THE CONTROL OF BLACKBERRY IN SOUTHERN FORESTS

by G. J. Voigt

TO : SUPERINTENDENT A.R. HILL

FROM : F/R G. VOIGT

SUBJECT : THE CONTROL OF BLACKBERRY IN THE SOUTHERN FORESTS

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1. PREFACE

This report was written mainly as it is the major component of my foresters examination. However, as I am the Officer in Charge of noxious weeds (blackberrys, thistles etc.) in the Pemberton division, this report will promote a fuller understanding of blackberrys in this area and thus help me considerably in setting up an effective blackberry control program.

2. INTRODUCTION

The following report deals with the control of blackberry (Rubus fruticosus)in southern forests. The first sections of the report relate to background information on the blackberry. The fight against blackberry has been "raging" for 87 years or so, and still the blackberry survives. This information will acquaint the reader with a plant which has stood the test of time.

The report will then focus on the past, present and future control methods for blackberry. After 87 years there are signs that new herbicides such as Roundup® and triclopyr are having deceiving victories.

The final section of the report makes recommendations with respect to eradication or control of blackberry and future Departmental policies.

3. NOMENCLATURE

Rubus fruticosus L. agg.

Rubus - is the ancient Latin name for blackberry and refers to the red fruit before it is ripe.

fruticosus - is from the Latin fruticose, meaning "shrubbby

agg. - is an abbreviation for aggregate, indicating that there are many closely related species grouped under this name.

In Victoria there are nine species of blackberry and in Western Australia two types - the broad leaf and small leaf. Both are grouped under the name Rubus fruticosus L. agg.

4. HISTORY

Blackberry was deliberately introduced into Australia from Britain by early settlers for gardens and hedgerows. Old newspaper articles claim that blackberry had been planted in the Bathhurst area in Victoria in the late 1830's, Sydney in 1851 and in Tasmania in 1843. The fruits of the blackberry were used fresh and to make jam and pies. A blackberry picking enterprise was set up - sending 4 tons to Sydney in 1894. By 1912 the harvest reached 200 tons. Blackberry was recommended, and actively planted, for control of soil erosion along creek banks. The blackberry thrived.

The potential for the plant as a weed, however, was beginnin to be recognized. The Sydney Mail of February 12th 1887 reported that blackberry planted for hedges was ruining farming land. Blackberry was first declared a noxious weed in 1894 for part of Victoria and by 1908 for the whole of the state. It is also declared in Western Australia, Queensland, South Australia, Tasmania, A.C.T. and New South Wales.

5. OCCURRENCE OF BLACKBERRY

5.1 World Occurrence

The world occurrence of blackberry is shown in Fig. 1. It grows in areas where the annual rainfall exceeds 760 mm and in latitudes 30° to 65°N and 28° to 40°S. Blackberry also occurs near the equator, but only in areas of high elevation

In Australia blackberry is an important weed in Western Australia, South Australia, Victoria, Tasmania and New South Wales and to a limited extent in Queensland. Fig. 2

5.2 Western Australian Occurrence

Blackberry is confined to the south west area of Western Australia - mainly south of a line extending from Perth to Albany. This line approximately follows the 760 mm isohyet.

