Cultivating Australian Native Plants

Achieving results with small research grants

A report for the Rural Industries Research and Development Corporation

by Dr Malcolm Reid
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Foreword

Ten years ago the Australian Special Rural Research Council was determining priorities for the funding of research and development for Australian native cut flower growing and exporting. Views were divided as to whether to develop a diverse selection of native flora or to concentrate on major crop groups such as waxflower, kangaroopaw, Proteaceae and Verticordia.

In 1990, the successor to ASRRC, RIRDC set up a specific industry program in Wildflowers and Native Plants with an objective to improve the profitability, productivity and sustainability of the wildflower and native plant industry.

Meanwhile, the Australian Flora Foundation Inc. had set up a procedure distributing modest grants from community donations for research on the biology and cultivation of Australian plants. The volunteers who administer this scheme may be contacted at GPO Box 205 Sydney 2001.

This report details the progress of five projects set up under this scheme and shows what can be achieved with small grants, up to $5000 for one or two years.

The report, a new addition to our diverse range of over 250 research publications, forms part of our Wildflower and Native Plants R&D Program.

Peter Core
Managing Director.
Rural Industries Research and Development Corporation

Acknowledgements

The voluntary effort of members of the Board of the Australian Flora Foundation and of its Scientific Research Committee, which assesses and approves research proposals, is gratefully acknowledged. Donors and members of the Foundation have enabled this project to proceed. As well, thanks should go to those who established the Foundation in 1981 at the International Botanical Congress, particularly to Mr. W.H. Payne.

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About the Author

Dr. Malcolm Reed is a plant biologist; senior lecturer in the School of Biological Sciences at Macquarie University NSW 2109. Recent research interests include mycorrhizas and seed biology, particularly of the Epacridaccae. He teaches an introductory course in plant science.

From 1991 to 1998, Dr. Malcolm Reed has been elected President of Australian Flora Foundation Inc. which raises money to foster research into the biology and cultivation of Australian native plants.

1 Summary

Applications were called for seeding grants of between $3,000 and $5,000 for research on the biology and cultivation of Australian native plants with commercial floriculture potential. 44 applications were received, five of which were funded after competitive assessment. Three were funded for two years.

As a result of these projects, in Victoria, two species of helichrysum daisies were identified which can be used as floral fillers to complement the market for rice flower. The limited natural colour range of *Ozothamnus diosmifolius* can be enhanced and complemented through the use of the related species *Ozothamnus obcordatus* and *chrysocephalum semipapposum*. There is already increasing demand for rice flower in both local and export (particularly Japan) markets. A number of clones from both species have been collected which exhibited the physical characteristics, had an acceptable vase life and a good strike rate. Continuing assessment in regard to propagation, agronomic potential, pest and disease resistance, and post-harvest vase life is under way.

In N.S.W. the diversity of mulla mulla (*Ptilotus*) was studied. 116 accessions were made covering 32 species or possibly 45 species, given the taxonomic uncertainties. 67 of the collections were from natural habitats with recorded provenance details. An explanation for the poor performance of many commercial and field-collected seed batches was found. Satisfactory procedures for small-scale propagation by seed, cuttings and transplanting were established.

In Victoria, new plantations of *Thryptomene* can lose 40% of plants from *Phytophthora* root rots. It has been shown that composted chicken manure provides effective protection against root rot caused by *P. cinnamomi* in a model plant system, lupin. Disease control was shown to be associated with higher total microbial activity, in particular the presence of higher numbers of antagonistic microbes such as the endospore-forming bacteria and actinomycetes, in amended soils.

A reproducible assay to test the effectives of soil amendments against *Phytophthora* root rot has been developed. A range of actinomycetes bacteria and fungi isolated from composted chicken manure antagonise the growth of the pathogen.

In Queensland, propagation of *Persoonic virgata* was studied as it has potential as a new plantation species. Seed germination studies have shown that the endocarp is a major barrier to germination. 40% to 60% germination, *in vitro*, occurs if half of the endocarp is removed, *ex vitro* procedures are not successful. Success with cuttings varies with individual stock plants. Growth cycles of plants in their natural habitat have been established.

In Tasmania, a novel approach to sourcing soft tree fern (*Dicksonia*) was investigated. Results suggested that light, moisture and nutrient requirements of *Dicksonia* can be provided in plantation forest understoreys or beneath disturbed native forests, without compromising either the productivity of the plantation or the ecological succession of

native forest gaps. Protocols and media requirements for the *in vitro* propagation of sporelings have been derived experimentally.

These five sets of results indicate how much progress can be made with tiny grants for projects, competitively assessed and administered by a voluntary body (in this case, the Australian Flora Foundation Inc.).

2 Introduction, Objectives and Methodology

Of the 16,000 native flowering plants in Australia (three quarters of them endemic), few of them have been studied extensively for commercial cultivation or sustainable harvesting from the wild. This deficiency may have been because the majority of botanists employed by state governments were taxonomists, whilst in universities interest in native plants is a recent development (Western Australia excepted).

Members of the Societies for Growing Australian Plants and Wildflower Societies around Australia were aware of the deficiencies and in 1981 founded the Australian Flora Foundation to promote research into the biology and cultivation of the native flora. Modest grants ranging from $500 to $3000 became available.

The objectives of these research grants were determined by the researchers. The money available from donations and community groups was not sufficient to entice work towards specific goals.

