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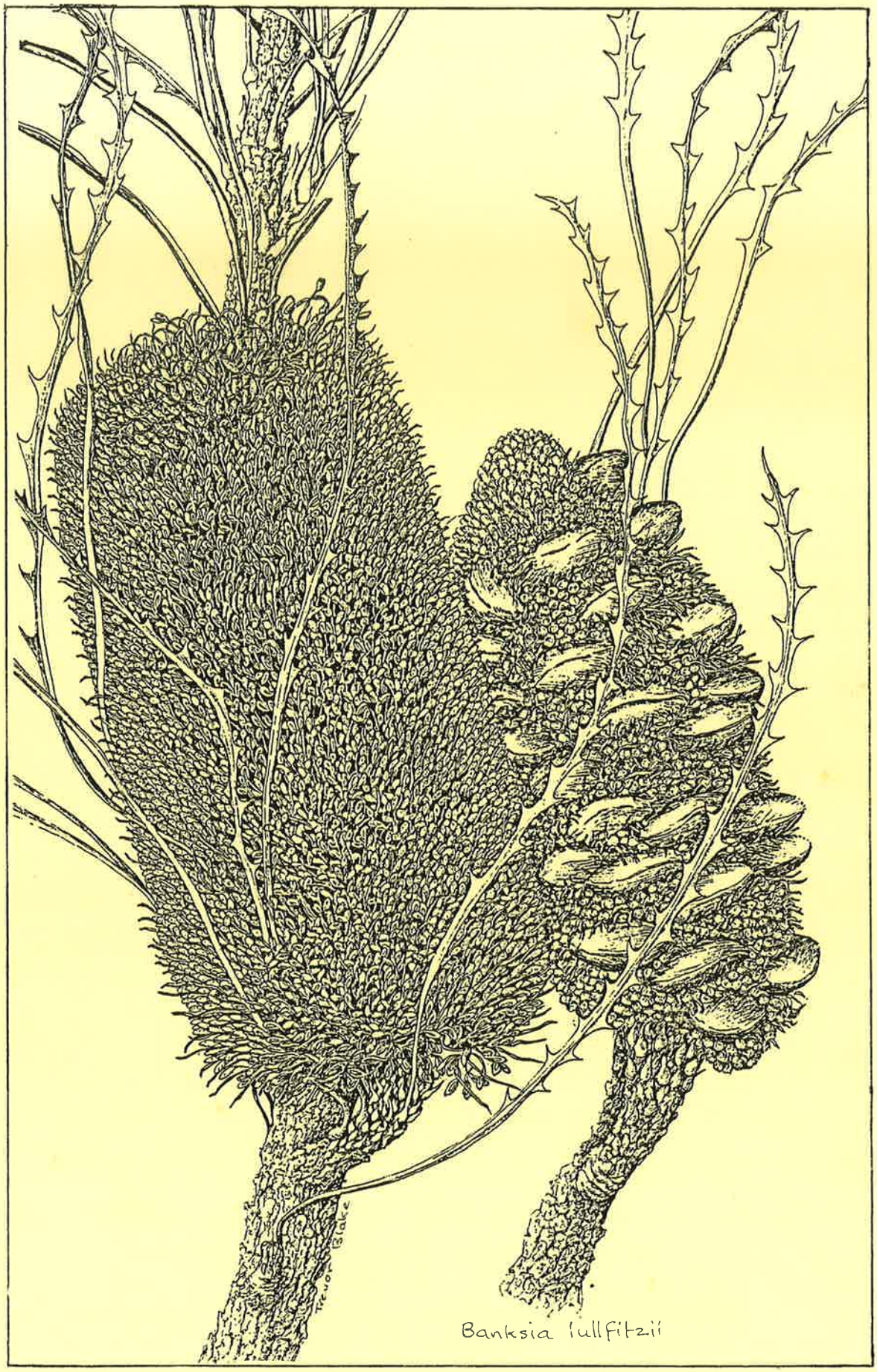
BANKSIA STUDY



REPORT 8

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BANKSIA STUDY REPORT NO. 8 1988

With the publication of the long awaited Banksia Atlas, the revision of the Banksia Book and staging of an exceptional Banksia Spectacular in Sydney's Botanic Gardens at the end of April, the publishing of new species and varieties of the genus in Nuytsia the climate has been set for the production of Report No. 8.

There are a number of issues which present themselves. Firstly, the demand for information on the genus has increased greatly. The need for experimentation for the more successful growing throughout the country has increased. The role of the nurserymen/cut flower growers is one that needs to be addressed. Information on horticultural aspects of all of the more recently described species is needed to complete a more comprehensive picture of the genus.

For most of the W.A. species to be grown in the more populated area of the eastern states with shallow clay (Melbourne) topsoil or in the centres with wet humid summers (Sydney, Brisbane) much more work needs to be carried out with grafting. At present this is being done by amateurs who have pioneered some interesting results. This needs to be carried further by more professional and scientific bodies that have the facilities and resources to carry out the work needed. The BSG is aware of work that has been started at a number of Universities, Institutes and Horticultural Colleges, and it would be useful to be able to outline some of the studies so that we can be aware of directions of developments.

BS Reports are being sought after by students and librarians of many educational organisations.

There are many projects currently being undertaken which may lead to a better understanding of this genus in cultivation. Some of these include:-

- West Ryde Agricultural Coll. 'Commercial Production of Flowers From the Proteaceae Family'.
- Sydney University 'The Gross Morphology of Proteaceae.
- WAITE Institute 'The Development of Banksia for Ornamental Horticulture'.
- Macquarie University - Germination and Grafting Trials.
- Black Hill Native Flora Park and S.A. Dept. of Agriculture. 'Grafting Trials.'
- Knoxfield HR Inst. - 'Nutrition and Pollination of Banksias.'
- WAIT - 'Reproductive Biology and Conservation Status of 2 Rare W.A. Banksias.'
- Northern Rivers CAE - 'Study of Bitou Bush' (its invasion into natural banksia areas).
- WAIT - 'Research into Banksia burdettii.'
- Hawkesbury Ag. College - 'Germination and Grafting trials.'
- Adelaide University - 'The Floral Biology of Banksia in Relation to Crop Production and Management.'

MULTIPLE HEADS - Trevor Blake

The occurrence of Banksia species with multiple flower heads is not that uncommon. Some species appear to do this in their natural habitats and others more frequently produce this malformation in cultivation. The question is whether it is a genetic variation or is it climatically or nutritionally induced? I have seen plants of B.marginata in the wild with this characteristic and it is photographed in Encyclopaedia of Australian Plants Vol. 2, P.296. B.robur and paludosa both seem to produce such abnormalities in cultivation. A form of B.ericifolia with multiple flower heads has been around for some years in the nursery trade. This species was propagated from cuttings, and the characteristic remained true indicating a genetic cause. We would like to hear of other observations and occurrences in other species. It would also be interesting to know whether cutting grown material passes on this characteristic.

MULTIPLE FLOWER HEADS ON B.ROBUR - Inez Armitage

In a recent article by Alex George reprinted in N.S.W. N/L "Native Plants" he comments that some specimens in Canb. B.G., B.ericifolia, B.integrifolia and in particular B.robur have "multiple flower spikes up the stem". I have 2 plants of B.robur, 3 years old which produce bunches of flower heads at ground level clustered on the main trunks. So far they have not matured properly - die away at about half size.

UNUSUAL FLOWERING OF B.ericifolia - B. Cousins

I have something unusual perhaps even rare, in an inflorescence on a cutting grown Banksia ericifolia - the shrub is about 3 yrs. old and has flowered for the first time this year. It has one typical brush as well as this odd arrangement.

The central brush appeared a couple of months ago, and is now drying up. I noted some small swellings surrounding the base of the brush and these have developed into 8 small crowded brushes now beginning to colour.

Whether all the brushes arise from a common point is impossible to determine, without breaking up the specimen.

If this floral set up happens to be uncommon, I could arrange for one of my SGAP friends to do some photos. If it is really rare and worth reporting to a botanist, I am prepared to cut off the whole branch as a specimen.

The thought has occurred to me that the arrangement may indicate a genetic mutation and thus cuttings could perhaps reproduce the feature in their progeny.

THE BANKSIA STUDY NEEDS HELP - Trevor Blake

There have been 18 new species and 14 new varieties created plus 2 name changes with the revision in 1981. Since these species and forms have been recognized for several years there must be plenty of them in cultivation by now. Below are listed all those in this category. On the last page of this Report is a data sheet that could be detached and returned with any information you can supply.

Banksia aculeata
- blechnifolia - (sp. Lake King)
- chamaephyton
- conferta var. conferta
- conferta var. pencillata
- cuneata
- epica
- ericifolia var. macrantha

gardneri var. gardneri (syn. prostrata)
gardneri var. brevidentata
gardneri var. hiemalis
grossa
incana
integrifolia var. aquilonia
integrifolia var. compar
lanata
leptophylla var. leptophylla (sphaerocarpa var. pinifolia, var. major)
leptophylla var. melletica
meisneri var. adcendens
micrantha
nutans var. cernuella
oligantha
oreophila (syn. quercifolia var. integrifolia)
plagiocarpa
saxicola - (sp. Mt. William)
scabrella
seminuda -(syn. littoralis var. seminuda)
sphaerocarpa var. caesia
sphaerocarpa var. dolichostyla
sphaerocarpa var. sphaerocarpa
spinulosa var. collina
spinulosa var. cunninghamii
spinulosa var. neoanglica
telmatiaea

NEW BANKSIA DESCRIPTIONS - Trevor Blake
(Ref. 2nd Edition "The Banksia Book" - A.S. George)
- (Nuytsia Vol. 3 No. 3 1981 - W.A. Herbarium)

Banksia epica

This new species was originally collected in 1974 from one of the two populations on the western edge of the Great Aust. Bight but the 1986 collection from Point Culvert is the type found in coastal heaths in deep white sand. It is similar to B.praemorsa and B.media but differs as outlined:-

	Perianth length	Pollen presenter	Leaves
B.epica	40-44 mm	1.5 - 1.8mm	115-500mm small flat
B.media	32-38 mm	0.75 mm	Slightly recurved 11-12 cm long
B.praemorsa	33-34 mm	1 mm	2-6 cm long

Banksia spinulosa var. neoanglica - A.S. George

Found in woodland and heaths on the New England Tablelands and in the Macpherson Rge. Another of the variations of B.spinulosa with a lignotuber but differing as tabled below.

	Lignotuber	LEAVES Shape	Margins	Veins
B.spinulosa var. neoanglica	Yes	Broad linear	recurved, entire to serrated.	Nerveless above.
B.spinulosa var. spinulosa	Yes	linear-obtuse	revolute, short 3-12mm partially serrated	No prominent veins.
B.spinulosa var. collina	Yes	linear to narrow obovate	recurved serrated	Lateral veins obvious both surfaces
B.spinulosa var. cunninghamii	NO + taller growing habit	Linear to broad linear	Serrated to entire slightly revolute	Lower surface veins feintly apparent

Banksia seminuda - A.S. George
This species was given separate species status and was previously named B.littoralis var. seminuda.

Banksia leptophylla var. melletica - A.S. George
This is a distinct form of B.leptophylla which occurs in shrublands between the Murchison River and Geraldton. It occurs in deep sands over limestone. It differs from var. leptophylla as set out below:-

	Flower size	Perianth	Pistol	Flowering Period
B.leptophylla var. leptophylla	Larger 3-10cm long x 7-12 wide	42-47mm long	56-62 mm long	December-April
B.leptophylla var.melletica	Smaller	30-36 mm long	33-44 mm long	Winter

Banksia leptophylla was frequently referred to as B.sphaerocarpa var. pinifolia or B.sphaerocarpa var. major neither of which had been formally named.

Banksia oligantha - A.S. George

This 3m shrub is found in tall shrubland, 28km north of Wagin, in association with B.attenuata + B.prionotes either as a single or several stemmed plant. With only one stand known of a few hundred specimens, this species would have to be regarded as rare.

It differs from B.ilicifolia and B.cuneata as seen in this table:

	Leaves	Flowers	Leaf Surface
B.ilicifolia	3-10 cm long 3-4 cm wide	more flowers	glabrous
B.cuneata	1-4 cm long 5-15 m wide	50-60 flowers	dull green
B.oligantha	1.5-3.7 cm long x 4-20 mm wide	20-35 flowers	glabrous

BANKSIA QUINTESSENTIAL AUSTRALIAN PLANT GENUS
- Indigofera

Reprint from Canberra Times Wednesday Magazine

Bushwalkers on Tidbinbilla's Mountain Creek Trail at this time of year will see the odd gnarled and lichen-encrusted banksia daring to display its yellow blooms in the dank, gloomy depths of Canberra's ersatz Mirkwood.

The silver banksia, Banksia marginata, is the only banksia species occurring naturally in the ACT, though six others can be found within two hours' drive of the city. B.marginata is a curiously alien presence in the cool, moist woodland at Tidbinbilla. Most banksias grow in drier, more hostile environments, where the ubiquitous eucalypt of Australian landscapes may be rare or even absent - for example: in salt-seared coastal heathlands or shallow, impoverished sandy soils in subcoastal ranges.

Whatever the poets may say about our eucalypts and wattles, banksias are the quintessential Australian plant genus. Banksias little different from today's species grew extensively in Australia 55 million years ago, and their pedigree traces back to the mists of the mid-Cretaceous, more than 100 million years ago.

The family to which banksias belong, the Proteaceae, is so isolated among plant groups that botanists are unable to detect any consistent affinities with any other family - it was almost certainly a very early and successful experiment in flowering plants.

Several years ago, a 55-million-year-old fossil banksia seed cone found in sandstone in the Kennedy Ranges, inland from Carnarvon in Western Australia, was almost indistinguishable from the modern species, B.attenuata, which grows throughout the south-west. Not only was it similar, it showed evidence of having been parasitised by the same insect larvae as drill into the cones of modern banksias, and some ancestor of present-day cockatoos had apparently broken off one seed follicle with its powerful beak while in search of the juicy grub - just as its modern descendants do.

The floral structures still evident on the fossil suggest that the inflorescence, the huge collection of small individual flowers that makes up the banksia flowering head, was probably designed to attract birds to pollinate it, just as they do today. When birds visit your garden to suck a banksia's syrupy, almost sickly, nectar, you are privileged to witness a ritual that is old beyond the comprehension of most mortals.

In contrast, the oldest definite eucalypt fossils are little more than half that age, and wattles do not appear until about 25 million yaers ago. Their ancestors were probably present, but clung to the margins of the rainforest that banksias had foresaken aeons earlier.

Banksias have endured because of their exceptional ability to find nutrients where most plants would starve. They possess an extraordinary root system, almost as fine as the threads of a fungus, which may extend to 10 times the radius of the leaf canopy in search of food - one reason why banksias often resent disturbance in their immediate area in the garden.

Banksias serve as an indispensable link in nature's grand scheme for feeding birds, mammals and insects that have chosen to live in the harsh heathlands. Despite barren soils, the banksias and, to a lesser extent, their cousins the hakeas and grevilleas, offer a prolific source of energy-rich nectar and protein-rich pollen that allows the heathlands to seethe with life and colour during spring and autumn.

In places like Jervis Bay, where B.integrifolia, B. serrata, B. paludosa, B.oblongifolia, B. spinulosa and B.ericifolia all grow in heathland or woodland, the different species tend to flower at different times of the year, with some overlap, so that the animals that pollinate them are provided with food all year round.

Some species, like B.ericifolia, actually produce their maximum nectar flow in mid-morning and late afternoon, when the birds are most active. In Western Australia, several bizarre prostrate species exude a nectar redolent of over-mature football socks, which presumably attracts the small nocturnal rodents that help pollinate them.

The heath-leaf banksia, B.ericifolia, arguably eastern Australia's most beautiful banksia with its spectacular "candles" range in colour from deep orange, verging almost on red, to a pale orange-yellow on other bushes. It can produce a few flowers in autumn, but its main flush is in winter and early spring.

Both the old-man banksia, B.serrata, and the coast banksia, B. integrifolia, are common in beach areas and woodlands along the coast of N.S.W. and Victoria.

Less well known than all of these is Australia's only sub-alpine banksia species, Cane's B.canei, which occurs in four isolated groups in Victoria and N.S.W. This species is presumably a relic of a colder epoch, whose original range in the Southern Highlands and ranges of northern Victoria was dissected by climatic change.

The four groups are separated by hundreds of kilometres, and have each evolved distinctive leaves and flowers. The two Victorian ones, at Wulgulmerang and Wellington River, have beautiful purple and lemon flowers, and very prickly, almost holly-like leaves. A good stand can be found at Mount Tamboritha, and will be in flower in autumn.

Another form with much longer, smoother leaves and a slightly less pronounced purplish cast to the flowers grows on Greg Greg Track, north of Corryong. The most distinctive form grows east of Cooma, in the Kybeyan Range and Wadbilliga National Park. It has very large, snowy-lemon flowers and just one or two "prickles" on an otherwise smooth leaf. The form also has quite hairy stems and young leaves. It is so distinctive that it may deserve recognition as a variety.

B.canei somewhat resembles the silver banksia, B.marginata, and in the Kybean Range a sub-alpine variant of the latter often grows nearby at slightly lower altitude. It was this resemblance which caused botanists to overlook B.canei until the early 1960s, when Victorian amateur botanist and nurseryman Bill Cane drew it to the attention of the Victorian Government botanist, Jim Willis.

It is not particularly closely related to the silver banksia - in fact, its nearest relative is another recently recognised new species, B.saxicola, which grows in the Grampians, in central western Victoria, with a small outlying stand on Wilson's Promontory. It was formerly thought to be a broad-leafed variant of the coast banksia, B.integrifolia.

The seed cones of B.canei and B.saxicola are very similar, and, uniquely among banksias, their seeds must be exposed to a prolonged period of cold before they will germinate. The natural environment normally provides this cold, but the horticulturist can mimic it by placing the seeds in a mixture of sterilised wet sand and peatmoss wrapped in plastic in the crisper section of the refrigerator - not in the freezer!

Both B. canei and B.saxicola make handsome garden plants, and are well adapted to Canberra's bitter winters.

A PRELIMINARY DESCRIPTION OF THE BANKSIA PROJECT CONDUCTED AT MACQUARIE UNIVERSITY MAY 1985 - APRIL 1986. - K.D. Cairncross & A.A. Parks

1. As part of a broad based project, seed was collected, or obtained, for banksi species indigenous to eastern Australia. These were germinated in covered watch-glasses containing vermiculite which was dampened with water containing Fongarid at a concentration of 100mg/dl. The seeds were placed in a constant temperature cabinet at 15°C in maintained darkness. They were inspected at weekly intervals, and germinating seeds transferred to 4cm diameter pots.

   The potting mixture was 50% crushed quartz and 50% sterilised potting mix, th whole dampened (but not saturated) with water containing Fongarid (100mg/dl). The germinating plants were placed in a non-heated glasshouse with constant air-movement. The plants rapidly established given this regimen.

