BANKSIA STUDY

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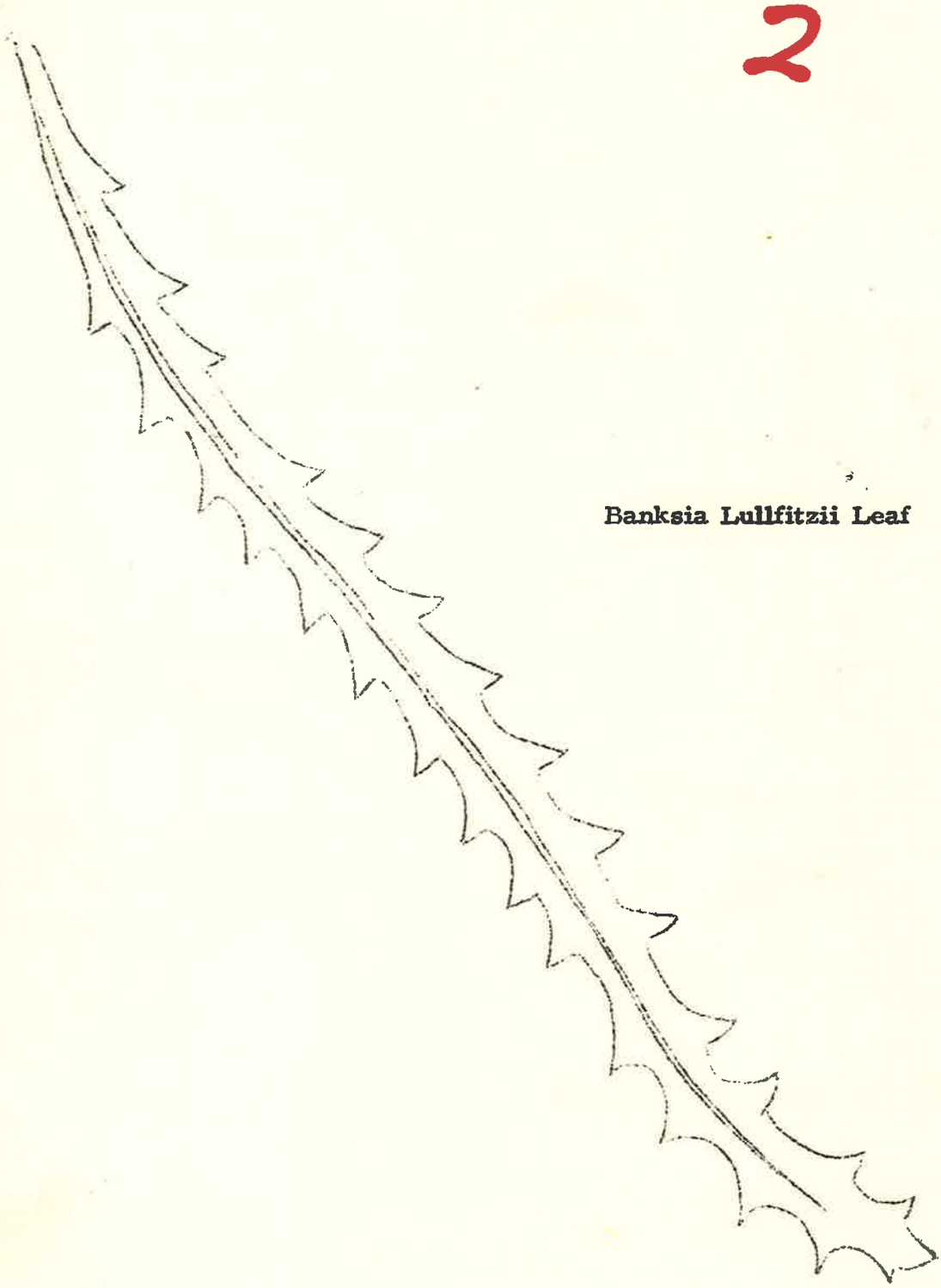

Banksia Lullfitzii Leaf

BANKSIA STUDY GROUP : JUNE 1973

WESTERN BANKSIAS AT MT. GAMBIER By Mrs. D. ROWLEY

Although a large number of Banksia species are growing well in my garden, the Banksia survey indicated that Banksia goodii, B. praemorsa, and B. pulchella have achieved higher growth rates here than in most other areas, and my report on B. lullfitzii was the only one received. Here are further details of these species and the growing conditions.

We live in the South-eastern corner of South Australia, eight miles south of Mt. Gambier, and eleven miles from the coast. The country is mainly flat, and very little bush remains in the area. We have had to plant belts of trees to break the wind. The original vegetation consisted of Eucalypt, Acacia and Melaleuca species, and possibly B. marginata.