When the Rural Industries Research and Development Corporation took over from the Australian Special Rural Research Council and established its Wildflowers and Native Plants Program in 1990, five-year plans, in consultation with the industries and research community in all states, had yet to be developed.

The opportunity thus arose to utilise the voluntary skills of members of the Australian Flora Foundation in administering and distributing small grants to increase the number of native plant species and/or genera under scientific study as the basis for novel products or industries and to increase the number of scientists doing research on native plants.

The Australian Flora Foundation circulated a call for applications for Special Research Grants (funded by RIRDC) of $3000 to $5000 for up to two years, closing date July 30, 1993. 44 requests for detailed guidelines for applications were received; 15 applicants responded. Eight were from university researchers, 2 commercial growers, 2 at TAFE and 3 from other state bodies. (Distribution by state : New South Wales 5; Western Australia 3; Victoria 3; Queensland 2; South Australia 1; Tasmania 1).

Five of these were selected at a Board Meeting of the Foundation for sending to the Scientific Research Committee of the Foundation for ranking and approval. This Committee consists of :

- Professor Emeritus Trevor Clifford (Honorary Associate, Queensland Museum),
- Dr. Kingsley Dixon (Assistant Director and Adjunct Professor, Kings Park and Botanic Garden, Perth),

- Professor Betsy Jackes (Dean of Science, James Cook University of North Queensland),
- Dr. Peter McGee (Senior Lecturer, University of Sydney),
- Professor Richard Williams (Department of Plant Production, University of Queensland, Gatton)

Two projects were funded. The following year, a similar procedure was used. 33 applications were received and three were funded.

In the following Chapters the objectives and outcomes of each of these five projects are presented as reported to the Foundation by the researchers. A general discussion assesses the efficacy of funding research on native plants by this means.

3 Selection and Evaluation of Helichrysums as cut flowers

Researchers :
A.T. Slater and A.D. Allen
Institute for Horticultural Development Knoxfield
Department of Agriculture, Victoria.
Private Bag 15, South East Mail Centre, Vic. 3176.

Background

The Australian Flora Foundation has had success with funding research into Australian native daisies towards their use for varied horticultural purposes. The first grant ever awarded by the Foundation was to Ms Sandra Lacey, then a research horticulturalist at the Redlands Research Station of QDP1 in 1987. This grant was for a collection of *Helichrysum diosmifolius* (now known as rice flower) selections. Growers in south-eastern Queensland were interested in this species for cut flowers, but seed produced variable plants and other propagation was difficult. QDPl could find the staff time for this project but $1500 was needed for travel outside the Brisbane area.

Progress in this rice flower project was rapid - the commitment of various grower, state and federal bodies had been $190,000 by 1993 (Yencken 1994).

In 1992, the Australian Flora Foundation funded a further QDPI project carried out by Dr. K.V. Sharman and Mr. R.M. Dowling. The germination requirements of 27 species of Australian native daisies were evaluated at Redlands Research Station (Bunker 1994). By the time that the horticultural uses of Australian daisies were reviewed in 1996 (Bunker 1996), 87 species were identified as having applications as hanging basket specimens, flowering pot plants, tub specimens, rockery or bedding plants, and fresh or dried cut flowers.

With this background, the Board of the Flora Foundation sent this project of A.T. Slates and A.D. Allen to the Scientific Research Committee of the Foundation for appraisal and approval when the applications was received for the first round of special grants funded by RIRDC in 1993-94.

Outcomes

Tony Slates and Anthony Allen reported to the Flora Foundation in November 1994 that "our work has identified two species of daisies which can be used as floral fillers to complement the market for rice flower. The limited natural colour range of *0. diosmifolius* can be enhanced and complemented through the use of the related species *0. obcordatus* and *C. semipapposum*. There is already increasing demand for rice flower in both local and export (particularly Japan) markets.

“We have identified a number of clones from both species which exhibited the physical characteristics, had an acceptable vase life and a good strike rate. Continuing assessment in regard to propagation, agronomic potential, pest and disease resistance, and post-harvest vase life is under way. Potential cultivars from our initial selections will be trialled with current rice flower growers to determine their suitability for commercial cultivation. The market potential of the selections will be assessed by surveying local florists, flower wholesalers, and exporters of wildflowers.”

They presented a poster at the “3rd National Workshop for Australian Native Flowers’
at Gatton Campus, University of Queensland, in February 1994 (Allen *et al* 1994) and the project continues with RIRDC, QDPI and growers support in the Wildflowers and Native Plants Program of RIRDC.

Project Details

Tony Slater and Anthony Allen said “The objective of our work has been to survey field populations of *0. obcordatus* and *C. semipapposum* for plants which show characteristics suitable for development as cut flowers. These plants were then collected from the field to determine their vase life, and the suitability of these selections for commercial propagation and cultivation.

“Herbarium records were examined to identity sites with promising material, as the two species are variable in their vegetative and floral forms throughout their range. In order to maximise the variability sampled, plant populations were surveyed over a large part of Victoria. Populations were surveyed at St Arnaud, Stawell, the Grampians, Inglewood, Bendigo, the Brisbane ranges, Glenrowan and in the high plains.

“Selections from populations of the two species were made according to the following characteristics:

- stem length suitable for harvesting (longer than 40 cm),
- vigorous erect habit,
- large number of stems per plant,
- corymb at least 8 cm in diameter,
- capitula within the corymb displayed at an even height, and even floral maturity,
- clear bright colours,
- early and late flowering forms.