2. Having established the feasibility of this system as a means of germinating banksia species, some 50 species of West Australian banksia seeds were obtained from Nindethana Seeds, W.A. These seeds were subjected to the germination regimen previously described. All species attempted germinated and were potted on, with the exception of B.canei and B.saxicola (the mountai banksias). These were treated as described for other species, but were place at 4°C for up to 60 days. Germination was induced using this methodology, and following germination, the plants were treated as previously described.

3. The plants, once established were not disturbed for a period of 6-8 weeks. They were maintained in the glass-house and watered by capillary attraction. They received no nutrients.

4. Once the plants had developed past the cotyledon stage, 8-10 osmocote granules were introduced below the potting mix surface (using artery forceps) in each tube. The plants remained undisturbed until reaching 10-21cm growth height.

5. On reaching viable maturation, the plants were "potted-on" into 10cm diameter pots. The same potting mix plus Fongarid was employed. The plants have remained in this environment for some six months, and now show the characteristics of the adult species (some plants, e.g. B. brownii, B. quercifolia being greater than 50cm in height.) Others, e.g. B.menziesii, speciosa, baxteri hookerana have assumed the adult form.

6. The plants are now watered - sparingly - by overhead spray on a bi-weekly basis.

7. At this stage, specimens of the western varieties have been "planted-out" in specially prepared beds. These have the following specifications: Length - 20 metres, breadth - 2 metres, depth 1.5 metres. The trench dug to reach dry sandstone, dry sandstone pieces were placed in the trench, together with 10cm agricultural drain draped in hessian and the whole was filled with 100 tonnes of river sand to form a bank - above ground of 1.5 metres. Thus, the total effective depth of the bank is 2 metres. The bank runs east-west giving opportunity for varied sun exposure.

8. Before planting, the bed was drenched with Fongarid and allowed to lie fallow for three weeks before plants were introduced.

9. Following planting, several important points relating to cultivation emerge:

   a) Optimum growth in W.A. species appears not to be associated with the development and maturation of inflorescence. Thus, good growth occurs in baxteri, solandri, goodii, coccinea, hookerana to name but a few, well into the autumn period (late March, April).

   b) This equates with a similar time period for the growth of eastern species (ericifolia, integrifolia, serrata and spinulosa var. cunninghamii). These varieties of banksia grow without benefit of a lignotuber, and as such, should form a suitable host for compatible W.A. species science grafts. (Using the taxonomy described by A.S. George, Nuytsia 3, 239-474, 1981).

   c) Thus, the time for optimum grafting success appears to relate to a time period some 3-4 months prior to appearance of mature inflorescence. In the author's experience: coccinea on serrata (x 5), solandri on integrifolia (x3) grafted in December 1985 - February 1986 showed evidence of graft (scion) acceptance, with good callus development, but the graft (scion) remained dormant for a 3-4 month period. In mid-April scions of both varieties grew some 5cm in 14 days. This enabled the serrata host to be removed.

   d) The environment of dormant scion material following introduction to the host is important.

10. Our experiments examined two situations:

    i) coccinea-serrata;
    ii) solandri-integrifolia.

    In both (a) and (b), grafts (x2 x 2) were maintained in a misted glass-house (mist 7 am and 7 pm) and in a cold glass-house (hand watered at 3-4 day intervals). Preliminary results suggest maintenance of the scion-host graft under mist is beneficial for up to 14 days helping maintain intracellular trugidity. In other words, absorption of fluid by the graft is adaptive of self.

11. However, if the scion-host union is attempted during the "dormant" (heat-induced) period, then fungul infestation (from the scion!) is likely to occur in plants maintained under mist (Fongarid is without beneficial effect). The conclusion must be that maximal humidity is beneficial in the short-term, (14 days), thereafter no evidence of scion deterioration being apparent, transfer to a low humidity environment is beneficial.

12. Additionally, the literature is deficient in when the optimum time for successful grafts should be undertaken. (See Item 9(c) above). Thus, more research is needed.

13. The grafting technique.

Four types of graft have been examined:

a) Top wedge
b) Side wedge
c) Approach graft
d) Mature plant graft

(a) 11 top wedge grafts were attempted. None were successful. (*In terms of experience, probably attempted at the wrong time of year, with immature host plants).

(b) Side wedge grafting has proved successful.

The following grafts were undertaken:

(i)	integrifolia	on integrifolia	(x6)	Success	(x6)
(ii)	verticillata	on cunninghamii	(x5)	Success	(x5)
(iii)	coccinea	on serrata	(x5)	Success	(x4)
(iv)	solandri	on integrifolia	(x3)	Success	(x2)
(v)	nutans	on ericifolia	(x2)	Success	(x2)

(vi) Other grafts, attempted on a single (double) basis have proved (to date) successful, - e.g. serrata, baxteri, goodii, ashbyii etc.

These results remain to be exploited (see item 9 above).

(c) Three approach grafts were attempted:

(i) integrifolia and quercifolia (20/2/86)
(ii) ericifolia and brownii (20/2/86)
(iii) ericifolia and occidentalis (20/2/86)

At the time of writing, callus formation has occurred. The grafts have not been separated at root, but host plants are cut back.

(d) Mature plant graft:

The Australian Flora Foundation made available mature (2 year plus) specimens of B. serrata and ericifolia. These mature plants when received appeared unsuitable as root-stock for 6-8 month scion material. However, many plants had a branching (bush-type) form. It was decided to severely prune the mature plants leaving branches whose diameter was compatible for more juvenile scion material. Using this technique grafts of mature serrata with coccinea, baxteri, baueri, solandri, grandis, ashbyii, menzesii, burdettii, audax and speciosa have been completed during late March, April 1986. At the time of writing (21/4/86) these grafts look extremely promising, and the authors feel that this technique could prove to be the method of choice- when undertaken in optimum growing conditions for scion and root-stock.

SUMMARY AND CONCLUSIONS:

(i) A preliminary study in the germination, hardening and grafting of banksia species has been undertaken - with encouraging results.

(ii) The objects of the study are threefold:

(a) to examine the feasibility of grafting W.A. species on eastern root-stock on a taxonomic basis (- to minimise the effects of phytophthora cinnamomi).

(b) to examine the possibility of raising W.A. species (grafted) to maturity in Sydney's prevailing climate.

(c) If the answer to (b) is affirmative, to examine the question - does the technique result have application in the area of ornamental plants and/or the cut flower market?

(iii) The following preliminary conclusions are reached:

1. Grafting based on taxonomic classification is feasible in the right environmental conditions and when undertaken in the correct season.

2. Scion material fulfilling the criteria enumerated in (1) show good growth and development.

3. The results obtained warrant further investigation and support, and could have commercial application.

RARE OR THREATENED SPECIES - Trevor Blake

Did you know that there are 13 species of banksias in this threatened category with one species classed as endangered? (C.I.T.E.S.). This is Banksia lullfitzii rated E3 (Leigh, Boden, Briggs) which designates endangered as having a range of over 100 km, but occurring in small populations. Frequently habitats are threatened by any of a range of factors such as land clearance, pests and diseases, grazing, drought or fire. The categories to which species can be designated are 'Extinct' 'Endangered', 'Threatened or Vulnerable', 'Rare' and 'Depleted'. B. lullfitzii grows in heathland in only 2 small populations in the Southern Cross area of the W.A. wheatbelt and is basically threatened by agriculture, roadworks and cmopetition from other vegetation due to its low numbers.

With the recent revision two more species have been added to the rare list, these are Banksia epica and B.oligantha. Although only named in 1987 the first is known from 2 localities and the second from one stand of about 300 plants. The rarity of various species is categorized thus by Leigh, Briggs and Hartley (1981).

E = Endangered, could disappear within 2 decades.

R = Rare - not yet endangered or vulnerable.

V = Vulnerable - long term risk.

C = Conserved in National Park or Reserve.

2 = Distribution within 100 km.

3 = Distribution over 100 km but in small populations.

B. aculeata 2 RC
benthamiana 3 RC
blechnifolia 3 VC
* brownii 2 RC
burdettii 2 VC
* chamaephyton 2 RC
conferta var. conferta 3 VC
conferta var. pencillata 2 VC
* cuneata 2 EC
dryandroides 2 V
elegans 2 VC
epica 2 oC
ericifolia var. macrantha V
gardneri var. gardneri 3 RC
var. brevidentata 2 RC
var. hiemalis 3 RC
* goodii 2 VC
grossa 2 RC
hookerana 2 VC
incana 3 R
integrifolia var. aquilonia 3 RC
laevigata ssp. laevigata 2 RC
lanata 2 VC
laricina 2 VC

B. lindleyana 2 RC
lullfitzii E
meisneri var. meisneri 3 VC
* var. adcendens 2 EC
micrantha 2 V
nutans var. cernuella 2 RC
occidentalis 3 VC
oligantha 2 RC
oreophila 3 RC
pilostylis 3 RC
plagiocarpa 2 RC
praemorsa 2 VC
quercifolia 2 RC
saxicola 3 RC
scabrella 2 V
seminuda 3 RC
solandri 2 RC
* sphaerocarpa var. dolichostyla 2 E
telmatiaea 3 R
* tricuspis 2 V
verticillata 3 VC
victoriae 2 RC

This list of ratings increases the number regarded as rare or threatened and it is interesting to note that most are partially protected by some form of reserve. There are 3 with no habitat protection, B. incana, B.lullfitzii and B.telmatiaea which increases their vulnerability. The W.A. Wildlife Conservation Act has listed 7 species as rare (marked *) and these species can only be collected with written permission from the State Minister for Conservation. It is considered that another 10 species should be added to this list.

Any species not mentioned in the above list is considered to be in numbers and has a distribution that does not pose them a threat.

The Banksia Study Group urges all people interested in the growing and conservation of Australian plants to respect these laws. Collectors frequently pose a threat which is not intentional, but nevertheless, should be added to the list, through the collecting of seed cones. If these rare and threatened plants have no seed to shed after habitat degradation then they will quickly join the list of 'EXTINCT' species.

GRAFTING BANKSIAS BY IRRIGATED APPROACH GRAFTING

- Steve Clemesha, Woolgoolga, N.S.W.

I began grafting Banksias about 6 years ago after reading Colin Wilson's report on the subject, in Banksia Study Report 6 pages 40-46.

The first method I tried was approach grafting. I had quite a few successes with it but some scions which appeared to have made a good union collapsed within a few days of cutting. The chief limitation of this method is the requirement for the scion to be a growing plant in your own collection.

I next tried wedge grafting which I have done successfully with avocados and cacti. My results with it with Banksias were very consistent - 100% failure despite covering with plastic bags, plants in full shade, plants in terrariums etc.

I then heard of irrigated approach grafting being used on Grevilleas so decided to try it with Banksias. I did and it was successful and now is the main grafting method I use.

The grafting method you use is not important. Any that work for you are satisfactory.

Irrigated approach grafting differs from approach grafting in that the scion is a cutting which stands in a bottle of water on or beside the pot. The scion is side grafted onto the stock. Water is maintained in the bottle for 3 months or till the scion starts to grow.

As with all grafting methods, failures occur. These mostly in the first month by all leaves of the scion yellowing and falling off. The method is not very stressful on the stock and if the graft fails the stock plant can be used again.

In my climate, failure rate is high in autumn and winter, but low in spring and summer. The problem is related to the slow growth plants make in winter and not temperatures, as winters here are not very cold. Failure rate in winter is highest with scions from cold climates, I expect because of their more complete winter dormancy. Here summer temperates are mild. Those above 30°C are rare and we have reasonable summer humidity. Summer grafting may be unsatisfactory in hot dry areas. Experience has taught me a few tips to save "headaches" when grafting.

1. Before you make any cuts have a few different sized bottles on hand. Place the scion against the stock, work out where you will join them and which bottle size fits best. Failure to do this has resulted in my having to balance pots or bottles on bits of wood stones etc. to get them to the right height.

2. Try to have the scion's end going a few cm. at least into the water. If it only just reaches it you have to watch the water level very closely.

3. In grafting one is always advised to have as exact a fit of stock to scion as possible. This I find is easier said than done. I aim to match up one side as well as I can, this I call the front of the graft. The back is the side, I don't try to match and I don't usually look at them. Some backs match quite well while others miss by a few mm. or more. Match the "front" as exact as you can. If one way looks bad check the other. If it is bad too, some retrimming may be needed. Of greater importance than a perfect fitting graft is the time of year. The cambium has only to match in one place

for the graft to work. Two I grafted 11 months ago have joined top and bottom but I still can see light through the middle. Callous tissue grows quickly in spring and summer and fills the gaps and holes etc.

The main advantages of this grafting method are it is easy and you do not need a glasshouse, misting etc. A bush house or semi-shade on a verandah or under a tree is satisfactory.

The only disadvantages of the method are scions need to be long enough for their end to stand in water and water must be maintained in the bottle.

The cut ends of the scions often build up callous and some produce roots. Where it is desirable for the plant to grow on its own roots this can be done and the stock separated from the scion. If it is not desirable the callous scion end can be cut off.

Successful results using B.integrifolia as stock.

B.seminuda - Growing well but after 5 years no sign of flowers - about 2 metres tall.

B.littoralis - A plant I approach grafted 5 years ago is healthy,bushy and nearly 2 metres high but I have had no success remaking the graft.

B. dentata - For me this grows much better grafted than on its own roots. Eldest 2 years old.

B.integrifolia var. compar. N.S.W. North coast form. Easy grows well. Eldest 5 years old.

B.integrifolia undescribed var. from New England plateau. Easy, provided it is grafted in spring or summer. Oldest plant 5 years.

B.integrifolia var. aquilonia. I have only had this for one year. It appears to graft satisfactorily.

B.marginata - Sydney form - easy - grows well and has flowered, 5 years old.

B.marginata - Snowy Mountains form - has taken,looks as if it will succeed. 4 months old.

B.conferta var. conferta Glasshouse Mountains form - easy has flowered and set seed 3 times. 5 years old.

B.conferta var. conferta Lamington Plateau form. Seems to be easy and successful - 1½ years.

B.conferta var. pencillata. For me this grew very poorly on its own roots but it does very well when grafted. 4 years old.

B.paludosa. This grew very well when grafted. It allowed the scions to form their own roots. Then I separated the plants from the stocks. They produced a well developed lignotuber just below ground level within a year.

B.saxicola - Successful and easy, oldest plant 5 years. I have not had material of B.canei or B.plagiocarpa so do not know if they would be successful or not.

Unsuccessful grafts using B. integrifolia as stock.

B.pilostylis Though Colin Wilson found this combination successful all 20 I tried failed.

B.oblongifolia Some of these survived for 18 months and made one or two flushes of growth before dying. Some scions of it will form their own roots. I do not know if plants of this or B. robur started this way will form lignotubers but think they will.

B.robur None of these have made any growth after grafting. Some scions have formed their own roots but it is not an efficient way to propagate the species as the success rate has been fairly low though I have mainly made winter grafts.

B.grandis I was sent scions of this but all had their leaves cut off and they did not grow.

B.lindleyana Failed.

B.attenuata Failed.

B.violacea & B.laricina These both failed with me though they were successful with Colin Wilson.

Grafting using B.oblongifolia as stock. As B. robur is not very successful started from integrifolia. I have tried one grafted onto a B.oblongifolia. The graft appears to have taken. I do not think such a combination will be successful long term, as I think the B.oblongifolia will eventually form a lignotuber. The robur already is callousing at its cut end and should form roots soon. B.robur is a bit "top heavy" for oblongifolia.

Grafting using B. ericifolia and B.spinulosa var. cunninghamii as stock.

I have grafted B. nutans var. nutans and B. nutans var. cernuella onto B.ericifolia var. ericifolia and B. ericifolia var. macrantha. All combinations with these have been successful.

B.X. 'Giant Candles'. This will graft successfully onto both B.ericifolia and B.spinulosa var. cunninghamii at least short term. I have planted my plants out with the scion end in the ground so they can eventually form roots.

B. spinulosa var. spinulosa will graft well onto var. cunninghamii. I will plant the plants with the graft union below ground so they can form a lignotuber.

B. lemmaniana. I grafted about 20 plants of this onto B. spinulosa var. cunninghamii and expected success as Colin Wilson had good results with it. I did not - all scions died. I used the N.S.W. Blue Mountain's form of B. spinulosa var. cunninghamii whereas Colin probably used the form that grows near Melbourne.

My grafting to date has shown a good easy grafting method but why I have had no success with combinations Colin Wilson was successful with I do not know.

for the graft to work. Two I grafted 11 months ago have joined top and bottom but I still can see light through the middle. Callous tissue grows quickly in spring and summer and fills the gaps and holes etc.

The main advantages of this grafting method are it is easy and you do not need a glasshouse, misting etc. A bush house or semi-shade on a verandah or under a tree are satisfactory.

The only disadvantages of the method are scions need to be long enough for their end to stand in water and water must be maintained in the bottle.

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Successful results using B. integrifolia as stock.

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B. dentata For me this grows much better grafted than on its own roots. Eldest 2 years old.

B. integrifolia Undescribed var. from New England plateau. Easy provided it is grafted in spring or summer - oldest plant 5 years.

B. integrifolia var. aquilonia I have only had this for one year. If appears to graft satisfactorily.

B. marginata Sydney form - easy - grows well and has flowered 5 years old.

B. marginata Snowy Mts. form - has taken, looks as if it will succeed. 4 months.

B. conferta var. conferta Glasshouse Mts. form - easy has flowered and set seed - 3 times, 5 years.

B. conferta var. conferta Lamington Plateau form - Seems to be easy and successful - 1½ years.

B. conferta var. pencillata For me this grew very poorly on its own roots but it does very well when grafted. 4 years.

B. paludosa This grew very well when grafted. I allowed the scions to form their own roots then separated the plants from the stocks. They produced a well developed lignotuber just below ground level within a year.

B. saxicola Successful and easy, oldest plant 5 years. I have not had material of B. canei or B. plagiocarpa so do not know if they would be successful or not.

BANKS'S FLORA BLOOMS AT LAST

ARTICLE FROM "GOOD WEEKEND"

BOB EVANS

Banks's Florilegium, the greatest scientific legacy of Captain Cook's historic voyage of discovery has sat idly in the British Musuem of Natural History for 200 years. Banks's Florilegium is an exquisite set of 738 fine-line copper-engraved plates which record in impeccable detail samples of the botanical specimens collected by the young Joseph Banks and his Swedish colleague Daniel Carlsson Solander on their vogage around the world with Cook from 1768 to 1771.

Cook had been commissioned by King George 111 to plot the transit of Venus on behalf of the Royal Society, and with the backing of the Admiralty. An accurate observation of Venus as it passed in a direct line between the earth and the sun would have given the exact distance between the two and obviously was of great astronomical significance.

The transit of Venus is one celestial event that does not come to us with the regularity of Halley's Comet. Attempts to chart the planet had failed in 1639 and 1761. The next opportunity would not be until 1874. The transit of 1769 was the second and last chance for the ilustrious Age of Reason to get it right.