In summer we get a cool sea-breeze about 2 p.m. most afternoons. Winters are usually wet but mild. Annual rainfall is about 28 inches. The 1972 winter was exceptionally dry and we had 14 heavy frosts instead of the usual two or three. The Banksias are in an area that gets the frost, so I usually cover the young plants each night, or water the frost off them before sunrise. I have lost young plants of B. victoriae from frost. The older plants do not need protection; the only species which had frost-burn this year was B. quercifolia. We apparently had one very heavy frost in October which I did not know about until a few days later. There was no frost damage to the young Banksias, but there is grass three feet high around them.

The garden is on a gentle rise, 70 feet above sea level, and it slopes down to the south and east. The depth and pH of the soil are both extremely variable. The topsoil consists of about six inches of brown sandy loam; available potassium is marginal. The subsoil is a very light red-brown sand, varying in depth from several inches to 12 feet. Porous limestone with a coral-like structure underlies the subsoil. The water table is about 60 feet down. The soil can absorb an almost unlimited amount of water; I have never seen it waterlogged, even after several inches of rain.

The pH of the topsoil and subsoil ranges from 6 to 8. I have 400 - 500 native plants and only a dozen of these suffer from chlorosis. A couple of old Banksias are a little yellow in the leaves, B. brownii (15ft.), and B. occidentalis (12 ft.), but they are still healthy.

I water all my Banksias for at least 12 months after planting. Each week Brian and I cart water - two gallons for each of the Banksias I planted this year. The following established species are in an area which is normally watered perhaps three times a year; B. brownii, dryandroides, grandis, occidentalis, and praemorsa. The following have done well in an area that is not watered; B. baueri, coccinea, laricina, lehmanniana media and praemorsa.

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This season has been unusually hot and dry, and we have been watering more often. B. caleyi has been growing well without water, but its flowers have apparently been affected by lack of water. The buds which were almost ready to open turned purplish and withered. Other plants of B. caleyi which have been watered have flowered satisfactorily.

Some of the other Banksias are not going to flower as well this year. One plant of B. occidentalis (pink flowered form) has been affected by the conditions despite the fact that it is getting water. Its buds seem to be dying off. Another plant (red form) is going to flower well, but I think it has had more water.

Banksia goodii is a very rare prostrate species which grows, or once grew, from 4 - 10 feet wide in its natural habitat along Millbrook Road near Albany, on deep sandy loam, in either full sun or partial shade. A report by Alf Gray (Aust. Plants, Dec. '69) states that in areas which were formerly heavily timbered it tended to adopt a more erect habit. The leaves are about 12 in. long and 3 in. wide, irregularly toothed, and form a circle around each of the large chestnut-coloured flower spikes. It blooms in summer.

I raised my plant of B. goodii from seed planted in March 1969. Germination took 5 - 7 weeks. It was planted out on a built-up rockery and after 3½ years is a circle of leaves measuring 15 in. x 15 in. It is in full sun, on 2 ft. of topsoil (pH 8) and 2 ft. of subsoil, and is watered twice weekly if the weather is hot and windy. This species is much slower than the other p ostrate species, B. petiolaris, prostrata and repens.

Banksia lullfitzii grows on deep, yellow sand in the Coolgardie District. It is believed to reach a height of 3 or 4 feet and a width of 6 to 8 feet. The leaves are fairly sharp, saw-toothed and very rigid, the upper surface is shiny dark green, the undersurface is brownish grey.

Mrs. Osnam, Secretary of the West Australian Wildflower Society has advised that B. lullfitzii grows on the Great Eastern Highway, near Southern Cross, at the 271 mile vicinity. It also grows in an area north of the Ravensthorpe - Esperance Road and is likely to occur in other placed in the area south-east of Southern Cross. It is thought to be a natural hybrid between B. audax and B. elderana which also grow in the area. No research has been done to ascertain whether this is so, and this opinion is based on the appearance of the foliage. Mrs. Oxnam has been told it is woolly like B. audax and has foliage like B. elderana, but the flowers are not pendant.

Banksia praemorsa. This species grows to 6 x 6 ft. on shallow sandy loam on coastal limestone cliffs near Albany. The leaves are 2 in. x ½ in. dark green on the upper surface and light green below, with lightly toothed margins.

My two plants are four years old, and should flower for the first time this year. The greenish-purple buds are 9 in. long. One plant is 9½ x 5 ft. in a sheltered position where it receives morning sun and summer watering

monthly. Depth of soil is 4 ft. (Topsoil pH 7, subsoil pH 6.5) The other plant is 7 x 4½ ft., in an open position where it receives full sun and no summer watering. The soil there is 2 ft. deep (topsoil ph 6. subsoil pH 6.5). Both bushes are really flourishing.

