in January from lush container-grown material will strike readily whether cuttings have one or two nodes.

Not enough attention was paid in this trial to where the roots developed and in what densities along the cutting. It is known that two node cuttings of *H. violacea* produced roots from the basal node only, but the root development patterns of the single node cuttings were not closely observed.

It is not known how the struck cuttings will develop as they grow in the tubes, and whether the effect of different root production patterns will affect subsequent growth patterns.

Finally, in conjunction with the results and these reservations any economic benefits must also be evaluated. There are many climbers where the cutting material is so tangled that a degree of loss is acceptable if single node cuttings permit faster production rates, albeit with a correspondingly higher non-strike rate. Offset, of course, by the extra cost of labour, nutrients, space and time. It becomes a bottom line decision.

KANGAROO PAW BREEDING—THE "BUSH GEMS" CULTIVARS

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I would like to dedicate this paper to my late friend and mentor, Mervyn Turner, who during the last decade of his life dedicated himself almost entirely to breeding kangaroo paws (*Anigozanthos* spp.). His breeding program gave rise to the "Bush Gems" range of hybrid cultivars. Merv had a vision for breeding not just kangaroo paws, but also a whole range of other Australian native plants, such as Christmas bells (*Blandfordia* spp.), pimeleas (*Pimelea* spp.) and numerous others.

As a tribute to Merv Turner I would like to review the results to date of the "Bush Gems" breeding program. I hope that the experience gained with kangaroo paws will be of assistance to those interested in the genetic improvement of Australian plants.

The genus *Anigozanthos* contains species with a spectacular range of colours and flower forms and often within a species a range of colour forms exists. The large range of colours and colour combinations available to the breeder has only been partially exploited to date.

The greatest limitation to the horticultural development of

kangaroo paws has undoubtedly been the condition known as "ink spot". After extensive experience it is my view that "ink spot" is caused by a variety of factors. One cause has been isolated as a fungal leaf pathogen in the genus *Alternaria* (2); however, I have observed several environmental factors which cause leaf blackening ("ink spot"). These include frost, snail damage, chemical spray damage, and nutritional stress. It appears that leaf blackening results from pigments released following cell death, and I believe this makes the goal of breeding ink spot tolerant cultivars extremely difficult.

The only kangaroo paw species which has been consistently reliable in cultivation has been *A. flavidus*. This species has been widely planted as an ornamental landscaping subject, and its success in cultivation appears to derive from its distinctive tough, leathery strap-like leaves. Although the commonly grown forms of *A. flavidus* are unspectacular, this species has proven to be the key parent for breeding hardy cultivars. Almost all of the commercially successful "Bush Gems" cultivars have *A. flavidus* in their parentage.

Thus, the *A. flavidus* hybrids have proven to be the most successful part of the kangaroo paw breeding story. In particular, hybrids between the two metre tall, *A. flavidus* and the smaller species such as *A. humilis* and *A. bicolor,* have yielded a range of hardy, long-flowering dwarf cultivars including 'Bush Baby' and 'Bush Ranger'. These cultivars have established a niche for kangaroo paws as flowering pot plants and have been a great success.

Some of the taller *A. flavidus* hybrids with species such as *A. rufus, A. pulcherrimus,* and *A. manglesii* have also been successful. These plants are equally useful as landscape specimens or for cut flower production. The cultivars 'Bush Dawn', 'Bush Noon' (both *A. pulcherrimus* × *flavidus*) and 'Bush Sunset' are hardy, productive and relatively free of ink spot.

The versatility of the range of "Bush Gems" cultivars has greatly enhanced their commercial appeal, and any prospective breeders of Australian plants would do well to choose genera which have potential for multiple uses.

The strengths of the "Bush Gems" kangaroo paws could be summarized as:

- Improved vigour and hardiness.
- An improved colour range.
- Longer flowering season.
- An increased range of heights, from dwarf to tall.
- An improved range of plants for cut flower production.
- The attraction of nectar-seeking birds to landscape plantings.

Whilst the "Bush Gems" cultivars have been well accepted

there have been problems with other hybrid kangaroo paws. I am sure that Merv would wish that others could learn from both the good and bad experiences with kangaroo paws.

Perhaps the biggest problem has been in relation to "ink spot," and one of his main aims was to select cultivars with a high degree of tolerance to this condition. However, in hindsight the environmental factors which are a primary cause are ultimately beyond the control of the breeder. Thus, even the best cultivars will develop leaf blackening if grown under sub-optimal conditions such as heavy shading or poor drainage. It is my current feeling that rather than stress that cultivars be bred for tolerance to "ink spot," a better approach would be to emphasize how to avoid it by appropriate cultural practices. There can be no doubt, however, that the best of the "Bush Gems" cultivars show greatly increased tolerance to ink spot. A number of potential cultivars were, however, rejected because of their susceptibility.

Another problem confronted was the practical difficulty in adequately trialling promising hybrids. In this regard, I was extremely interested in Bruce Macdonald's paper outlining the Plant Introduction Scheme in Vancouver, Canada. Australia, with its vast range of climatic types would do well to adopt a scheme such as this which would allow new cultivars to be evaluated on an objective basis over a wide range of geographical areas. Introduction of new cultivars in Australia at present is, at best, a rather hit and miss affair. It would be a fitting gesture if such a scheme could be initiated in our Bicentenial year.

In conclusion, I would like to make some observations about the future of genetic improvement of Australian plants generally. Biotechnology, such as genetic engineering, has captured the imagination of many people and a great deal of money is being invested by entrepreneurs and governments. Greg Lamont's use of plant tissue culture techniques, such as ovule and embryo culture, to facilitate the breeding of *Chamelaucium* hybrids provides an excellent example of how the new biotechnology techniques can be used effectively. However, I believe that these new techniques should be kept in perspective, particularly in relation to the breeding of Australian plants.

A great deal has been said and written about the untapped potential of the Australian flora. It should be remembered that this untapped potential exists because the Australian flora has not yet received the sustained attention from plant breeders that genera such as roses, carnations and chrysanthemums have had. For many Australian genera, new taxa are constantly being discovered and most genera have had little or no systematic breeding. Thus, I feel it is imperative that the limited private and public resources available for breeding Australian plants are used in the most cost-effective way. Our first priority, as propagators, should be to continue the

task of clonal selection from wild sources. This wild genetic resource represents our greatest tangible advantage over competitors from overseas who are working with our flora. Rapid advances in domestication of our flora have been made by the judicious integration of conventional breeding and the new biotechnology techniques. Merv Turner's work with *Anigozanthos* (1), and Greg Lamont's work with *Chamelaucium* provide outstanding models of how this can be achieved.

Finally, it is my hope that this presentation of the late Merv Turner's work will serve as a model and an inspiration to those interested in the horticultural development of our wonderful flora.

LITERATURE CITED

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STOCK PLANT MANAGEMENT

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My experience as a production manager in a large container nursery showed me the need for an area to be put aside for stock plants to be managed efficiently for large scale cutting production.

The main reasons for having stock plants are to:

a. Obtain an increased strike rate in less time.
b. Obtain large quantities of favourable wood.
c. Increase efficiency in the ease and speed of collecting cuttings.
d. Improve convenience and cut down travelling time.
e. Ensure the early introduction of new cultivars thus discarding inferior forms.
f. Ensure accurate labelling of plants from which cuttings are taken—cuttings are always taken from accurately labelled plants.

If stock plants are regularly replaced with stock which have been hygienically grown and have good vigour and juvenility, high strike rates will follow.

Stock plants should be controlled and managed by the propa-