Ironically, the able Captain James Cook also failed to chart the planet's course accurately from his vantage point in Tahiti and so the great scientific achievement of the voyage ultimately resided in the glorious profusion of Bank's botanical specimens.

He and Solander collected and identified 3,607 specimens of plants. They took back 30,382 individual specimens and almost half of those - the majority of them being Australian - were entirely new to science.

While Banks and Solander foraged ashore for specimens, the young botanical artist Sydney Parkinson hurriedly painted and drew the plants back in a cramped cabin on the Endeavour before they withered and lost their colour.

Banks wrote: "We sat till dark by a great table with our draughtsman opposite and showed him in what way to make his drawings and ourselves made rapid descriptions while our specimens were still fresh."

Even produced under those conditions, Parkinson's paintings are considered to be among the finest botanical artworks in the world. Regrettably, the young artist died of a fever in the Dutch East Indies on the return leg of the voyage. He had completed 269 out of 942 drawings and sketches.

On his triumphant return in 1771, Banks immediately set about preparing his discoveries for publication. He commissioned five botanical artists to complete the work begun by Parkinson.

Banks also began the long process of recruiting a team of the finest engravers to make copperplates of the drawings.

The engravers' art had probably reached its peak in English history. However, some of the best botanical engravers of the age were already engaged on long-term projects.

By the end of 1773 - having scoured Europe and England - Banks had assembled a team of engravers led by Daniel MacKenzie, Gerald Sibelius from Holland and Gabriel Smith. The whole process eventually took 13 years and employed the talents of 18 engravers.

Joe Studholme, the managing director of Alecto Historial Editions in London and co-publisher of the Florilegium, is certain that even though colour engraving was rare in Europe at the time some work used one or two colours to augment the monochrome that Banks intended printing in Colour. "Banks was a high technologist" Studholme says. "I certainly believe, if Banks was looking at them now, this is the way he would have done them."

Banks spared no expense. He outlayed 7,000 pounds for the engraving. He was determined to maintain the same high degree of botanical accuracy that Parkinson had achieved when the plants lay freshly cut in front of him. Meanwhile, the scientific community waited with bated breath.

Carl Linnaeus, the great Swedish naturalist and mentor of Banks's colleague Solander, confessed that he could not sleep when he heard that "their matchless and truly astonishing collection such as had never been seen before, nor may never be seen again, is to be put aside untouched, thrust into some corner to become the prey of insects."

Linnaeus pleaded in a letter from Sweden: "By all that is great and good, I entreat you to do all that lies in you for the publication of these new acquisitions, that the learned world may not be deprived of them. I confess it to be my most ardent wish to see this done before I die." His wish was not granted.

Banks's failure to publish was a blow to art and science, although he did make his collection freely available to colleagues. But is also one of the great puzzles of history.

Joe Studholme speculates on probable reasons. Most relate to the magnitude of the project and its enormous cost.

The first blow to the project came with the death of Solander, in 1782. He had played a key role in the process - supervising the artists and engravers and, more importantly, writing the text.

Studholme also points to the American War of Independence, from 1775 to 1781, which seriously affected the wool trade and Banks's income. The economic climate had slumped by 1784 and the prospects of selling the publication were bleak. The period of depression was exacerbated by the French Revolution of 1789 which ultimately led on to the Napoleonic Wars.

"Banks had intended to publish the Florilegium in parts and had hoped to attract many subscribers from the Continent," Studholme explained, "but from that time on, until after 1815, England was cut off from Europe."

Another important reason, according to Studholme, is that Banks by then had an established reputation: "He was president of the Royal Society, he was no longer the enthusiastic young adventurer anxious to make his mark on the world."

For Studholme and Alecto Editions, the publication of the engravings has been almost as arduous and as slow as the original preparation of the copperplates 200 years ago. Studholme first raised the prospect of printing a selection from the Florilegium in 1963. "The museum quite rightly showed us the door," he says. However, Studholme made another approach to the British Museum after collaborating with the Tate Gallery on a printing of William Daniel's Voyage Around Great Britain. "There was a different climate altogether in 1978. Musuems were much more prepared to give people access to their treasures by then.

"It is inconceivable, "Studholme says, "that anyone will ever print the entire collection again. The museum has guaranteed there won't be a printing for at least 50 years. But there's no need to now - we've done it once properly and there are many more sophisticated ways to reproduce the engravings without going through this torture again."

POLLINATION BIOLOGY OF THE GAZETTED RARE SPECIES BANKSIA TRICUSPIS

Stephen van Leeuwen

Extract from A.P.E.S. Newsletter

Banksia tricuspis is a gazetted rare species that is geographically restricted to the Gairdner Range, 250 km north of Perth. This species belongs to the series *Spicigerae* which has numerous floral features which have been inferred as adaptations for pollination by small mammals. Most of the research conducted to date on this species has examined the importance of mammals as pollinators, especially with reference to the other groups of floral visitors, insects and birds.

A large suite of avian floral visitors has been observed and recorded visiting the inflorescences of this species, the most frequent of which is the brown honeyeater (*Lichmera indistincta*). The introduced honey bee (*Apis mellifera*), native bees and thynnid wasps are considered to be the most important insect visitors in terms of their ability to effect pollination, based on polen loads and foraging behaviour. Two species of small mammals, the house mouse (*Mus musculus*) and the honey possum (*Tarsipes rostratus*), also visit inflorescences of this species. Pollen loads on the honey possums are usually one hundred times larger than on the birds. This information suggests that, if the foraging behaviour patterns of honey possums conform with the breeding system requirements of *B. tricuspis*, then they may be the main pollinating agents.

Results from hand pollination trials, bagging, exclusion and emasculation experiments and pollen/ovule ratios indicate that this species has a xenogamous breeding system. Anthesis and nectar production occur throughout the day and night with no obvious peaks being noted. As a supplementary observation from the bagging and exclusion trial, it is evident that avian floral visitors and ants play an important role in suppressing inflorescence predation, particularly by Lepidopteran larvae. There also exists a close correlation between inflorescence damage by cockatoos and the presence of larval borers.

Further research will aim to determine the rates of pollen removal and deposition by the different types of pollinators and which group of pollinator is most successful at effecting pollination and reproductive success in terms of fruit/seed set. Attempts will also be made to determine the patterns of pollen flow associated with the different pollinating agents, particularly the honey possum.

OTHER MEN'S FLOWERS

Tom Richards

Famous British soldier Lord Wavell is also noted for having compiled a book of poems with the above title in which he used other men's poems and works, so I plagarise the title almost with a pun to use other men's work with flowers to speculate on possible conclusions.

In the June 1986 issue of a magazine, Australian Horticulture, an article by one Kevin Handreck of CSIRO described the experiments he had been carrying out to test the effect of lack of sulphur in potted plants. His descriptions of those plants lacking sulphur so closely fitted my 1000 Dryandra formosa and Banksia coccinea drooping in my small nursery and dying by the dozen, that I paid close attention to his writings, photos and conclusions.

Several points I noted:

1. Kevin mentions that the Melbourne water supply may have as little as 0.3 ppm sulphur whereas Perth may have 40.0 ppm. As the amount of sulphur in the water supply probably reflects the background of available sulphur in the ground, the thought occasioned by this observation was that maybe, here was the solution to the question as to why many WA wildflowers are so difficult to grow in the East (including my nursery plants), possibly including a solution to damping off.

2. My next step was to check my soil analysis sheets to find what sulphur content was in my local soils. The proforma sheets covered the major nutrients and trace elements but sulphur did not even rate a mention; so I got no help there. On the other hand, my plants tend to recover when planted out in the field. The nursery seed mix and potting mix is almost pure sand with a little composted pine bark and peat moss 10:1:1. Moisture retention was not important, as during summer they are in a shade house with sub-irrigation using local spring water and at which stage they prospered. With the coming of winter and sufficient rain to supply the moisture, the plants started to discolour and languish. Initially, they were picked up with pure nitrogen at a pinch per 3 inch plastic bag. Then they failed again with the drying of the young tender leaves and yellowing and ultimately dying of the older leaves. The root system was strong being 4 and 5 inches deep and spread throughout the 3 inch bag. As with most people, I blamed the frosts. Moisture was OK. After reading Kevin's article I then wondered whether total watering by sulphur free rain could be the cause. So they then got a pinch of gypsum per bag. Results are inconclusive. The nearly dead went on and died and the stronger recovered.

3. I then bethought myself of certain articles in Australian Plants magazine from SGAP, Vol. 9, No. 71 by Jim Webb and J. Gotham and G. Butler. All of them mentioned that in Canberra they had found vigorous growing specimens of WA Banksia's, all growing close to walls where builders' rubble containing mortar and cement had been dumped. Their conclusions after allowing for some protection from the walls was that the calcium and lime in the cement and mortar had produced this growth. Knowing that some areas of Western Australia have subsoils of limestone, they experimented but it appeared that their experiments were inconclusive.

   DIGRESSING: Cement for concrete and mortar is made by mixing limestone with a clay containing silica and alumina with a minor content of iron and cooking the powdered mixture in a kiln where it forms a clinker which comes out as chunks. This clinker is rather like molten rock and is reasonably inert in water until it is ground to a powder and about 5% GYPSUM (CALCIUM SULPHATE) IS ADDED to control the setting time.

   Could Webb, Gotham and Butler therefore have been misled to attribute the banksia growth in mortar to the major constituent limestone rather than to the minor addition of sulphur via the gypsum.

4. In his article, Webb also mentions that he had experienced no difficulties in growing WA plants at Broken Hill despite the conditions (frost) and also had seen plenty of these plants in South Australia. I myself have seen D.formosa and B. coccinea growing magnificently at Millicent in SA in a limestone marl and terra rossa with 12 inches of red soil and then limestone marl.

   From my understanding, we get most of our supplies of gypsum from dried lakes in Western Victoria and NSW. That is from West of the Divide and out in the flat country of Broken Hill and SA.

And so I question ????

1. What are the general sulphur contents in soils around:

   a) Melbourne and Sydney
   b) Broken Hill
   c) Millicent or equal in SA
   d) Perth and WA generally (Kambalda and its sulphides)

2. What happens when we use gypsum in our potting mixes and around our growing plant (I'll get my own answer to this);

3. Water analysis with special attention to sulphur in various areas (again, I'll get my own answer.)

4. Has anyone ever actually taken an auger to WA and sunk test holes beside certain plants, say B. coccinea, B. baxteri and dryandras? Taking say a sample of each foot of depth and testing for all elements including sulphur.If so, where published?

5. I read a great deal in Australian Plants and say the Banksia Book about foliage, flowers, seeds and growing habits but nothing much about roots, depths, thicknesses, water seeking (tap roots as opposed to flanged supports etc.)

6. But the big question really is: Have we devoted or wasted a lot of time and effort and talking on testing pH and calcium levels and missed the point of sulphur?

7. Even as a random thought, I wonder what effect large quantities of sulphur would have on Phytophthora cinnamomi?

BANKSIAS AT THE ROYAL BOTANIC GARDENS - ANNEXE AT CRANBOURNE VICTORIA - Alf Salkin

A Brief Geological and Social History of the Gardens.

The present natural landforms of dunes and perched lakes are most likely the result of wind blown sand during fairly recent geological times. By the beginning of the Quaternary epoch these mobile dunes had been "fixed" by vegetation. The type of plant association of these sands became known, early in the colonization of Victoria by Europeans as the Sandringham Heath. It was a common vegetation unit from St. Kilda down the coast to Frankston and also inland through Springvale to the foothills of the Dandenongs where the sand persisted in patches mainly as cappings to the much older Silurian mudstone sediments. It was on these lighter soils that market gardens were developed. With later demands for building materials and garden soil these sands were mined. These developments meant that the rich and varied flora associated with these heaths gradually disappeared. The block at Cranbourne of approximately one square mile is the last large remnant of the Sandringham Flora and as far as I can ascertain was uncommitted Crown Land. It was used by the Army occasionally who presumably used it for manoueveres. An area in the North-West known as Empire Hill was leased to Cranbourne Sands from 1928 and sand was removed from a 30m face. From 1960 Pioneer Quarries continued the mining of Empire Hill as well as another in the South. This mining continued up until 1972. Some further mining to make two large ornamental lakes was continued until 1987.

The Cranbourne Annex was purchased from the Department of the Army by the Victorian Governmnt in 1969 the aims being:

1. To preserve the last large remnant of the Sandringham Heath type of vegetation.

2. To preserve the habitat of Mitchells Hopping Mouse.

3. To carry out research into Australian plants.

4. To establish a Botanic Gardens outside the Metropolitan area and to grow plants such as those from the West Australian sand plains which cannot be grown on the heavier clays of the botanic garden in Melbourne.

Early Developments at Cranbourne

The first plantings at the annexe were done in 1976 by the staff of RBG. and consisted of windbreaks on the north and western fences where the truncated remains of Empire Hill still stood. As this was an area of mobile sand a heavy mulch was used. This was a traditional material that had been used in RBG Melbourne since von Mueller's time. A symbiosis - so to speak - between the police stables and the botanic gardens, a thick layer of horse manure and straw. When I first saw it in 1976 the plants including Banksias baueri, media laevigata, prionotes, speciosa, and verticillata were flourishing, but so were the weeds that had been brought in as seed with the horse manure. The flat weeds were as big as dinner plates. I thought they were introducing a future problem for themselves, but the sands are so easily leached and so deficient in minerals that once the plants became established and no further manure was introduced the weeds shrank and finally disappeared. They are at present being replaced by two other colonizing weeds Epacris impressa and Ti-tree. Leptospermum myrsinoides

My own interest at that time was to find out if I could use some area to plant out banksia spp. that I had collected in Eastern Australia. This was to be experimental cultivation in support of an MSc. thesis. The main idea being that if the plants were genetically different they would show their differences if grown in a standard environment.

The plantings were begun in 1977 from material collected and propagated from 1974 onwards.

The area I was given was devoid of any vegetation and was in fact a small mobile dune on the northern fence line half a kilometre from the entrance in Balarto road. As this was then strictly 4WD country, plants had to be barrowed or carried to the site. The fence posts were numbered as a method to locate species and plants were set out north-south with upto six plants in a row.

Practically all plants were grown from seed collected in the wild from over 200 provenances. Records have been kept in growth flowering and fruit set up till 1984. Losses were very few and were confined mainly to one group of plants from highland areas. B. canei and B.saxicola

DISCUSSION

Seed Germination

Seed generally germinated over a period of time. For example seed of Banksia robur collected in the wild at Noosa germinated rapidly, of twenty seeds planted on the 13th of March the results are as follows:

Day 17	30 Mar.	5 germinated	
19	1 Apr.	2	
22	4 Apr.	3	
24	6 Apr.	1	$\frac{11}{20}$ = 55% germination
		11	

Seed was sorted and only apparently fertile seed was trialled so this is not a very good result.

Banksia spinulosa var. cunninghamii from near Gembrook was better.

No. of seeds planted 34 12 May

Day 34	14 July	2	
36	16 July	1	
47	27 July	13	
48	28 July	1	$\frac{31}{34}$ = 91% germination
53	2 Aug.	9	
61	10 Aug.	5	
67	16 Aug.	1	

Planting Out

Plants were generally planted out two to three years after germination, the pot size being either 4" or 6". To give an example:- B.spinulosa var. cunninghamii from the Narrow Neck peninsula in the Blue Mountains was sown on Mar. 8 and germinated Apr. 10, 1974. Three plants were planted Aug. 22, 1977 average height then being 0.8m with a width of 0.3m. In June 1979 two plants had one flower spike each and by December, 30 and 38 follicles had developed on each spike and a new flowering spike was developing on one plant.

As it was discovered that this species releases its seed without the agency of fire, and seed was germinating on bare sand, two plants were taken out leaving one example of this form. Other examples of this potentially environmental weed will be taken out leaving only one example each of the N.S.W. and Victorian B.spinulosa var. cunninghamii.

Eastern banksias are also grown in the southern experimental zone and in the discussion of species that follows the banksia numbers from 129 to 231 are in this southern area.

Banksia robur

Col.	94	Maryborough	Qld.	Col.	157	French's Forest	N.S.W.
"	197	Noosa	Qld.	"	185	Gosford	N.S.W.
"	219	Yeppoon	Qld.	"	231	Crowdy Bay	N.S.W.
"	230	Cooloola	Qld.				

The collections 94 and 157 are planted close together near the perched lake so that even in summer their roots are within easy reach of water. The two collections are distinctly different. The N.S.W. form is taller and has no ligno tuber, whereas the Queensland form has a prominent ligno tuber and even has flowers on the ligno tuber. The differences are genetic and are presumably due to genetic drift. The colonies must at one time have been continuous when the climate was wetter. With increasing aridity the conditions favourable to this species were reduced mainly to the Wallum in Queensland and the perched swamps of N.S.W. mainly on the Hawkesbury sandstones.

There is an isolated occurrence of this species at Julaten on the Atherton Tablelands, N. Queensland. I have a pressed specimen of this species but no seed. Whether this is similar to the Wallum form or N.S.W. form I have no idea. The only way it can be determined definitively is by the method of comparitive cultivation.

Other forms of B.robur are being grown in the southern experimental area. 185 is from Gosford, N.S.W. and 187 is a putative cross between B.robur and B.oblongifolia. 197 is from the Noosa area in Queensland. One plant which has recently flowered for the first time was like its parent a flower which in bud is such a dark green it is almost black. Flower colour appears to be a genetic character somewhat like eye colour - recessive or dominant. The black colour I suspect is the rarer recessive gene. Four other forms are planted in the southern area.

Banksia oblongifolia

Planted east of B. robur and in a dryer situation as occurs in their natural habitat is a collection of B. oblongifolia from the following provenances:

44 Nr. Mt. Coochin, Qld.	50 McLean, N.S.W.
46 " Mt. Tibrogargan, Qld.	64 Nr. Mt. Bilewillam, Qld.

Whilst there is some difference in height between provenances it is probably not statistically significant. In its natural habitat 64 from the Wallum near Mt. Bilewillam was dwarfed but this may have been recovery from the lignotuber after a fire. The majority of B. oblongifolia have lignotubers but one plant did not have an obvious one. It should be noted that even though the N.S.W. form of B. robur does not have a lignotuber it will recover from the base if the trunk is cut off.

Banksia serrata	and	Banksia aemula
74 Provinence Ponds, Vic.		93 Perigian Beach Qld.
132 Kurnell N.S.W.		186 Birdie Beach, N.S.W.
140 Sisters Creek, Tas.		203 Fraser Island
161 Golden Beach, Vic.		228 Woodside
164 Yanakie, Vic.		229 Noosa

These two species have proved difficult to identify in the field but when grown under standardized conditions side by side there is no doubt which is which. The leaf of B. aemula is narrower than B. serrata and the flower spike is also narrower.

One species of B. aemula (229 Noosa) was only 0.5m high in its natural habitat on an exposed headland. If it behaves as the B.serrata dwarf from Green Cape, only a small percentage will be dwarfed. It is too early to say at this stage if any are dwarfed although they are flowering now at less than half a metre high.