Banksia pulchella reaches 3 x 3 ft. on deep sand in the Eyre District. It has small heath-like leaves, crowded along the slender stems, and small, pale-yellow, globular flowers in winter.

I have two 5 year old plants. One, 3 x 4½ ft., is in a very sheltered position, in partial shade (¾ sun), and receives summer watering fortnightly. Soil depth is 2 ft. (topsoil pH 7, subsoil pH 6.5). It has flowered very well but only set seed once. The other plant reached 2 x 2 ft. in an open position where it received only ½ sun and no summer watering. Soil is 2½ ft. deep (topsoil pH 6, subsoil pH 6.5). This plant has not been thriving; it flowers sparsely and always had some dead wood. However, I have been giving it regular watering this year, and it is now a different looking bush. It has a lot of fresh young growth - lack of water was obviously its problem.

Banksia elegans. This is one species I have not yet been able to establish. I planted two seeds in November 71, two in December 71, three in April 72, but none germinated. I planted nine seeds in August 72 - two of these germinated and one later died.

There is only one small patch of B. elegans known of that sets seed, so seed is rare. It has been suggested that this is possibly because fires may have destroyed the marsupial mouse or whatever it is that pollinates them. Another possibility is a mineral deficiency of the soil. B. elegans occurs on very poor, deep, water-washed sand, usually on the edge of clay-pans. It is usually a spindly tree about 6 ft. high with scraggy old butts, but it may be 4 x 4 ft. in sheltered spots. The lovely bluish-green leaves are saw-toothed and often curled. The greenish flowers are the size of a tennis ball, with protruding green styles. Some flowers have a pink blush over them, others are more yellow than green.

Banksia Suckers. Several suckers have grown around some of my plants of B. marginata. The roots of the parent plants may have been damaged when I chipped around them, or the sheep may have nipped them. Perhaps some of the Western species, such as B. elegans, may also regenerate by suckers.

Other Proteaceae. I hav other Proteaceae; a dozen or so Dryandras, 2 or 3 Petrophiles, 5 or 6 Isopogons, 15 to 20 Hakeas, 2 Lambertias, and numerous Grevilleas. I have little difficulty establishing these plants, apart from spots where pH is very high. Even there, these species are now growing in association with the more tolerant species.

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BANKSIAS ARE A (VERY) DEAD LOSS

By Noel HOPE, Papua New Guinea

Plants native to the southern parts of Australia, including Western Banksias, are almost impossible to grow here in Boroka. I had ideas of planting Eucalypts, Banksias, etc. around the large areas we have. What a flop! I planted hundreds, or I should say thousands of seeds, and only succeeded in raising three small Grevilleas. One of these died and the other two have just existed. I tried every combination; little water, lot of water, shade, sun, sand leaf-mould etc. But the seeds don't even germinate. I believe that its just too humid for them.

Banksia detata. I have only sighted this Banksia in the one area in Papua, along the Sirinuma-Dam Road. It grows about 1500 to 1700 feet above sea-level, as a rather scrubby tree, about 15 feet high x 10 feet wide, on a very acid clay. The flowers are not very large, they are inconspicuous on the tree but are most attractive when picked. During the wet season the soil seems very waterlogged, because of the constant rain, even though it has good drainage. In the dry season this clay is very dry and crumbly, and opens into large cracks. The area is subject fo fires.

NOTES ON BANKSIA ELEGANS AND BANKSIA GOODII

By KEN STUCKEY, Furner

Banksia elegans. Few attemps have been made to cultivate this species, because of lack of seed. It seems it may normally regenerate by sickers. I have searched for seed for many hours among plants in their natural habitat, without finding a single seed cone. However, I asked a friend living in the Dongara - Eneabba area (Irwin District), to watch out for any cones, and eventually some plants were found which had produced a few seeds. I propagated six plants from these in 1970 and planted them out in 1971. Unfortunately that was the year we had very heavy rain (40"), and now only two rather weak plants are left.

Last year I visited the area the seed-producing plants were found, and secured a few more seeds. The plants appeared to be very old, and to have withstood numerous bush-fires; the trunks were blackened, and new growth had been produced from the trucks, making new branches. B. elegans is found in association with B. hookerana, with about on plant of B. elegans to each ten of B. hookerana. As we can grow B. hookerana reasonably well here, there is still hope of success.

Banksia goodii The habitat of this beautiful and extremely rare species is being cleared for farming, and it is on the verge of extinction. As far as I could find out in W.A., nothing has been done to ensure its survival. (Presumably such a task would be the responsibility of the Managing Secretary, National Parks Board of Western Australia, 664a Murray Street, Perth

I have given seed and plants of B. goodii to various growers, and hope someone can get it to grow well and produce further seed.

