa
V. insignis subsp. *compta*
V. insignis subsp. *eomagis*
V. insignis subsp. *insignis*
V. lehmannii
V. roei subsp. *meiogona*

Easy - Group 2

V. attenuata
V. bifimbriata
V. blepharophylla
V. brachypoda
V. brownii
V. carinata
V. centipeda
V. drummondii
V. eriocephala
V. halophila
V. hughanii
V. lindleyi subsp. *lindleyi*
V. lindleyi subsp. *purpurea*
V. luteola var. *luteola*
V. luteola var. *rosea*
V. paludosa
V. pholidophylla
V. wonganensis

Moderate

V. aurea
V. cooloomia
V. dasystylis subsp. *dasystylis*
V. dasystylis subsp. *kalbarriensis*
V. dasystylis subsp. *oestopoa*
V. laciniata
V. multiflora subsp. *multiflora*
V. multiflora subsp. *solox*
V. nobilis
V. ovalifolia
V. patens
V. picta
V. polytricha
V. pritzelii
V. pulchella
V. rutilastra
V. serotina
V. serrata var. *ciliata*
V. serrata var. *linearis*
V. serrata var. *serrata*
V. sieberi var. *curta*
V. tumida subsp. *therogana*
V. tumida subsp. *tumida*

Round-Leaf

V. aereiflora
V. albida
V. argentea
V. chrysostachys var. *chrysostachys*
V. chrysostachys var. *pallida*
V. comosa
V. dichroma var. *dichroma*
V. dichroma var. *syntoma*
V. etheliana var. *etheliana*
V. etheliana var. *formosa*
V. fragrans
V. grandis
V. muelleriana subsp. *minor*
V. muelleriana subsp. *muelleriana*
V. oculata
V. venusta

Hard

V. capillaris
V. endlicheriana var. *compacta*
V. endlicheriana var. *endlicheriana*
V. endlicheriana var. *major*
V. endlicheriana var. *manicula*
V. gracilis
V. grandiflora
V. harveyi
V. helmsii
V. humilis
V. integra
V. interioris
V. lepidophylla var. *lepidophylla*
V. lepidophylla var. *quantula*
V. mirabilis
V. mitodes
V. oxylepis
V. rennieana
V. roei subsp. *roei*
V. sieberi var. *lomata*
V. sieberi var. *sieberi*
V. spicata subsp. *spicata*
V. stenopetala
V. subulata

Interspecific and intergeneric hybridisation within the Chamelaucium tribe.

Tony Scalzo and Digby Grown,

Dr Tony Scalzo completed his PhD in Microbiology in 1986 and worked at the University of Western Australia for over 25 years in medical research. He has held leadership positions with the Friends of Kings Park for over 20 years, including organising their Growing Friends group. He joined the Plant Development Team at Kings Park as a staff member 6 years ago.

Digby Grown (B (Hort Sci) Hons) is the Senior Plant Breeder at Kings Park and Botanic Garden. He manages programs in the breeding and development of Anigozanthos, Boronia, the Chamelaucium tribe, Corymbia, Grevillea and Scaevola. He has worked for many years on the development of Australian native plants for horticulture, and is responsible for the release of over 40 new varieties of native plants including Grevillea 'RSL Spirit of ANZAC', and Anigozanthos 'Anniversary Gold'. He has led research into new technology developments in plant tissue culture, biotechnology, grafting and plant breeding.

The Chamelaucium tribe within the plant family Myrtaceae is a grouping of genera with its main centre of diversity in the South-West of Western Australia. It comprises the genera *Chamelaucium*, *Verticordia*, *Darwinia*, *Pileanthus*, *Actinodium* and *Homoranthus*, the latter genus being exclusively found in the eastern states of Australia.

Kings Park and Botanic Garden has a sophisticated plant breeding program developing interspecific and intergeneric hybrids within and between these genera. The aim is to use the well known and widely cultivated *Chamelaucium uncinatum* as the base species and hybridise with other species with bright, electric colours that can enhance the colour palette of the hardy and vigorous *C. uncinatum*.

Many species in the *Chamelaucium* genus have flowers with a 'waxy' texture. Their



The *Chamelaucium* parent of the fused hybrid.

