RESEARCH INTO PROPAGATION OF AUSTRALIAN NATIVE PLANTS

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The Black Hill Native Flora Centre was established in the 1970's with the broad aim of promoting the cultivation and conservation of the native flora. This was to be achieved by propagation and research of the State's flora, the establishment of landscaped display gardens and a comprehensive information service, as well as the sale and distribution of a wide range of native plants, particularly those not readily available elsewhere. The research programme aims to bring into cultivation a wide range of the State's native plants, both as an aid to conservation and revegetation programmes and to select and improve species with horticultural potential. To date the work has concentrated on the collection of a wide range of plant material and the development of propagation techniques.

Field Collection. The first step in the research programme is the location and collection of plant material and establishment of a comprehensive seed bank and stock plant collection. At the same time information is collected on the growth characteristics, distribution, and natural environment of each species as a guide to its likely requirements and performance under cultivation. This information, combined with detailed records of nursery propagation trials and observations of plants under cultivation, will provide an extensive information data base on the flora.

Seed Bank. The seed bank at Black Hill contains several thousand lots of seed mostly of known wild origin. All seed is stored in an air conditioned room to prolong its storage life although we do not know the optimum conditions for long-term storage of most species. Ideally, we would test all seed for germination under controlled conditions at the time of collection and then periodically, to determine its viability and shelf-life but staff levels do not permit this. However, we do attempt to grow some plants of each collection, and their germination under nursery conditions is recorded. Where seed germination is found to be difficult more detailed research may be carried out.

Seed germination. Temperature is one factor which may affect germination. Whilst most seed will germinate at around 25°C some require more specific conditions. Of particular interest from species examined to date is the finding that seeds of a number of native species germinate better at lower temperatures, i.e. 15 to 20°C, e.g.

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Myriocephalus stuartii, (Table 1). Some seeds germinate best under fluctuating rather than constant temperatures (e.g. *Helichrysum bracteatum*). Others may enter secondary dormancy if exposed to 30°C or higher, so that they no longer germinate when placed at the lower temperature.

Table 1. Effects of temperature on seed germination.

Temp. deg C	Percent seed germinated (T-50)*		
	Helichrysum bracteatum	*Helipterum humboldtianum*	*Myriocephals stuartii*
Constant			
10	31 (10)	60 (7)	37 (9)
15	35 (6)	55 (5)	63 (6)
20	35 (3)	97 (3)	53 (4)
25	31 (3)	99 (2)	27 (4)
30	19 (3)	93 (2)	33 (4)
35	4 (6)	36 (2)	13 (14)
Alternating 16hr/8hr.			
15/10	51 (7)	53 (8)	51 (7)
20/15	32 (6)	80 (4)	49 (4)
25/20	25 (4)	97 (2)	37 (3)
30/25	19 (3)	97 (2)	27 (4)

*T-50 = number of days to reach half final germination.

These examples highlight the need to consider temperature requirements for routine seed germination. Where seed sowing is usually carried out during spring or summer, it may be advantageous to germinate seeds of some species in a cool place rather than in the open sun where soil temperatures may be far above that required. If sowing time can be managed to coincide with the most suitable temperatures germination will be more uniform and quicker. This could be particularly important for direct sowing, e.g. in the case of bedding plants.

There are many treatments which have been used to stimulate germination of dormant seed: scarification, hot water, chipping, chilling, heating, or firing etc. Often a simple treatment can dramatically affect the rate or percentage of seed germination. The difficulty with native species is simply the diversity of seed germination requirements of different species. Sometimes consideration of their natural environment can give a clue to which treatments might work but often trial and error is the only way. The systematic testing of a wide selection of native species will provide valuable information.

One treatment which has proved effective on species previously difficult to germinate is pretreatment with a gibberellic acid solution (500 ppm). This may be combined with scarification where a hard seed coat is present. Two striking examples are *Ptilotus* and *Epacris* seed which have been difficult to germinate in the past but give near 100% germination following this treatment.

Cutting propagation. It is often desirable to propagate using cuttings rather than seed. The importance of the quality or condition of the cutting material cannot be over-emphasised. This is frequently a problem with wild plant sources. In our programme the aim is to at least get a few plants under cultivation, after which propagation success often improves dramatically. We are also testing a range of treatments in order to find suitable conditions for rooting the wide range of species available.

Responses obtained with rooting hormones vary considerably, not only between concentration and types of hormone but also with the season and condition of the plant material. As a matter of routine, each batch of cuttings in the nursery is subject to a range of hormone treatments in order to detect species and seasonal differences (Table 2). It is not practical to list details of the many species here but to date we have obtained at least 70% rooted cuttings with about half of the species tested. Some species have responded better to particular types of hormone whilst 22% of the species have shown little difference in response.