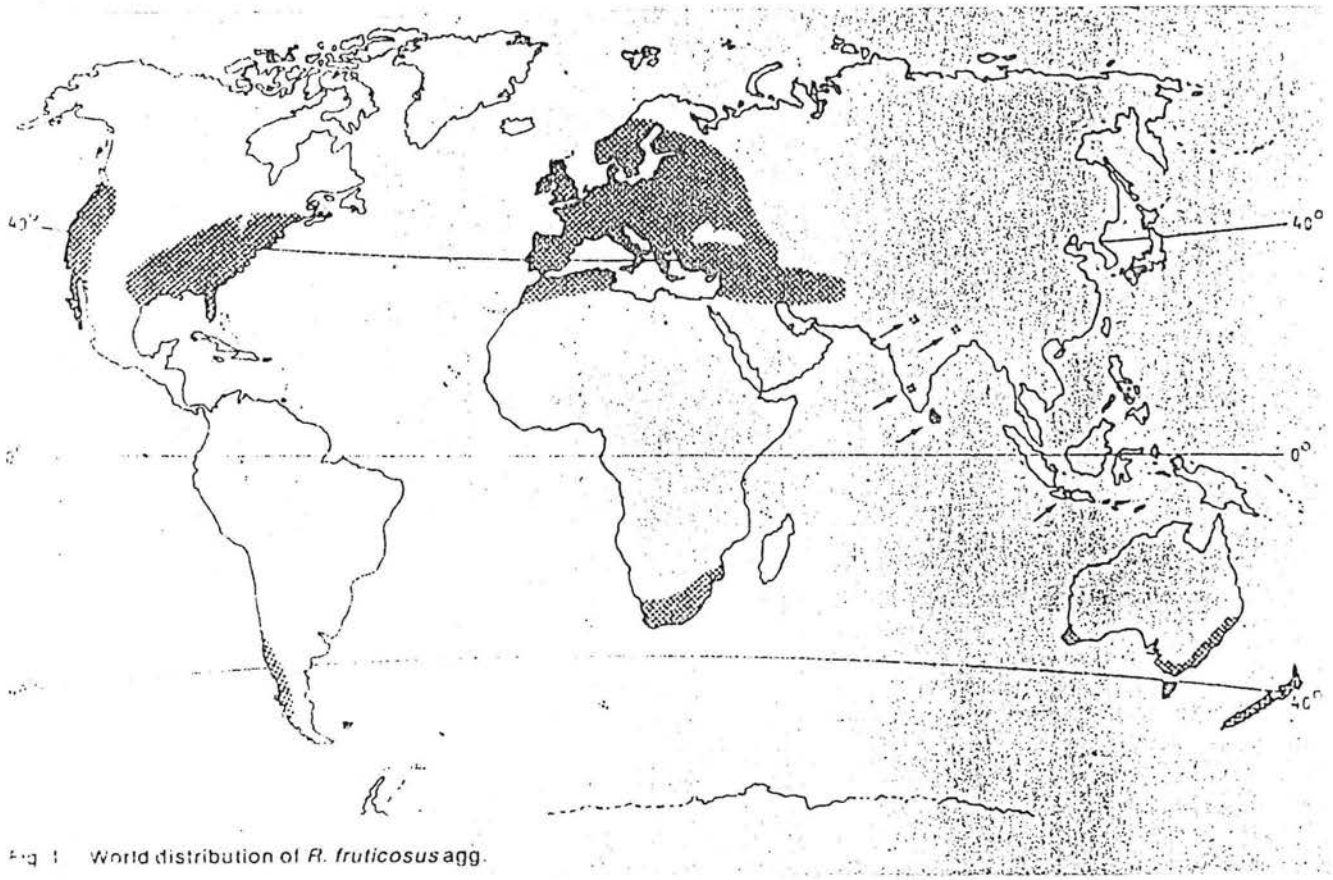

Fig 1 World distribution of *R. fruticosus* agg.

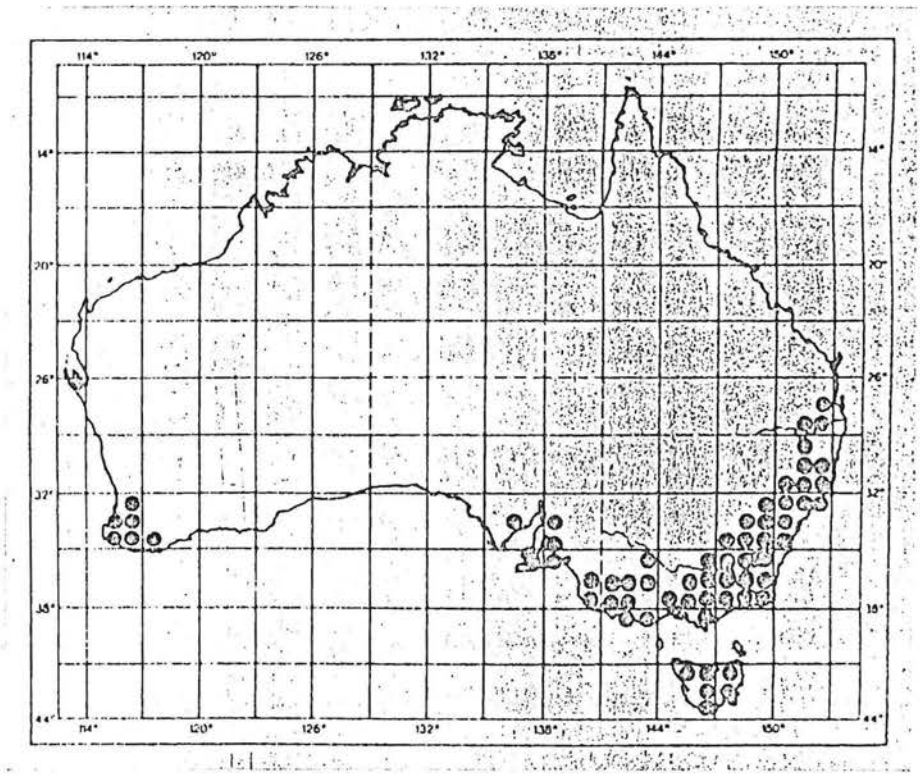

FIG. 2 AUSTRALIAN DISTRIBUTION OF BLACKBERRY

5.2 Cont.

Occurrence of blackberry north and east of this line has been noted in the higher rainfall pockets in the Jarrahdale Dwellingup and Collie areas and also in some moist gullies around Mt. Barker.

5.3 Presence in Pemberton Division

The problem of blackberry infestation in the Manjimup and Pemberton Divisions of the Forests Department is greater than in any other area in the southwest. Blackberry infestations can usually be limited with vegetation disturbance - in the Pemberton Division sawmills, logging camps and farms were the original source for todays infestations. Blackberry was planted at these sites probably with the view to gathering the fruits. However, streams, rivers and animals helped spread the plant so that today it grows in all main river systems, many stream, old mill sites, disused railway formations and neglected farms.

The maps in Appendix I show the occurrence of blackberry in the Pemberton Division of the Forests Department. They were compiled with assistance from the Agricultural Protection Board, Forests Department employees and personal sightings. These maps are continually updated as new infestations are found.

5.4 Main Areas of Blackberry Occurrence in Pemberton Division

5.4.1 Main rivers and streams: the main rivers and streams infested with blackberry are the Warren River, Lefroy Brook, East Brook and Quininup Brook. At many points along these water courses the blackberrys grow along both banks for hundreds of metres and up to 50 metres in width. The rivers and streams provide optimum conditions for blackberry growth i.e.