In total, 48 clones of the two species were collected. The 24 clones of *C. semipapposum* were collected based on variations in flowering time, stem length and leaf size. The colour of the stem and leaves also varied, possible due to the cover of hairs. The colour of the flower heads was also selected for, as they varied from lemon through to orange-yellow. The 24 clones of *0. ozothamnus* were collected mainly on flowering time, stem length and the diameter and presentation of the flower head. The diameter of the flower head was also noticed to vary in association with leaf size, with the smaller leafed selections having smaller flower heads.

“Propagation and cultivation : The plants were propagated using semi-hardened tip cuttings, dipped in Clonex purple gel (3g/L indole-3-butyric Acid) and placed into a mist bed. As expected the strike rate of the material which was collected in the field varied from clone to clone. The majority propagated in acceptable numbers while there were a few clones where very few struck, and 13 clones which did not strike. As the exact collection site was recorded for each clone, further collections can be made if necessary.

“Vase life : Plants selected in the field were assessed for their post-harvest vase life. Five stems were collected from each plant, placed in a plastic bag with moistened paper then placed on ice for transport back to the laboratory. Transport and treatment of the flowering material occurred within 48h of harvest. The stems were placed in distilled water and maintained under controlled environmental conditions (20°C, 65% relative humidity, 10 μmol $m^{-2}s^{-1}$ light), until they were no longer considered suitable for sale. The assessment of the vase life for all selections was terminated after 14 days inside the controlled temperature room.

“The optimum length of vase life for both species could not be determined as the field collected material was of unknown maturity, and was kept dry for up to 48 hours after harvest. The stems of *C. semipapposum* remained acceptable for a period of between 7 and 14 days. Some of the *C. semipapposum* stems developed leaf tip die back and blackening. Further work will be required to determine if this would occur on cultivated stems, and if antisenescence or ethylene-inhibiting treatments could control leaf blackening as shown for rice flower. The stems of *0. obcordatus* were generally selected from the field when they would have been deemed to be over mature. These stems remained acceptable for a further period of between 5 to 13 days. Further work is required to determine the optimum vase life of stems in cultivation.”

4 Identification of Mulla mulla suitable for domestication for the cut and dried flower trade

Researchers :
P.G. Abell and J.D. Oates
Plant Breeding Institute, Cobbitty
University of Sydney
Private Bag 11, Camden, NSW 2570

Background

The large colourful flower spikes of the amaranth *Ptilotus exaltatus* have attracted horticultural interest for many years. Wrigley and Fagg (1989) list eight species of *Ptilotus* which has been tried with some success and point out that, with approximately 100 species in the genus, many more might be useful but, growing as they do, in arid or tropical areas of Australian, have been neglected.

Professor Richard Williams has worked on production system for *Ptilotus* for a decade, initially at Black Hill Flora Centre, Athelstone, South Australia. He wryly points out that there was little interest in commercial production in Australia. However when flowering pots of *P. exaltatus* won an award in Europe in 1993 the genus is receiving deserved attention (Williams 1996).

One of the applicants for the first round of Special Grants of the Australian Flora Foundation in 1993-94 (funded by RIRDC) was J.D. Oates of the Plant Breeding Institute, Cobbitty University of Sydney. The project intended to collect and grow a comprehensive germplasm collection of *Ptilotus* and determine potential for cut or dried flowers.

The present Plant Breeding Institute grew from the establishment at Castle Hill in Sydney, which had served wheat and other industries since 1945. Since moving to Cobbitty, it has included ornamentals and native plants in its objectives, using facilities for long-term seed storage, liquid nitrogen storage, tissue culture and molecular genetics. The collection of species of *Ptilotus* would make use of the extensive personal contacts of the Institute.

The Scientific Research Committee of the Australian Flora Foundation assessed and approved the application.

Outcomes

116 accessions were made covering 32 species (possibly 45 species, given the taxonomic uncertainities). 67 of the collections were from natural habitats with recorded provenance details.

An explanation for the poor performance of many commercial and field-collected seed batches was found. Satisfactory procedure for small-scale propagation by seed, cuttings and transplanting were established. Floristic and horticultural merit are being assessed.

Project Details

J.D. Oates reported to the Australian Flora Foundation in March 1996 that “the collections have come from The University of Sydney staff, Royal Botanic Gardens Mt. Annan, Kings Park and Botanic Gardens Perth, private collectors John McCarthy and Zyllis Ashby. Commercial seed sources: Royston Petrie Seeds, NSW; Kimberly Seeds, D. Orriell Seed Corporation, Vaughans Wildflower Seeds and Nindethana Seed Service, all of Western Australia. A 10-day field trip through central Australia added to our understanding of their biology, 15 species were identified and accessioned. Material has been accessioned from all states except Victoria and Tasmania.

“**Propagation from seed :** Seed is usually harvested from the natural habitat and supplied as flowers with the seed enclosed. We have found significant fluctuations in seed set from field collections and commercial seed sources. The range in one species, *P. exaltatus*, was 2% to 70%. Pollination vectors and environmental factors would be the major influences on seed set. An added complexity is the variation in the viability of 'set' seed (0-100%). Germination rate of extracted seed was far more reliable than that achieved from sowing the flower/seed bulk, indicating either a physical or chemical barrier in the flower.

