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Brachychiton Breeding: What's Happened So Far and Where to Next

Des Boorman

South Gundurimba, NSW 2480, Australia

biyamitifbb@bigpond.com

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Summary

This *Brachychiton* Schott & Endl. breeding program started in the mid-1990s with the acquisition of several Cape York species, *Brachychiton velutinosus* Kostermans, *B. grandiflorus* Guymer, *B. garrawayae* (Bailey) Guymer and the naturally occurring hybrid *B. x carneus* Guymer (*Brachychiton grandiflorus* x *B. garrawayae*) to add to *B. bidwillii* Hook. a low growing cold tolerant, versatile and floriferous species with a short juvenile phase.

This small collection of stunning species highlighted the immense potential for the genus and led to the establishment of the breeding program. Plant breeding and improvement has long been an interest having taken plant breeding as a subject in my final year at the university. Once pollination parameters were established it was easy to produce significant quantities of hybrid seed to grow out for assessment.

Hybrid seed is easy to produce; growing resultant progeny out is where the work starts and in the case of trees can be time consuming and expensive, hence the need to develop strict selection criteria before commencing any breeding program. I did start the breeding with an intentional group of traits that I saw as being a part of a good ornamental tree. Traits such as compact growth habit, free and annual flowering, a short juvenile phase, adaptable to a range of climates and less likely to be weedy or suffer from genetic leakage are all factors to consider. Having been involved in regional, state and national strategic

weed management, I felt weediness factors are also quite important.

While having had a couple of failed commercial launches that resulted in setbacks, some great insights were derived from them.

1) Protecting IP and structuring any formal agreements professionally will provide clarity for all parties. Such agreements should always be read in the 'event of the worst case' scenario as they are never referred to when everything is going along well.

2) Throughout the commercialisation process observations may influence the selection of additional or alternate traits that were not previously considered.

Results so far have produced many extremely suitable hybrids to assess for commercialisation and also highlighted the opportunity for ploidy manipulation, including double flowers, multiple tepal layers and petaloid filaments.

This paper is an update of my journey with breeding *Brachychiton* Schott & Endl., what I'm currently working on and what future opportunities I see.

INTRODUCTION

Australia has an amazing floristic diversity, covering nearly every climatic range other than extreme altitude and cold, lending itself to both amenity and functional horticultural applications. Much of that diversity remains unexplored from a crop improvement or plant breeding perspective.

There has and continues to be a massive interest in native plants generally, however this comes with several major risks. The two most serious risks are: 1) non-endemic weediness; a classic example being *Schefflera actinophylla* (Endl.) Harms, a high-altitude North Queensland native dispersed by frugivores that is perfectly suited climatically to much of the east coast of Australia where rainfall is adequate and is quite invasive.2) genetic leakage where a non-endemic species can hybridise with rare or other natives in its cultivated range threatening the integrity of a species and possibly causing its specific extinction as more adept fertile hybrids take over, such as *Acacia baileyana* F.Muell. in the Cumberland Plain of the Sydney Basin and the rare *Acacia pubescens* (Vent.) R.Br. (NSW National Parks and Wildlife Service, 2003). This risk is also extremely high with numerous *Syzigium* cultivars on the market and widespread cultivation of *Eucalyptus* and *Corymbia* species.

Brachychiton Schott & Endl. is a widespread genus of over 33 species, within Malvaceae with the most species occurring in Northern Australia with two species occurring in Papua New Guinea: *B. velutinosus* Kostermans that also occurs on Cape York and the endemic *B. carruthersii* F. Muell. Several species are widely utilised in ornamental and commercial applications across Australia and internationally, *B. populneus* is used as a fodder source in its natural distribution and also cultivated as a hardy street tree in inland parts of Australia and internationally, such as in South Africa.

The genus also has potential to yield more new species and natural hybrids such as the recently described *B. guymeri* J.A.Bever., Fensham & P.I. Forst (Fensham et al., 2019) and the yet to be described *B. sp. Ormeau* (L.H. Bird AQ435851) (DoE, 2024), both being critically endangered due to their limited distribution and habitat loss threats. There are several naturally occurring and quite a few spontaneous and intentional hybrids already in cultivation. These hybrids are versatile and used for street trees, parks and specimen tree applications. While the current hybrids being cultivated are quite good, there is immense potential to intentionally hybridise *Brachychiton* to be more versatile and satisfy a greater number of niche applications and importantly hopefully reduce significantly and ultimately remove the risk of weediness and genetic escape through production of sterile cultivars or complex bred cultivars with reduced fertility.

Egyptian research has identified compounds in *B. populneus* (Schott. & Endl.) R.Br. with extremely effective anti-hypoglycaemic effect, with similar or better effect than commonly utilised pharmaceutical preparations (Ragheb et al., 2019).