Pileanthus limacis grows prostrate at Coral Bay where we obtained cuttings. But after two growing seasons in the nursery, it sent up vertical



shoots and now grows into an upright plant. I think because its genes tell it to grow upright but being so near the coast it grows prostrate.

On a trip in 2015 we found another *Pileanthus*. We believe this to be a hybrid between *Pileanthus bellus*

and *Pileanthus peduncularis*. This plant is more compact than *P. bellus*, only a metre high and wide like *P. peduncularis* but with larger leaves like *P. bellus* has. And of course, the petals being pink and orange add to that. And one last fact is that both *P. bellus* and *P. peduncularis* are fertilised by the same insect. This too has propagated well and we will soon have it in the nursery.



Photos: Sally Page.



Pileanthus species are easy to grow from cuttings. I take tip cuttings, one full node below where the outer surface changes from a yellowish colour to brown. These are dipped 1 to 2 cm into Purple gel from Growth Technology. The cuttings mix is 50/50 seed raising mix and medium grade perlite. We use 2 litre soft drink bottles with the bottom 1/3 cut off as a mini hothouse, even though it is in a hothouse tunnel. It helps keep pests away as well. Pots are checked every week for root growth from about 2 weeks. Once roots appear the bottle tops are removed to enable some hardening up of the root system prior to potting up into tubes. Potting mix is the same seed mix with some gravel mixed in it for better drainage and some slow release fertiliser added.

How to Grow *Verticordia* Long Term in Pots

My *Verticordia* collection is held in both 200 mm (5 litre) pots and 70 mm super tubes. An early conscientious use of water saving pots worked well in summer yet was lethal to *Verticordia* in winter. Good drainage holes extending up the sides are important or “bottomless” tubes. The potting mix is 2:1-native potting mix:coarse propagation sand with Apex 21-0.86-5.8 Low P fertiliser added. Some species particularly *V. staminosa* infraspecies, *V. pityrhops* and *V. crebra* along with other species in poor soils occasionally display chlorosis. This can be corrected with application to the soil of half strength iron chelate or preferably Fetrilon Combi 2 applied to the foliage. Good sun exposure especially in the morning helps reduce fungal issues along with generous spacing to encourage air flow. Furthermore plants are watered by drip irrigation to minimise water on leaves. One of the most important factors for *Verticordia* in pots is to let the soil nearly dry out between watering. From experience *Verticordia* will recover rapidly from too little water but too much water usually results in death. That means for about 4 months over winter in Perth no watering is normally required for the 200mm pots whereas in summer it is every 2-3 days depending on pot size. Cold is tolerated but cold and wet conditions make plants susceptible to defoliation. “Round-Leaf” *Verticordia* tend to be attacked by botrytis in warm and wet conditions. As long as the conditions are not prolonged it is usually not fatal and often results in self pruning promoting branching.

The Future?

There remain several hurdles to complete the collection. A few species will require special licence permissions to collect due to their locations. DRF species I hope(?) to obtain from the groups working on their conservation. Learning to graft the “Hard” group of *Verticordia* is now my main focus and may in time solve the three tropical tree species obstacle. Recently *Verticordia* sp. Dundas has been described from old herbarium specimens. It has not been seen for many decades and along with its remote and indeterminate location may provide the final challenge.

Acknowledgements

The author would like to thank the past and present members of the Northern Suburbs Branch of the Wildflower Society of W.A. for their guidance. Particular thanks go to Hazel Dempster for her sage advice and Sally Page for her skilled propagation support over the years. Finally Elizabeth A. George & Margaret Pieroni for their wonderful book “*Verticordia: The Turner of Hearts*”.

Verticordia and Pileanthus heritage garden

Sally Page

Sally Page is a qualified horticulturist who has forty plus years' experience in propagating and growing W.A native plants. For the last eight years she has been a volunteer for the Wildflower Society of W.A Northern Suburbs Nursery. In this article she writes about her garden which includes *Pileanthus* and *Verticordia*.