Fertilisers. I believe the use of fertilisers on young seedlings is of questionable value. It will promote fast growing and healthy looking plants, but when they are planted out they tend to collapse if left to fend for themselves, as they are unable to collect sufficient water or nutrients to support to succulent top growth. In addition, I feel that such plants are more likely to suffer from wind damage.

BANKSIA ROOT SYSTEMS

By D. GORDON, Queensland

I think that the answer to the problem of growing Banksias will be found by giving more consideration to the nature of the sub-soil and to what lies below it.

When in W.A. I paid particular attention to details revealed by deep road cuttings and gravel pits in the wildflower areas. The horizontal surface roots of the heathland plants penetrated only about 9 to 12 inches. But all plants, even those a few inches high, had tap-roots going straight down 15 ft. or more. In my opinion it is the deep tap-roots which draw moisture from the depths that sustain the plants during the long, dry, W.A. summer.

I have been told that Phytophthora crinnamomi periodically wipes out large areas of Banksia serratifolia (syn. aemula) in the Wallum country of Queensland. But B. robur, which flourishes in areas which are alternatively submerged under a foot or more of water, and are later dry for long periods, seems to be immune to the disease. B. robur may therefore be a suitable rootstock on which to graft other species.

POSSIBLE LIMITING FACTORS

By BYRON LAMONT, Botany Dept., University of W.A.

Banksias are not really good drought plants - their roots must reach water throughout the year for survival. In their natural habitats, Banksia species grow in positions where the soil is generally deep and sandy, and although the topsoil may dry out during the summer, the subsoil is invariably damp some depth below. Generally, Western Banksias tolerate dry conditions but they do not favour such conditions. What is surprising is their wide range of tolerance, since most species will grow satisfactorily under conditions quite unlike those found in their natural habitats.

The main distribution of Banksia species is roughly the 50 mile coastal strip, (around Australia) which suggests that the incidence of severe frosts may also be a significant limiting factor in their establishment.

BANKSIA SPECIES FROM THE HIGHER RAINFALL AREA OF W.A.

By J. J. HAVEL

Soil Composition and Structure Western Banksia species do not all occur on infertile soils. Banksia grandis and B. litteralis, for example, often occur on fertile, moist soils. However, most deep soils in W.A. are relatively infertile, and in a Mediterranean climate such as in the S.W. of W.A., the

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depth, and hence the moisture storage, is critical. The chief effect of deep sandy soils is that they serve as deep underground, water storage, whereas heavier textured soils tend to be much shallower.

In hot areas, high summer transpiration can only be met from deep storage. The Forests Department has documented the drying out of deep sandy soil by banksia woodland, to the depth of 22 feet in most summers.

Banksia species appear to have the best capacity to cope with drawbacks of sandy soil e.g. very rapid external drainage and low fertility.

Notes on Individual Species

B. attenuata : very wide tolerance with regard to moisture regime; from swamp margins to top of dunes.

B. grandis : optimum development on very deep lateritic gravels of the Darling Range; a partially seral species which builds up following logging.

B. ilicifolia : maximum development on sands which permanent water table below but rarely reaching the surface.

B. littoralis : within the forested area of the S.W., it occupies chiefly sandy swamps and stream margins; a variety or species previously known as B. verticillata occupies more fertile alluvial loams in creek and river valleys from Dwellingup southward. In appearance the two are totally different. A third variety, with red flowers, has recently been found at Dwellingup.

B. menziesii : more drought resistant than any other banksia species of the forested S. W.; relatively rare on moist sites, common on dune crests.

B. prionotes : strongly seral species, reaching optimum development after disturbance, and on abandoned farms.

B. sphaerocarpa : one type occurs on shallow sands over limestone north of Perth; the other on dry sandy gravels south-east of Perth.

With regard to attack by Phytophthora cinnamomi, it is worth noting that banksias, in particular B. grandis, are the earliest indicators of the presence of the pathogen in many areas. Their death usually precedes the death of susceptible Eucalyptus species by several years.

: More ecological information on some of these Banksias is available in :

Havel J. J. (1968) - The potential of the Northern Swan Coastal Plain for Pinus pinaster plantations. Bulletin No. 76 from Forests Dept. R. & I. Building, Barrack Street, Perth, W.A.

(This article is adapted from an article published in the S.G.A.P. Qld. Region, Bulletin of January, 1972.)

The Eastern banksia species are identified using characteristics that include habit, colour of the underside of leaves, shape and size of leaves, styples and seed.