5.4.1 Cont.

i) plenty of year round moisture

ii) fertile soil. Observations by scientists in Victoria have shown that the blackberry can grow on most soils although growth is more prolific on fertile clay loams My own observations around Pemberton Division support these findings.

iii) the rivers provide a gap in the forest canopy. This allows a greater amound of sunlight to reach the ground and this is beneficial for blackberry growth. As a result the thickets are dense and high (up to 3m) and often grow out over the water - choking the stream

Heavy creek infestations will often spread up the hill sides, suppressing native vegetation. This has occured where roads pass close to creeks infested with blackberry. A good example of this can be seen on Pump Road.

5.4.2 Neglected Farms

Many farms in the Pemberton area were settled in the 1920's, the new farmers often planting blackberry for the fruit. Later when the plant became a pest the farmer did what he could to control it - burning, grubbing it out by hand. Unfortunately these methods of control never fully wiped out the plant, it always managed to survive. Paddocks infected with blackberry which were left ungrazed soon became choked with the plant. Even paddocks without a history of blackberry often became infested due to the dropping of animals such as emus and foxes. The young blackberry plants grow well in neglected paddocks, free from competition of native plants and in full sunlight they soon become the dominant feature of the area.

5.4.2 Cont.

Where such a paddock abuts forest the vigorous blackberrys will enter the forest - suppressing the native understorey to form new thickets. Even in upland forest sites the blackberry can become established. The lack of year round moisture in these upland sites is overcome by completely suppressing the native undergrowth and by developing an extensive root system. However, the very dense native understorey and shaded aspect of the forest is not optimum for the blackberry. In most upland infestations the degree of infestation decreases as the distance from the main source increases.

5.4.3 Logging Coupes

Areas of forest which have been logged - especially those near blackberry infestations, run the risk of being infected. This is due to two main reasons:-

i) Droppings from emus and foxes containing blackberry seeds are very likely to occur. The disturbed ground in the coupe is ideal for blackberry growth and there is little competition for several years.

ii) Blackberry fragments can be brought into the area during the coupe roading programme. An example of this can be seen in the Dombakup area.

Areas of infestation in logging coupes which I have seen are as yet small. With continual vigilance and spraying of infested areas the blackberry should not be a problem.

5.4.4 Pine Plantation

The main area of blackberry growth under pine in the Pemberton Division is the Dombakup plantation - south-west of Pemberton. The pine trees have suppressed all native vegetation by blocking out the sunlight and through the pine needles creating an acid soil. In several places, mainly along creeks-gullies, the blackberry is growing. Both the broad and small leaf varieties occur in this area. At present the infestation is small but if left unchecked would escalate into a major problem. Current logging in the plantation is gradually opening up the stands. This could allow the blackberry to flourish.

6.0 BIOLOGY AND GROWTH HABITS

6.1 Morphology

The blackberry, Rubus fruticosus L. agg, is a prickly perenial shrub which often forms large thickets to 3 m high. The canes bear prickles and can be inpenetrable to man and grazing animals.

6.2 Perennation

The root system is perennial and the canes live for only two or three years; in old thickets up to 70 percent of the top growth may be dead. New canes are formed in spring from buds on the crown and occasionally from the roots. Daughter plants are formed in spring at the apices of canes which have tip rooted in late autumn. This ensures the survival and spread of the thicket.

6.3 Physiological Data

Stages in the development of blackberry seedlings grown in pots in the open are shown in Fig. 3. The cotyledons are oval, 4-5 mm long and die after 9 weeks. The depth of the roots increased by 1.4 cm long/day for the first 69 days. Little aerial development of the blackberry seedlings, after 4 simple leaves had been formed in the first year, was observed, although the roots continued to elongate over winter. Depth of seedling roots is often 10 times the height of the top growth.

In the second summer after germination several cones are produced. These grow quickly due to the extensive root system developed over winter. In the autumn cane elongation ceases and the tips of the canes, where they touch the groun take root.