History

My passion for Verticordias came from my mother and father (Patricia and Norman Moyle) who in the late 1970's were volunteer collectors for Elizabeth George's book "*The Turner of Hearts*". In the 1980's they established a half acre Verticordia garden at the top of their five acre property at Mandurah Parklands, Mandurah, growing approximately 130 species, subspecies and varieties. At the time there were few species of Verticordia available from nurseries so all were collected and propagated using techniques developed by them.



The Moyle's Mandurah garden 1993. *V. monodelpha*, *V. chrysostachys* var. *pallida*.



Plants showing roots



The species I collected was *Pileanthus bellus*, pink flowers.



Pileanthus peduncularis has orange flowers with a dark centre,. The right picture has *Calytrix strigosa* in the background.



Pileanthus vernicosus, has red flowers, with the occasional orange flowered plant (right).



Pileanthus rubronitides.



Pileanthus filifolius.

My journey with WA wild flowers

Jeff Mountstephen

Jeff's working life began when he left school at age 15 to join the RAAF. After three years training, he emerged as an aircraft instrument fitter. He served 15 years at various locations from Melbourne to Darwin to Sydney to Malaya to Perth. He retired from service life then got a job with a company called Selby Scientific. He served 22 years with them. In his first year he bought a block, built a house and moved in.

My journey with WA wild flowers began shortly after moving into our new house in Glen Forrest. It is a suburb of Perth located in the hills east of Perth. I was looking through Fairall's book on West Australian Plants in Cultivation while in a break from doing a course at TAFE. In it I found on page 236 a picture of *Verticordia pritzelii* and fell in love with it. I wanted one for our new garden. I never did see one in its natural state though. I asked about it and found a lady, Jean Hooper, with a backyard garden in Gooseberry Hill Lesmurdie, who knew a lot about *Verticordias*. Her nursery eventually became Zanthorrea Nursery at High Wickham. From her I found out about Les Norton who collected *Verticordias*. As it turns out, Elizabeth George (Berndt) was also communicating with Les Norton though we didn't meet till some years later.

I eventually joined the WSWA and at a meeting met Elizabeth George (Berndt) when she asked for volunteers to help collect *Verticordias* for a reclassification of the genus. Years later, I took a trip up north, staying at Kalbarri.



From there I went further north and found this location and these flowers.



Plants being propagated in my hothouses.

I decided on that trip I would like to grow these plants (*Pileanthus*) so set about getting myself a hot house. Another trip north and I collected some cutting material. These were propagated in my hothouse and surprisingly took root in just 4 weeks.(see picture opposite).

In recognition of their work, a brass plaque at Kings Park, acknowledges their contribution to the genus.

Beginnings

In the mid 1990's my husband Greg and I purchased a 120 ha property south of Gingin W.A. On this property we established a mango orchard and nursery specialising in and propagating W.A. native plants, with the emphasis on *Verticordia* and *Pileanthus*. Hybrid *Verticordias* from my parent's property were trialed in gravelly sand plus rows of *V. chrysostachys* var. *chrysostachys*, *V. chrysostachys* var. *pallida*, *V. cooloomia*, *V. densiflora*, *V. grandis*, *V. monadelpha* var. *callitricha*, *V. monadelpha* var. *monadelpha*, *V. muelleriana* ssp. *minor*, hybrids, *V. plumosa* var. *plumosa*, *V. plumosa* var. *grandiflora* on deep white sand.



Trialling hybrid *Verticordias*, 1998.



Photo of hybrid *V. muelleriana* crosses, these seem to be a more compact, smaller and more floriferous than the parent plants.

Verticordia garden

Our property was sold in 1998 and we purchased the farm across the road to grow wine grapes. This kept us busy for the next decade until the collapse of the grape industry in 2009. The upside of this collapse was it enabled me more time to return to propagating and extending my Verticordia gardens.

Having access to our original farm, I was able to propagate the species of Verticordia that I had to leave behind, together with the many hybrids that had since appeared. Whilst most of the original hybrids had been ploughed in by the new owners, some of the original rows of *V. monodelpha*, *V. plumosa* and *V. cooloomia* were untouched. These had no irrigation for ten years.