“The efficacy of commercial collection strategies was investigated. This was done as a conscious part of the field work in central Australia. The conclusion drawn was that a large portion of the inflorescence was collected which included immature seed or even unopened flower buds. This is supported by field observation showing that the mature flowers with ripe seed detach very quickly from the inflorescence. It was noted that only a small amount of ripe flower (with ripe seed) was available at any one time for collection. Another indicator was the bleaching of the mature flowers from our field collection compared to the rest of the developing inflorescence. This meant that seed counts (by extraction) generally showed a significant increase over counts from material supplied commercially. A number of collections from commercial sources yielded no seed.

“Seed was germinated in nursery flats in a medium of washed river sand and peat moss (2:1). Initial germination occurred in 7-21 days although some species (e.g. *P. obovatus*, *P. exaltdtus*.) continued to germinate for up to three months.

“All species have so far exhibited a high level of susceptibility to ‘damping off’ whilst very young. Pasteurization and fungicide drenches have not controlled the problem always. Pricking out the seedlings into plugs with a very porous medium and a reduction in watering to an absolute minimum has proven effective.

“A seed germination protocol was developed to overcome some of the above propagation problems. This method involved germinating seed in petri dishes on pasteurized moist peat moss. The lid was replaced and the germination monitored. The small seedlings were pricked out and potted into tubes and grown on normally.

“**Propagation from cuttings :** Both soft tip and semi-hardwood cuttings have been used successfully to produce clonal replicates. High humidity and temperature stability are considered the most important environmental factors. Our system consists of a 'tent' within a controlled environment room. The room was set at 25°C (considered to be an appropriate temperature). The 'tent' has a controlled level of humidity (90-95%). The humidity is in the form of a "fog" generated from a 'Uni Fogger' ultrasonic humidifier. Soft, herbaceous tip and stem cuttings from cultivated plants work well with most species. *P. polystachys* and *P. obovatus* strike at a rate of better than 90%. Older woody material such as is found in the natural habitats is usually more difficult to strike. Early removal of cuttings from the propagation system after rooting is advised as prolonged exposure to higher levels of moisture often allows fungal attack. With the exception of *P. polystachys*, the use of flower scapes as stem cuttings is to be avoided due to their reluctance to produce roots and lateral shoots.

“**Cultivation** : As the plants grow in the drier inland regions of Australia, it was assumed that the basic water requirements would be low. This is certainly true in practice. Container grown plants, both glasshouse and shadehouse, produce weak root systems when the media water content was kept at a constant high level. However, the division between ‘too wet’ and ‘too dry’ was critical so the most reliable production method involved improving the air-filled porosity and hence drainage of the media.

“Field beds have been prepared to provide information on the performance of *Ptilotus* in a 'garden' or 'crop' situation. These consist of our local alluvial soil formed as beds raised l25mm above ground level. These beds were mulched to a depth of approximately 30mm with 'Vita Mulch' to help retain water and retard weed growth. Watering was carried out by a network of drippers that, at present, operate manually. This method appears to be very effective. Plants of several species have proven to be quick to establish and are quite hardy in the field. Even considering the recent drought, the field plantings required very little supplementary water. The best performers at this stage are *P. obovatus, P. exaltatus, P. nobilis, P. calostachys* and *P. po1ystachys. P. clementii, P. polakii, P. ledifolia, P. macrocephalus, P.rotundifolins* were weak growers in the field.

“**Floristry** : Flowers within the *Ptilotus* inflorescence consist of persistant bracts surrounding a sometimes hairy perianth with 5 segments. The 5 stamens are frequently reduced to only 2 fertile stamens due to the production of staminodes. This could be one explanation for the often poor production of seed in nature.

The inflorescence is usually a cylindrical, ovoid or globose spike. It mostly is set terminally with the occasional axillary spikes. The scapes vary in length up to 0.5 metre, depending on the species and environmental conditions. Flower colour in *Ptilotus* is rarely considered intense, being usually pastel shades of pink, mauve, green, pale yellow and also white. Yet they are most striking, due to the numbers of flowers produced and the size of the inflorescence. The overall floral presentation is often enhanced by long scapes presenting the inflorescence on or above the plant.

"At present there would be three areas within the existing flower markets for *Ptilotus* spp. Dried material, fresh flowers for mixed bunches and fresh flower 'fillers'. Initial trials into vase life are very encouraging. Seven species have thus far been cut and placed into distilled water. All lasted at least 14 days, with *P. polystachys* maintaining condition for a full 7 weeks (49 days). This species, although not an attractive colour (green) could be used in the same manner as grasses in floristry. There is currently a lack of fill in the floristry industry. *P. obovatus* has great potential to provide material in this area. It has a compound, branching inflorescence with globular flower heads of 10 - 15mm diameter, in colours from white through pink to mauve. Some forms present the flowers on scapes of up to 300mm long which could be considered adequate.

"**Horticultural merit** : *Ptilotus* spp. have ornamental appeal; they exhibit a range in plant form from prostrate/trailing through to erect herbs to small shrubs. Leaf colour varies from bright green to silver/grey; the flower colour range and inflorescence form has been mentioned above. This variation provides plant form and foliage contrast not found in existing landscape species. This all points to a group of plants that, if found adaptable to horticulture, could fill a range of floristry needs.

"Merit testing within existing and developing gene pools has continued. Observations of the following traits were taken:

1. Container and in ground performance.
Container production in a controlled environment is without doubt the most reliable method of production. Growth is usually rapid with *P. exaltatus* being a possible '8 week' plant when under production. In drier climates many *Ptilotus* spp. will perform very well in the field.