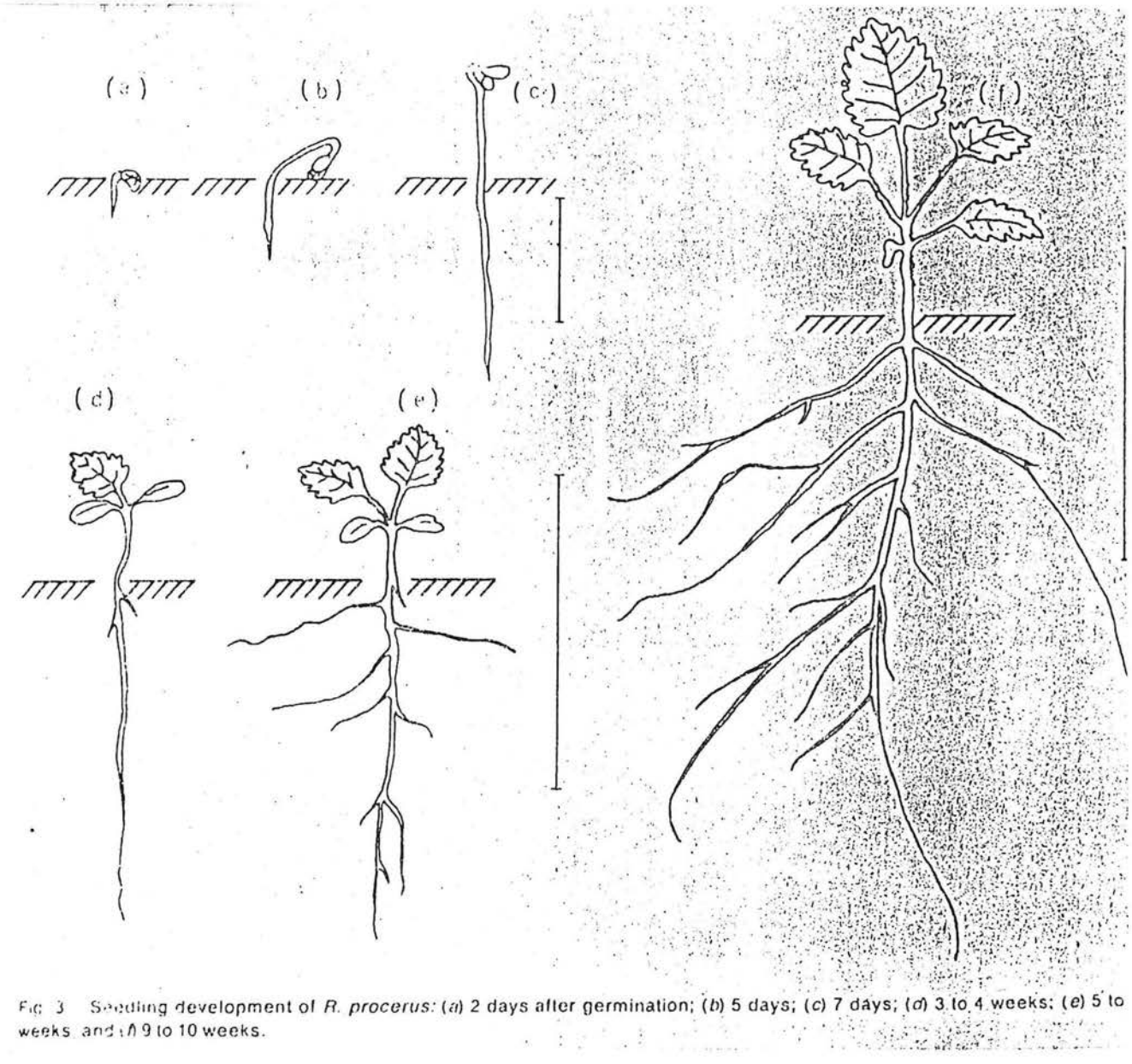

Fig. 3 Seedling development of *R. procerus*: (*a*) 2 days after germination; (*b*) 5 days; (*c*) 7 days; (*d*) 3 to 4 weeks; (*e*) 5 to weeks and (*f*) 9 to 10 weeks.

6.4 Phenology

Seed germination occurs in spring. Flowering of mature canes commences in late spring and early summer, Canes that were formed in the spring elongate rapidly during summer and form single compound leaves at intervals along the cane, but do not bear flowers or fruit. This occurs in the second and third years. The plants lose most of their leaves in winter and are dormant until cane growth commences again in spring.

6.5 Mycorrhiza

Mycorrhiza are not present on the roots of blackberry.

6.6 Reproduction

6.6.1 Floral Biology

Little work has been done on the method of pollination. It is generally thought that the nectar secreted from the receptacles of the flowers attracts bees, butterflies. See Fig, 4.

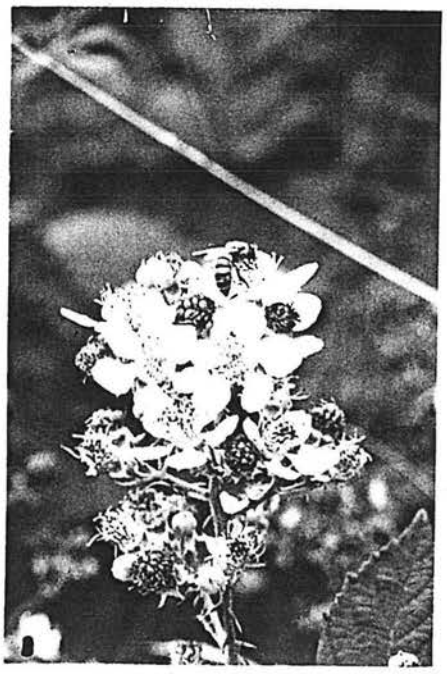

FIG. 4 BLACKBERRY FLOWER

6.6.2 Seed Production and Dispersal

The fruit of the blackberry consists of a number of loosely adhering druplets, see Fig. 5. Each druplet contains two ovules, one of which usually aborts. The number of seeds produced by a single open grown blackberry has been estimated at between 170 000 to 400 000 depending on the seaso: Another count of seeds in a 7 year old thicket growing at Flinders, Victoria, was 7 000 to 13 000. This is considerably less than in the ope n grown single plant situation, the main reason being that the plant flowers less in shaded positions.

Research has shown that blackberry seeds are dispersed by birds (e.g. parrots, emus), foxes and by water (rivers, streams). Seed counts of emu droppings revealed a mean of 2460 seeds per dropping, and for foxes 570 seeds per dropping.