Much to my surprise in amongst the rows of pink *V. monodelpha*, a



Rows of *V. monodelpha* var. *monodelpha*, *V. monodelpha* var. *callitricha* and *V. cooloomia*.

white *V. monodelpha* had appeared, as well as others with horticultural potential with dark red rather than green buds.

The new garden is approximately 1600 m² with variable soils from gravel and light loam to yellow sand. In summer it is reticulated twice a week. I am constantly planting new species and replacing those that have died, some because they are simply not suited to the conditions. These I keep going in pots. I also have problems with rabbits which I now control by placing wire hanging baskets over new plants. Strong easterly winds can also uproot mature plants. Overcrowding of plants has made the plants more susceptible to fungal disease. The lesson

sand over sandstone, white sand, in heath or *Banksia sceptrum* shrubland. Flowering between late September and early November. Name from Latin: rubro meaning red and nitidus meaning shiny, referring to the shiny red petals of this species. The Mount Magnet collection has longer stamens than the western material of this species. This highly disjunct population needs recollecting. This species has been frequently confused with *P. filifolius* in the past, but differs in flower size, petal colour and in having entire stamens.

Pileanthus septentrionalis G.J.Keighery

Spreading open shrub, to 1.5 metre tall by wide by 4 metres wide. Petals, white, not overlapping, 3-4 mm long by 2-3 mm across, apex lacinate – dentate. Occurs between Cape Range and the Kennedy Range, on the Eastern side of Lake McLeod on red sand dunes. Flowering from August to October. Name from Latin: Septentrionalis for Northern. This is the northern most member of the genus. Closely related to *P. limacis* differing in the smaller white flowers with non overlapping petals and the thin leaves.

Pileanthus vernicosus F. Muell.

Upright slender shrub to 1 metre tall. Petals red, base pinkish, 8-11 mm long and 7-9 mm wide, margins lacinate. Occurs between Geraldton and Peron Peninsula, Shark Bay. Grows on red or yellow sand in *Banksia sceptrum* shrubland, Tree heath, coastal heath and Acacia shrubland. Flowering between mid September and early November. Name from the Latin Vernicosus abounding in varnish, probably referring to the shiny oily coating on the young floral buds. Closely related to *P. filifolius*, a northern replacement for that species. A single record notes that the plant was 2.5 metres by 2.5 metres across.

With large flowers that are white, pink, orange and red, plants that range from slender tall erect shrubs to prostrate mats, several that flower in summer, these should be spectacular in a sunny well drained garden as they are at Kings Park.



Pileanthus aurantiacus

Photo: Phil Vaughan.

Grows on sand or lateritic sand, in *Banksia hookeriana* heath, *Banksia* low woodland and *Eucalyptus tottiana* Mallee over heath. Flowering mainly December to January. Has the largest flowers of any species.

***Pileanthus limacis* Labill.**

Low spreading or prostrate shrub to 80 cm tall by 1 metre wide. Petals white with centre flushed pink to red, or pale pink, overlapping, 8 mm long by 6 mm wide, margins laciniate. Occurs in near coastal situations and offshore islands from Shark Bay to Waroora Station, on coastal dunes usually over limestone. Flowering July to October, depending on rainfall. From *limacis*, greek for slug, owing to the short fat leaves having a resemblance to a slug.

***Pileanthus peduncularis* Endl.**

Low spreading shrub to 1.5 metre tall by 3 metres wide, usually less. Petals orange, base purple, reddish or orange, 7 - 9 mm long and 4 - 6 mm wide, margins laciniate. Stamens purple or pinkish red. The most widespread species, occurs from Minilya to Bruce Rock. There are two subspecies.

Petals orange with the base and anthers purple, leaves glabrous
ssp. *peduncularis*

Petals entirely orange, leaves with scattered hairs
ssp. *piliferus*

Pileanthus peduncularis* ssp. *peduncularis

Flowering Period August to November. Occurs from Nerren Nerren Station south to Mogumber, inland to East Yuna, Wongan Hills and Bruce Rock. Growing on sand usually in heath.