Seed Production Banksias are generally considered incapable of self-pollination as the pollen is produced before the stigma becomes receptive. Insects, birds and small marsupials serve as pollinating agents. Observation of garden grown plants of Banksia robur suggests that some factor prevents setting of seed at certain times of the year. Again, although three B. serrata plants in my garden have flowered for several years, not one has set seed, even though the closely related species, B. aemula, nearby, sets seed readily.

The flower spike consists of many small flowers, of which only a few are destined to produce seeds. Many of the flowers, although outwardly normal, contain no ovules. The seed container is a woody follicle containing two winged seeds. Counts made on upper and lower seeds in follicles indicate that often only one is fertile, and more often it is the lower seed that develops. For example, in B. collina between 0 - 11% of the seeds in the upper part of the follicle were developed, whereas 85 - 100% of the lower seeds were developed.

Seed is not shed spontaneously except from B. integrifolia and the Western species B. menziessii. Others require heat to open the follicles. However, the conditions necessary to cause the follicles to open have not, to my knowledge, been subject to detailed investigation. The following points were determined by experiments :

1. Heat applied to the base of the follicle does not result in the follicle opening, whereas heat applied to the tip is effective.
2. Heating one follicle has no effect on adjoining follicles.
3. A temperature of 250°C opened the follicle of four species in 7 to 75 seconds. For instance, B. ericifolia follicles opened in 5 to 13 seconds. More heat increased the size of the opening, but 4 minutes should be sufficient to remove the seeds.

Methods for heating the seed heads include throwing them into a fire or onto a piece of hot iron, or using a domestic oven. When the follicles are open, the two seeds with the intervening dividing piece can be shaken out in many cases, but they may require assistance with a sharp pointed object. Finally, it has been said that seeds of some species may take up to four years to mature.

Seed Germination An opinion has been expressed that best results are obtained with fresh seed. But in my experience, they have germinated even though stored under sub-optimal conditions for several years. Seeds germinate in 20 - 90 days. For example, B. aemula varied from 20 - 44 days, whereas one batch of B. dentata took 88 days before the first seed germinated. Many mixtures have been used as media for sowing - sand, sand and peat moss and Yates seed raising mixture. All of these are satisfactory. The best time for sowing in Brisbane is late autumn or early spring (i.e. March or August), but they will germinate in any month. I prefer to have the seedlings a reasonable size before they have to endure hot, wet, summer conditions.

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Cultivation Banksias are not easy to grow, and failures are frequent. These difficulties may be the result of the special nature of their adaption to the environment. Of these, two factors may be significant.

1. They are found on poor, generally sandy, soils with considerable subsoil moisture.
2. They have a special root system that includes dense clusters of very fine "proteoid roots". If well developed, these form a mat beneath the plant. This material is hydrophobic and so the soil is difficult to wet. Proteoid roots have a short life and their development seems to be associated with deficiencies of certain soil nutrients, especially nitrogen and phosphorus.

Not much is known about banksias nutritional requirements. They appear capable of obtaining adequate phosphorus from soils very poor in this element, and their natural occurrence is regarded as an indicator of deficiency of available phosphorus. Although it has been shown that high levels of phosphorus can adversely effect them, the same element does not influence their germination, and application does result in increased growth.

Here are a few comments on some of the Eastern species :

B. aemula under natural conditions can be a magnificent, medium sized tree, but because of the persistent large cones and tendance to hold dead branches, it is not always as attractive as it is when given some attention. On parts of Bribie Island it can be seen growing on sandy areas quite close to the sea. Although it frequents wet areas it apparently requires some drainage, as plants put into a rather waterlogged area on another part of the island did not survive.

B. collina grows on higher ground, often on clay soils and in shade. This is one of the most decorative of the Eastern banksia species. It varies in height from about 4 to 10 feet, and once established can have a very long life.

B. integrifolia is attractive but tends to be neglected for its ornamental value. It has a wide distribution and varies in habit from a somewhat gnarled tree 10 feet high, to an upright, clean tree, 40 or 50 feet high. The flowers are greatly attractive to parotts and honey-eaters.

B. oblongifolia is a low-growing, wet area shrub, two to six feet high. Certain plants form a low, spreading canopy, ideal for a rockery, whereas others are more upright.

B. robur grows in wet areas, and under natural conditions is not a very striking shrub; the large leaves are likely to show marked damage by insects, and the greenish coloured flowers are not prominent in amongst other plants. However, in the garden it shows its potential with large glossy leaves, and the iridescent sheen of the flowers shows up to a marked degree. It will attain a size of 8 feet high and 10 feet wide under cultivation.

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Seed and Colour Slides

Seed has been gratefully received from T. Blake, Mrs. B. M. Rowley, J. Sambrooks, K. Stuckey, Mrs. M. Thornton and R. Wait.