A number of B. serrata from the type area at Kurnell (Col. 32) were cut off at the base close to the ground to see if they would recover by sprouting. It appears they do not have this ability even though in the bush they recover by epicormic growth from the trunk after fire.

The Banksia spinulosa complex

Apart from Banksia marginata there are more plants of this group planted than any other species. Whilst var. cunninghamii is easy to distinguish, there are intermediates between var. spinulosa or var. collina which make it difficult to decide which group to put them in.

B. spinulosa var. spinulosa

16 Bobbin Head, N.S.W.	58 Putty Road, B. Mts. N.S.W.
20 Beecroft Peninsula, N.S.W.	59 Windsor, N.S.W.
21 " " N.S.W.	83 Atherton, Qld.
22 Pigeon House N.S.W.	205 Julaten, Qld.
23 " " N.S.W.	
24 " " N.S.W.	
26 Green Cape	
28 Princes Hwy. Nr Green Cape T.O.	
45 Mt. Timberwah Qld.	
46 Mt. Tibrogargan, Qld.	

The plants are scattered in rows running N.S. through the rest of the collection but a group of plants collected between Singleton and Windsor on the Putty road through the Blue Mountains show a gradual change from B. spinulosa var. collina to var. spinulosa.

A number of topodemes are worthy of note, there are local forms that have drifted genetically due to isolation. Collection 83 from the Wallum Trig. near Atherton Queensland is a very low shrub compared with other forms and 205 from near Julaten also on the Atherton Tablelands has long fine leaves with a golden tomentum of hairs on the back of the leaves.

A number of colour forms occur. 59 from Windsor has golden styles and there are other variations from orange through dark red to black.

B. spinulosa var. collina

43 Mt. Coochin, Qld
44 " " "
47 Capalaba, Qld.
49 McLean, N.S.W.
50 " "

55 Putty Rd. Bl.Mts. 81m N.Windsor, N.S.W.
56 " " " " 60m " " "
57 " " " " 50m " " "
90 Mt. Coolum, Qld
126 Carnarvon Gorge, Qld.

The main differences that can be observed from B. spinulosa var. spinulosa are in leafsize particularly width. Leaves are always wider in var. collina. A number of observers have said that the leaf of var. spinulosa is very revolute but this is not very pronounced in fresh material and occurs as the leaf dries out. The recent Banksia Atlas shows the distribution of B. spinulosa var. spinulosa mainly confined to the area south of the Hawkesbury and although it is just north of the Victorian border it does not cross it. Banksia spinulosa var. collina grows north of the Hawkesbury but so also does var. spinulosa.

One isolated form of var. collina comes from the Carnarvon Gorge, this has particularly long, entire leaves and a pale lemon flower, presumbably a case of genetic drift. B. spinulosa var. cunninghamii.
B. spinulosa var. cunninghamii.
As mentioned previously, most of these plants will be taken out because of their potential as environmental weeds but collections that have been planted are listed below:

C Tarimbuk, Vic.
D Gembrook, Vic.
E Gillwell, Vic.
P Ship Rock, Vic.
X Norman Bay, Vic.
Y Sealers Cove, Vic.
3 Kanangara Wall Bl.Mts. N.S.W.
6 Bridal Falls " " "

8 Narrow Neck Bl.Mts. N.S.W.
9 " " " " "
10
61 & 60 Green Cape Rd, N.S.W.
63 Genoa Pk. Vic.
65 & 66 French Island.
70 Sealers Cove, Wilsons Prom. Vic.
75 West Wingan Tk. Vic.
84 Montrose, Vic.

Despite the wide range that these banksias come from, there is no discernable difference, the only major difference is that 66 from French Island collected from a species in the wild that had a yellow perianth and style - the more usual form has a style which changes to dark red to black. The seedling from this plant was also yellow flowered and it was registered as a cultivar. Plants raised from seed on this second generation have so far turned out to have back styles. An experiment to determine the percentage with yellow styles is being conducted at the moment. Seed has been taken from one cone and these have been germinated and plants will be distributed to interested people to grow to see what percentage will be yellow styled. It may turn out to be a straight mendelian inheritance where the yellow form is recessive and we should get a one out of four with yellow styles.

Presumably in the wild the yellow form has some advantage such as attracting particular pollinators but when surrounded by bark styled plants in a garden situation a different set of controls work.

Banksia spinulosa var. neoanglica

53 Gibraltar Range, N.S.W.

This is a form that was previously included in B. spinulosa var. collina, like the forms of B.spinulosa var. spinulosa from the Atherton Tablelands and the B.spinulosa var. collina from the Carnarvon Gorge it is an example of genetic drift caused by isolation. Why B.spinulosa var. cunninghamii is so stable throughout its range is a question to which there is no answer at present.

The Banksia Atlas reveals that there is over 100 km between the 3 major colonies. The only answer I can think of is that prior to European colonization the colonies were continuous and there has not been sufficient time for drift to take place.

Banksia ericifolia.

One very early success of the comparative cultivation at Cranbourne was distinguishing the differences between the northern and southern forms. Apart from the difference in leaf size and flower colour there is a difference in the flowering time.

Banksia ericifolia var. ericifolia

7 Bridal Falls Blue Mts. N.S.W. 17 Gordon Smith Pass, Kanangara Walls. Bl.Mts.N.S.W.

Banksia ericifolia var. macrantha

48 Byron Bay, N.S.W. 51 Ballan N.S.W.

When grown together the differences between the two forms are very obvious. The leaf of var. macrantha is shorter and narrower than var. ericifolia the style is a maroon as opposed to orange. There is also a difference in flowering time, var . ericifolia flowers (pollen presented) during May, June and July whereas var. macrantha flowers July, Aug. Sept.

Banksia marginata

This was the species first collected for the project and many were collected locally. It is ironic that many of these forms are no longer to be found in their natural habitat. It was realised at this time how many topodemes (geographical forms) would be collected so a letter was designated for each collection, these are listed below.

A. Kerns Park, B.Cardinia Creek, F & G. Browns Road, Dromana, H. Dromana Tech. I.Osbourne St., Springvale, J. Bay, Rd, Black Rock, M. Archibald's Honey Factory Springvale. N. Moorooduc, O. Aire River, P. Ship Rock, Q. Point Addis, R. Billywing, Grampians, T. Otways, All in Victoria.

1. Beechworth, Vic., Z. Wombeyan, N.S.W. 3 Kananga Wall, N.S.W.
31. Boggy Ck nr. Buchan, Vic. 32 Mt. Gambier, S.A. 33 Casterton, Vic.
35 Penola, S.A. 37 Little Desert, Vic. 38 Glen Isla, 41 Mt. William, Vic.
52 Gibraltar Range, N.S.W. 67 Port Lincoln, S.A. 74 Providence Ponds, Vic.
76 Wingan Inlet, 77 Princes Hwy, Vic. N.S.W. Border. 78 Merimbula, 79 Nimitabel,
81 Reedy Ck. E. Gippsland, 86 Dartmoor, Vic. 87 & 88 Black Range, Vic.
89 Mt. Sturgeon, 104 Western Arthurs, Tas. 106 Barrys Beach, Vic. 112 Dalesford, Vic.
113 Kangaroo Is. S.A., 114 Smythsdale, Vic. 117 King Is. Tas. 118 Morwell, Vic.
119 Omeo, Vic. 120 Dandenong Ck. Glen Waverley, 122 Hallam, Vic. 124 Gurdies

Westernport, Vic. 125 Cranbourne Annexe RBG., 135 Dove Lake, Tas. 136 Port Sorell, Tas, 137 Frenchmans Cap. Tk.Tas, 138 Strachan Tas, 139 Rocky Cape, Tas. 141 Eagle Hawk Neck, Tas. 142 Safety Cove, Tas. 143 Roaring Meg Beach, Tas, 144 Lime Bay, Tas. 145 Adventure Bay Bruny Is. Tas, 146 South Coast Bay, Tas., 147 Mt. Eliza, Tas, 148 Mt. Amos, Tas. 149 Hazzards Beach, Tas., 150 Frankford, Tas. 151 Franklin River, Tas. 152 Farm Ct, Tas, 155 Flinders Is. Tas, 163 Roses Gap Grampians, Vic. 199 Tuross Falls, Kybean Range, N.S.W.

The number of collections of this species is an indication of its cosmopolitan nature but it is also a species that inhabits a wide variety of niches from lowland swamps to rocky mountain ridges. It is an extremely plastic species or perhaps a better term would be a species with a number of demes, from large forest trees to dwarf, almost prostrate forms from exposed coastal situations. There are also a number of variations in the colour of the limb with some attractive shades of peach. Flower size is another variable. One of the most important clues to the origin of so many forms is the fruiting cone, there are some demes in which the follicles will only open after fire and others where all follicles open, like B. integrifolia, when the seed is ripe. In between these extremes there are intermediate forms where a few follicles only open. As there are hybrids which I will discuss later - it would appear that B. marginata is part of a gene pool which includes B. integrifolia, B. conferta, B. saxicola and B. paludosa. In the chapter on hybrids this will receive further discussion.

A number of forms of B. marginata sucker. This is usually triggered by fire or some other sort of damage, it is a characteristic it shares with some forms of B. integrifolia var. integrifolia.

One surprising thing, and the Banksia Atlas confirms this, B. marginata is not found in Queensland. The northern most limit appears to be in the Gibraltar Range.

Banksia paludosa

19 Cordeaux Dam, N.S.W.
26 Green Cape Heath, N.S.W.
171 Nerriga N.S.W.
192 Huskinson, N.S.W.
25 Track to Bittangabee, N.S.W.
29 Beaucroft Peninsula, N.S.W.
182 Budawang Mts. N.S.W.

Banksia paludosa is a variable species in the wild but when grown under standard conditions these variations even out. Plants grown from coastal heaths, which were dwarfed, responded in the same manner as those from woodland. This plasticity of response is a characteristic of most banksias even B. integrifolia can modify its growth habit and espalier itself over rocks in coastal situations. There are a number of flower colours, 192 from Huskinson Jervis Bay has an attractive orange limb and a much larger than normal flower spike. There are other colour variations including one with a pale grey limb; the limb being the outside of the four petals which, when in bud surround the stigma.

Banksia canei

30 Wulgulmerang Topodeme* 80 Kybean Range Topodeme, 194 Snowy Mts. Topodeme, 73 Wellington River Topodeme.

Attempts to grow these subalpine banksias at Cranbourne has met with mixed success. The Wellington River form has not been established yet and only one plant of the Wulgulmerang form is surviving. The Snowy Mts. form tends to suffer during the hot dry summer, but the Kydra Peak form is growing well in the southern area . The differences observed in the field are maintained in cultivation.

B. dentata

71 Jardine River, Qld.

It is very difficult to grow this tropical banksia at Cranbourne even when given protection by other shrubs from cold southerly winds. It doesn't, if one can be anthropomorphic, look happy. Only one plant is present; it has a large lignotuber shaped like a large inverted carrot, but has not yet produced the large dentate leaf so characteristic of this species.

* A topodeme (Gilmour et al) is a geographical race due to isolation of a population.

Banksia integrifolia

5 Little Oberon Bay, Vic.
52 Gibraltar R. N.S.W.
72 Syndal, Vic.
78 Merimbula, N.S.W.
92 Perigian Beach, Qld
133 Kurnell, N.S.W.
158 Green Cape, N.S.W.
193 Green Patch Jervis Bay, N.S.W.
217 Cape Hillsbrough, N.Qld.
218 Cape Palmerston, N.Qld.
219 Yeppoon N.Qld.
223 Mt. Beerwah, Qld.
225 Lamington Plateau, Qld.

When grown in a standard environment there appear to be no major differences discernable in the banksias from the coast as far as the Queensland tropics, that is up to Rockhampton. One collection from Seventeen Seventy- North of Maryborough, however, which in the field looked like variety compar has quite different juvenile leaves and I will be watching its development with interest. Another form from the Yeppoon area has a bark like an Iron Bark and this is already developing on the young plant.

The form from the Gibraltar Range and other parts of the highland area from Armidale to the Queensland border is different again from the coastal forms and should have varietal status at least. In the Washpool forest, I have seen very large trees forming the canopy with Coach wood at an estimated height of 30m. At Cranbourne they grow much faster than var. integrifolia, the cones are small, the follicles black and they remain closed even when removed from the tree.

The other forms from N. Queensland are variable but if I were asked to put them in a group it would be in var. integrifolia. 72 from Syndal Victoria is interesting in that it suckers. This is usually a characteristic of some forms of B.marginata. I am at present experimenting with seed grown plants to see if there is any variation in seedlings which might indicate that this inland coastal banksia has B.marginata genes other than its propensity to sucker.

Banksia saxicola

40 Mt. William Grampians, Vic. 129 Wilsons Prom., Vic. These plants are growing next to each other in the Southern experimental area and they are at present indistinguishable.

Banksia ornata

200 Flat Rock Grampians, Vic.

These are growing in the southern experimental area where they are growing and flowering.

Banksia conferta var. conferta

170 Mt. Tibrogargan, Qld.

Growing well, flowering and setting seed.

Banksia conferta var. pencillata

195 Glen Davis, N.S.W. 198 Mt. Darcy, N.S.W.

There appears to be little difference between these two categories. The main difference between var. conferta and var. pencillata appears to be that the former has an entire leaf. Flowering time and flower colour are the same. Rate of growth is comparable.

Banksia plagiocarpa

235 Bishop Peak, Cardwell, Qld.

This species is planted in both the northern and southern area. Despite the fact that it is a tropical species it is doing very well. Perhaps the fact that it grows at 1,000m may contribute to this.

Hybridization of Eastern Banksia Species

A number of natural crosses occur in the wild and tend to colonize the ecotone, the area between two ecosystems. In the case of the cross between B.marginata and B.integrifolia this is often less than 100 metres inland. The crosses are readily distinguished and seed collected in the wild breeds true the various forms listed below.

Banksia integrifolia X B. marginata

68 Sealers Cove Wilsons Prom. Vic.

82 Thurra River, E. Gippsland, Vic.
159 Walkerville, Vic.
165 Cape Patterson, Vic.

The last example though taken from a putative cross is nothing like the parent plant. It is a very low form of B.marginata with flowers held above the foliage. The other two are distinguished from B.integrifolia by the folicles remaining closed after seed is set and the retention of the perianth parts. The Walkerville plants are much larger than the Thurra River ones.

B.spinulosa X B.ericifolia

It has not been determined whether the parent to B.ericifolia is B.spinulosa var. spinulosa or variety cunninghamii, but it is suspected to be var. cunninghamii. The species breeds true so far but segregation may take place if it is grown sufficient times from seed.

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Western Australian Banksias - At Cranbourne RBG Annexe (Alf Salkin)

Following the success of planting eastern banksias, a much larger dune knowm as the Southern Experimental Area was provided to study groups for experimental planting. The Banksia and Dryandra Study groups began planting in 1980 and replacements and new species have been planted each year since.

The problem of trying to recolonize a large mobile dune are the movement of sand due to both wind and water. Apart from the obvious sand blasting effect there is the effect of exposure of roots or the build up of sand around low or prostate plants. Various forms of shields have been used - half tins simply filled up and buried the plants, shields made of plastic roofing if they were not shattered or blown out of the ground worked a little better but contributed to sand building up in the lee of the shield. The most effective method was using plant material such as branches of tea-tree stuck into the ground.

Now that plants have established on the dune, colonization by the indigenous species is now proceeding.

At present, apart from banksias, the following species of Proteaceae are planted. Dryandra, a very large collection including all known species and forms some as yet undescribed. The collection will be used as evidence in writing the Dryandra section of The Australian Flora.

Practically all of the Eastern and Western Hakea spp. are planted. These are in the most difficult area - the crest of the dune. Whilst some have not done well others look as though they belong there and have flowered and set seed for a number of years.

The other genera are Isopogon and Petrophile Lambertia Adenanthos Synaphae Conospermum Xylomelum Persoonia and there is even one Telopea.

Eastern Banksia sp. which have been difficult to grow in the northern area have been grown successfully here and recent collections, for which there is no room in the north, are being planted.

Alphabetical List of W.A. Banksia Species at the Southern Experimental Zone - Cranbourne - RBG Annexe.

68	aculeata	3 plants growing slowly. Planted 1985.
1	ashbyi	Only one plant left of four planted for this species.
2	attenuata	Planted 1980. a metre high no flowers yet.
3	audax	Four plants - three are B.laevigata and I don't think the other is audax.
4	baueri	Up until this last hot windy summer, there were six plants, one was a metre high by two wide: its now a large dried arrangement. Both pale and orange forms are flowering now (June). Planted 1980 & 85.
5	baxteri	Six plants planted 1980. Some over 2m high most have flowered.
6	benthamiana	Five plants with a range of ages and heights.
7	burdettii	Three plants making very slow growth. Planted 1980.
54	blechnifolia	Six plants planted in 1980. All suffering from magnesium deficiency. The problem appears to be that leaf litter does not collect and nutrients are not recycled. I will put in low fences to hold litter and see what effect this has.
8	brownii	Four large plants more than a metre high and 3 smaller plants all look healthy, the large ones have small buds.
9	candolleana	Six plants planted 1980 seemed to have suffered this summer, but appear to be recovering - flowered a number of times and flowering now.
10	caleyi	Planted 1980. Four plants which have flowered a number of times.
67	chamaephyton	Three plants planted 1986. Growing slowly.
11	coccinea	Six planted in 1980 made good growth looked healthy. Now only two plants left-never flowered. Have new seedlings to try again.

51 cuneata	One plant left of seven: 30cm high. Six planted this year.
12 dryandroides	Six plants planted in 1980 very compact flowers and produces seed. Part buried in drift sand.
13 elderana	Four plants planted 1982 - suffered from hot windy conditions this summer but now recovering.
14 elegans	Had two plants that got smaller and smaller and one day they weren't there any more.
15 goodii	Three plants, oldest planted 1983 has flowered, all being covered by sand drift but appear to be healthy.
16 grandis	Five plants planted 1980 over two metres high. Flower spikes developing for the first time.
32 gardneri var. gardneri	Five plants planted 1980. Healthy - have not flowered being drifted over with sand.
52 gardneri var. heimalis	Three plants planted 1985, small but healthy.
53 gardneri var. brevidentata	No plants of this rare variety yet.
72 grossa	Nine plants planted 1984. 0.5m high. Buds developing in May 1988.
17 hookerana	Six planted in 1980. Now only two left and these don't look too good.
18 ilicifolia	Six planted in 1986 - growing slowly.
19 laevigata var. laevigata	Two plants left from six. Flowered a number of times. Planted 1982.
64 lanata	Nine plants planted in 1986. Still small but healthy.
20 laricina	Four plants in 1984. One sick looking plant left - never flowered.
21 lemanniana	Seven plants 1980 some reached half a metre. Only one left.
66 leptophylla	Four small plants planted in 1986.
22 lindleyana	Planted in 1980 - 2 plants 2m high now flowering.