***Pileanthus peduncularis* ssp. *piliferus* G.J. Keighery**

Differs from *P. peduncularis* subsp. *peduncularis* in having either pure orange petals without a colour change to red or purple at the base. Plants may have either orange or pinkish red anthers. The vegetative leaves are covered in non glandular hairs and the bracteoles are covered with tubercular hairs. Flowering August to November. Occurs from Minilya to Kalbarri. Grows on red or yellow sand dunes, or red, yellow or white sandy flats in *Banksia sceptrum* heath.

The two subspecies overlap between Kalbarri and Nerren Nerren Station, but no intermediates have been recorded.

***Pileanthus rubronitidus* G.J. Keighery**

Erect shrub to 1 metre tall. Petals red-orange, 7-8 mm long by 8 mm wide, margin entire. Occurs between Kalbarri and west of Northampton, with one very disjunct collection from Mount Magnet. Grows on grey

learnt is to increase spacing between the more vulnerable species.

Because the farm previously ran sheep, I have a huge weed problem each year. Starting from May to the end of October I hand-weed. Up until four years ago I was able to combine hand-weeding with herbiciding to control weeds but now that I have *Verticordia* species, *Pileanthus* and hybrid seedlings coming up, hand-weeding is the only option for weed control. So far the new seedlings are *V. argentea*, *V. blepharophylla*, *V. eriocephala*, *V. fragrans*, *V. monadelpha* var. *monadelpha*, *V. monadelpha* var. *callitricha*, *V. plumosa*, *V. staminosa*, *Pileanthus vernicosus* and *P. rubronitidus*. It was four years before seedlings appeared, probably due to the time it takes to establish insect pollinators.



Garden planted winter 2009.



Garden 2012.



Garden 2011.

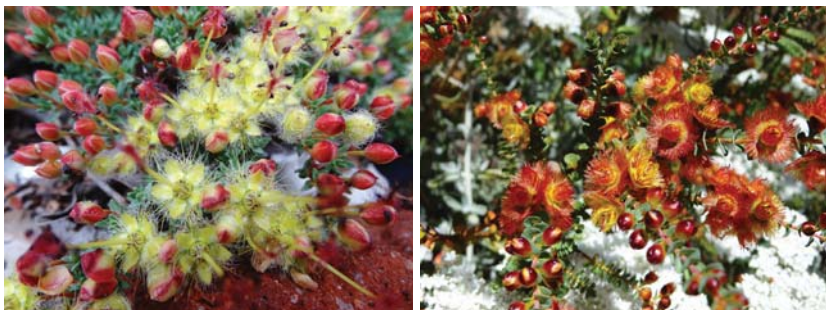


V. helmsii, *V. blepharophylla*.



V. interioris.

Currently I have 125 out of the 145 species, subspecies and varieties of *Verticordia* and 9 of the 10 species and subspecies of *Pileanthus*. The garden in part is shaded by three *Corymbia calophylla* trees (Marri trees) which run down the western side. These were originally part of the landscape along with *Xanthorrea preissii* and I am now finding many other indigenous species appearing. With the arrival of insects and because of the cover provided by the growth, I am now seeing many birds, such as Splendid Blue Fairy-Wrens, Scarlet Robins, Silver Eyes, Western Spinebills and many varieties of Honeyeaters in the garden.



V. penicillaris.

A dark *V. chrysostachys* var *crysostachys*.

Propagation

Cuttings for the nursery and my garden are obtained with the appropriate licence from trips away with volunteers from the Western Australian Wildflower Society's Northern Suburbs Nursery. These volunteers include Hazel Dempster, Jeff Mountstephen and Dr Shaun Tennant.

Only a small amount of material is taken and the plant is photographed and geotagged. If propagation of the plant is unsuccessful, we can return to the same location/plant. I find summer is best for me when propagating *Pileanthus* and *Verticordias* but this is not always possible because of lack of suitable cutting material.

I have a 12 metre by 4 metre tunnel covered with plastic. In summer shade cloth is placed over the top. Misting sprinklers are on for ten seconds every fifteen minutes during the hotter months and gradually taken back to five seconds every half hour during the colder months.

I take tip cuttings and dip them into hormone gel and then place them into seedling punnets with three parts perlite to one part peat. Roots usually appear in 3-6 weeks I pot them up in tubes as soon as roots appear, which results in a healthier root system for plants.