I chose to work with *Brachychiton* many years ago because the genus contains many beautiful species, but few hybrids are utilised widely with *B.* x *roseus* selections being the main ones and even fewer are strategically produced considering the immense potential for such work in the genus.

MATERIALS AND METHODS

Brachychiton Schott & Endl. is a relatively easy genus to work with as flowers are functionally unisexual by abortion so accidental hybridisation or selfing is easily avoided. Pollination needs to be undertaken on the first day of flower opening within the first few daylight hours. Night flowering species are a different proposition; flowers are generally receptive throughout the night, so pollen needs to be collected off day flowering species and stored to enable pollination between the two groups. Limited success can be obtained by pollinating early in the morning. Flowering is also synchronised between male and female flowering flushes in most species that I worked with, some only produce male flowers some seasons which can impact on breeding programs and obvious biennial, or triennial flowering is also an issue.

Style length also seems to have an influence on successful seed production and short styled species need to be the female parent not the pollen parent.

RESULTS AND DISCUSSION

Initial Hybrid Development

The initial hybridisation undertaken in 1999 consisted of 3 separate crosses: *B. velutinosus* Kostermans and *B. bidwillii* Hook, *B. grandiflorus* Guymer and *B. bidwillii* Hook., and a complex hybrid between *B.* x *carneus* Guymer and *B. bidwillii* Hook.

The first group of hybrids produced consisted of inter-specific hybrids between *B. velutinosus* Kostermans and *B. bidwillii* and as to be expected with inter-specific hybrid ratios, the progeny was somewhat 50% of either parent in leaf, habit and flower form (**Fig. 1**). However, as is also to be expected, there is a significant variance in how each of those traits are expressed in the progeny so as an example flower colour, size and shape was spread quite a bit in the expected bell curve pattern as traits are not dominant or recessive as such as you would

expect when undertaking inter-specific hybridisation. It is noted that red is quite a strong colour in *Brachychiton* and can dominate progeny flower colour, however the brilliant magenta of *B. velutinosus* Kostermans also carries through in many of these hybrids.

Figure 1. A group 1 hybrid displaying an 8 petalled flower. This group commonly produces flowers of 6 or more petals.

The 2nd group of hybrids were *B. grandiflorus* Guymer x *B. bidwillii* Hook. and like the previous inter-specific hybrids were somewhat between both parents though flower size tended to be more on the larger side like *B. grandiflorus* Guymer, and the red of *B. bidwillii* Hook. was not expressed as a pure colour (**Fig. 2**) unlike in the *B. bidwillii* Hook. x *B. velutinosus* Kostermans cross where there were definite all red hybrids.

Figure 2. A group 2 hybrid showing *B. bidwillii* Hook. shape but *B. grandiflorus* Guymer size.

The 3rd group consisted of *B. x carneus* (*B. garrawayae* (Bailey) Guymer, *B. grandiflorus Guymer*) x *B. bidwillii* Hook and resulted in some interesting outcomes as there were three species in the mix. Flower size, shape and colour varied greatly in these tri-specific crosses. While some could be identified like the closely related inter-specific crosses of the second group, there was also some recombinations of flower traits that resulted in beautiful varieties that did not resemble any of the parentage singly (**Fig. 3**). Colours were also quite varied with red, orange, salmon and potentially white in the mix. The red from *B. bidwillii* Hook. Was carried through in many hybrids but was not necessarily attached to that species' flower shape.

Figure 3. Group 3 hybrids show amazing variation, and several are worthy of cultivation.

Interestingly *B. bidwillii* Hook leaf characteristics were quite dominant in all hybrids, particularly with reference to the leaf lobing and density of trichomes, and the small hairs that cover many *Brachychiton* spp.

From these 3 groups of hybrids, roughly 100 of each cross were produced and there were numerous stunning and quite different looking hybrids that warranted commercial exploration. Several of these have also been utilised in further breeding works. A hybrid possibly expressing polyploidy is shown in **Fig. 4** with eight petals instead if the characteristic five petals.

Figure 4. A possible polyploid from a Group 3 hybrid showing extra petals where this branch has eight petalled flowers, not five.

Second Generation Hybrids

In 2008-9 after several years of not producing more hybrids as I was waiting to see the initial results, some of the best hybrids (in my opinion) from the first group were selected to produce another range of hybrids. There were several combinations to choose from but what I didn't want to do was to duplicate my previous crosses, but rather add additional traits from other species that I consider worthy or important when considering the ornamental potential of this genus. To facilitate this, another four hybrid combinations were produced incorporating new species or complex combinations.

The 4th group was an inter-specific cross between *B. velutinosus* Kostermans and *B. populneus* (Schott. & Endl.) R.Br. that has produced a range of hybrids as expected with one being exceptional and is slated for release later in 2024. Many of

these hybrids are yet to flower but the selected genotype has great form and growth habit along with prolific and regular flowering which makes it a worthy commercial specimen (**Fig. 5**) regardless of what flowers in future.