2. Susceptability to pests and disease.
Soil borne fungal disease is the biggest hurdle to overcome. The use of supplementary water and fertiliser certainly increases the growth rate, but this also increases the susceptibility to fungal attack. Plants being grown in the glasshouse can be attacked by insect pests. Aphids and white fly have been observed causing damage to a number of species.

3 Flower presentation, production and timing.
Ptilotus spp. vary greatly in the floral presentation. Several species, including *P. clementii, P. fusiformis, P. polakii, P. chamaecladus,* are of little ornamental value floristically. They are either shy flowers, poor flower presenters or of nondescript colours. Many species mature and flower quickly in cultivation. Many will begin

flowering from seed in 8 to 10 weeks. This may continue for 2 to 3 months (or more) with some species.

4. Plant form and end use.

Applied selection, to ensure the most appropriate forms for particular markets, is of a high priority. The weakest or most untidy forms should not be grown. *P. obovatus* shows significant variation both within and across collections and has the potential to provide forms for landscaping, containers and floristry.

5. Ease of propagation.

With the previously outlined methods seed propagation is a relatively straightforward means of production. Vegetative propagation via cuttings provides only minor problems with appropriate material and conditions. *In vitro* micropropagation provides the most satisfactory method of 'mass' production.

“The establishment and growth under zero-maintenance conditions of plants with minimal water has been quite successful. Although generally cold or even frost-hardy, many species were killed by a very severe frost during July 1995. There are also opportunities to develop selections for the mass container markets both in Australia and overseas. These could be multiple stemmed or compact free flowering types or possibly hanging basket plants such as *P. axillaris*.”

5 Biological control of *Phytophthora cinnamomi* in Grampians Thryptomene using manure treatments

Researchers :
D.I. Guest and N. Aryantha
School of Botany, University of Melbourne, Parkville, Vic 3052.

Background

In a review of root rots caused by *Phytophthora* in Australian (Irwin *et al*. 1995), a 1993 estimate of costs across all industries is quoted : $200 million. This review lists existing controls of these pathogens in the horticultural industries : improved drainage, chemical application or drench of soil and resistant cultivars. For many species there currently is no viable control measure; selection of resistant cultivars for a wide range of species will take many years.

Since the early 1980s, D.I. Guest has had extensive experience in research into the biology and control of *Phytophthora* diseases in plants, including studies on the pathogenecity of *Phytophthora* spp., the defence mechanisms used against these pathogens by plants and the involvement of these defences in the protection of plants by phosphorate fungicides. Hence, he became involved in a *Phytophthora* problem of *Thryptomene* growers in western Victoria. This problem could be a case study for biological supression of the pathogen based on observations that the disease is less prevalent on soils of higher organic matter. The organic content of the soil might encourage growth of micro-organisms which are antagonistic to the pathogen.

The present cultivation of *Thryptomene* species is reviewed by Beardsell (1996). The Grampians species (*T. calycina*) is an important winter cut flower crop in Victoria, located near the natural range of the species. New plantations have been set up in recent years, but *Phytophthora* can cause the death of up to 40% of plants.

This research project, trialling added organic matter for supression of *Phytophthora* root rot in *Thryptomene* was assessed and approved by the Scientific Research Committee of the Australian Flora Foundation.

Outcomes

It has been shown that composted chicken manure provides effective protection against root rot caused by *P. cinnamomi* in a model plant system, lupin. Disease control was shown to be associated with higher total microbial activity, in particular the presence of higher numbers of antagonistic microbes such as the endospore-forming bacteria and actinomycets, in amended soils.

A reproducible assay to test the effectiveness of soil amendments against *Phytophthora*
root rot has been developed. A range of actinomycetes, bacteria and fungi isolated from composted chicken manure antagonistise the growth of the pathogen.

Project Details

In a progress report to the Australian Flora Foundation, D.I. Guest and N. Aryantha said "Chicken, cow, horse and sheep manure, composted for 0, 2 or 5 weeks before incorporation into potting mix infested with *Phytophthora cinnamomi,* were screened for their abilities to reduce the incidence of root rot in lupin, a useful and readily available indicator plant. Soil samples from each treatment were analysed every 2 weeks for pH, organic matter content, total microbial activity and populations of *P. cinnamomi* and antagonistic microorganisms. Antagonistic fungi, endospore forming bacteria, fluorescent pseudomonads and actinomycetes were isolated for further testing both *in vitro* and *in vivo.* The most effective antagonists were then used to treat thryptomene seedlings grown in *P. cinnamomi*-infested potting mix.

"Chicken manure composted for 5 weeks was the most effective treatment in suppressing root rot symptoms in lupins. When grown for 14 weeks in potting mix infested with *P.cinnamomi,* 96% of seedlings in potting mix amended with composted chicken manure survived, compared to 81% in composted cow manure, 58% in composted horse manure, 51% in composted sheep manure, and 57 % survival in unamended potting mix. One hundred percent of seedlings planted in manure-amended or unamended potting mix free of *P. cinnamomi* survived.

"Forty six microbes isolated from composted manure inhibited the growth of the pathogen *in vitro.* Of these, two bacteria, four fungi and seven actinomycetes protected lupin seedlings for up to 14 weeks (significantly different from control) when incorporated to infested soil. In these experiments there was little correlation between disease protection and survival of *P. cinnamomi*. In similar pot trials, two fungi and four actinomycetes reduced dieback in *Thryptomene* over 14 weeks. By this time all plants in unamended infested soil were killed.