- | | |
|---|---------------------------|
| 3. Flowers orange, horn long, terete | <i>P. aurantiacus</i> |
| 1. Anther cells on forked filaments. | |
| 5. Flowers cerise, magenta or red. | |
| 6. Flowers cerise. Petals 12–15 mm long.
Bracteole horn mucronate. | .. <i>P. filifolius</i> |
| 6. Flowers red. Petals 8–11 mm long.
Bracteole horn blunt | <i>P. vernicosus</i> |
| 5. Flowers white or pale pink | |
| 7. Leaves broad (c. 1 mm wide) | <i>P. limacis</i> |
| 7. Leaves narrow (c. 0.3 mm wide) | <i>P. septentrionalis</i> |

Notes on Individual Species

Pileanthus aurantiacus G.J. Keighery

An upright woody *shrub* to 2 metres tall, densely branched at base. Petals orange, overlapping, 8 mm long by 6 mm wide, margins lacinate. Found on the north west corner of the Eurardy sand sheet in undulating sandplain dominated by *Actinostrobis arenarius* shrubland over low heath. In this area all records are from interdunal sites on yellow sand over yellow sandy clays, but the species has been recorded on red sand over limestone in low mixed heath closer to the coast. Recorded flowering in October.

Closely related to *P. bellus*, differing in the longer slender floral leaves, curved pungent bracteole horn and orange flowers. The two species do not appear to occur together or overlap in distribution. *Pileanthus bellus* occurs on the tall yellow sand dunes of the Eurardy Dune System (as does another endemic of these dunes, (*Verticordia cooloomia*) which occurs to the east of the range of *P. aurantiacus*.

Pileanthus bellus G.J. Keighery

An erect *shrub* to 3 metres tall. Petals pink, 7-8 mm long by 8 mm wide, margins entire. Mainly confined to the Eurardy sand dunes, where it occurs on tall yellow dunes dominated by *Actinostrobis arenarius* shrubland, but also a disjunct southern record from shallow grey sands over sandstone emergent from low heath. Flowers from October to December. From the Greek, *bellus* for beautiful, referring to this species when in flower it is a stunning sight.

A hybrid between *P. bellus* and *P. peduncularis* has been recorded.

Pileanthus filifolius Meisn.

Multi stemmed shrub to 1 m, resprouts after fire. Petals 12–15 mm long, 9–14 mm wide, cerise, overlapping, margins lacinate-dentate. Occurs between Dongara, inland to Mingenew and south to north of Gingin.

Pileanthus-The Coppercups

Greg Keighery

Greg is a Senior Principal Research Scientist with the W.A. Department of Biodiversity, Conservation and Attractions. He has a particular interest in the taxonomy of the Myrtaceae of Western Australia, especially the group around *Chamelaucium* and *Darwinia*. With this interest he has published new species in *Darwinia* and revisions of the Genera *Hypocalymma* and *Pileanthus*.

The genus is easily separated from *Chamelaucium*, *Darwinia* and *Verticordia* in having 20 perfect stamens and no staminodia, the calyx lobes deeply bilobed giving the appearance of 10 calyx segments, the silky hairy hypanthium and the large soft petals. The genus has the largest and most colourful flowers of all these closely-related genera and populations are spectacular when in full flower, normally in late spring and early summer.

The pollination syndrome is also dissimilar. Whereas the other genera deposit their pollen onto the stigma at anthesis (in the bud) in an oily droplet, this does not happen in *Pileanthus*. All members of the genus are pollinated by native bees and very specific bee pollination by *Euryglossa semaphore* has been documented in one species (*P. filifolius*), which has bilobed stamens (Houston, T.F. 1992. Three New Monoleptic Species of *Euryglossa* (*Euhesma*) from Western Australia (Hymenoptera: Colletidae). Records Western Australian Museum 15: 719-728).

The genus *Pileanthus* consists of eight species endemic to southern Western Australia. Members are found on sandy soils in the Avon Wheatbelt and Geraldton Sandplain Biogeographic regions of south Western Australia and extend into the adjacent Carnarvon Biogeographic region of arid Western Australia. There is a concentration of species on the northern margins of the Geraldton Sandplains.

