DEVELOPMENTS IN PROPAGATION AND HYBRIDISATION OF *ANIGOZANTHOS* AND *MACROPIDIA* (KANGAROO PAWS)

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INTRODUCTION

Kangaroo paws occur naturally only in the southwest part of Western Australia. They are fairly new to cultivation, only having become widely grown since the 1970's, but they are now grown in many countries and are now well established in the international cut flower trade. They are also being sold as container plants and used in landscaping and amenity horticulture.

Kangaroo paws have bizarre, colourful, uniquely beautiful bird-pollinated flowers that are covered in a velvety "fur" which, together with the strange, but attractive shape of the inflorescence, makes them a widely appreciated and highly desirable plant to grow. Growing kangaroo paws has not always been easy, many species are difficult to grow from seed and many species are short-lived and are also subject to attack by debilitating fungal diseases that usually prove to be fatal in susceptible species. Long-lived hybrids have been developed that have good resistance to the fungal diseases and micropropagation methods have been developed to reproduce these hybrids.

I will review some species and hybrids, developments in raising plants from seed, and developments in micropropagation techniques for reproducing hybrids and species.

Species and hybrids. There are 12 species of kangaroo paws, 11 of which are placed in the genus *Anigozanthos,* with the other one being placed in the genus *Macropidia,* the "black kangaroo paw".

Within the genus *Anigozanthos*, the three most important species horticulturally are *A. manglesii, A. pulcherrimus,* and *A. flavidus.*

A. manglesii is the most famous and well known kangaroo paw and is the floral emblem of the State of Western Australia. It is commonly red and green but also comes in many other colours.

A. pulcherrimus is the most widely grown species for the cut flower trade. It is reasonably disease tolerant and easy to grow, has brightly coloured yellow or orange flowers, has excellent wilt recovery, and is easily dried, bleached and dyed. The very similar and closely related *A. rufus* provides various red shades.

A. flavidus is noted for its vigour, hardiness, adaptability, disease resistance, and longevity. It is generally considered to be one of the

least attractive of the kangaroo paws, nevertheless there are some attractive forms of this species in cultivation, but these have rarely been used as cut flowers.

All of the other species of *Anigozanthos* have been hybridised with A. *flavidus* to obtain hybrids that show varying degrees of vigour and disease resistance, and hybrids with *A. pulcherrimus, A. rufus, A. manglesii* and *A. humilis* are quite common, while hybrids with *A. preissii, A. onycis, A. viridis* and *A. bicolor* are also well known. Hybrids between *A. flavidus* and *A. kalbarriensis* and *A. gabrielae* are very rare

All attempts to cross the black kangaroo paw, *Macropidia fuliginosa* with species of *Anigozanthos*, have failed up to the present.

When *A. flavidus* is crossed with *A. pulcherrimus, A. rufus, A. onycys* or *A. preissii*, (all of which are in the same subgenus), the hybrids are slightly fertile. However, when *A. flavidus* is crossed with *A. manglesii, A. viridis, A. humilis, A. bicolor, A. kalbarriensis* or *A. gabrielae*, all of which are placed in a different subgenus, *Haplanthesis*, then the hybrids are highly sterile. This low fertility in the former case, and sterility in the latter, has been overcome by the production of fertile allotetraploids from the interspecific hybrid diploids. These fertile allotetraploids have been further crossed among themselves and some of the current hybrids are very complex crosses.

All of this hybridisation has resulted in a good variety of vigorous, hardy, disease-resistant, long-lived hybrids which come in many sizes, forms and colours, and this process is continuing at a rapid pace. Some well known hybrid kangaroo paw series are my own "Western Star" series and the "Bush Gems" and the "Southern Aurora" series.

One problem with the use of these hybrids for cut flowers has been that the flowers do not have the same wilt recovery as the widely grown species, *A. pulcherrimus*. This has been overcome by suitable post-harvest treatments. The stems are pulsed by standing them in a solution of 2.5 grams of 8-hydroxyquinoline sulphate and 200 to 2,000 grams of sugar per 10 litres of water for a minimum of 12 hours, (Adrian Bowden, Linda Manning, pers. comm.), or by the use of similar treatments.

The hybridisation of kangaroo paws has been covered much more fully elsewhere. (8, 10).

To sum up, then, it would be fair to say that hybrid kangaroo paws are now well established, both within Australia and overseas, and are gaining widespread acceptance, both by the general public and by professional growers. This trend is expected to continue, as the obvious advantages of hybrids are enhanced, and any

disadvantages are minimised by further careful breeding and selection.

Raising Kangaroo Paws from Seed. Seeds of many species are difficult to germinate and often results have been low or even nil. Various methods have been tried to overcome this problem including burning paper or leaves on top of planted seeds; stratifying (1): sulphuric acid treatment (9); hot water treatment (9); weathering the seed in the sun over summer (4); a combination of treatments including sulphuric acid, hydrogen peroxide, hot water and gibberellic acid (GA_3) (12); embryo excision (11); and germination in vitro (Bowden pers. comm.).