23 littoralis	Of six plants in 1980 four plants left, all flowering in June.
0 lullfitzii	Two plants left out of four planted - two died early this year, remaining plants flowering as did all four last year. Planted 1982.
24 media	In other parts of Cranbourne, Such as the northern wind break, this species does very well but in the exposed southern area it is struggling. Five plants planted in 1980. One further plant 1982.
25 meisneri var. meisneri	Growing extremely well as low compact shrubs. Flowering since 1984 and setting seed.
46 meisneri var. ascendens	No plants at present.
26 menziesii	Seven plants planted in 1980 with a further four in 1982. This year hot dry weather reduced the number to 6. Yellow and pink forms present both flowering well.
61 menziesii dwarf	Five plants growing slowly - one flowering this season.
50 & 65 micrantha	Eleven small plants planted in 1984.
27 nutans var. nutans and var. cernuella	Twelve plants of both varieties planted together flowering and setting seed.
28 occidentalis	Six plants planted in 1980 three plants left in spring 1988. One plant is 3 x 3m and covered in flowers other two plants look sick.
oligantha	2 small plants.
74 oreophylla	Ten plants planted in 1983 - all healthy in May 1985 - 1 metre high many with flowers.
29 peliolaris	Three planted in 1980 still looking healthy even though being drifted over with sand.
33 pilostylis	Three planted in 1980 - one 12", one 6" and one 4" pot. The one in the 12" pot flowered in 1980 then died in Jan. 1981. Four small seedlings were planted in May 1983. In May 1988 there were six plants.
30 praemorsa	Seven plants in 6" pots planted in 1980, growth very slow. Looked unhealthy until given dolerite In 1988 still small but healthy, less than 1m. Never flowered.
31 prionotes	Planted in May 1980. Four plants three from John Top. Two metres high flowered every year since 1983.

34 pulchella	Numerous plantings but only two surviving in the sand drift area. One specimen that made a dramatic appearance among the hakeas - a case of mistaken identity is a metre high and flowering in May.
35 quericifolia	Have seedlings to go in in November. Others planted turned out to be Banksia oreophylla.
36 repens.	Seven plants planted 1982. Healthy even though being drifted over with sand. 3 B.gardneri var. gardneri planted by mistake in same row.
69 scabrella	Four plants each one metre square. Flowering and setting seed.
38 sceptrum	No success with this species, winds probably too cold for this plant from north of Geraldton.
71 seminuda	Eight plants of ten planted in 1982. Most plants of red flowered form the others yellow. Four metres high.
37 solandri	Five planted in 1980 grew rapidly flowered and set seed. Four died in 1983, but plantings in 1982 leaves seven plants, these are two metres high.
39 speciosa	Eight plants from John Top planted in 1980. Four speciosa and four victoriae. Not growing as they do in their natural environment. Just surviving.
40 sphaerocarpa var. sphaerocarpa	Six planted in 1980. (Provenance Mullewa). Growing slowly with an occasional inflorescence
62 " " "	Seven plants of original planting of eleven in 1984. Growing slowly no flowers yet.
63 sphaerocarpa var. caesia	Four plants planted in 1983 one plant still struggling.
48 sphaero. var. dolichostyla	This is a species of limited distribution and as yet we have no plants.
49 telmatiae	Four plants making slow growth.
41 tricuspis	Four plants planted in 1980 now 1.5m high. No flowers as yet.
42 verticillata	Seven plants 2m high.
43 victoriae	2 plants and 4 in row 39 making reasonable growth, flowered a number of times.
44 violacea	Only one plant flowers almost black. The other plant at this stake is B.sphaerocarpa var. sphaerocarpa.

THE MAPS OF THE PLANTINGS

Southern Plantings:

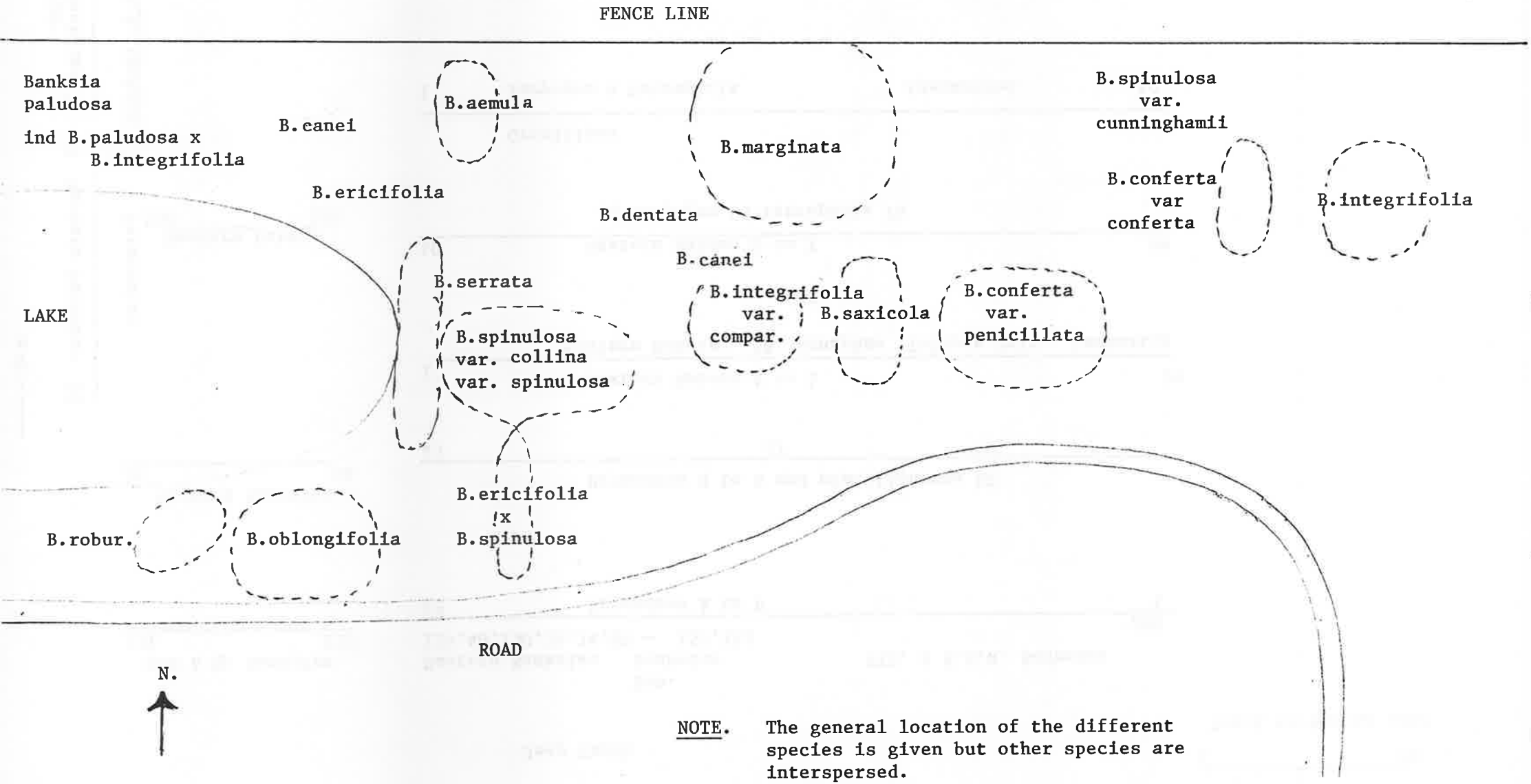
This shows the stake lines and the number of the stakes in a particular row. Lists of the different genera show the species planted at each stake. i.e. Stake 1 Western Banksia sp. is B.ashbyi, 74 is B. oreophila

Northern Plantings:

Plants are once again in rows, but in a much more haphazard way, although rows run north and south. A general map of the approximate location of species is given.

It should be noted that a collection of Correas is planted among the banksias. These are part of an experimental planting for a Ph.D. Thesis on the taxonomy of Correas by Robert Anderson of Latrobe University.

SKETCH MAP OF EASTERN BANKSIA SPECIES PLANTED FROM 1977 AT R.B.C. ANNEXE CRANBOURNE



NOTE. The general location of the different species is given but other species are interspersed.

SKETCH MAP OF PROTEACEAE EXPERIMENTAL PLANTINGS AT RBG ANNEXE CRANBOURNE

Dryandra varieties
1 — 30
Track to Smiths Lane

Jeep Track

NSW & Q. Banksias
231 — 210

Eastern Banksias 129,40,130,34,74,80 - Tas. Banksias 155,161 — VIC. & N.S.W. Banksias
42 — Dryandras A to P — 200, 1

Western Banksias
19 — 44

Dryandras Q to S and miscellaneous SP
43 — 57

1 — Western Hakeas A to L — 39
Eastern Hakeas 38. synaphae Telopea Xylo. Lambertia

Persoonias
Western Hakeas
100 — 104

40 — Western Hakeas L to V — 99
56 Isopogon 68 Petrophila 76

Grevilleas
1 — Isopogon & Petrophila — Adenanthos — 60

1 — Dryandra varieties — 30

N

New spp. 45 — 60
WA. Banksias 59 — 74
New W.A. Banksia
0 — 18
Western Banksias

Track to Southern Lookout

BANKSIA GROWING IN NORTHERN CALIFORNIA

RANDALL LINKE

My interest in Australian flora began with the eucalypts. It was while researching these that I began to discover more of the interesting and often fantastic flowers and plants of Australia, including the Proteaceae. I planted my first seeds of Banksia, Isopogon, and Grevillea in January of 1984 and have been hooked on them since.

I grew Proteaceae in Smartville for three years before moving in July of 1986 to Sonoma County on the Northern California coast. Smartville is located at the northern end of the Motherlode, or gold country, in the Sierra Nevada foothills.

Climate: The climate of Smartville is typically Mediterranean with long hot summers and moist, mild winters. In winter, frosts are usually light and infrequent. This is not always true. In the winter of 1984-85 there were several heavy frosts. Some of these were late, hitting after many of the seedlings had emerged. Fortunately there were no losses from these.

In the winter of 1985-86 we had very early cold with heavy frosts. We awoke to two or three inches (50-75cm) of very rare snow on November 11, 1985. This was followed by several days of temperatures in the mid to high 20's for a morning low, (-6°C). Then the first three weeks of December again had lows in this range and highs just above 40°F, (4°C). At this time a few banksias and dryandras were lost that were in gallon cans. All of the older plants that had been planted out came through with nothing more than very slight frost damage.

Soil: The topsoil is generally about 2 to 3 inches deep, clayey and nutrient poor. Underlying this is a rocky, yellow clay subsoil up to about 2 to 3 feet (60 to 90cm) deep. Beneath this is a gray clay hardpan.

Turning the soil in the early spring and then again about six weeks later usually renders a workable garden soil. This worked well for most Proteaceae so long as they were planted on a slope. For areas with a slight grade mounds built up by mixing two parts garden soil with one part sand and two parts redwood compost gave excellent results. Many Proteaceae did grow in the heavier, poorly drained areas, however growth was superior in areas with a lighter texture and good drainage.

Irrigation: In the seedbeds, containers, and after planting-out, overhead irrigation was used. None of the plants tested were adversely affected by this. Drip irrigation was used on several banksias through one summer with one gallon per minute drip heads, left on for about a half hour at a time. Frequency of watering on these one year old plants varied from twice a week to every other day depending on the temperature and was very successful. Unfortunately this was done only over one summer so I was unable to test reduced watering frequency the following year.

Pests and Diseases: Proteaceae has been remarkably trouble free. Deer have occasionally nibbled at the leaves but do not do serious damage and seem to quickly learn to leave the plants alone. Although we have a serious gopher problem they never burrowed near the plantings. There is a report by the Dryandra Study Group of the Society for Growing Australian Plants, of destruction of dryandras in Southern California by gophers.

The only other problem was a minor infestation of white flies on my banksias and dryandras. They were only on the plants I had set close together in gallon cans and did not seem to do any appreciable damage.

In heavier soils chlorosis was a major problem with the banksias and dryandras. This was easily corrected with an iron spray. I do not know if this would be a problem with some of the other genera. Only Isopogon, Hakea, and Grevillea have been planted in heavy soils since my first trials and none of these have shown signs of chlorosis.

Seed Propagation: I have been starting seed in open frames filled with equal parts of potting soil and either peat moss or wood compost. The wood compost mix drains better and I prefer it to the peat moss mix. When rain is not adequate to keep the seed bed moist it is watered with a light overhead spray.

Germination usually starts six to eight weeks from planting and continues for about a month. Germination rates have averaged around 60% though total failure, even after a year, is not uncommon. I have always planted from mid January through mid April.

Transplanting when done carefully produces few casualties. Plants are either put into seed pots after opening their seed leaves, or cotyledons, or they are transplanted directly into gallon cans after opening their second set of true leaves. A lightened mix of garden soil is good for plants that you intend to plant out or a well drained potting soil.

Planting-out: The plants should be held in gallon cans until the fall or the following spring. The usual care given to any plant coming out of a container will give good results. Fertilizing should not be done until the plant is well established and only a weak, slow release, phosphate poor fertilizer is recommended. I used ½ cup of ¼ strength 5-1-1 fish emulsion when new growth starts or about a month after planting out.

In addition to my own plantings I have given a few plants to friends. I gave one Banksia integrifolia and several hakeas to a friend who lives in the Sacramento Valley where frosts are heavier. The banksia has done quite well after an initial problem with chlorosis. The hakeas, unfortunately, were planted in an area that became waterlogged in the winter and all were lost. Unfortunately we are currently living on the floor of a canyon in a redwood forest The cold air settled on my Proteaceae. With the lack of sun and air circulation, temperatures that they had easily withstood previously became fatal.

Below is a summary of my experiences with the species. Those species marked by an asterisk (*) were never planted out and have been grown in containers only.

Banksia: The banksias have generally given very good results from seed though I have had some total failures and some with poor germination in the seedbed.
B. ericifolia and B. nutans, these small leaved banksias tended to sunburn in Smartville. They did best in light shade and did tolerate full morning sun until about noon. Both suffered some cold damage in Rio Nido (Conoma County).

B. integrifolia, B. collina, B. hookerana, B. quercifolia, and B. occidentalis; All grew quite well in Smartville and survived the winter in Rio Nido with minimal damage. They took the inland sun better than the first two but seemed to perform better when they were protected from the hottest afternoon sun. Plants in containers in Fort Bragg grew in full sun.
B. speciosis, B. violacea*, B. elderana*, and B. media; These were tried only under afternoon shade inland. B. speciosa seemed to be the most sensitive to frost. All of these were lost in Rio Nido.

B. gardneri; This was the only banksia to thrive in full sun in my Smartville garden and suffered no damage in Rio Nido.

Dryandra: Dryandras have also grown very well from seed though I have experienced slightly lower germination rates from them than from banksias. They tend to be more sensitive to poor drainage than the banksias and more sensitive to cold.

A BANKSIA PLANTATION MT. BARKER W.A.

K. COLLINS

Our interest in banksias started with a garden effort in Perth successfully growing 8-10 varieties 75/83. We have since, in early '83, moved to the small country town of Mt. Barker and have aquired a 21 acre farmlet on which we are growing banksias.

Our farmlet has a large range of soil types. Deep sand, wet peaty sand, gravel and sand or loam over gravel.

We have commenced a plan to grow a showpiece banksia and dryandra farm and are endeavouring to grow each and every species with varieties.

Currently we have 37 varieties of banksia established with 9 others in pots and seeds of a further 32 species starting to come up.

We are logging soil types, progress, setbacks, flowering etc.

The only variety planted >5 is B. coccinea which flower readily in this area. We have 100 established and a further 100 in punnets. Our major setback to date has been a wingless grasshopper plague.

BANKSIAS, SAND AND SUPERPHOSPHATE DON'T MIX. Brett Robinson.

(Reprinted from Far North Coast Group Newsletter - April 1988)

Phosphorus is a chemical element which is essential for the growth and reproduction of plants. It is contained in structural materials such as cell walls, metabolic chemicals such as ATP and RNA, and the genetic blueprint molecule, DNA. Soils contain many kinds of phosphorus chemicals which may be of mineral, vegetable or animal origin, but for the purpose here they can be regarded as either readily available or sparingly available to plants. The quantity of sparingly available phosphorus in the soil is usually very much larger than the quantity of readily available phosphorus.

Most of Australia's soils and rocks contain relatively low amounts of readily available phosphorus. The main exceptions to this are loamy alluvial soils and soils derived from basalt. These soils generally support rich vegetation such as rainforest or dense eucalypt forests (except where water availability is severely limited). The most phosphorus deficient soils are those from ancient, strongly weathered soils developed 'in situ' from sedimentary rocks such as sandstone or from coarse alluviums. Deep sands and podsolics (sand over clay subsoils) are typical phosphorus deficient soils, and heaths and xeromorphic shrublands are typical vegetation types of low phosphorus soils.

Within various plant communities there are many adaptations used to obtain and retain phosphorus, and these are most developed in the heath vegetation, since efficient use of the extremely limited soil phosphorus is critical to their survival. For example, they often have enormous root systems (even in moist areas). To retain phosphorus many heath plants have tough, unpalatable leaves to resist attack by pests and grazing animals.

Some members of the Proteaceae from the heath and shrublands, including many *Banksia* spp. and *Grevillea* spp. possess an unusual adaptation known as proteoid (pro-tee-oid) roots. Proteoid roots are highly active in phosphorus uptake and may be able to utilize some of the relatively large quantity of sparingly available phosphorus in our poorer soils. Unfortunately, while these plants are beautifully adapted to poor soils, they may suffer from phosphorus toxicity if fertilized with soluble phosphorus fertilizers.

All fertilizers have an N:P:K ratio on the packet, such as 23:5:18 or 10:5:0. Any fertilizer where the middle number is not zero can cause phosphorus toxicity in sensitive species. Safe fertilizers include things such as urea (43:0:0), ammonium sulphate (21:0:0), lime (0:0:0) and muriate of potash (0:0:30?). Most 'general' fertilizers contain phosphorus.

However, the good news is that most phosphorus fertilizers such as superphosphate are either quickly utilized by plants or converted to sparingly available forms. This is especially true in light soils (i.e. coarse grained) which have a low phosphorus buffer capacity. This means that they have little resistance to changes in the quantity of readily available phosphorus in them. Therefore, plants in light soils can go quickly into a toxic state and may die, but the soil will quickly (a few years) recover. After 2-3 years the readily available phosphorus sand would usually be almost depleted. Heavy soils and acid soils usually have a high phosphorus buffer capacity and are less likely to go toxic, but are also slower to recover if toxicity does occur.

Ways to speed up the removal of readily available phosphorus from soil with a toxicity problem include adding a soluble form of iron such as ferrous (iron) nitrate or making the soil more acid by adding ammonium sulphate. Treatment with iron and calcium nitrate will have a slight acidifying effect, as well as adding soluble iron, and so should be especially good. Iron sulphate should also be quite an effective treatment. Fairly high rates of these chemicals are usually required (see the labels for directions).

If toxicity occurs on heavy soils, especially those that are already acid, the most realistic solution may be to grow rainforest rather than heath plants.