Some of each species has been passed onto Professor Stubbs of Melbourne University and to Mr. C. Nancarrow of the Plant Research Institute, where it is being used for research purposes.

Some seed of the following species is available :

B. ashbyi, attenuata, bauerii, hookerana, occidentalis, ornata, praemorsa, repens, robur, serrata and spinulosa.

Colour slides have been received from T. Blake, Mrs. B. M. Rowley, G. Simmons, Mrs. I. Stanton, Mrs. T. Y. Stead and K. Stuckey.

Photographs suitable for publication are still required of the Western species: B. ashbyi, benthamiana, caleyi, candolleana, dentata, elegans, littoralis, lullfitzii, meisnerii, menziessi, solandri, tricuspis, verticillata, victoriae, and of any Eastern species.

Chemical Control of Phytophthora cinnamomi and Related Fungi

By Keith ALCOCK, Boronia, Vic.

The group of fungi Phycomycetes contains some of the most important pathogens of cultivated crops. The historical outbreaks of potato blight in Ireland in the nineteenth century were caused by Phytophthora infestans. Bordeaux mixture, the first major fungicide, was first used for control of downy mildew caused by Plasmopora viticola, a Phycomycete. Consequently there has been a great deal of research into chemical control of this group and many fungicides have been developed for this purpose.

Diseases of the below ground portion of plants present extra problems as opposed to diseases of above ground plant parts as there are complications introduced by soil properties and the physical difficulties of application. However there are two fungicides which are considered outstanding for control of Phycomycete root and crown diseases :

1. Difolatan : This fungicide has a wide range of fungicidal activity both on foliage and fruit diseases and also soil diseases. It is particularly effective on Phycomycetes. It has also shown a remarkable degree of persistence.

2. Dexon : This has a very narrow range of activity, restricted to the Phycomycetes and a few other genera. It can only be used as a soil fungicide or as a seed treatment as it is unstable in aqueous suspension, in the presence of sunlight. "Dexon" is however, very persistent in soil, away from sunlight.

Both chemicals have been used commercially for control of diseases similar in nature to the current problems in Australia with Phytophthora cinnamomi. Instances are control of crown rot of applies (Phytophthora cactorum) and control of top rot of pineapples (Phytophthora cinnamomi and Phytophthora parasitica), both by soil drenches. The theory of treatment in this way is that chemicals are applied and dispersed in soil in the region of pathogenic activity. The fungicides either inhibit or kill the target organisms thus giving protection to the growing plant. The components of this theory are detailed below :

1. Fungicidal Activity

"Difolatan" and "Dexon" are both active against the Phycomycete group of fungi including Phytophthora, Pythium and Aphanomyces. The activity of "Dexon" is limited to these above and it has been shown to have no effect on other soil fungi such as Fusarium, Trichoderma and the Mucorales. Thus the rest of the soil microflora is undisturbed.

2. Longevity

Much work has been carried out to establish the persistence of "Dexon" as a soil treatment. Results, primarily of glasshouse tests, have had varying conclusions. Tests based on the recovery of target fungi after treatment with "Dexon" have indicated a linear fall off of activity over 28 days. However tests based on protection of plants against disease have shown activity for periods up to twelve months. Recovery of the chemical itself has confirmed this long life in soil and it appears that "Dexon" is a very persistent chemical.

"Difolatan" in limited tests so far has shown a long life in soil but there are indications that this is less than "Dexon".

3. Redistribution in Soil

Again most work has been done with "Dexon". It has been shown that "Dexon" when applied to the soil surface percolates in soil to a depth of 5" - 6" but that the majority is retained in the upper surface and is not readily leached. This is so no matter what soil type is tested.

4. Crop Safety

There is no evidence of any damage to roots of treated plants with either "Difolatan" or "Dexon" as a soil treatment at recommended rates.

At this stage there is a need for further work to establish the use of fungicides for the specific problem of Phytophthora cinnamomi control in native plants. The two compounds "Difolatan" and "Dexon" are certainly worth trial as their properties coincide with the requirements of the problem. A guideline for work is set out below.

1. Rates

"Difolatan" : 10 oz. of 80% wettable powder per 100 gallongs.
"Dexon" : 12 ox. of 70% wettable powder per 100 gallons.

Application rate should vary from one pint to a 2 ft. seedling to one gallon to an established tree.

2. Method of Application :

The chemical must be applied to as much as possible of the rooting area. Where roots are only likely to be in the top 6" then chemical can be applied by watering in followed by a drenching by hose. Where roots are deeper chemical must be injected to a greater depth.

3. Availability :

Neither chemical is readily available from nurserymen but can be obtained from suppliers of orchard and market garden chemicals.

