To Dick Perry
with the Authors Compliments
W. D. Glass Smith

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WESTERN AUSTRALIAN DEPARTMENT OF AGRICULTURE

STEM CANKER DISEASE OF RED FLOWERING GUMS

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STEM CANKER DISEASE OF RED FLOWERING GUMS

By W. P. CASS SMITH

Of the many native Eucalypts in Western Australia few are more attractive than the red flowering gum. It flowers generally during the Christmas period and provides a beautiful display for several weeks, with blossoms of several colours including dark red, scarlet, orange and pink.

Because of its beauty, the red flowering gum (*Eucalyptus ficifolia*) was widely planted in Western Australia, but, from about 1930 onward its popularity declined because of the ravages of a canker disease which has attacked plantings in many parts of the State.

The disease was first noticed in Perth during the 1920s, when it was apparently confined to a relatively few specimens. However, from about 1930-34 the disease began to spread alarmingly throughout the Perth Metropolitan Area, and caused great concern by destroying hundreds of trees, in lovely avenues in Kings Park, on street verges and in home gardens. Ironically, in other parts of the world where the red flowering gum has been introduced, it has remained free of the canker disease.

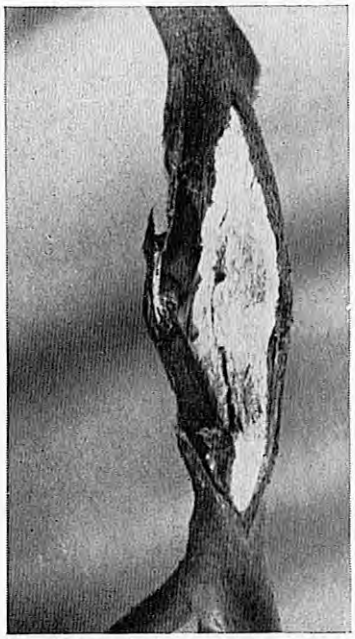

Fig. 1.—Naturally occurring canker on red flowering gum branch.

Symptoms and effects

Canker development on small branches is the first specific symptom of the disease. The cankers cause a splitting of bark and a swelling of the underlying woody tissue, which shows a surface coating of white powdery material (Fig. 1).

The cankers gradually enlarge until each affected branch is girdled, when the distal leaves and twigs die.

Withering of leaves and death of small branches is generally the first noticeable manifestation of the disease. This usually occurs in summer, when tree growth is vigorous and temperatures are high. Cankers may also occur on larger branches or tree trunks (Fig. 2), but here swelling of the affected area is less, and the white coating is mostly confined to the edges of the canker. Canker development may proceed rapidly until most of the branches are killed and the diseased tree dies.

Cause and spread

In 1935, former Western Australian Government Plant Pathologist, H. A. J. Pittman, demonstrated that the disease is

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* Pryor, L. D. Proc. Linn. Soc. (N.S.W.) Vol. 82, Part 2, No. 384, p.p. 199-200.

caused by a parasitic fungus. Pure cultures of this fungus were forwarded to the Imperial Mycological Institute, Kew, where it was identified as a new species and named *Sporotrichum destructor* (n. sp. Pittman).

Further work on this disease by Pittman between 1935 and 1938 (when he resigned), showed that this parasite can only cause infection through bark injuries, often made artificially by lopping of branches to avoid overhead wires, or breaking-off of flower bearing branches, or naturally, by biting insects such as borers. Also, that the white powder on the canker surfaces consists of numerous fungal spores which when transmitted by wind, rain, etc., can spread the disease.

Fig. 2.—Naturally occurring canker on trunk of red flowering gum at Middleton Beach Road, Albany.

Pittman observed that not all affected red flowering gums were badly damaged, and suggested that while fungicidal sprays might give some control, vegetative propagation of resistant specimens was likely to be the soundest method.

He appealed to nurserymen to assist with this propagation work.

Since 1938, further work on this disease has been conducted by the author, the main results of which are now briefly presented.

Fig. 3.—Canker developed on red flowering gum seedling following artificial inoculation with a pure culture of **Sporotrichum destructor.** Symptoms are similar to those in Figure 1.

Disease origin and host range

As the fungus causing this disease is a new species, which has not been recorded in any other country where red flowering gums have been planted, the disease must have originated in Western Australia. Despite exhaustive searches no occurrence of the disease has been found on red flowering gums in their native habitat in the Nornalup-Walpole coastal area, as would be anticipated if it had originated on this tree species. However, host range studies by artificial inoculation with several red flowering gum isolates of the causal fungus showed that the native marri or red gum (*Euc. calophylla*) is also susceptible to this disease.

As a result of this knowledge searches were made and naturally infected marri

Fig. 4.—Naturally occurring symptoms of canker disease on native marri.