"As well, *Thryptomenes* were grown in the glasshouse in a sand peat potting mixture, amended with composted chicken manure, with selected antagonistic microorganisms isolated from field soils, or treated with the fungicide potassium phosphorate. Disease development was observed over the ensuing four weeks, and soil samples from each treatment were analysed for pH organic matter content, total biological activity, and survive of *P cinnamomi*.

"These trials showed a significant reduction of survival of *P. cinnamomi* disease incidence (% plants showing symptoms) and severity (% plants dying) when potting mix was amended with composed chicken manure. There was a strong correlation between the effect and the level of organic matter, total biological activity and populations of antagonistic actinomycetes and bacteria. Soil drenches of potassium phosphonate at transplant also reduced disease, without a corresponding increase in soil organic matter, total biological activity or populations of antagonistic actinomycetes and bacteria.

“Field trials have been established at a commercial *Thryptomene* farm near Horsham and at the Cranbourne annexe of the Royal Botanic Gardens comparing phosphorate drenched soils with composted chicken manure and untreated soils.”

6 Propagation of *Persoonia virgata* for the development of a new export floricultural crop

Researchers :
L.M. Ketelholn and M.E. Johnston
University of Queensland, Gatton Campus, Lawes, Qld 4343.

Background

Persoonia always have been an enigma for horticulturalists. Recruitment in the wild is reliable after fire or other disturbances, yet as John Wrigley pointed out ten years ago (Wrigley and Fagg 1989), many attempts have been made to overcome the dormancy of the seeds. The few successes have not yielded repeatable techniques. Similarly, propagation from cuttings is unreliable.

The distinct green of the foliage of *Persoonia* makes some species attractive for cut foliage as well as in yellow flower. *Persoonia virgata* and *P. cornifolia* are harvested from the wild on the warm east coast (Ketelholn *et al*. 1994).

In Tasmania, several species of *Persoonia* are on the ROTAP list. In 1992 the Australian Flora Foundation funded Dr. Janet Gorst, then at the University of Tasmania, to identify impediments to seed germination and tissue cultures of these species.

Since 1993 Lynda Ketelholn has been exploring propagation of *P. virgata*. By 1994 it was found that removal of half the woody endocarp of the seed longitudinally was a promising treatment. Certain media and hormone treatments had been identified as more likely to produce rooted cuttings (Ketelholn *et al.* 1996). So, in the second round of grants, funded by RIRDC, this project was assessed and approved by the Scientific Research Committee of the Australian Flora Foundation.

Outcomes

Seed germination studies have shown that the endocarp is a major barrier to germination. 40% to 60% germination, *in vitro*, occurs if half the endocarp is removed. However, more commercially viable, *ex vitro* procedures are not successful. Success with cuttings varies with individual stock plants. Growth cycles of plants in their natural habitat have been established.

Project Details

Lynda Ketelholn reported to the Foundation that, in an experiment to assess "the effects of various mesocarp removals, endocarp removals and chemical applications on the germination response of seed that had been cool-stored for 20 weeks. Seeds that were soaked in hydrogen peroxide or gibberellic acid, at varying concentrations, did not produce germination results significantly different to the control treatment.

Seeds that were fermented and then had the majority of the endocarp removed produced 54% germination, being significantly higher than other combinations of mesocarp and endocarp removal treatments. This experiment was repeated using fresh seed, to determine if cooling had affected germination. These results also showed no significant difference in germination of chemically treated seeds compared to the control. The mesocarp and endocarp removals produced significantly different germination results, though there was no significant interaction effect.

These results would suggest that the embryo may not be dormant and that adequate oxygen is reaching the embryo when parts of the endocarp is removed. The endocarp appears to be a barrier to germination, and developing a method to more easily remove it will be important in developing a commercial system of propagation."

Cutting propagation : Using established stock plants in glasshouses. "a preliminary experiment investigated the effect of blanching cuttings. One juvenile stock plant was used, with five out of the eight cuttings examined, producing roots. A larger experiment, involving a number of mature stock plants, was conducted. However, no rooting resulted among 600 cuttings. The major differences between the two experiments were : (1) different genotypes may have different rooting responses, (2) juvenile cuttings may be easier to root than mature cuttings, and (3) the experiments were conducted at different times of the year."

In an experiment investigating the rooting of juvenile and mature shoots from stock plants, higher percentages were achieved with juvenile plants than 'medium' plants. However, in both types results from individual stock plants varied enormously.

7 Regeneration biology and Silviculture of Tasmanian Soft Tree Fern *Dicksonia antarctica*

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Background

A truckload of *Dicksonia* tree fern stems is a disturbing sight. Defronded and sawn off at ground level, the ferns are destined for the insatiable garden and landscaping trade, both indoor and outdoor. Unlike a truckload of logs of trees, of similar age to the ferns, there is no land set aside, nor cultural practices available, for the replacement of the ferns. As John Wrigley wrote in 1989, "this method (of propagation by 'cutting') is not to be encouraged unless the individual tree fern is doomed to die in its present position. By sawing the trunk through. the top part of the tree fern will form roots and regrow, but the base will die".

Given this situation, the Australian Flora Foundation was pleased to receive an application for funding an imaginative project aimed at establishing silvicultural requirements of the tree fern as a commercial understorey crop in eucalypt plantations. This application, in the second round of grants to be funded with RIRDC moneys, was assessed and approved by the Scientific Research Committee.