29.8.72

The draft report is an excellent collation of accurate observations on the Banksias. Please feel free to make use of the following comments on the articles.

re :- Noel Hope :

There's no doubt that the Proteaceae dislike very humid conditions. For experimental reasons, I have grown them in large bottles, but their leaves were very small and there was very little root system compared with plants grown in pots under otherwise identical conditions (even where the plants were under sterile conditions in the bottles). However, as Noel didn't even get the seeds to germinate, we can't be convinced that the Proteaceae won't grow in Papua-New Guinea - since several other proteaceous spp., as well as Banksia dentata, are indigenous to that area. No doubt they would do better in the less fertile regions of the uplands.

re : Ken Stuckey :

I agree with Ken's remarks on fertilisers. When I have grown Hakeas under high-nitrogen conditions the plants were much more susceptible to death though drought than plants grown under low-nitrogen conditions, even though the size of the plants varied little between the two treatments; and when water was abundant the low-nitrogen plants consumed much more water.

re : G. Simmons :

B. serratifolia is the current name for B. aemula. It is true that Banksias have an unusual root system, the most noticeable feature of which is the 15 cm deep mat of proteoid roots just beneath the leaf little layer. These fine roots are covered with root hairs and cling firmly to the leaf litter. When this layer dries out in summer it becomes almost impenetrable to water. This can be overcome by making rims around the plants. I have used a half 4 gallon drum knocked into the ground around young plants trying to establish in this mat - another way is inserting the hose into the soil.

Studies have show that proteoid roots of the inland form of Banksia serrata (formerly B. ornata) are able to absorb 2.5 times the amount of phosphate than normal roots. Work on Banksia ericifolia, B. aspleniifolia, and B. serratifolia did not reveal such a marked difference.

My own work on Hakeas has shown that proteoid roots form in preference to normal roots under low levels of nitrogen and phosphorus. None are formed under high levels of these nutrients, although the plants grow very well. Proteoid roots last only 6 to 12 weeks, and are continually replaced by new ones during winter and spring. For more information readers could refer to Jeffrey's (1967) paper, and my papers (1972) in the Australian Journal of Botany.

re : Keith Alcock :

As these fungicides have not been proved for controlling Phytophthora cinnamomi in Australia, and in view of the large areas that would have to be treated, I don't think these control measures should be attempted by home gardeners.

If an area is occupied by Phytophthora, then soil and leaf litter should not be removed from that area, dead root systems should probably be left in the ground, watering of the area should be kept to a minimum - certainly avoid waterlogging of living plants, and replace dead plants by phytophthora resistant species, such as Eucalyptus calophylla and E. miciocoup (State Forest Departments woule elaborate on resistant and susceptible species.) As has been pointed out before, Western Banksias are amongst the most susceptible to this disease - though some Proteaceae are resistant.

By the way, what happens to these reports? They could be condensed for the Australian Plants Journal or made into a supplement of the Journal, or published along the lines of Ken Newbey's or Arthur Fairall's books. Their circulation appears to be only amongst the converted at present.

BANKSIA Species arranged in Related Groups

By A. S. George
Dept. of Agriculture
W.A.

Sect. Oncostylis
pulchella R. Br.
meisnerii Lehm
violacea C. A. Gardn.
sphaerocarpa R. Br.
laricina C. A. Gardn.
nutans R. Br.

ericifolia L. F.
spinulosa Sm.
collina R. Br.
tricuspis Meisn
occidentalis R. Br.
littoralis R. Br.
verticillata R. Br.
brownii Baxter
dryandroides Baxter

Sect. Banksia
dentata L. F.
integrifolia L. F.

robur Cav.
paludosa R. Br.
aspleniifolia Salisb
~~oblongifolia~~
~~acinula~~
serrata L. F.
ornata F. Muell
serratifolia Salisb.
marginata Cav.
canei J. H. Willis

grandis Willd.
solandri R. Br.

Sect. Banksia cont'd.
repens Labill
prostrata R. Br.
goodii R. Br.
petiolaris F. Muell.

quercifolia R. Br.
baueri R. Br.
pilostylis C. A. Gardn.
attenuata R. Br.
media R. Br.
praemorsa Andr.
audax. C. A. Gardn.
laerigata Meisn.
benthamiana C. A. Gardn.
ashbyi E. G. Baker.

victoriae Meisn.
prionotes Lindl.
burdettii E. G. Baker
hookerana Meisn.
menziessi R. Br.
sceptrum Meisn.
baxteri R. Br.
candolleana Meisn.
speciosa R. Br.
lullfitzii C. A. Gardn.
elderana F. Muell et tate
lehmanniana caleyi R. Br.
elegans Meisn.

coccinea R. Br.