Fig. 5.—Die-back of marri caused naturally by canker disease in Pickering Brook locality. The symptoms are similar to those on the red flowering gum.

have now been found in many parts of the State, including Kings Park, Albany, Denmark, Bridgetown, Greenbushes, Pickering Brook and other localities. The cankers found on marri, and especially on the smaller branches, closely resemble those on red flowering gum (Fig. 4).

Reciprocal inoculations of marri and red flowering gum seedlings with isolates from both hosts have yielded closely similar symptoms and microscopically the fungal isolates are identical.

On marri the disease is slower to develop, especially on larger branches, due probably to its characteristic habit of gum exudation from wounds which retards the development and spread of the fungus pathogen. Nevertheless, in the final stages the disease may be very destructive (Fig. 5).

The widespread occurrence of the same canker disease on marri in areas remote from red flowering gum, and conversely, its frequent occurrence on red flowering gum when introduced and planted in close proximity to infected marri (for example, at Albany, Denmark, Bridgetown and Kings Park), leaves little doubt that the canker disease has originated on marri rather than red flowering gum.

The only other hosts of this disease revealed so far by infection experiments are the pink flowered marri (*Euc. calophylla* var. *rosea*) and the mountain marri (*Euc. haematoxylin*). Like the marri, both these hosts develop the disease more slowly than red flowering gum.

Control aspects

Canker diseases of forest trees are extremely difficult to control, and the canker disease of the red flowering gum conforms with this rule. Possible approaches to control of such diseases are the use of therapeutic methods, the detection and propagation of resistant specimens, and breeding for resistance.

Therapy

Attempts to control the disease therapeutically have yielded disappointing results.

Surgical removal of affected branches at an early stage and the application of a wound dressing to the pruning cuts may delay the spread of the disease, but this treatment is only practical where one or two trees are grown, and constant attention can be given, such as in home gardens.

Surgical treatment of cankers on the main trunk has yielded negative results and such trees eventually die. The application of fungicidal sprays or dusts has also proved ineffective.

The detection of resistance by infection experiments

This work began in 1938 in Kings Park. At the author's request Mr. J. E. Watson, former Superintendent of Kings Park, surveyed 180 trees in this area. Most of these were visibly affected with canker, and only 24 showed no obvious symptoms coupled with good habit of growth and flower colour.

These 24 trees were tested by artificial inoculation of the branches with pure culture isolates. Subsequently all but two gave a susceptible reaction, indicated by the development of typical branch cankers.

Additional attempts to infect these two specimens were made, with a wider range of fungal isolates. One of these trees, which is in Fraser Avenue and is now known as Tree 90, has remained healthy to this day and appears to be immune. The other, in the Subiaco portion of Kings Park and now referred to as Tree 14, developed one canker only and was classed as resistant.

Red flowering gums raised from seed of resistant trees have proved disappointing as sources of resistant material.

In 1943 some 230 seedlings, largely the progeny of immune Tree 90, were tested by infection experiment. They had been raised in containers by Kings Park staff. All but 15 showed marked susceptibility. However, after more vigorous growth had been obtained by planting out in the ground only one out of the 15 appeared to be immune when re-inoculated. Unfortunately, this tree has a white flower colour similar to the marri.

In subsequent years, many hundreds of seedling trees have been raised by the Department of Agriculture, and tested for resistance by infection experiments. Mostly these have been the progeny of true Nornalup-Walpole seed, supplied by the Forests Department, for trees of this origin generally bear scarlet or other attractive shades of blossom.

The disease reactions shown in these tests may broadly be grouped in four classes—

1, very susceptible; 2, susceptible; 3, resistant; and 4, immune.

The vast majority of these young red flowering gum trees have given class 1 or 2 reactions. Class 3 and 4 reactions are extremely rare, particularly the latter.

In the resistant class have been placed those trees which are difficult to infect; the disease makes little if any natural spread, and in some cases the cankers fail to develop beyond the initial stage.

Two further observations of importance have been made during the course of these experiments:

- No case of seed-borne transmission of the disease has been noticed.
- The disease-causing capacity of the numerous test isolates has shown little variation; therefore, the chances of a breakdown of resistance due to the evolution of a new, more virulent strain, seem remote at present.

The vegetative propagation of resistant specimens

As resistant red flowering gums are so limited in nature, multiplication by vegetative means offers the best chance of combatting the canker disease.

Numerous attempts have been made by various people, including skilled nurserymen, to propagate the tree from stem cuttings, or by budding or grafting red flowering gum scions onto stocks of red flowering gums or marri.