Figure 5. A Group 4 hybrid.

The 5th group is a poly-specific cross (four species) between a group 3 hybrid and *B. australis* (Schott. & Endl.) A. Terracc. - the broad leaf bottle tree. This tree has amazing form and dense lush foliage and is worthy of wider cultivation **(Fig. 6).** There are 18 hybrids in this cross remaining, displaying a range of leaf and growth characteristics including dwarf traits identified by short internode length. Unfortunately, none have flowered yet, however in the past year these hybrids have been revived and are showing great promise with the pachycaul trunk of *B. australis* (Schott. & Endl.) A. Terracc. being obvious on all of them. The intention is to breed a floriferous and compact flowering bottle tree. I expect to see some flowering of these hybrids in late 2024.

Figure 6. A Group 5 hybrid showing unique leaf characteristics.

The 6th group is another poly-specific cross (involving five species) which utilised the commonly cultivated cross *B.* x *roseus* Guymer, (*B. acerifolius* (Cunn. ex G. Don) Macarthur *x B. populneus* (Schott. & Endl.) R.Br.) colloquially known as 'Jerilderie Red' a widely cultivated and accepted variety with many suitable traits. For this cross I wanted to get as much in the mix as I could so selected a group 3 tri-specific cross that was worthy of cultivating. This resulted in the production of 35 poly-specific cross progeny with 5 different species' genetics at play. From observations so far, the red of *B. acerifolius* (Cunn. ex G. Don) Macarthur and its flower shape are heavily expressed in the progeny that have flowered to date (**Fig. 7**). Interestingly this poly-specific cross has also produced some quite unusual and unexpected recombinations such as prolific and bushy free branching growth along with quite a few dwarf plants where internodes are significantly compressed

even when compared to the shorter growing species in the hybrid. One genotype selected in this group is currently being bulked up for release.

Figure 7. A selection from Group 6 with elongated flower characteristics.

The 7th group is a group 3 tri-specific crossed to *B. populneus* (Schott. & Endl.) R.Br. though none have flowered yet and may do so in the following season.

The Next Steps

Brachychiton is a precocious genus with many naturally occurring hybrids being identified in both wild populations and cultivation (Guymer, 1988). Currently I have two selections of *Brachychiton* x *vinicolor* Guymer (*B. discolor* F. Muell. x *B. acerifolius* (Cunn. ex G. Don) Macarthur) with seed set to a group 3 hybrid and several natural inter-specific hybrids. These natural hybrid combinations are *B. chillagoensis* Guymer x *B. australis* (Schott. & Endl.) A. Terracc. a yet undescribed hybrid collected near Chillagoe in north Queensland, *B.* x *allochrous* Guymer (*B. grandiflorus* Guymer x *B. muellerianus* Guymer), *B* x *turgidulus* Guymernotho subsp. *tugidulus*, (*B. rupestris* (Mitchell)ex Lindley) Schumann x *B. populneus* (Schott. & Endl.) R.Br.), *B. rupestris* (Mitchell ex Lindley) Benth. x *B. acerifolius* (Cunn. ex G. Don) Macarthur and *B. australis* (Schott. & Endl.) A. Terracc. x *B. acerifolius* (Cunn. ex G. Don) Macarthur. What is exciting about these hybrids is that it was possible to select from a range of unique mature specimens so that desirable traits could be viewed and determine whether they have immediate horticultural value and/or potential for further breeding work. These hybrids will reduce generation time (between 4 - 10 years) as they are a known quantity and deliver results at a significantly lower cost because there has been no need to go through the pollination, growth and evaluation stage to pick a suitable desirable plant or even if one does get produced that is distinctly better.

The hybrids involving *B. australis* (Schott. & Endl.) A. Terracc. or *B. rupestris* (Mitchell ex Lindley) Benth. also bring in an important and highly desirable trait of pachycaul trunks which I have been working towards for over a decade. Unfortunately, I am yet to see any hybrids that contain both *B. australis* (Schott. & Endl.) A.Terracc. and *B. rupestris* (Mitchell ex Lindley) Benth. but you just never know what is around the corner. There are several other more compact pachycaul *Brachychiton* species with two of these viz. *B. compactus* Guymer and *B. collinus* Guymer being included in future breeding.

CONCLUSION

Plant breeding, especially tree breeding can be time consuming, take up space and costly, but the rewards of producing new and unique cultivars ready to commercialise is something else and I urge anyone with the interest to just give it a red-hot go.

My only advice is making sure you have a clear plan of what you want to achieve and initially be conservative because sometimes you will get setbacks but that is par for the cause and when you get thru them the satisfaction will be that much greater. If it was easy everyone would be doing it.

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