FIG. 5 BLACKBERRY FRUIT

6.6.3 Seed Germination

Blackberry seeds germinate in spring but there is often little germination in the first spring after formation. Studies by Northcroft (1927) found no germination of new seed until 13 months after sowing. Amor (1974) found only

6.6.3 Cont.

1% germination in the first year, 9% in the second and no germination in the following two years. This low germination rate is partly due to defective seeds. Research by Herr (1954) showed that 65% of apparently normal seed had collapsed embryos. Amor (1974) found that 28% of seed collected at Flinders, Victoria, contained no embryo.

Research by Herr (1954) and Amor (1974) showed that germination can be improved by the removal or at least damaging hard endocarp. Amor damaged the endocarp with sulphuric acid and then stratified the seed at 3°C for 3 months. Brunner et al (1976) reported 22% to 35% germination of seed collected as berries and from droppings of emus and foxes. It is suspected that the passage through the animals may result in the damage of the endocarp by body acids, thus leading to a higher germination rate.

Following germination seedling survival can be reduced by shade. Amor (1974) showed that seedlings receiving less than 44% of full sunlight in December to February did not survive. This indicates that few blackberry seedlings should survive in dense pastures or forest situations.

6.6.4 Vegetative Reproduction

In autumn the canes elongate rapidly until they reach the soil. The apices penetrate the soil producing adventitious roots and a resting bud which develops in the following spring. See Fig. 6. The rooting process is a response to reduced day length in late summer. These new plants, known as daughter plants, have an advantage over seedlings as they are attached to the main plant and can draw nutrients from it while developing its own root system. The blackberry can spread up to 6 m per year by this process.

6.6.4 Cont.

Suckers (adventitious roots) are occasionally formed on roots and can emerge from a depth of 45 cm.

Blackberry can also reproduce from root fragments. Several examples of this can be seen in the Pemberton Division (Treen Block). This occurs mostly where a grader has passed through an infested section of road and carried the blackberry fragments furhter along the road where they are now shooting. The initial gravelling of a road can also spread blackberry by root fragments (Dombakup Block).

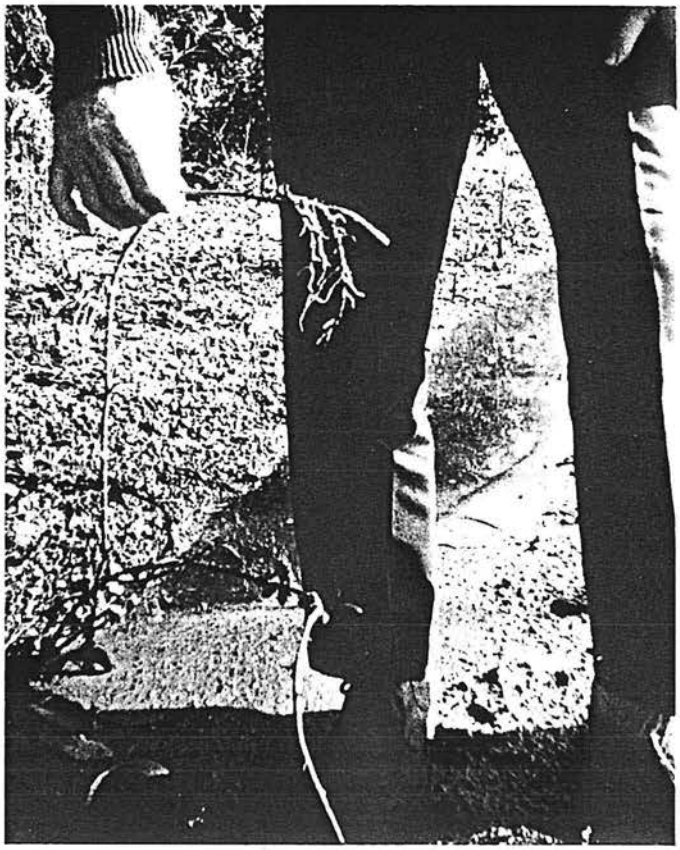

FIG. 6 TIPROOTING - DOMBAKUP BLOCK

7. CONTROL OF BLACKBERRY

7.1 Past Control

When early settlers found, to their dismay, that the blackberry they planted for fruit was starting to take over more land than they planned - they pulled it out. This is known as "grubbing" and is hard work. The top

7.1 Cont.

growth was slashed then as much of the roots dug up as possible. This was effective but practical only on small areas.

Burning was also tried. This was a risky business in the early days because if you were not careful a lot more than blackberrys was burnt. For all the danger, this method did not work well as the plants grew back with renewed vigour.

Mowing and ploughing of blackberry thickets was also tried and was temporarily effective. In 1940 a series of experiments involving cultural and chemical methods commenced at Bridgetown and Greenbushes. The results showed that if the area ploughed is sowed with a perennial pasture the blackberry could be controlled. Pasture species used were Kikuyu grass, perennial ryegrass, white clover and subterranean clover depending on soil moisture content. In this method the blackberry shoots must compete with the pasture and are also eaten off by cattle or sheep grazing.

The chemical trials of 1940 involved the use of sodium arsenite, acid sodium arsenite, arsenic pertoxide and sodium chlorate. Sodium chlorate was the most effective but after a period of three years, materials and labour had cost more than £25 per acre and some weak plants still remained.