Rainforest plants, including members of the Proteaceae family, such as Silky Oaks, Wheel-of-fire, Beefwoods and the Ivory Curl, are not sensitive to phosphorus fertilizers. With lots of phosphorus floating around, they grow like mad, and then the main things to worry about are water and nitrogen. But that's a very different story .....

GROWING W.A. BANKSIAS IN CONTAINERS IN SYDNEY - Anthony Meyer.

Having tried to grow western banksia species in the ground in Sydney and having been rewarded with the anticipated disasters, I decided to try growing them in large containers. I have grown a number of species in 50-60 cm black plastic pots since 1983 with good results and I believe that I have learned one or two important lessons. My experiences are summarised below.

Methods

1. Propagation - This is generally easy from seed and there are many different workable methods. I use coarse sand mixed 1:1 with #3 vermiculite and sterilised; this is bottom-irrigated with boiled water to minimise damping-off. Autumn seems the best time for germination.

2. Growing on - Seedlings raised in tubes are potted on into 15cm pots as soon as roots are seen at the bottom of the tube. From this point I have found it helpful not to wet the stems or leaves when watering and to protect the plants from rain until they are fairly woody, at about 1 year of age. It is also at this point that I begin treatment with 'Fongarid' because the plants are moved into unsterilised potting mix. When well established I transfer the plants into the largest plastic pots.

3. Potting mixes - I have tried various recipes from pure furnace ash to sanding mixes and heavier loamy concoctions and it seems that banksias will grow and flower in almost any medium. Mixes based largely on sand or other very nutrient-poor materials produce much less vigorous plants of poorer appearance. My best results have been with a commercial soilless mix designed by Neil Black at the Ryde School of Horticulture. This very freely draining mixture has a high proportion of pinebark fines and is used in the nursery trade in situations where frequent watering is needed.

4. Watering - In fact I water my Banksias daily in the hotter months and I try never to let the potting medium dry out completely.

5. Maintenance - I give the plants as much sun as possible but I have found that they will do quite well as long as they get full sun for a few hours each day. I try to protect the sides of the pots from overheating by grouping them together or with old rooftiles. During the winter some species seem to "switch off" their growth and they can then be decanted from their pots for trimming of roots and replenishment of potting mix. Incidentally, plants grown in richer potting media do not seem to produce proteoid roots.

6. Fertilisers - Soluble low-phosphorus fertilisers can be used at full strength without ill-effect in my experience although plants grown in nutrient-poor media do not do much better even with heavy fertilising. Slow release fertilisers seem to be quite adequate for most purposes.

7. Fungicide - I believe this to be the critical component. As mentioned above, all my plants are treated with 'Fongarid' as soon as they leave the sterilised seed-raising mix. Thereafter they are treated monthly in summer (or with soil temperatures over 19°C) and every 6 - 8 weeks for the rest of the year. Each 50 - 60 cm pot receives ¼ level metric teaspoon of powder in 1 - 2 litres of water, or proportionately less for smaller pots. This is somewhat above the recommended rate but there have been no problems with toxicity. I have found that periods of prolonged rain or high humidity have no detrimental effects and in fact I have not lost a plant treated in this way.

8. Pests - These are very few, fortunately, the main offender being the borer which destroys flower buds in the very early stages. The best weapons against these seem to be constant vigilance and a syringe full of methylated spirits. I have recently noticed that a small black spider inhabits the growing tips of many of my plants and that where there is a spider the flower will form unhindered.

Results

In two words, very gratifying. So far I have flowered *Banksia victoriae* (two seasons), *B. hookerana* (two seasons), *B. burdettii*, *B. menziesii*, *B. dryandoides* and *B. gardineri var. gardneri*. These species all produced flowers at 3 - 4 years of age from seed. Also growing but without signs of flowering are *Banksia meisneri*, *B. coccinea*, *B. caleyi*. It seems to be important to prevent flowers of species such as *B. victoriae*, which are rather woolly, from becoming wet as this seems to produce permanent discolouration.

Attempts to replace 'Fongarid' with the longer-acting 'Ridomil' on *B. meisneri* and *B. caleyi* produced serious problems due either to toxicity or reduced protection from root fungi. In any case the plants were successfully "rescued" with 'Fongarid'. No attempt was made to control pH in potting media but this was generally neutral or slightly acid.

I suppose the next logical step is to return my attention to growing these plants in the garden. Most of my efforts to date, even with 'Fongarid' treatment, have not been terribly successful. I suspect that it is more difficult to adequately treat a plant growing in the ground with the fungicide but I feel that many failures have been due simply to inadequate watering in soils which are too sandy. Success has been achieved with dry-country Grevillea spp. in heavier soils mixed with gravel and raised into mounds. Perhaps this kind of soil preparation along with some modifications to the fungicide regimen will provide better results.

BANKSIA PLAGIOCARPA - A.S. George - Trevor Blake

Six seeds of this relatively little known species that was first found on higher reaches of Hinchinbrook Is. in 1981 and related to B. integrifolia, were planted in early November 1986. The soil mix was an open, sandy one with 1 part clay-loam and 2 parts well weathered pinebark. Seeds were covered with the potting mix and the mixture was kept moist, not wet. Three seeds germinated, growing steadily, enabling planting in April 1987 (20 cm high). The position selected has reasonable drainage in grey clay-loam over heavy yellow clay at 30 cm. With an overhead canopy of eucalyptus providing filtered sunlight for most of the day the plant has grown slowly and has survived a very long dry Melbourne summer with occasional deep watering in the autumn only. The plant looks extremely healthy and is still growing steadily reaching (30 cm).

The other two seedlings are in pots and have not attained the height of the one planted out. They have been receiving constant water with no fertilizing and have reached 20 cm.

This species is growing in association with B. canei, B. conferta var. conferta and B. sp. New England plateau all of which are very healthy and have flowered for three seasons. No frost or strong winds are received in this area.

BANKSIA sp. NEW ENGLAND PLATEAU

This species is growing under similar conditions as above in an average rainfall area of 850-950 mm per year. It has reached 4m in 5 years and has flowered for three. It is not a prolific flowerer in a relatively shady position, but has set seed each year. Sparse and open because of the shade I suspect, it appears hardy to dry periods and seems to suffer no ill effects. Melbourne in 1987/88 summer has experienced drought conditions from December to April. *

GERMINATION OF EASTERN BANKSIAS - David Banks

The following notes may prove useful to those people wishing to raise these plants from seed.

All eastern species, with the exception of B. dentata and the three varieties of B. integrifolia, retain their seeds until fire or extreme stress of the parent plant.

Extraction is best achieved by the somewhat messy method of barbequing the cones over an open flame. This opens the follicles fairly quickly and safely.

*This species is known to reach 20m on the edges of rainforest on the New England plateau (Barrington Tops also widespread over the plateau.)

After allowing to cool, the cones are placed in large paperbags and left to 'mature' for a week on a sunny windowsill. During this time the follicles will open wide and allow for easy access of the seed by shaking the bag. Sometimes tweezers are required for some of the species with smaller seed such as B. marginata.

The use of warm to hot ovens is sometimes advocated but this is a dangerous practice as the follicles open slowly, allowing heat to penetrate the seed for an extended period. This would result in poor germination later on.

Seed is best sown in the autumn or spring. Sowing in winter results in slow growing plants, inconsistent germination and the risk of death from frost is very high, whilst the damping off of seedlings is a real threat during the humid summer months.

No pre-germination treatment is required except for B. canei and B. saxicola. These species require a period of stratification for uniform germination. This may also be needed for some of the tableland forms of the variable B. marginata and B. integrifolia.

Seed is layed on damp paper towelling (6 layers thick), folded to make a 'sandwich' and placed in the butter compartment of the refrigerator for 60 days. You may find (like I did) that a percentage of the seeds will start germinating beforehand. These may be planted immediately whilst the remainder can be left until stratification is over.

I use 125mm squat plastic pots. I don't like punnet trays as these can restrict the young root system of seedlings.

The mix I use is 50% horticultural sand, 30% fine potting mix and 20% peat moss. This allows for a free draining medium which retains moisture.

Up to 20 seeds are planted for most species and covered with 1 cm.of potting medium. Species with larger seeds such as B.aemula and B.serrata are planted half a dozen to a pot or can be sown individually in tubes.

Seedlings can be transferred to tubes after the second pair of leaves are produced. This is usually 4-6 weeks after the cotyledons have emerged. You will be surprised how extensive the root systems are even at this early stage. Plants can then be transferred to the garden (or layer pots) when 15 cm.tall.

Germination times vary considerably between different species, even the same species from different localities. Temperature also plays a major part. Seed sown during February will germinate up to 20 days faster than the same seed sown in April. It seems an optimum temperature is between 20-25 °C.

I have yet to try B. dentata and B. plagiocarpa from seed but it should be similar to B. integrifolia and B. oblongifolia respectively.

The following table may be of some interest and I would welcome any feedback from members. David Banks, 183 Windsor Road, Northmead, 2152.

GERMINATION TIMES

14-28 days	28 - 42 days	42 days - 56 days
B. conferta v. conferta	B. aemula	B. marginata
B. ericifolia v. macrantha	B. conferta v. pencillata	B. paludosa
B. integrifolia v. integrifolia	B. ericifolia v. ericifolia	B. robur
B. integrifolia v. aquilonia	B. spinulosa v. spinulosa	B. serrata
B. integrifolia v. compar	B. spinulosa v. cunninghamii	B. spinulosa v. collina
B. oblongifolia	B. spinulosa v. neoanglica	

B. canei and B. saxicola germinate quickly after 60 day stratification.

There is still a lot to learn about banksias. With the current upsurge of interest in this genus it is important to share knowledge for the benefit of Australian plants.

DWARF FORMS OF BANKSIA AEMULA AND BANKSIA SPINULOSA VAR. COLLINA - David Banks

On the Central Coast of New South Wales at Lake Munmorah, abounds a number of unusual Hawkesbury sandstone plant species, dominated by Proteaceae.

Five Banksia species are found in the Lake Munmorah Recreation Park;

- Banksia aemula
- Banksia integrifolia var. integrifolia
- Banksia oblongifolia
- Banksia robur
- Banksia spinulosa var. collina

At Wybung Point, dwarf forms of B. aemula, B. oblongifolia and B. spinulosa var. collina dominate the hillside vegetation. B. oblongifolia reverts to a shrub in protected localities whilst both B. aemula and B. spinulosa var. collina retain their dwarf characteristics. It is therefore assumed that their morphology is genetic.

Banksia aemula

This species, popularised by May Gibbs as the 'Big Bad Banksia Man' (not B. serrata as often thought), is distributed from South of Gladstone, Queensland, along the east coast to Sydney, New South Wales. It is usually encountered as a tree or medium shrub.

At Wybung Point, B. aemula is a low spreading shrub. Plants are multistemmed and grow from an exposed lignotuber, 0.5 metre in height and covering an area of 3 square metres. In situ the plants appear to be prostrate, sometimes being smothered by native grasses.

Flowering occurs between March and May at Lake Munmorah. Flower inflorescences are slightly smaller than the tree or shrub forms.

After bushfires, the plants reshoot from the raised lignotuber from epicormic buds. Seed is also released at this time. In cultivation, seed germinates between 28 and 42 days.

It is interesting to note that plants in protected locations retain the dwarf habit of the plants near the ocean.

This form of B. aemula should prove popular as a coastal plant for small gardens and would probably respond well to pot culture in a sandy mix.

Banksia spinulosa var. collina

This plant occurs in the same aspect as B. aemula, B. spinulosa var. collina is distributed from Sydney, N.S.W. northwards to Gympie, Queensland with a Northern outlying population at Carnarvon Gorge.

B. spinulosa var. collina is usually a medium dense shrub which is common in cultivation along eastern Australia.

The dwarf form from Bybung Point has a very bright horticultural future for small gardens or as a border plant.

Plants are lignotuberous, multistemmed and reach dimensions of 0.4 metre x 2.5 metre. The foliage is dense, compact and attractive even when not in flower.

Flowers are produced between April and July and are borne well above the foliage, thereby temporarily adding to the plant's height. Flowers are deep orange with mauve styles.

This variety reshoots from the lignotuber after fire. In cultivation, seed germinates between 42 and 56 days. Plants can also be propagated by cuttings.

This banksia is indeed an eyecatching plant and should prove popular in cultivation once seed or plants become available.

BANKSIA PALUDOSA ... NATTAI RIVER FORM - Brian Walters

Banksia paludosa is normally a small, lignotuberous shrub common in southern N.S.W. extending from the coast to the Great Dividing Range.

One of the more interesting outcomes of the Banksia Atlas Project was the discovery of an apparently new variety of B. paludosa in the N.S.W. southern highlands, west of the village of Hilltop.

This new form was recorded independently by myself and Kevin Mills as a new location for B.conferta var. penicill as it is a large, bushy shrub without a lignotuber. The identification was tentatively confirmed by Alex George. However, later examination of plants in flower showed it to be more like B. paludosa with the typical narrow flower spike of that species, although the spike seems consistently longer. The flowers also do not have the characteristic pink to brown colouration at the bud stage that B. conferta var. penicillata exhibits.

The difference between the new plant and usual forms of B. paludosa is much the same as the difference between B. spinulosa var. cunninginhamii and the other varieties of B. spinulosa. It seems likely, then, that this new form could be described as a new variety of B. paludosa.

This new (presumed) variety occurs along a well known track called "Starlight's Trail" which leads down to the Nattai River. The plant is distinctly different from the normal forms of B. paludosa and it is surprising that it has not been collected previously. As one descends down to the river, the plants become progressively larger, some reaching over 4 metres in height.

I have a small amount of seed of this Nattai River form. Anyone interested could contact me at R23, West Wilchard Rd., Castlereagh, N.S.W. 2750.

GROWING BANKSIAS IN SOUTH GIPPSLAND

WENDY INMAN

Our land at Willung is situated near the Merriman Creek, across from the Holey Plains National Park. We back on to State Forest. We have 100 acres, 40 of which is bush. The bush contains 2 types of banksia, B. marginata and B. serrata. The latter occurs mainly along the sandy ridges whereas B. marginata seems to be more prominent in the gullies and on the road verges.

The ridge where we have built was covered in wedding bushes (Ricinocacpus pinifolius), heath, tea-tree and correa as well as other small natives. The area cleared to build has regenerated in parts and as there were many wildflowers we are not digging over our garden - but weeding only to allow the wildflowers to regenerate (we hope!)

Some orchids and others have appeared. We are mulching with litter from the bush.

The soil is a sandy loam pH 5-5.5 and well-drained (dry). There is a hard layer (sandstone?) about four feet down. We are in an area that receives very severe and unseasonal frosts.

Both native banksias self-propagate in the sandy soil. The other species planted are:-

planted 1985 - B. ericifolia, B. coccinea, B. paludosa, B. spinulosa (dwarf), B. gardneri.

planted 1986 - B. caleyi, B. meisneri, B. grandis (Shrubby form), B. menziesii (dwarf), B.burdettii, B. pilostylis, B. repens, B. dryandroides, B. collina, B. baueri, B. petiolaris.

All are growing well so far and all are showing new growth at the moment.

I have also tried germinating banksia seed. The seeds were planted in small individual pots and are developing better than last year when they were planted in trays and transplanted at an early stage. By soaking seeds for 24 hours in hot water they have germinated earlier than unsoaked seeds. Some species are easier to germinate than others. The species tried are:-

1985 - B. pulchella, B. sphaerocarpa var. caesia, B. grossa, B. violacea, B.laricina B. gardneri var. hiemalis.

1986 - B. petiolaris, B. laricina, B. lanata, B. sphaerocarpa var. caesia, B. ericifolia, B. violacea. (The last I have been unable to germinate). All my seed has come from the S.G.A.P. seed bank - except for an unidentified locally collected species.

Seeds are sown in a cold-frame and transferred to a sheltered part of the garden on germination.

GRAFTED BANKSIA: Max McDowell

Banksia media on B. integrifolia.

This was produced by a wedge graft of a seedling of B.media at the cotyledon stage (sown 19.3.85) onto a stock of an advanced seedling of B.integrifolia var. integrifolia. (I find the cotyledon to cotyledon graft too difficult for my poor eyes even with the aid of a 2.5x binocular magnifier). History does not record how much foliage was left on the stock. One of two similar grafts was successful, and was planted into the garden about Spring 1986.

After two years the plant is now 1 x 0.8m and has two flower heads.

Some coppice growth of the stock has had to be removed in Autumn 1988. This is one disadvantage of using an advanced seedling for a stock.

A similar type of graft of B.menziesii onto B.integrifolia was unsuccessful.

PROTEACEAE IN SCORIA-BASED GARDEN BEDS - (30 - 80 cm deep) Max McDowell

Soil mixtures containing 55-60% crushed scoria (6mm minus) were used to build raised garden rockery beds in 1976. The remainder of the mix includes equal proportions of clay-loam topsoil, sandy loam and mountain topsoil, with some small additions of compost and gravel.

I now prefer to include some coarse sand and compost in replanting these beds, as the scoria mix sets rather hard and unwettable in summer. Garden beds are watered about once per fortnight in summery's dry periods.

Most species chosen to grow in these beds have been selected from the difficult to semi-hardy baskets.

Ratings:

Hardy: Hakeas, esp. M.bucculenta, M.scoparia, M.verrucosus
Dryandras esp. D.quercifolia.
Isopogons and Petrophiles
Banksias esp. B.baueri & B. verticillata.
Myrtaceae esp. Eucalyptus (WA) Melaleuca and Eremaea spp.

Semi-Hardy: Grevilleas (except G.dielsiana which was hardy).

Difficult: Synaphaea, Hakea ruscifolia
Beaufortia spp.
Eremaea violacea

B.baueri orange (1.5 x 1.2m) 11 yrs old - straggly, has produced only two flowers. Situation too elevated and dry.

B baueri (1.0 x 1.2m) 9 years old, bushy heart, no flowers.

B.verticillata (2 x 0.8m) 8 years old, open hearts no flowers.

B.ashbyi (0.8 x 0.5m) 11 years old, straggly - two flowers - situation too shady.

B.grossa (0.4 x 0.5m) 2 years old - filtered sunlight.

B.media (1.5 x 1.2m) flowered at about 5 years of age but died in following October during a warm spell when old dead foliage was pruned from base of plant and nearby Acacia leioderma (section Pulchellae) was heavily pruned exposing the soil to direct sunlight.

B.littoralis (3.5m x 1.2m) grow in the shade of G.robusta but suffered severe foliage drop in the 1981-2 drought. It never regenerated foliage on the lower branches, and lasted about 2-3 years, but died without flowering despite removal of G.robusta.

B.praemorsa (1 x 0.8m), 6 years old, has flowered once.

B.ericifolia (squat, red 2.5 x 2m) 12 years old, flowers reliably -this year has particularly long heads (to 25 cm).

B.blechnifolia (two specimens to 1.2m+) - one in semi-open the other in filtered sun -both have flowered.

DISAPPEARING BANKSIA MARGINATA STANDS

G. WALLACE - CF + L

I have a particular concern, and I am particularly relieved that there are "Banksia People" who may be able to help me with it. Prosper the art of banksia propagation!