As Greg Unwin summarised for the Foundation "The spectacular tree gern *Dicksonia antarctica* is commonly found in moist forest understoreys of south-eastern Australia. For almost two centuries, this large fern has attracted the attention of botanists, pteridologists and palynologists, for its size, beauty and taxonomic relationship with other tree fern genera of both extant and fossil flora.

In recent years, commercial horticulture has provided an incentive to harvest mature *Dicksonia* stems from private and crown forests in Tasmania in order to supply Soft Tree Ferns at low prices domestically in Australia and to develop a very small market at high specialty prices for export to Europe. Extraction and marketing of *Dicksonia antarctica* for export raises new issues of conservation and management of the native fern flora in Australia.

At the same time, such an opportunity provides new avenues for research on the application of propagated growing stock and commercial silviculture of the tree fern within managed understoreys of fastgrowing *Eucalyptus* plantations.

Outcomes

Results to date suggests that light, moisture and nutrient requirements of *Dicksonia* can be provided in plantation forest understoreys or beneath disturbed native forests, without compromising either the productivity of the plantation or the ecological succession of native forest gaps.

Protocols and media requirements for the *in vitro* propagation of sporelings have been derived experimentally.

Two papers have been published (Unwin and Hunt 1996, Hunt *et al*. 1997) and the researchers have been able to bring international attention to the possibility of actually cultivating and managing propagated tree fern populations silviculturally for an expanding world horticultural interest in Australian native ferns.

Project Details

Greg Unwin reported to the Australian Flora Foundation in 1997. He said that "the second year of the project has sustained our cautious prospects for sustainable silvicultual production of advanced adult tree ferns in moist plantation understoreys. Silvicultural establishment trials will be implemented, as planned, in 1997 by outplanting nursery propagated sporelings in the plantation understorey. This experiment will test our explanation of plant environment relations derived through ecophysiological investigation as outlined in published results to date.

By way of background he said that "in recent years, commercial horticulture has provided an incentive to harvest mature *Dicksonia* stems from private and crown forests in Tasmania in order to supply Soft Tree Ferns at low prices domestically in Australia and to develop a very small market at high specialty prices for export to Europe. Extraction and marketing of *Dicksonia antarctica* for export raises new issues of conservation and management of the native fern flora in Australia. At the same time, such an opportunity provides new avenues for research on the application of propagated growing stock and commercial silviculture of the tree fern within managed understoreys of fast-growing *Eucalyptus* plantations.

"The Australian Flora Foundation / RIRDC support of these investigations during 1995 and 1996 has been instrumental in developing international interest in a continuing tree fern research programme for future years (presently proposed in an Internal Grant Application, Southern Cross University and University of Tasmania 1997-98). Even though financially limited in scale, the work to date has allowed the investigators to bring international attention to the possibility of actually cultivating and managing propagated tree fern populations silviculturally for an expanding world horticultural interest in Australian native ferns. The concept of actually raising and managing tree fern stocks for horticulture beneath rapidly expanding eucalypt plantations or disturbed farm forests, rather than simply exploiting or salvaging native populations for domestic or export sales, is somewhat new to Australian tree fern management (or our lack thereof).

“During 1996, our *Dicksonia* studies have developed along two lines of investigation, both of which have involved a training component among graduates of Applied Biology at University of Tasmania:

(a) The ecophysiology of the species regenerating in eucalypt plantation forest understoreys (following from a successful invitation made to a B.App.Sci. (Hons.) student in 1994), and

(b) The development and training of techniques for micropropagation of the tree fern in controlled sterile conditions (undertaken by another student as part of a Grad. Dip. in Ag. Sci.).

“The two investigations are linked by the common objective of future propagation of the species for commercial horticulture, taking advantage of shaded understorey environments in forest plantations, in moist uplands of northeast Tasmania. Hence the principal investigators have established a secure partnership with a large prominent forest nursery in northern Tasmania who is now providing in-kind shadehouse maintenance of planting stock and well managed field sites for the third stage of this project, i.e. underplanting of *Dicksonia antarctica,* beneath young eucalypt plantations.

“In moist forest sites of northern Tasmania, present rate of *Eucalyptus* plantation establishment by large private corporations varies from 3500 - 4500 ha per year, depending on seasonal and operational conditions. This rate of conversion is set to treble if national goals of the proposed 2020 Vision programme are delivered in Tasmania.

Additionally, tree growers on smaller family-owned farm properties are becoming increasingly well organised towards sustainable harvest and export of forest products from their collective forest estate. Tree Growers Cooperatives and the Farmwood Association in northern Tasmania are committed to optimal and sustainable long-term use of forest products from their farms, as a means to diversify and balance their agricultural operations, both financially and ecologically. The scale of farm forest development is ideally suited to improving productivity through small scale plantations and enrichment of disturbed native forest woodlots.

Accordingly, there is particular interest in the next stage of the project, namely the design and development of experimental dual crop silvicultural systems for *Dicksonia* beneath young eucalypt plantations, as planned for the second half of 1997.”

8 General Discussion

The objective of the RIRDC 'Wildflowers and Native Plants' sub-program is to "improve the profitability, productivity and sustainability of the Australian wildflowers and native plants industry" (RIRDC, 1997), including souther African Proteaceae. In 1996, the R.& D Plan 1995-2000 was produced (RIRDC, 1996) with the observation that the newness of the industry has the characteristic of "fragmentatin of the industry and its need to focus its activities, to promote greater awareness of market opportunities and needs and to enhance infromation flow, particularly to more recent entrants." This R & D Plan lists RIRDC initiatives which contribute to the focus of activities.