No further progress was made with chemical control measures until the advent of the hormone-like herbicides. These manufactured substances have most of the properties of the natural plant hormones including the ability to move through the plant tissue and even penetrate the roots. The plants react slowly but the final result is severe.

The first hormone spray available was 2,4-D., however, this caused little permanent effect. When supplemented by 2,4,5-T ester the reaction was much more severe. Early experimental work proved 2,4,5-T ester alone gave the better results per unit cost.

This was a big breakthrough in the fight against blackberrys - but the blackberry wasn't finished yet. Repeated applications of 2,4,5-T were necessary to kill thickets, even then the area required checking every year. There was also a strong tendancy to burn the plants soon after they died. This had the effect of not allowing the hormone to thoroughly affect the plant and thus not inflict as much damage as might have been possible without burning. Thickets were sometimes burnt in order to gain access for further spraying. Still, this was the first time that the control of the blackberry seemed feasible. The chemicals were relatively cheap and when used in conjunction with high pressure spray units or misting machines, large tracts of land could be treated. Some of the 2,4,5-T trade names used were Butoxone 80 by I.C.I. Australia Ltd and Herbicide B80 by Shell Chemical (Australia) Ltd.

During the 1950's spraying programmes commenced. These programmes were based on co-operation between the Department of Agriculture, Agriculture Protection Board, local authorities, farmers, Forests Department and State Sawmills. This programme produced very good results due to the fact that blackberrys were treated on a face irrespective of whether they occured on private, shire or government controlled land.

In the late 1970's the popularity of 2,4,5-T ester was waining. It had been linked with "agent orange" of the Vietnam war, making people very conscious of possible side effects. The ester was also very damaging when it came into contact with vegetable crops such as tomatoes, grapevines and cabbage. This had sometimes occured due to

7.1 Cont.

spray drift. There was also considerable concern about the effects of the chemical in rivers, streams and dams. The ester was phased out and the amine replaced it. 2,4,5,-T amine is not as potent as the ester, however, good results are still occuring.

Another problem of using 2,4,5-T is that only small amount of herbicide are translocated to the roots. There are two reasons:-

1) a considerable proportion of herb remains in the treated leaf.

2) The crown tissue restricts the amount of herbicide moving to the root system.

A result of the low concentration of 2,4,5-T in the roots of some blackberrys is to stimulate the plant to produce new suckers from laterial roots. See Fig. 7. A poor spraying program of 2,4,5-T could actually promote the growth of some blackberry plants.

Other chemicals used to control blackberry are Tordon 50 D, Weedazol T L Plus, Fosamine, picloram granules, Amitrole, Hexazinone, glyphosate and triclopyr.

7.2 Present Control (report on 1983 spraying)

7.2.1 Method

This season the blackberry spraying was put out for tender and a Perth firm won the contract - 2 men for $27/hr. Spraying commenced on the 24th of January 1983 and 223 ½ hours of spraying was completed.

The operator used a four wheel drive with a 1 000 l tank and two spray guns on separate reels of hose. The hose could be joined for an extended spraying distance.

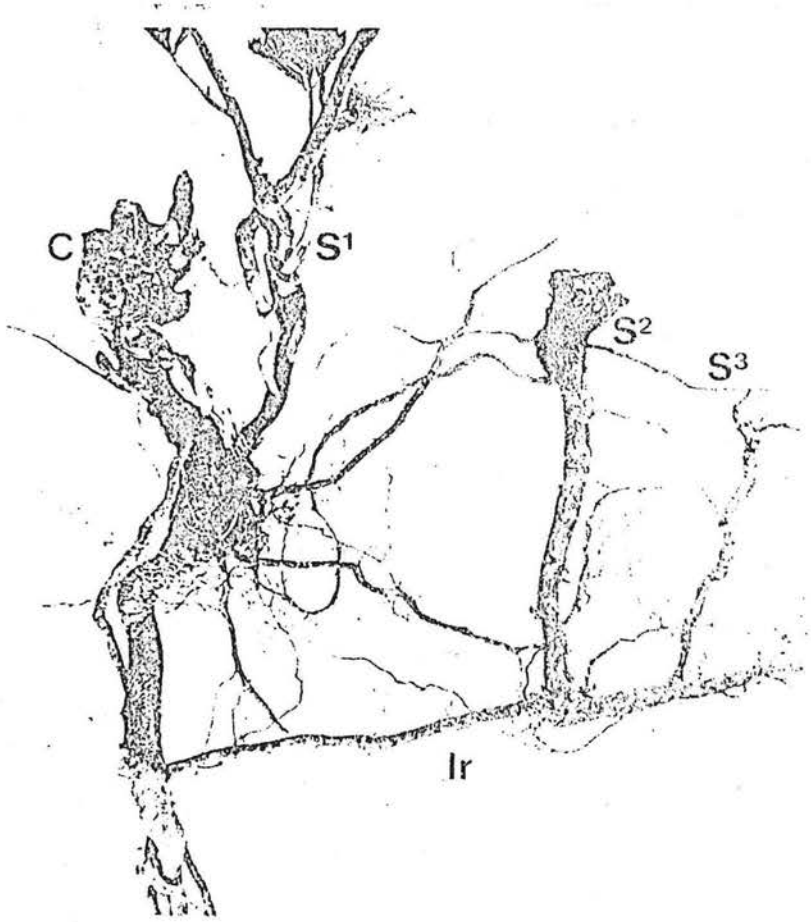

Fig. 7. Chemical treatment has killed the old crown (c) but stimulated a new shoot (S^1) from below the crown and also shoots (S^2 and S^3) from the lateral root (lr).