Members of the genus either have clubbed or forked stamens.

Key to species of *Pileanthus*

- 1 Anther cells contiguous on club-shaped filaments
 2. Leaves clustered on short side branchlets.
Ovules 8 *P. peduncularis*
 2. Leaves opposite decussate, not clustered. Ovules 4.
 3. Flowers pink or red, bracteole horn short
 4. Flowers pink, tepaline anthers erect *P. bellus*
 4. Flowers red, tepaline anthers incurved *P. rubronitidus*

Some recent successes



V. roei ssp *roei*.



V. venusta.



V. pritzelii.



V. multiflora ssp *solox*.



Tunnel with *Verticordia* tube stock in foreground.

Future plans

My aim is to extend the garden: collect and grow as many of the species as possible; develop propagating techniques; and learn about their cultivation requirements with the view of making these genera more accessible and easier to grow for the general public.

Our property is over 180 ha and we have ready access to good quality water. Expanding the gardens to 2 000 m² will become necessary as I gather more species of *Verticordia* and expand my collection of hybrid *Verticordias*. I only have the single remaining *Pileanthus septentrionalis* to collect.

Gathering the remaining species will require more field trips and acquisition through sharing with other like-minded people.

The hybridising of *Verticordias* in the garden has yielded many interesting plants, some of which are showing great promise as potential garden plants.

Hybrid *Verticordias* being trialed in the garden.



V. chrysostachys x.



V. forresti x *spicata*.



V. spicata x *mulleriana* subsp. *minor*.



V. chrysostachys x.

Recent views of the garden



White *V. blepharophylla*, red hybrid *V. etheliana* var. *etheliana*,



V. etheliana var. *etheliana*, *V. monodelpha* var. *monodelpha*, *V. polytricha* and *V. nitens*.

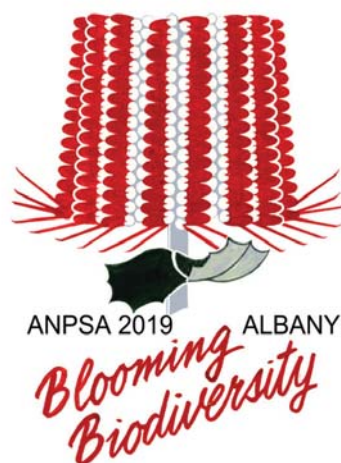


Pileanthus vernicosus and *V. galeata*



Back, white *V. monadelpha* then *V. halophylla* with Paddy's Pink in front. Right is Rebecca Anne one of the hybrids.

The garden is an ongoing labour of love. My purpose is to learn how to grow these unique and extremely colourful ornamental Western Australian genera and to carry on my parents' work. Any hybrids that are proven worthwhile are being named after my parents' grand daughters and great granddaughters.



PRELIMINARY INFORMATION

The 2019 ANPSA conference will be held in Albany, Western Australia in the week beginning 29 September 2019.

Albany is an attractive town about 400 km south of Perth. It is well set up with conference and accommodation facilities, and, best of all, is in the middle of wonderful wild-flower country.

The conference and seminar will be held in the Albany Entertainment Centre, a fantastic venue right on the foreshore — look it up with your favourite search engine.

We are currently investigating group accommodation options. However, there is plenty of accommodation in motels and in apartment complexes close to the Entertainment Centre.

Getting there

Especially if you are coming from the eastern States (as we call them) you might consider driving “across the Nullarbor”. Then, instead of continuing to Perth, turn left at Norseman and continue along the south coast.

If you fly into Perth, you could choose to travel to Albany using the TransWA bus which leaves from Perth railway station and travels down the Albany Highway. It costs about \$80 or \$40 concession. Like all airlines these days, fares with Rex airlines vary according to time and date but are rather more expensive than bus fares.

Or, you could choose one of the tours we are planning to start from Perth and finish in Albany. When these plans are finalized, details will be posted on the society's web site: <http://www.wildflowersocietywa.org.au/nn>

Jim Barrow



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