On the basalt plains of Western Victoria, east of the Hopkins and to the Leigh River, I know of only eleven surviving, isolated, Banksia marginata. These are all of tree form and usually of impressive proportion.

They are all isolates, all old, all subject to the next fire, all precious as they are a vulnerable genetic resource, all are flowering but only three set any seed even though all ripen some fruit each year, all are in grazed paddocks, all suffering a lack of "other" pollen and their usual means of pollination.

This species was once abundant on the stony barriers of basalt across the plains.

Propagation by cuttings is essential, I reckon, to produce a number of individuals of each, so that groups containing several cloned plants of each remaining tree can be put together to exchange their genes, and this system replicated in a number of places on the plains.

Interested people could contact Mr. Wallace, Resource Assessment Officer, Dept. of C.F. & L. Ballarat Region, State Public Offices, Cnr. Mair and Doveton Streets, Ballarat, 3350.

EASTERN SPECIES IN SOUTH GIPPSLAND

CORAL HUGHES

So far I have had mixed success with banksias. We live in South Gippsland with a 40" rainfall, mainly during winter and spring, on a shallow grey-loam, over clay soil. The winter and spring are often very soggy, then by Jan.-Feb. the soil is cracking with dryness. I have tried a few W.A. banksias - B. praemorsa, two died very early but the third on the northside of the house was 8 or 9 years old, 6 ft. high, 4 ft. wide and flower very well till it suddenly succumbed.

B. occidentalis (2) grew well for about 3yrs, 6 ft. high X 2-3 ft. wide, flowered very well, then a very wet spring and the first warm day in Nov., they both looked ill, by the end of the week dead. B. speciosa did not grow as well and went the same way.

So I have concentrated on the eastern species. As we have a farm we have planted several down the paddock, one patch 8 or 9 B. ericifolia would be 8 or 9 ft. high, 3 ft. wide and loaded with flowers. They are on the edge of a gully with probably ½ sun. Another row has alternating B. spinulosa var. cunninghamii and a short fat B. marginata. They would be 10 years old about 7 ft. high, 4 ft. wide and flower well.

About the house there is one B. integrifolia 8 or 9 years old heading for the sky (open spot) and just starting to flower, also several very tall skinny B. marginata, flowering poorly but very shaded. There are some B. spinulosa var. cunninghamii plus a B. spinulosa var. collina just under one metre high, 5 years old, probably older as it was in a large pot when bought from Tree Planters Springvale. The flower is rather dull. Another B. spinulosa var. spinulosa about a metre high, five leaves, flowers bright honey with red pins.

THE GRAFTING OF AUSTRALIAN NATIVE PLANTS

- By Doug McKenzie

ABSTRACT
This paper presents the results of a large number of experimental grafts using Australian native plants. It briefly considers several unusual grafting methods and discusses the problem of incompatibility.

MATERIALS AND METHODS

Because of the large number of grafts to be made, methods were adapted or developed to produce grafted plants as quickly as possible.

The three main methods involve using very young seedlings or tender shoot growth. The advantage of these methods is that adequate stock or scion material can be produced or gathered which is relatively homogeneous with respect to stem width and stem maturity.

1. Grafting at the Cotyledon Stage

A fairly detailed account of this method has been published in the journal Australian Plants (McKenzie, 1981). While this description applied to the grafting of Clianthus species, the same method may be used to graft other genera. In the case of Proteaceae special care must be taken with nursery hygiene due to the susceptibility of these plants to fungal disease in the first few months.

Grafting at the cotyledon stage is possible also with some Myrtaceae. Some genera produce seedling leaf stems, (hypocotyls) that are sufficiently robust if care is taken. Some Eucalyptus spp, and most Eremaea spp, Beaufortia spp and Regelia spp, produce quite a sturdy and relatively thick hypocotyl. Most of the stock species used with the latter genera (Kunzea spp, Leptospermum spp, etc.) are by contrast rather thin and spindly when very young. They therefore are grown to a size (perhaps 60-80mm) to obtain stems which match the diameter of the hypocotyl yet are still at the semi-mature (green)stage. As with all the methods mentioned, Teflon tape has been found to be the most useful. It is strong, can usually be 'torn' longitudinally, giving long strips of suitable width (1-3mm), is cheap, and does not need to be tied. The main problem is that it is rather hard to handle.

After grafting, plants must be kept in a humid atmosphere for up to 5 weeks. Small plastic throwaway medicine glasses are used over each individual plant. These are quite inexpensive and the plastic is semi-transparent allowing plenty of light in to the freshly grafted plant. The plastic medicine glasses are changed daily. Mist is used for some species without ill-effect, after the first week. The graft is finally unwrapped and slowly hardened off.

2. Grafting a Growing Tip

Stock plants are grown in tubes to the required size and decapitated at a point where the stem diameter matches the size of the scion. An actively growing green tip is taken from an older plant, its stem shaped to a wedge and is then placed in the top of the stock and bound with Teflon tapet. The plants are then treated in the same way as those grafted at the cotyledon stage.

3. Cutting Grafts

The method used is a side cutting graft. This method is an adaption of the method described by Burke (1983). A side wedge graft is prepared, bound using Teflon tape and buried in the cutting medium so that the graft itself is buried, but the leafy tops of stock and scion are above the medium. The cutting grafts are placed under mist until rooting of the stock takes place.

The young grafts are then potted into individual pots so that the graft union is well clear of the soil.

In each of the three methods described above, the material being used is small and quite difficult to handle. It has been found that a suitable lens is useful in cutting and positioning the scion. Either a large lens on a stand or a jeweller's binocular loupe worn over the eyes is suitable.

RESULTS

The table below summarizes the results of the trials. In the table the following symbols are used:-

X	likely to be incompatible.
+	" " " compatible.
?	either plants too young to be assessed, or ambiguous results.
+?	plants have lasted for some time but plants are showing signs of incompatibility, (particularly in growth rate).

TABLE ONE - PROTEACEAE

STOCK SPECIES	SCION SPECIES	NUMBER GRAFTED	NUMBER SURVIV--ED	AGE OF OLDEST	COMPATIBILITY
Banksia ericifolia	B.coccinea	1	0	4	X
	B.nutans	1	1	36	+?
	B.violacea	1	1	48	+?
	B.occidentalis	4	0	6	X
	B.sphaerocarpa	2	0	18	X
	Dryandra,praemorsa	1	0	6	X
	D.polycephala	2	0	6	X
Banksia.integrifolia.	B.baxteri	4	0	4	X
	B.benthamiana	3	1	48	+?
	B.brownii	10	5	55	+?
	B.burdettii	2	0	10	X
	B.coccinea	2	0	10	X
	B.grandis	2	2	36	+
	B.laevigata subspec.laevigata	1	1	42	+?

TABLE ONE (Cont'd)

	SCION SPECIES	NUMBER GRAFTED	NUMBER SURVIV--ED	AGE OF OLDEST	COMPTABILITY
	B.laevigata sub-spec.fuscolutea	13	7	45	+?
	B.lanata	2	1	18	?
	B.laricina	24	1	22	X
	B.lemanniana	2	2	40	+
	B.leptophylla	2	1	18	?
	B.lindleyana	1	0	8	X
	B.littoralis var. littoralis	3	1	36	?
	B.littoralis var. seminuda	3	3	24	?
	B.media	1	0	30	X
	B.micrantha	1	0	18	X
	B.occidentalis	35	30	48	+
	B.oreophila	1	0	5	X
	B.pilostylis	4	1	38	?
	B.praemorsa	2	0	24	X
	B.prionotes	2	0	12	X
	B.scabrella	9	1	18	X
	B.speciosa	7	0	18	X
	B.sphaerocarpa	2	0	18	X
	B.telmatiaea	2	0	12	X
	B.verticillata	3	3	39	+
	B.victoriae	3	3	60	+?
	B.violacea	3	3	24	+
B.integrifolia	B.sceptrum	4	0	9	X
	B.solandri	20	18	18	+
	Dryandra polycephala	8	0	15	X
	D.praemorsa	2	0	8	X
	D.speciosa	2	0	5	X
Banksia lem - anniana	B.burdetti	1	0	4	X
	B.oreophila	1	0	4	X
Banksia marginata	B.grossa	1	1	18	?
	B.lanata	3	2	18	?
	B.laricina	3	1	18	?
	B.nutans	1	0	12	?

TABLE ONE (Con'd)

	SCION SPECIES	NUMBER GRAFTED	NUMBER SURVIV--ED	AGE OF OLDEST	COMPATABILITY
	B.oreophila	2	0	5	X
	B.praemorsa	1	0	4	X
	B.sphaerocarpa	1	0	6	X
Banksia saxicola	B.scabrella	2	1	24	?
	B.leptophylla	5	2	24	?
	B.incana	1	0	12	?
Banksia robur	B.oreophila	2	0	5	X
Banksia serrata	B.baueri	1	0	12	?
	B.baxterii	2	0	5	?
	B.burdetti	38	15	36	?
	B.caleyi	1	0	18	?
	B.candolleana	1	1	24	?
	B.chamaephyton	1	0	4	?
	B.elderana	1	0	4	X
	B.lemanniana	1	1	24	?
	B.menziesii	7	4	30	?
	B.leptophylla	1	0	4	X
	B.incana	1	0	4	X
	B.pilostylis	2	1	18	?
	B.prionotes	1	1	36	+?
	B.speciosa	12	9	36	+?
	B.victoriae	6	2	28	+?
Banksis spinulosa var.spinulosa	B.brownii	2	0	12	X
	B.burdetti	3	0	6	X
	B.elderana	3	2	30	+?
	B.laevigata subspec.fuscolutea	3	1	24	?
	B.lindleyana	2	0	8	X
	B.littoralis var littoralis	2	0	4	X
	B.nutans	2	0	15	X
	B.occidentalis	2	0	4	X
	B.pilostylis	2	0	15	X
	B.praemorsa	5	2	36	?
	B.prionotes	3	0	4	X
	B.sphaerocarpa	2	0	18	X
	B.verticillata	2	0	8	X
	B.victoriae	1	0	4	X

TABLE ONE (Cont'd)

	SCION SPECIES	NUMBER GRAFTED	NUMBER SURVIV--ED	AGE OF OLDEST	COMPATABILITY
	B.violacea	2	0	6	X
	Dryandra praemorsa	8	5	60	+
	D.polycephala	2	0	5	X
	D.proteoides	3	0	8	X
	D.quercifolia	1	0	5	X
Banksia.spinulosa var. collina	B.ashbyi	2	0	3	?
	B.brownii	3	2	56	+?
	B.laricina	1	1	60	+?
	B.laevigata subspec fuscolutea	2	0	18	X
Banksia verticillata	B.coccinea	2	0	12	X
	B.scabrella	1	0	10	X
	B.micrantha	1	0	8	X
	B.oreophila	1	0	6	X
	B.elderana	1	0	6	X
Grevillea robusta	G.dryandri	2	2	36	+
	G.candelabroides	2	2	36	+?
	G.petrophiloides	5	0	24	X
	G.wilsonii	2	2	36	+
Grevillea barkleyana	G.petrophiloides	3	0	12	X
Grevillea	G.asparagoides	1	1	36	?
'Clearview	G.eriostachya	2	0	15	X
David'	G.flexuosa	2	0	12	X
Grevillea	G.petrophiloides	5	0	12	X
banksii	G.'Misty Pink'	1	1	36	+
Grevillea rosmarinifolia	G.petrophiloides	3	2	30	?
	G.wilsonii	3	2	15	+
Hakea laurina	H.francisiana	5	0	18	X
	H.coriacea	2	0	20	X
	H.multilineata	7	0	24	X
Hakea nodosa	H.coriacea	3	1	18	?

TABLE ONE (Cont'd)

	SCION SPECIES	NUMBER GRAFTED	NUMBER SURVIV--ED	AGE OF OLDEST	COMPATABILITY
	H.francisiana	29	15	18	+?
	H.multilineata	5	4	18	+?
Hakea salicifolia	H.bucculenta	200	180	48	+
	H.coriacea	100	80	48	+
	H.francisiana	500	460	48	+
	H.gramatophylla	20	10	36	?
	H.lorea	6	3	30	?
	H.multilineata	300	275	48	+
	H.victoriae	6	0	14	X
Hakea sericea	H.francisiana	5	3	30	+?
	H.multilineata	2	1	30	+?

TABLE TWO

Astartea fascicularis	Chamelaucium uncinatum	6	0	18	X
	Darwinia leiostyla	3	0	12	X
	Verticordia chrysanthera	2	0	12	X
Calytrix sullivanii	Chamelaucium uncinatum	3	1	18	X
	Darwinia leiostyla	2	0	8	X
Darwinia citriodora	Chamelaucium uncinatum	20	15	36	+?
	Actinodium cunninghamii	3	1	24	?
	Darwinia carnea	4	4	24	+
	D.collina	2	2	16	+
	D.hypericifolia	6	4	26	+
	D.leiostyla	20	18	36	+
	D.macrostegia	30	26	36	+
	D.oldfieldii	3	2	36	+?
	D.oxylepsis	10	9	36	+
	D.nieldiana	5	3	18	?
	d.purpurea	3	3	16	?
	D.squarrosa	4	3	18	+
	D.virescens	3	2	18	?
	Verticordia chrysanthera	5	4	36	+

TABLE TWO (Cont'd)

	SCION SPECIES	NUMBER GRAFTED	NUMBER SURVIV--ED	AGE OF OLDEST	COMPATABILITY
	V.densiflora	2	2	16	?
	V.mitchelliana	5	3	36	+?
	V.monadelpha	4	3	30	+?
	V.nitens	10	0	13	X
Darwinia fascicularis	D.macrostegia	1	1	18	?
Darwinia grandiflora	D.leiostyla	2	1	24	?
	D.macrostegia	2	2	24	?
Eucalyptus gummifera	Eucalyptus ficifolia	10	5	36	?
Kunzea ambigua	Beaufortia squarrosa	3	0	8	X
Kunzea ambigua	Eremaea beaufortioides	2	1	24	?
	Kunzea affinis	2	2	24	+
	K.baxteri	3	3	28	+
Leptospermum phylicoides	Beaufortia squarrosa	3	0	6	X
	B.sparsa	6	0	6	X
	Eremaea beaufortioides	4	0	5	X
	E.pauciflora	3	0	4	X
	E.fimbriata	3	0	4	X
	Kunzea affinis	5	5	30	+
	K.baxteri	15	13	30	+
	K.pulchella	3	3	24	+
	Chamelaucium uncinatum	10	0	12	X
	Melaleuca scabra	2	0	8	X
	Vericordia chrysanthera	4	0	6	X
	V.mitchelliana	2	0	6	X
	Regelia velutina	5	0	6	X
Regelia ciliata	Eremaea beaufortioides	2	1	24	?
	Beaufortia schauri	1	0	15	X
Regelia megacephala	Beaufortia orbifolia	2	0	6	X

TABLE TWO (Cont'd)

	SCION SPECIES	NUMBER GRAFTED	NUMBER SURVIV--ED	AGE OF OLDEST	COMPATABILITY
	Regelia velutina	2	1	18	?
Thryptomene saxicola	Actinodium cunninghamii	3	0	18	X
	Chamelaucium uncinatum	5	0	12	X
	Darwinia leiostyla	5	1	30	+?
	D.macrostegia	5	0	10	X
	Verticordia mitchelliana	3	1	18	+?
	V.monadelpha	2	1	18	+?

TABLE THREE

STOCK SPECIES					
PAPILIONACEAE					
Clianthus puniceus	Clianthus formosus	3000	?	60	+
RUTACEAE					
Boronia clavata	Boronia megastigma	5	3	24	?
Correa alba	Eriostemon verrucosus	2	0	26	?
C.'Marions Marvel'	E.australasius	3	0	6	X
C.'Dusky Pink'	E.verrucosus	1	0	15	?
	Correa 'Fat Fred'	1	1	18	+

DISCUSSION

The following points have become evident:

a) Many combinations of stock/scion species prove to be unsatisfactory as grafted plants. For a plant to be useful, growth rate ought to be similar to or better than the normal rate attained by the scion growing on its own roots. A number of grafted plants will survive for some time, but growth is extremely slow, (marked "X" on tables).

b) The classic symptom of incompatibility, (clean breaking at the graft union) can occur at quite a late stage (several years after grafting).

c) Using juvenile material incompatibility may be suppressed for a time. This delayed incompatibility may show up as one or more of the following symptoms, some months or even years later:

i) Clean break at the graft.

ii) Slow or stunted growth or general malaise.

iii) Gross disparity between stock and scion stem width.

iv) Tendency of stock to shoot continually.

v) Abnormalities at the union, (in particular a furrow appears right around the circumference of the bark stem, at the graft union, indicating discontinuity of the growing tissue beneath the bark.)

In general, the following combinations look very promising;

On Banksia integrifolia - B.grandis, B. solandri, B.occidentalis B.verticillata.

On Hakea salicifolia - H.bucculenta, H. francisiana, H. coriacea H.multilineata.

On Kunzea ambigua
or Leptospermum phylicoides Kunzea species.

On Darwinia citriodora - most Darwinia species and perhaps some Verticordia species.

On Clianthus puniceus - Clianthus formosus.

A number of other combinations may prove to be successful. It is perhaps surprising that so few of the trials produced satisfactory plants. Plants ought to be grown for a number of years before a claim of success is justified.

LITERATURE CITED

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COMMERCIAL GROWING OF BANKSIA IN SOUTH AFRICA - Philip Brink.

The banksia are doing very well here but I do find the odd one dying as the result of Phytophthora. This was established by the local research station.

At a rough estimate I have approximately 1000 plants each of burdetti, speciosa, victoriae, ashbyi, grandis, hookerana, prionotes and pilostylis. I also have about 500 each of sceptrum, coccinea, menziesii and a smaller quantity of ericifolia - about 300.

I find the ericifolia unaffected by the Phytophthora. As I treasure the plants and hate to see any of them dying, I shall be most grateful to hear of a spray which, I believe, was developed in Australia and, in addition, how it is applied?

I experience a certain amount of difficulty with germination done in sandy soil of some varieties, but I think my mistake was that I put the seed into the seed trays at the wrong time of the year viz November. Some, which were done in February, germinated much better.

I have been sowing and planting banksias for three years now - besides ericifolia which I have been planting for 5 years. The first year the young plants 2-3 months old showed signs of iron deficiency which I remedied with Iron Chelate. Since then, by using the sandy soil from the farm, I have not experienced the same problem - neither do the established trees indicate iron deficiency problems.

The first flowers of the prionotes and speciosa this year were, to a certain extent, spoilt by bees and some of them had black ants on them. If necessary, and the trees are in reasonable production, I will probably put some spray on to protect the blooms.

BANKSIA - GROWING IN WANGARATTA - Chris Rogers.