Three chemicals were used - 2,4,5,-T amine, glyphosate (Roundup®) and triclopyr (Garlon 480). Glyphosate and triclopyr are relatively new chemicals and their effectiveness on blackberry is not proven, although past results are encouraging. The table below shows the amount of herbicide used and the rate.

	l USED	RATE (LITRES)
Triclopyr	29.6	1:480
Glyphosate	40.0	1:80
2,4,5-T	68.0	1:80

Of the three chemicals used triclopyr has had the most noticeable effect so far. Within a few hours of spraying the blackberry tips were wilting and after a day or so leaves began to die. Glyphosate also showed quick results as did 2,4,5-T though not as soon as triclopyr. However, a true result cannot be guaged until spring of this year when the blackberry will put forward new growth. The amount of new growth will provide evidence of the effectiveness of the herbicides. All sprayed sites will be monitored in the spring and through the summer.

7.2.2 Problems Encountered

Several problems were encountered with this years spraying

i) The operators, being new to the area did not know their way around the division and consequently had trouble finding and mapping areas sprayed.

ii) The operators missed several small infestations - 1 to 2 plants. Again, being new to the area - often not quite sure where they were and the infestations being small were hard to locate in dense scrub situations.

iii) Blocked tracks - access could not be gained to several sites.

iv) No access to infestations - mainly along some river sections where there are no tracks.

All the above problems resulted in less actual spraying time and therefore reduced the effectiveness of this years program. To alleviate these problems in the 1984 program I propose the following:-

i) Retain the same contractor or engage one who has a good working knowledge of the area.

ii) O.I.C. checks access to all infestations prior to spraying and notes any work required. Visiting each site personally will enable the O.I.C. to guage the effectiveness of the spraying once completed.

iii) O.I.C. tapes small, 1 to 2 plant infestations.

iv) If contractor is new to the area then a forest workman will accompany them to ensure quick access and accurate mapping of areas sprayed.

An alternative to tendering for the spraying each year would be to allow the Agriculture Protection Board to spray areas with their own employees. There are several advantages in doing this:-

i) It frees the Forests Department from the operation and would allow the forest worker and O.I.C. of spraying available for fire control.

ii) Local A.P.B. employees know the district.

iii) Job quality would be high.

There is one disadvantage and that is the cost.

PRIVATE CONTRACTOR - TWO MEN	$27.00/hr
PLUS FOREST WORKMAN GRADE III & VEHICLE ALLOW.	7.06/hr
	$34.06/hr

AGRICULTURAL PROTECTION BOARD - TWO MEN	$56.00/hr

As the cost comparison shows, the private contractor accompanied by a forest workman is cheaper by $22/hr.

7.2.3 Chemical Cost and Performance

The cost of chemicals for the 1983 season are as follows. All chemicals were purchased from the A.P.B. in Manjimup.

HERBICIDE	$/l	$/20l	MIX	NO. OF 1000l TANKS/20l DRUM	COST/1000 l TANK
TRICLOPYR	35.70	714	1:480	9.6	74.37
GLYPHOSATE	20.45	409	1:80	1.6	255.62
2,4,5-T	2.55	51	1:80	1.6	38.37
*SUMMEROIL	1.30	26	1:200	4	

*Summer oil is used in conjunction with 2,4,5-T as a wetting agent.

The table shows 2,4,5-T and summer oil to have the cheapest unit cost and glyphosate the most expensive. Both these herbicides have showed varying degrees of control in blackberry. Triclopyr has given good results so far, however, as stated in 7.2.1 the final results will not be known until spring of this year.

7.3 Future Control

The future for the blackberry looks grim. Investigations into a rust - Phragmidium violoceam, to control blackberry have been continuing in southern France since April 1979. The rust is already being used in Chile and has caused cane die-back thus preventing spread of thickets by tiprooting, reduced the formation of seed and by lowering the height of the thickets enabled other plants to compete.

To allow possible entry into Australia the various strains of Phragmidium have been screened and in November 1980 the Australian Department of Health accepted a proposal for the use of a mixture of 15 strains to carry out specific testin In 1981 and 1982 continuous multiplication of the 15 strain has occured and selection has been made of the best strains for possible introduction into Australia. This work has been carried out by the Victorian Department of Crown Lands and Survey and the Division of Entomology, C.S.I.R.O. Test plants have been sent to Europe and so far 71 of the 99 plants have been tested for susceptibility to the rust. The important result to date is that the main commercial Rubus groups in Australia (rosberry, youngberry, boysenberry and loganberry) are all immune to the rust.

A stem boring sawfly Hartigia albomaculatus was also found to cause cane die-back in blackberry. However, during tests it was found that the sawfly was not specific enough to meet our quarantine standards, so the project was terminated.

7.4 Agriculture Protection Board (A.P.B.)

The main role of the A.P.B. in regard to blackberry control is to encourage and co-ordinate the spraying of the plant. The A.P.B. actively encourages farmers as well as government departments and shires to set up control programmes.