There are a number of authentic records of apparenty successful "takes" in which

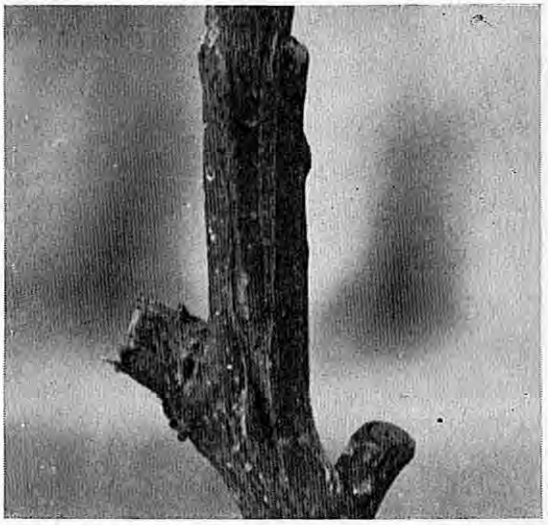

Fig. 6.—Cleft graft of resistant red flowering gum scion onto marri seedling understock. Propagated by glasshouse attendant J. Elliot, Department of Agriculture, 1963.

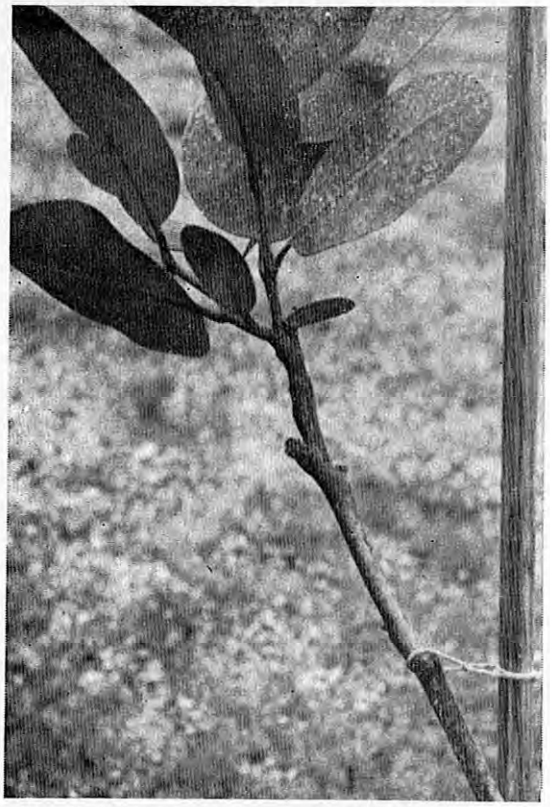

Fig. 7.—Scion growth from graft shown in Figure 6.

organic union of stock and scion was obtained and considerable scion growth developed; but the scion eventually died.

For example, in 1942 Mr. R. C. Owen, formerly an officer of the Department of Agriculture, successfully cleft grafted a Tree 90 scion onto a native marrie sucker at his Pickering Brook property. The scion made considerable growth for two or three years, but ultimately died.

Work of higher priority has allowed only limited attention to vegetative propagation of red flowering gums by the Department of Agriculture.

The compatibility of stocks of marri, red flowering gum and mountain marri has been studied and of these, marri appears to be the most promising (Figs. 6 and 7).

The production of roots from unsevered stems by Professor L. D. Pryor's technique known as marcotting or air-layering,* has also been tested and has shown some promise for initial increase of resistant red flowering gum material (Fig. 8).

Fig. 8.—Air layer or Marcot on stem of resistant red flowering gum seedling.

In this technique a ring of bark about $\frac{1}{2}$ in. wide is removed from around the stem and the under-lying surface is lightly scraped. The first ring is then enlarged by the removal of a further bark strip about $\frac{1}{8}$ in. wide at the distal end, but the under surface is not scraped. Peat moss moistened overnight and squeezed out to remove free moisture is then packed around the bark-removed area and covered tightly with polythene to form a bag with ends tied at top and bottom.

Where marcotting is undertaken on plants growing in the open it is adviseable to cover the polythene with cheese cloth or organdy to prevent bird picking and drying out of the peat. When roots become evident in the peat, the stem is severed and planted out after undoing the bottom tie. The polythene cover is then removed carefully so as to disturb the roots as little as possible. In hot weather the top may need pruning back to prevent wilting.

Propagation by normal stem cuttings has been attempted many times by the author in his own garden but facilities such as bottom heat and controlled humidity, have not been available. Woody cuttings of about half an inch diameter often survived for several weeks after planting, especially when some of the leaves were buried in the soil. However, little callussing occurred. A technique was therefore devised in which callussing was promoted on the branches before severing A ring of bark $\frac{1}{4}$ to $\frac{1}{2}$ inch wide was removed and immediately sealed with a thin layer of grafting mastic in which had been thoroughly mixed a growth promoting substance such as beta-indoleacetic acid.