Table 2. Responses of Australian native plants to rooting hormone applications. (IBA = indolebutyric acid; NAA = naphthaleneacetic acid; NOA = naphthoxyacetic acid).

Treatment ++	Percent of species tested* having	
	>70% rooted	>50% rooted
IBA 1000 ppm	27	47
IBA 500 + NAA 500 ppm	27	47
IBA 500 + NOA 500 ppm	29	45
IBA 1500 + NAA 500 ppm	33	49
At least one treatment	50	68
At least three treatments	22	42

++ 5 second dip in 50% ethanol solution.
* 230 batches of cuttings

We have now changed the range of treatments to include higher concentrations since some species respond to 10,000 ppm or more. By continuing to screen those species which have not yet given at least 70% rooting we will be able to focus on those which require more detailed research to solve propagation problems.

Many factors change within a plant through the seasons of the year, e.g. starch or hormone levels in the shoot, lignification, cambial activity, shoot growth, flowering, etc. These may have a direct effect on the rootability of cuttings. Some are due to the growth cycle of the plants whilst others result directly from the prevailing environmental conditions. As a preliminary study, a number of these plant factors were monitored through the year along with assessment of the rootability of cuttings collected from wild plants.

There was no clear correlation between changes in the factors

studied and the results of rooting trials but a couple of points are worth noting. Firstly, the commonly held view that cuttings should not be taken whilst the plant is in flower is not necessarily valid for the species we worked with. The main period of rootability of cuttings overlapped the flowering period in both *Epacris impressa* and *Ixodia achilleoides*. Secondly, since different species growing at a particular site but having different seasonal growth patterns, may still have similar rooting periods, environmental factors have a direct effect. Periods of higher rootability appear to follow the occurrance of rainfall after a dry spell. These broad observations must be tested over several years or under controlled conditions before definite conclusions may be drawn but they indicate the type of factors to be considered.

Tissue culture applications. The use of tissue culture as a means of propagating plants is commonplace today. We have been developing techniques for native species particularly as an adjunct to the conservation of rare or endangered species but the principles are the same. Generally, the woody native species are more difficult to culture with the culture conditions required often varying among species or even varieties. We have successfully cultured over 20 native species but of more importance is the need to improve the efficiency of establishing new species in culture by determining the critical or limiting factors at each state of the culture cycle.

The pH of the medium, initially and as the cultures progress, has been shown to markedly affect root initiation. One might ask what effect the pH of conventional cutting media has on some species? Also, as with cuttings, the condition of the original plant material may be critical in establishment of tissue cultures as demonstrated by *Epacris impressa*. This species proved elusive in culture until suitable material was obtained from pretreated stock plants. Fresh growth was included by increased nitrogen and pruning of plants grown in the glasshouse. A similar response has been obtained with *Astroloma humifusum*, another difficult species from the same family.

The transfer of plants out of culture into potting media is often a critical stage. We are investigating the pretreatment of plants in culture to improve the success at this stage. The type of roots produced in culture affects plantlet survival. Different hormone treatments may all induce roots but root morphology can vary and thereby affect survival. Another aspect is the susceptability of leaves to desiccation. By reducing humidity in the culture tube for a period prior to transplanting, either by changing the osmotic potential of the medium or by loosening the cover on the tube, the plantlets may be hardened in culture. Exposure of plants to higher light intensity and reducing the sucrose level in the medium may promote photosynthetic activity. These refinements of technique will each contribute to the efficiency of tissue culture propagation.

Most work on plant tissue culture is centred on vegetative propagation but *in vitro* techniques can also be applied to aspects of seed propagation. Some techniques which have practical applications include immature seed or embryo culture and in-vitro pollination of incompatible species.

Stock Plants. As mentioned above, the condition of the plant material used for both conventional cuttings and tissue culture is important. Where stock plants are held under cultivation appropriate management of the plants can greatly increase the yield and rootability of cuttings. Having established a wide selection of species in containers we are examining the effects of nutrition, water regime, and regular pruning on the yield of cutting material. Other practices to be considered are the application of plant hormones or growth regulators and the control of light levels to precondition the shoots for improved root initiation on cuttings or shoot multiplication in culture.

Conclusions. Many species of our native flora have potential for cultivation either as landscape plants or as commercial crops, others need to be cultivated for conservation purposes. The Black Hill Native Flora Centre programme is introducing a wide range of species into cultivation and researching improved propagation techniques. Plants with particular merits can then be selected for further research into their cultural requirements and development for commercial production. This research programme, combined with the promotion of public understanding and appreciation of the flora, should benefit both the conservation of our natural vegetation and the expansion of horticultural utilisation of native species.