7.4 Cont.

Some organizations which they are involved with are - Public Works Department, National Parks Authority, local shires, Fisheries and Wildlife Department and the Forests Department.

The A.P.B. has also set up two herbicide screening trials. One on Brockmans property by the Warren Bridge and the other also on private property several kilomtres north of Pemberton. Various blackberry thickets were sprayed with either 2,4,5-T, glyphosate of triclopyr at different rates. The results were expected to show how the relatively new herbicide, glyphosate and triclopyr, perform under Western Australian conditions and the best rate to apply them. Unfortunately both screening trials were terminated. The trial on Brockmans property - due to an unexpected fire and the other when the owner engaged a bulldozer to clean up the paddock. These were both bitter blows to the Board as a lot of time was spent in setting up the trials and the results would have been invaluable. New trials are to be set up later this year.

The board is also undertaking to map all blackberry and other noxious weeds occurrence, together with spraying history and place it on the Forests Management Information System (F.M.I.S.). This is a computer information storage system recently set up by the Forests Department. When all the information has been entered detailed information on noxious weed occurrence and spraying history will be available at any time. F.M.I.S. squares are 8 000 m x 8 000 m and these squares can be further divided into 2 ha units. At the moment this is the smallest area on which information is supplied. Information stored in this system by the A.P.B. will be available to the Forests Department.

8. SUMMARY

The blackberry is indeed a very hardy plant. Its biology, and growth habits are all geared to ensure the survival of the plant. The blackberry has survived all attempts at it eradication. Man has had victories over the blackberry, however, "the price of victory is eternal vigilance".

Many of the reports I have read in compiling this report have concluded that the blackberry is under control and should pose no further problems. Some of these articles were written 20 years ago and to my way of thinking there are still problems with blackberrys. I feel that the total eradication of blackberry will never occur, control however will be achieved.

9. RECOMMENDATIONS

To control blackberry I make the following recommendations for future Departmental Policy.

1. Spraying to be carried out annually with the following priorities:-

   a) All upland infestations - this aims at restricting blackberry infestations to water courses where conditions are optimum for blackberry growth and eradication is difficult. Priorities for upland sites -

      i) areas of forestry importance i.e. settlements, picnic areas, arboreta

      ii) infestations adjacent to private property. Priority given to areas where the private property owner has commenced control measures.

      iii) other infestations within the forest itself.

   b) Infestations in Water Courses - initial spraying in the headwaters followed by progressive spraying downstream. The possibility of re-infestation

9. Cont.

by water bourne seed is then greatly reduced. A low oral toxicity herbicide is recommended i.e. Roundup for all spraying near water.

c) Major River Systems - again spraying the headwater then working downstream.

Many sections of main rivers in the Pemberton Division are inaccessible. To allow spraying, thousands of dollars would need to be spent in constructing access roads and at present this money is not available. Spraying of main river systems should wait until upland and stream infestations are controlled. By this time the rust Phragmidium violoceam, or some new form of control may be available.

2. The priority for weed control in State Forests be increased and additional funds be made available on a continuing basis provided a suitable control programme is established.

The control programme should include:-

i) B.O.C.S. - Blackberry Operational Control System. This would work similar to the H.O.C.S (Hardwood Operational Control System)and P.O.C. (Pine operational Control System). The maps would be 1:25 000 A.P.I's or 1:12 500 if possible. They should also be divided into F.M.I.S squares, to be inline with the A.P.B. system.

ii) Liaison with the local A.P.B. officer to coordinate spraying. Both departments having the same mapping system should help.

iii) Blackberry spread be considered when roading, (either by Forests Dept, Main Roads, shire or the timber industry), is anticipated. Hygiene measures should be introduced i.e. closing of all infested gravel pits, no new gravel pits in infested areas.

3. Safety

i) Spraying be undertaken by contractors or by wages employees who have volunteered for this work.

ii) Where contractors are used, half of the payment be deferred until the effects and quality of the work done can be assessed.

iii) Glyphosate (Roundup) be preferred for use on water supply catchments.

iv) The local water authority officer be advised one month before any spraying is undertaken in a water supply catchment.

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ACKNOWLEDGEMENTS

Mr David Lund, Agriculture Protection Board, Manjimup

APPENDIX 1

F.D. 1601-C

SOUTHERN REGION

INDEX TO F.M.I.S. SQUARES

SCALE 1 750000

Each F.M.I.S. square is an 8000 metre by 8000 metre area defined by the Australian Map Grid. It is identified at its south-west corner by the thousands value of the eastings and northings respectively. See example.

LEGEND

- Forest Blocks
- Pine Plantations
- Karri Occurrence
- State Forest, Timber Reserves (Forests Act) and other land under the control of the Conservator of Forests
- National Parks
- Flora and Fauna Reserves
- Forest Regions
- Forest Divisions
- Forests Dept. Division Office
- Forests Dept. Office
- Towns

EXAMPLE OF F.M.I.S. SQUARE IDENTIFICATION

The hatchured square has the unique number 368 336. The number 368 is derived from the easting A.M.G. coordinate of the south west corner which is 368000 metres. The number 336 is derived from the northing A.M.G. coordinate at the south west corner which is 336000 metres. The identification value is the easting value first

F.M.I.S. SQUARES IN PEMBERTON DIVISION WITH BLACKBERRY OCCURRANCE

F.D. 1601-C