I also produced strong evidence in 1989 that low day/night temperatures are a requirement for good germination of mixed hybrid seed, (max 20 °C.—min 10 °C.), although the occasional seed does germinate in quite high summer temperatures.

With the possible exception of the methods of Watkins and Shepherd (12), the above methods have not always proved to be convenient, consistent, or reliable and obviously some rigidly controlled trials are needed to give us some understanding of the process of germination, and provide reliable methods for the propagator.

Some work along these lines has been done by Professor John Considine and Mr. Nipat Sukhvibul at The School of Biological and Environmental Sciences at Murdoch University, and it is hoped that when this is extended to cover all species (and hybrids) germination problems will be solved. Some indication of the scope and results of this work are given below.

The influence of stratification, plant growth regulators, and various scarification treatments on the germination of *A. manglesii* seed were studied

METHODS

Stratification—The seeds were placed between two layers of filter paper in a petri dish and moistened with 5 ml water mixed with a 1 g/l Benlate fungicide solution. They were wrapped in plastic and stored at 4 °C. for periods of 0, 2, 4, 8 and 12 weeks and moistened with water every 7 days during the storage period. Four replicates of 20 seeds each were stored for each period.

Scarification with sulphuric acid—The seeds were submerged in 50% v/v sulphuric acid for periods of 0, 5, 10, 15, 20 and 25 min. at room temperature, with gentle shaking during the entire treatment. The seeds were then washed in running water for 30 min.

Scarification with potassium hydroxide—Seeds were immersed in a 5M potassium hydroxide solution for 10 min. at room temperature and then washed in running water for 30 min.

Scarification with sodium hypochlorite—Seeds were gently shaken in a 6% sodium hypochlorite solution (available chlorine approximately 62 g/l at room temperature for 10 min. and then washed in running water for 30 min.

Gibberellic acid treatment—Seeds were placed on double filter papers soaked with 10 ml GA_3 solution for 24 hours at room temperature. GA_3 concentrations of 0, 0.3, 1.0, 3.0 and 10.0 mM were used. The seeds were then rinsed twice with distilled water.

GA_3 and cytokinin, [6 Benzylaminopurine (BA)] treatment—Same as for GA_3 treatment except that the solutions were also 0, 0.03, 0.1, 0.3 and 1.0 mM in BA.

Hot Water Treatment—The seeds were immersed in water at 60° C. for two hours.

Germination—Seeds were placed between two moistened filter papers in a petri dish which was wrapped in plastic and placed in an incubator at 22° C. Seed was kept moist by additions of water weekly.

RESULTS

Both stratification and hot water treatments proved to be ineffective, and seeds with these treatments did not germinate.

Soaking the seed in the aqueous GA_3 solutions increased germination. The addition of BA reduced this GA_3 promotion of seed germination.

Chemical scarification with either sulphuric acid or potassium hydroxide also led to increased seed germination. The effect of these treatments was in addition to, and independent of that of the gibberellic acid.

Total germination increased with longer scarification time with 50% sulphuric acid—up to about 30 to 60 min.—as well as with the concentration of gibberellic acid, up to 10 mM, the limits tested in this study.

A treatment of about 30 to 60 min. in 50% sulphuric acid followed by a treatment of 24 hours in 10mM gibberellic acid provided the most effective enhancement of both total seed germination and speed of germination. This combined treatment gave germination of 55 to 91%, with germination beginning in 10 days. This was compared to 5 to 7% germination obtained with the controls.

Most seed in this study was germinated in the dark in a controlled temperature incubator set at 22° C., which appears to be quite satisfactory. Seeds in trials in the light at room temperature germinated more slowly.

CONCLUSIONS

A full discussion of the extent or implications of this work cannot be given here but it is hoped that this work will be published in full soon and that the work will be extended to cover all species and fertile hybrids.

TISSUE CULTURE OF KANGAROO PAWS

This has been developed and documented in references (5) and (6), but a greatly improved technique has been developed at the Plantex Australia Pty. Ltd. Laboratories (2). This is briefly outlined below.

Sterilisation of young unopened flower buds gives approximately 80% clean explants of which approximately 30% directly produce adventitious shoots. Cultures multiply within 12 weeks of sprouting.

Potting out of plantlets—Rooted shoots are removed from the agar, washed, then potted into a mixture of 50% polystyrene beads, 40% sphagnum peat, and 10% crushed rock. Plants are placed in a misthouse at 80% humidity and watered by overhead mist for 10 sec. every 15 min. Plantlets are treated with Previcure fungicide once a week. After two weeks the mist is reduced, and after four weeks the plants are transferred to a normal glasshouse for four to six weeks.

Explants may be rapidly and easily obtained from selected clones of kangaroo paws while they are in flower without damage to the plant, and with a minimum of contamination problems, by the use of this method.

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