Sect. Isostylis
ilicifolia R. Br.

Banksia Study Group,
12 Little John Court,
VERMONT, VIC. 3133

June, 1973.

Dear

It is with sadness that I have to report to all members of Study Group the sudden and accidental death of the leader Jim Carney early this year.

Jim was a member of Maroonda Group of the Victorian Region of SGAP and made significant contributions to our knowledge of native plant cultivation by conducting a plant survey of Melbourne's Eastern Suburbs.

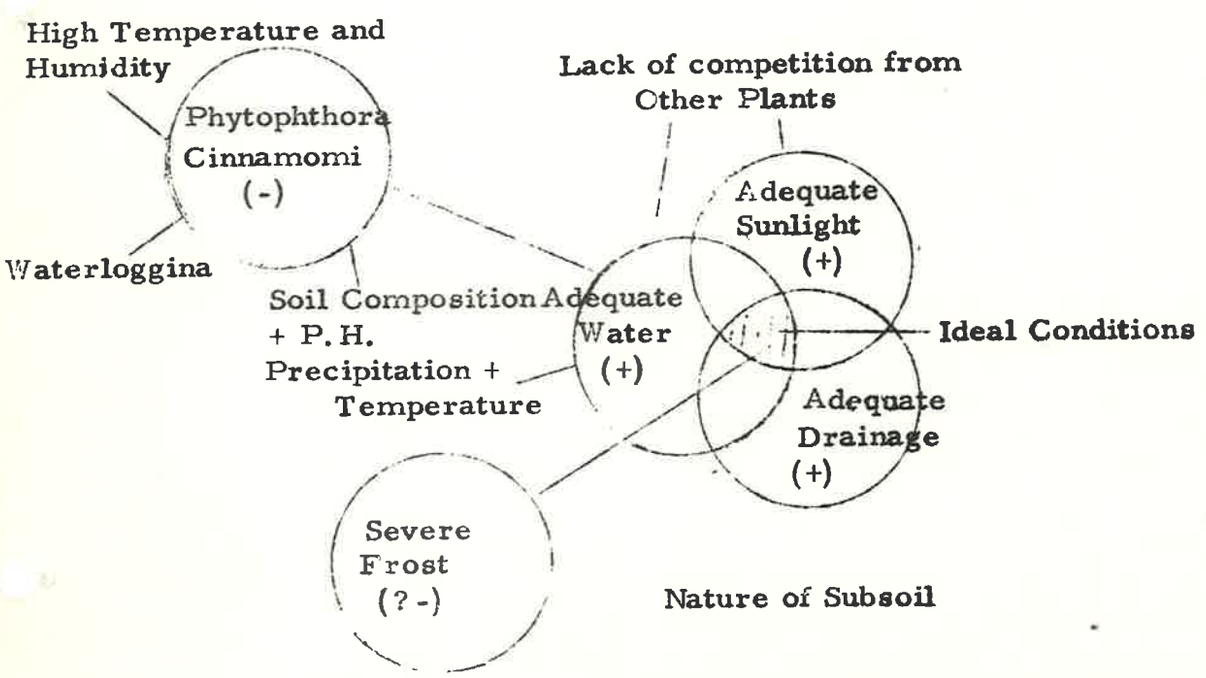
His work and contributions to the understanding of the problems associated with growing banksia species has been thorough and rewarding and his loss as a conservationist and friend is great.

This report takes us a step further in understanding the growing conditions required by Banksia species.

It appears that quite a large number of environmental factors influence the chance of success. But, as Alf Gray has suggested, certain key factors may be regarded as "primary causes". Various other factors which are relevant may have only an indirect influence.

From the information we have gathered so far it appears that the basic requirements include adequate water, sunlight and drainage (for most species), and the absence of certain pathogens, and perhaps the absence of severe frost.

Possible inter-relationships of some of the factors considered are illustrated in the following diagram.



It would help to know the areas which are infected with Phytophthora cinnamomi and which banksia species are susceptible before conclusions can be drawn from trials with chemicals.

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Research is being carried out on both these matters, but it is too early to be able to report on the results. Once it is known which species are attacked, growers will be able to help keep a watch out for Phytophthora.

Discussion and interest certainly indicates that we must not limit the scope of this report to Western Banksia species. Enclosed with the report are data sheets that were used in the original study. It would be of interest if the severity and frequence of frosts, and whether the species are protected or exposed could be indicated in the additional column.

To enable costs of postage, paper and duplication to be covered and the purchase of some seed that will be available to all members, a levy of $1.00 is being made.

Thank you for your interest and participation in this study.

Yours sincerely,

STUDY GROUP LEADER

May 28, 1973.
Enc.