By contrast, the project reported here, "Distribution of priming grants for wildflowers and native plants" did not have a specific focus; the topics funded were the choice of individual researchers, within the general constraint of the Call for Applications. Nevertheless, all five projects addressed targets of the RIRDC R & D Plan for Wildflowers and Native Plants, as detailed below, and added to the technical information available to industry participants and students.

The funded projects had been ranked by the Scientific Research Committee of the Australian Flora Foundation after consideration of the likelihood of successful outcome. The track record of the researcher and the facilities available. As these were small grants it was essential to have existing infrastructure, researchers and students.

The project on helichrysums, *Ptilotus* and *Persoonia* addressed Objective 3, 'identifiying and developing new fresh products' of the R & D plant, and drew on one of the strengths identified inthe SWOT analysis of the program viz. ability to use bush material to establish markets. The helichrysum study also contributed to Objective 6, 'to extend continuity of supply'.

The trials with *Dicksonia* in plantation forests of Tasmania pertain to Objective 7, 'to improve production efficiency', fostering production systems that are cost effective and ecologically sustainable, whilst the research on controlling *Phytophthora* which organic matter targeted 'Environmentally acceptable pest, disease and weed control packages'.

The project chapters in this report indicate clearly the extent of progress which can be made with research grants in the range $5,000 to $10,000. All five projects have involved training of young people in research methods, for instance, the progress with *Ptilotus* was made with vacation employment of students. Furthermore, the results are presented in "Native Australian Plants horticulture and uses" (K.A. Johnson and M. Burchett, eds, 1996) which provides technical information for future students and those in the industry who are new to the business. The RIRDC R& D Plan for the Wildflowers and Native Plant Program identifies developing the people in the industry as a key issue : - "many within the industry are new to the business and there is a need to ensure that they are well informed abou the industry, with regard to both its potential and its pitfalls. It is important that they have improved access to information and to training in both business and technical skills" (RIRDC, 1996).

9 References

Allen, A.D., Slater, A.T., and Howell, G.J. (1994). Development of South-eastern Australian daisies as cut flowers. in “Proc. Third National Workshop for Australian Native Flowers’ pp. 3.9-3.11. (Story Horticultural : Toowoomba.)

Beardsell, D.V. (1996). *Thryptomene, Micromyrtus* and *Scholtzia* in ‘Native Australian plants horticulture and uses’ (Eds K. Johnson and M. Burchett) pp. 182-189. (University of New South Wales Press : Sydney.)

Bunker, K.V. (1994). Overcoming poor germination in Australian daisies (Asteraceae) by combinations of gibberellin, scarification, light and dark. *Scientia Horticulturae* **59**, 243-252.

Bunker, K.V. (1996). Native daisies. in ‘Native Australian plants horticulture and uses’ (K. Johnson and M Burchett) pp. 228-241. (University of of New South Wales Press : Sydney.)

Hunt, M.A., Davidson, N.J., and Unwin, E.L. (1998). Ecophysiology of soft tree fern *Dicksonia antarctica. Australian Journal of Botany* (in press).

Irwin, J.A.G., Cahill, D.M., and Drenth, A. (1995). *Phytophthora* in Australia. *Australian Journal of Agricultural Research* **46**, 1311-1337.

Johnson, K., and Burchett, M. (1996). ‘Native Australian plants horticulture and uses’.
(University of New South Wales Press : Sydney.)

Ketelhohn, L., M., Johnston, M.E., and Cage, J. (1996). *Persoonia virgata*. In ‘Native Australian plants horticulture and uses’. (Eds K. Johnson and M. Burchett.) pp. 56-67. (University of New South Wales Press : Sydney.)

Ketelhohn, L.M. (1994). Propagation of *Persoonia* species. In ‘Proc. Third National Workshop for Australian Native Flowers’, pp. 4.18-4.22. (Story Horticultural : Toowoomba.)

RIRDC (1996). ‘R & D Plant for the Wildflower and Native Plant Program 1995-2000’. (Rural Industries Research and Development Corporation : Canberra.)

RIRDC (1997). Annual Report (Rural Industries Research and Development Corporation : Canberra.)

Unwin, G.L., and Hunt, M.A. (1996). Conservation and management of soft tree fern *Dicksonia antarctica* in relation to commercial forestry and horticulture. In ‘Pteridology in Perspective’ (Eds J.M. Camus, M. Gibby and R.J. Johns). pp. 125-137. (Royal Botanic Gardens, Kew : London.)

Williams, R.R. (1996). *Swainsona formosa* (Clianthus, Sturt's Desert Pea). In 'Native Australian plants horticulture and uses'. (Eds K. Johnson and M. Burchett.) pp. 102-117. (University of New South Wales Press : Sydney.)

Wrigley, J. and Fagg, M. (1988). Australian Native Plants; A Manual for their Propogation, Cultivation and Use in Landscaping ? 3rd Edition. (Collins : Sydney.)

Yencken, J. (1994). The Australian wildflower industry : future directions and stategy options. In 'Proc. Third National Workshop for Australian Native Flowers' pp. 2.15-2.21. (Story Horticultural : Toowoomba.)