* Pryor, L. D. Proc. Linn. Soc. (N.S.W.) Vol, 82, Part 2, No. 384 pp. 199-200.

On vigorous trees, massive callussing occurred within a few weeks, when the branch could be severed and planted (Fig. 9). This technique was helpful in propagating a number of other species by cuttings, and it seems worth re-testing on red flowering gums where controlled environmental conditions are available.

The removal of bark as suggested by Professor Pryor for marcotting may also be helpful.

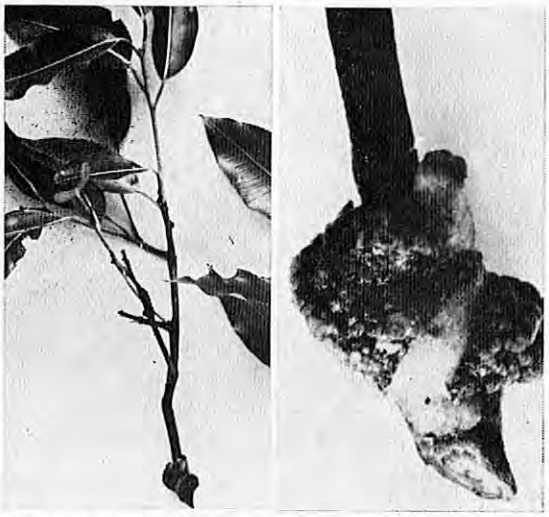

Fig. 9.—Left: Callus achieved on unsevered branch of red flowering gum by removal of bark and sealing with grafting mastic containing beta-indoleacetic acid. This shows the callussed branch severed and ready for planting as a cutting. Right: Enlargement of the callus area.

Plant breeding

Some preliminary work on plant breeding aspects of control has been carried out and is reported here.

As seedling progeny of immune Tree 90 comprised such a low percentage of resistant specimens, self pollination by hand was carried out under controlled conditions with the object of improving the percentage.

However, in several trials no seed was set, even though techniques recommended for inducing self fertility were also tested. It appears therefore, that under natural conditions red flowering gum seed results entirely from cross pollination with other red flowering gum trees, and probably with marri and other closely related species also.

This explains why seedlings raised for sale, even from seed collected from red flowering gum trees of good flower colour and habit, often disappoint the buyer.

In view of this result reciprocal crosses of Tree 90 and Tree 14 were made in January, 1947.

Later the hybrid seed was raised at Hamel Nursery, and in August, 1949, 54 hybrid seedlings of this origin were planted at Gnangara pine plantation together with 47 others of doubtful parentage.

The latter were derived from blossoms which became exposed during the hand pollination period, when the bags containing them were damaged. Thus, pollen from other sources could well have been introduced by insects.

The Gnangara location where the hybrid seedlings were planted is isolated from marri and is not open to the public, so appeared to be an ideal site.

In February 1951, the first artificial inoculations were made with two isolates of the causal fungus from separate localities. At this date there were only 39 surviving hybrid seedlings and 28 of doubtful parentage, the remainder having died from insect attack and harsh summer conditions. In January 1952, young trees which showed no evidence of the disease were re-inoculated with further pure culture isolates.

The disease soon attained epidemic proportions in susceptible trees, which included many of the hybrids and most of those of doubtful origin. All affected specimens were allowed to remain in order to expose the remaining healthy trees to natural infection under these severe conditions.

Inspections have been made periodically up to the present time. Only 16 hybrid trees have survived. Of these one appears to be immune and several others resistant. The latter trees developed some cankers at an early stage but these did not persist. However, these results must be interpreted with caution, for due to high summer temperatures, low summer rainfall and absence of irrigation, the trees have not made very thrifty growth; therefore, the full expression of symptoms may have been masked.

Suggestions for further work

If the red flowering gum is to be re-established as a desirable ornamental tree, more work is urgently required to

increase the limited amount of stem canker-resistant material now available.

Vegetative propagation appears to be the best means of achieving this, and even if techniques which prove successful cannot initially be adapted for commercial use, they will at least increase the amount of resistant material and provide clones for further trial.

Propagation by budding and grafting onto red flowering gum or other closely related understocks, together with air layering, deserve further trial in view of the limited success already achieved by these methods.

Self pollination of resistant red flowering gums also requires more attention, for if a successful technique could be developed the percentage of resistant progeny would probably be increased materially.

For self pollination studies, scions worked onto an understock in glasshouse or nursery, would be more manageable; and if a range of understocks could be used there may be more scope for success.

It is hoped that this article will stimulate renewed interest in this problem by those equipped to carry out propagation work.

Acknowledgments

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