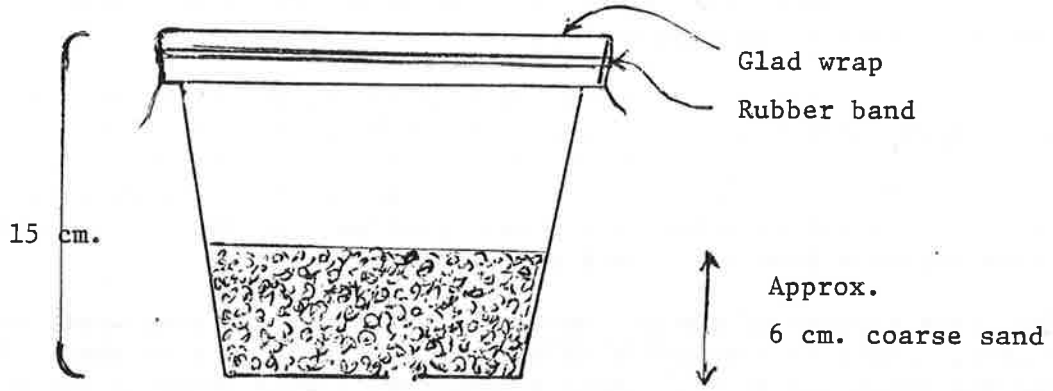
My first attempt with 40 varieties of seed, chosen by "prettiness" in the Banksia Book met with mixed success. For general propagation I have used a homebuilt bottom-heated misting propagation box, which has been terrific for callistemons and grevillias and my two attempts at banksia (ericifolia and seminuda). The seeds with a short germinating time worked well, but those with long germinating times were attacked by fungus before they really started, so I will try them again in a drier environment. Probably 30/40 gave viable seedlings, all of which survived their first winter in a glasshouse in Ballarat. These were planted out in spring in Wangaratta and 20/30 survived a rather frosty second winter and unusually dry summer to date. The plants had very little attention once planted out.

I have claimed these as successes in Wangaratta B.nutans, violacea, pilostylis, baueri sphaerocarpa, grandis, speciosa, solandri, dryandroides, baxteri, caleyi grown from commercial seed started in a misting bottom-heated box in Dec, potted up into tubes and planted out as vigorous seedlings in autumn, now looking good as plants 15-30 cm high.

There are also some others which I am unsure of for various reasons. There were others of my own seedlings that did not survive the frost or dry summer once planted out. Obviously, the climate and soil were inappropriate for some species. Over the last 3 years the plants have had to survive in a paddock with rabbit guards and a grass slashing in October. As a casual observation those banksias that grew in an area of fairly sparse Wimmera rye grass had a much higher survival rate than those that grew in areas of heavy paspalum and dock. The seedlings were planted at random, and I suspect that the difference in survival was not only a matter of frost damage but also a matter of free air circulation in the wet winter months which lessened the problem of fungus and mould damage. Next winter I will try and keep a cleared area aroung each seedling.

SEED GERMINATION - David Handscombe

I germinated my seed in large yoghurt containers.



I place the seed on the coarse sand and wet the sand thoroughly. I then spray the seed with Benlate and place on a desk that receives sun between 12 noon and 2 p.m. I have found that the seedlings develop a good top root and are easily pricked out once the dicot. leaves have opened out fully.

RESULTS OF MY GRAFTING EFFORTS - Philip Strong.

Earlier this year, I obtained seed of several species of W.A. banksias from Nindethana Seed Service, sowed them during autumn (using the "Bog Method" which I find very successful) and grew on the seedlings during autumn and winter. At the same time, seedlings of Banksia ericifolia, B.serrata and B.integrifolia were raised for root stock trials. All the seed for root stock was obtained locally and deliberately chosen from trees growing on "tough" sites, i.e. heavy soils which are relatively poorly drained.

I try to do grafting during October/November to avoid hot weather and the attendant heat stress problems. Fungal attack of scions seems to be less of a problem at this time.

Successful grafts so far seem to be Banksia speciosa and B.lemanniana onto B.ericifolia, and B.candolleana onto B.serrata.

B.caleyi has so far resisted my efforts, whether by incompatibility or my technique remains to be elucidated. All grafts have been done by the "Top Wedge" method.

I have not used B.integrifolia as a root stock yet - the plants are very slow growing and are only now approaching a size where the graft can be made fairly easily.

In conclusion, I should point out that a graft of B. prionotes onto B.serrata, carried out in October of 1983 is alive and well - no flowers as yet of course.

SETTING UP A CUT FLOWER PLANTATION - Tom Richards.

I have planted a couple of thousand banksias on my property and I am now evaluating which may be suitable to the area for production of cut flowers.

I raise my own seedlings and I am trying almost any banksia and am quite prepared to find that frost is a major decimator.

Next winter I'll try gypsum around some plants. After all, several things happen at the same time in winter: We get rain that possibly leaches out sulphur; we get frost; we lose most of our sun and the grass etc. dies down. So we take a pick as to the problem.

In passing, I plant on steep 1 in 3 and 1 in 2 slopes on sandstone and shale derived and underlying soil. I rip to break hard pan (natural) and allow the bracken to grow around the plants for the first year. Protection from the sun in the first summer and then a touch of a chemi hoe with Roundup kills it and leaves it standing dry and dead through the winter for protection from frost.

BANKSIA GROWING AT KEMPSEY - Inez Armitage.

My banksias are growing in poor ex grazing land, 6" to 7" clay loam over solid grey clay. Ph 6.5. Rainfall average 48". Very Erratic. 1985 - 70", 1986 - 36" Usually once to three times a year 6" to 10" in 2/3 days.

No discernible wet season.	No watering after first year.
Drainage very poor.	All in full sun.
Mild frosts.	No salt.

I have no yardstick by which to assess growth except that for 10 years before coming here I lived in Sydney on 5 acres adjoining Kuringai Chase on untouched bush where the following Banksia grew naturally. B. serrata; ericifolia; marginata; spinulosa; oblongifolia.

All were fully mature on arrival with scarcely a young plant to be seen. There had not been a fire through the property for about 10 years. In the 10 years I was there little or no growth was noticeable on any of the banksias except a foot or so on B.serrata. Based on the plants I had there I would say that B.marginata, B.spinulosa, ericifolia and oblongifolia would be about on a par; B.serrata can also be considered good but in my opinion not sufficiently well branched.

As well as the 20 plants listed, I lost 6 others making an average loss of 23%. This compares very favourably with my overall loss figure which is about 50% out of a total planting of 1800 assorted shrubs and trees in seven years. About 90% of all plantings have been of eastern species. 30% to 40% of all losses have been due to water lying around for long periods after excessive rain.

	Height ft.	Age	Mulch		Moisture
B. ericifolia	10 x 8	7½ yrs	in grass	No	
" "	8 x 8	7½ "	"lawn"	Mulch	
" "	11 x 8	7	"	"	
B. marginata	8 x 7	7½	"	"	
" "	8 x 7	7	"	"	
B. paludosa	1½ x 2½	7	"	"	Inadvertently in as dry as this grass land permits.
B. serrata	10 x 5	6½	"	"	
" "	10 x 4	6	"	"	
" "	10 x 4	6	"	"	
B. oblongifolia	5½ x 4	6½	Natural mulch		
	6 x 5	6	"	"	
	5 x 5	6	"	"	
	7 x 5	6	"	"	
B. spinulosa	8 x 6½	6	grass "lawn"		
" "	3 x 3	3	Natural mulch		
B. integrifolia	14 x 7	7	Grass "lawn"		Very open. Insufficient branches.
" "	6 x 1	3	In rough grass.		Healthy but very "slim".
B. robur	5 x 4	3	Planted on septic drainage area, natural mulch.		
" "	6 x 4	3			
" "	8 x 4½	3	Multiple flowerheads at ground level.		

Later plantings of B. paludosa, B. saxicola and B. dentata are doing much better on the bank of a recently dug dam giving much better drainage. Failed several times with B. ornata and B. canei. Two very good germinations from B. saxicola without stratification before I knew it was "necessary". Am about to try fertilizing for the first time! Long overdue. Just a 10-4-6 general fertilizer.

P.S. Just thought of something else which might interest you.

About 18 months ago (no record kept) I sowed a number of Banksia seeds including 20 B. serrata which were labelled "Bega" or somewhere on the south coast, guaranteed 80% germination. 90% germinated and proceeded into the healthiest seedlings you have ever seen. At about 10 cm. in height they began to yellow and this continued as they looked more and more unhappy (all 18 of them) and died off one by one until only 8 were left.

They had been potted into my usual potting mix which is roughly equal parts of household compost, river sand, local topsoil and a small amount of charcoal. I tried small applications of iron chelates, which have never had any effect on anything at any time with me, and trace elements. No effect either.

Then I took myself off to Crescent Head area where there is plenty of typical grey sand which supports the local heath flora. Repotted the 8 remaining plants and all but one recovered to full health slowly at first but eventually into very fine plants. This sand, according to a Ph measuring device which some experts say is "useless" gave a reading of Ph 4.. I have enquired from people who should know and they say that would not be an unusual reading for this type of sand. It has always puzzled me that we all know we must use coarse sand and yetthis is quite fine. Incidentally, there were B. serrata growing in the area from which it was taken, said area having been entirely ravaged by sand mining.

With this result I repotted all seedlings of B. paludosa, B. dentata and B. saxicola and B. ornata. All but the last recovered into good looking plants. None of the others was ever nearly so badly affected as the B. serrata. Five of these are now planted out, with plenty of the same sand integrated at planting time. At four months old they look terrific. Noticeable that I had no trouble in getting the three 7-yr olds under way so it looks as though they become more tolerant as they grow older. The original three were bought from nurseries or given by friends and were 12-18 months old when planted.

I use Osmocote in Nutricote 10-4-6 or thereabouts in pots.

BOTRYTIS ON BANKSIA SEEDLINGS - George Wade (Tas. Region Newsletter)

I was recently given some seed of Banksia burdettii and I was very pleased when every seed that I sowed germinated and began to grow well. However, some of the cotyledons and young leaves began to develop brown areas, which spread rapidly.

At first I thought it was "damping off", but closer examination showed that the problem was due to the grey mould fungus, Botrytis cinerea. I therefore sprayed the plants thoroughly with "Sumisclex", which is very effective against this fungus, and I saved all the plants except those that were already very heavily infected.

I record this for the benefit of those who encounter similar trouble with banksia seedlings. You can confirm the diagnosis by placing some of the infected tissue on moist blotting paper in a loosely closed container. If the trouble is in fact due to Botrytis the tissue will rapidly become covered with fawnish grey masses of spores.

Unfortunately "Sumisclex" is not available in home garden quantities. Probably the best readily available alternative would be "Mancozeb". "Benlate" would also work provided a strain of the fungus resistant to "Benlate" is not involved.

BANKSIA GROWING IN CORK, IRELAND - Professor Alan Myers.

In 1979 I spent 6 months in Sydney and first became acquainted with Banksia spp. On my return to Ireland I tried to grow some Banksia (B. burdetti) from seed purchased in Sydney. Unfortunately, I failed through the dreaded damping-off. I have recently returned from a further 6 month visit to Sydney and this time I joined S.G.A.P. and came back loaded with books, information and seed, determined to succeed this time. I collected 7 east Australian species from the bush (B. aemula, B. serrata, B. spinulosa, B. ericifolia, B. marginata, B. oblongifolia and B. integrifolia) and purchased four others (B. burdetti, B. baueri, B. gardneri var. hiemalis, and B. media).

Here in Ireland we have very mild winters with light frosts only. This year was exceptional with 4°C of frost, but even so my Eucalyptus and Callistemon survived in the garden, where they have grown successfully for over 15 years. We have relatively cool summers and rather a lot of rain, not good I imagine for Western Australian banksias. I imagine that East Australian spp. especially Tasmanian spp. should be O.K. The soil is well draining as we are right next to the sea, but this of course also means strong winds at times. I also hope to grow a number of species in my greenhouse in tubs. I mention all this in the hope that you can give me some general advice on growing Banksias in my climate.

I have pregerminated seed and then potted in coarse sand/vermiculite/peat (4:1:1) and water with "captan". One problem I have had is that the cotyledons do not seem to be able to break free from the seed case so that I have to peel them away with forceps - easy with big seeds but not with small ones. Is this normally a problem? Also, apart from B. serrata which are growing quite rapidly, the other species have sat with their cotyledons out for over a month without any signs of further growth.

GROWING WESTERN AUSTARLIAN BANKSIAS IN BRISBANE, NUMBER 2 - by Heather Robb.

I was fortunate enough to purchase some healthy specimens of Banksia praemorsa, B. benthamiana, B. laevigata, B. pilostylis, and another B. media. The plants were bought just prior to the summer of '86 and were repotted into 12 inch pots, in a fairly dry medium. This consisted of milled pine bark, washed river sand and slow release low phosphorus fertilizer. This mixture was sterilized in the oven and then drenched in Fongarid.

After repotting, the plants were placed outside in the open for a couple of hours each day to harden up. A week of constant summer rain proved too much for my nerves, so the plants shared the house for the remainder of the wet. Meanwhile their own shelter was being constructed, and consisted of a timber floor with supporting posts on which a roof was placed. The roof was left off as much as possible, but during the wet humid weather was left on.

That period of rain caused a fungus to develop on the leaves of most of the plants. This fungus was not isolated but was treated by removing as much of the affected leaves as possible, then the plant was sprayed with mancozeb. Banksia benthamiana was the worst affected, the other species in varying degrees. The mancozeb was continued fortnightly for several weeks and finally B. benthamiana, B. laevigata and B. pilostylis succumbed to the fungus and were soon painful reminders of a life long dream.

Fongarid was used on the remaining plants to prevent Phytophthora developing. These were to be planted out in the cooler month of April, but April became October and were eventually planted out in prepared holes. Large holes were dug and the original ash fill was removed and replaced with slightly acid sandy loam. Dolomite was added to the soil to increase the pH to 6.5. The soil was mounded up 12-18 inches above the ground which in turn improved drainage. The plants were planted under established Casuarinas on the waterfront, and received good sea breezes.

Thus they were shaded from the humid summer sun. Individual frames were made to fit over the plants, and were covered with shade cloth and a roof was placed on top for extreme wet and humid weather. Fongarid was still being applied at six weekly intervals during the summer and they all looked very happy.

I did however have problems with caterpillars eating the new leaves and flower buds. Dipel was used to combat this problem. I continued the use of Mancozeb for the control of developing fungus.

The plants are always watered in the afternoon when the sun is not on them. The frames were removed during the cooler months of this year, Banksia praemorsa x2 having survived and B. media. It is now August and I had intended to transplant one B. praemorsa. I was concentrating on protecting them from the hot humid sun and consequently shaded them too much. The plant I had intended to move is now covered with black spots on the leaves and does not look at all happy. I'm afraid it may soon be reunited with the other Banksias.

My older specimens of Banksia nutans, B. media are also suffering from lack of sun and I will transplant B. nutans, but B. media is too large. In February I took a few cuttings of B. nutans and one appears to have struck.

I have recently purchased some more Banksias, namely B. baueri, B. baxteri, B.caleyi, B. coccinea x 2, B. occidentalis, B. prionotes, B. ashbyi, B. menziesii, and B. sphaerocarpa. Once again I obtained these plants earlier in the year with the intention of planting them in April. I had no idea where to plant them as I am fast running out of room in the garden. I decided to remove an extremely large shrub which measured 15 feet in diameter, and was still growing. Once the shrub was removed the area had to be filled with soil, so six metres of sandy loam was used in making a mounded garden bed. Once again Dolomite had to be added to correct the pH. I only wish I had thought to remove this bush earlier in the year. I have also planted some Dryandras and Western Australian mallees in this garden, and so far have planted a total of ten Banksias and Dryandras. I still have to have filtered sun in summer, but more winter sun is to be allowed on these plants. The plants are being watered regularly and are not shaded artificially. I will try not to worry too much over this lot, and will be trying to maintain a more open, sunny area. Banksia paludosa x 2 aer planted at the edge of this garden and have been happy for the past 12-18 months. Hopefully when report No. 9 is out I will be able to talk about my successes !!! .

SEED SOURCES

Bushland Flora, P.O. Box 435, Subiaco, W.A. 6008

Nindethana Seed Service, R.M.B. 939, Woogenilup, W.A. 6324

K.G. Seeds, P.O. Box 182, Albany, W.A. 6330

H.G. Kershaw, P.O. Box 84, Terry Hills, 2084

Goodwin and Sons, Bagdad, Tas. 7407

Tasmanian Forests and Seeds, Summerleas Farm, Kingston, Tas. 7150

Harper Seed Co., P.O. Box 111, South Perth, W.A. 6151

Vaughans Wildflower Seeds, P.O. Box 66, Greenwood, W.A. 6024

Aust. Tropical Plant Supplies, Pinnacle Rd., Julattan, Qld. 4880

L.S. Langley Aust. Seed Co., Robertson, N.S.W. 2577

R. Horner, 1 Grundy Street, Alice Springs, N.T. 5750

C. & S. Seeds, 5/19 Thurlowe Ave, Yokine, W.A. 6060

H. Grant, 90 Wingewarra St., Dubbo, N.S.W. 2830

Dorriell Seed Exporters, 45 Frape Street, Mt. Yokine, W.A. 6060

Kimberley Seeds Pty. Ltd., 51 King Edward Rd., Osborne Park, 6015

Northrup King Pty. Ltd., P.O. Box 335, Dandenong, 3175

Northrup King Pty. Ltd., P.O. Box 43, Rouse Hill, N.S.W. 2153

Northrup King Pty. Ltd., P.O. Box 130, Capalaba, Q. 4157

S.G.A.P. REGIONAL SEED BANKS

N.S.W.	S.G.A.P. Seed Service, c/- 17 New Zealand St., Parramatta, 2150
QLD.	Mr. D. Sharpe, 202 Bielby Rd., Kenmore, 4069
VIC.	Mr. A. Salkin, 38 Pinewood Dve, Mt. Waverley, 3149
A.C.T.	Mr. D. Harvey, 14 Coles Place, Torrens, 2607
W.A.	W.A. Wildflower Society, P.O. Box 64, Nedlands, 6009
TAS.	Mrs. C. Howells, 31 Kunama Dve., Kingston Beach, 7050

Name and address of grower, or locality grown (include postcode):-

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Details of topsoil: State depth, whether it is sand-loam, clay-loam or clay (and pH if known). Also give brief description of subsoil,

NAME OF SPECIES	HxW FT.	AGE YRS.	MULCH	MOISTURE WINT.	MOISTURE SUM.	DRAIN	SUN	FROST	SALT (airborne)

Height x Width: To nearest foot.

Age: Years since planted.

MULCH: (if any) Depth and type; sawdust, gravel, cover plants etc.

Moisture: Whether soil is wet, moist or dry.

Drainage: Good, moderate or poor.

Sun: Full, 3/4, 1/2, 1/4, or nil.

Frost: Severe, light.

Salt Laden Winds: Very exposed, partially sheltered, protected.

PLEASE RETURN COMPLETED DATA SHEET TO THE LEADER OF THIS STUDY GROUP:-

Trevor Blake,
22 Vista Avenue,
RINGWOOD EAST, 3135.