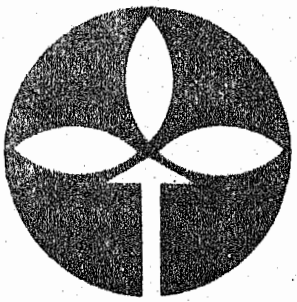

DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

Agronomy Branch Report

A SUMMARY OF BUSHFIRE RESEARCH

1964 - 1974

Conducted under the guidance of the

Bushfire Research Committee

and the

Senior Weeds Officer

Department of Agriculture

by

L.T. Jacobs

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HISTORY

Following the disastrous Kongorong fire in January 1959, the State Government formed the Bushfire Research Committee to investigate economic land use methods to minimise the effects of bushfires, and to advise landholders on the best methods to reduce fire losses.

By 1961, a wide range of new herbicides of varying effectiveness, mode of action and costs were available on the market. Many of these herbicides were potentially useful for controlling the growth of unwanted vegetation. Landholders were becoming interested in using herbicides to reduce fire hazards, but had difficulty in deciding the best ones to use.

The Committee decided to undertake a programme of testing the effectiveness and economics of fourteen selected herbicides which were then commercially available.

A research project with the following aims was commenced:-

1. To investigate the control of unwanted herbaceous growth on roadsides with herbicides.

2. To investigate the use of herbicides to provide a base from which burning can be started as a protective measure and in times of emergency.

3. To study the medium to long range effects of repeated applications of herbicides on botanical composition in relation to -

   a. Encouraging species of low flammability

   b. Encouraging undesirable weed species.

4. To study the possibility of using herbicides for the protection of buildings and other concentrated areas.

It was decided to seek the appointment of a graduate in Science or Agricultural Science with Botanical training as no member of the Bushfire Research Committee staff or the Weeds Section, Department of Agriculture was available.

First Appointee

T.A.F. Quinlan-Watson, M.Sc., commenced duty on the 7th January, 1963, as Research Officer with A.F. Tideman, Senior Weeds Officer, as Supervising Officer. He was appointed Officer-in Charge, Kybybolite Research Centre in December, 1965.

Second Appointee

L.T. Jacobs, R.D.A., Dip. For. was seconded from the Woods and Forests Department and commenced duty on 15th February, 1967, as Bushfire Officer with A.F. Tideman, Senior Weeds Officer, and later G.B. Baldwin, Senior Weeds Officer, as Supervising Officer. He retired in August, 1974.

FIRST APPOINTEE

1. TRIAL WORK

1.1 Long Term Herbicide Experiments - Change in Botanical Composition

The use of herbicides for fire protection purposes changes the botanical composition of the roadside verge or wherever they are used. The removal of annual grasses and other plants creates space which allows perennials and resistant weeds to become established, which may be harder to control, or more of a nuisance than the original vegetation.

In 1963 a trial was laid down at Struan, Caroline, Turretfield, Shepherd's Hill and Bray using four herbicides at four rates and four spraying times replicated three times. Herbicides used were atrazine-amitrole mixtures, atrazine, diuron, all with surfactants and diuron without surfactants, on 0.0004 ha plots, sprayed in May, July, September, and October. A vegetation assessment was carried out before spraying, and in June, July, September and November.

From observations made during 1963 it appeared that 2.7 kg/ha a.i. atrazine-amitrole mixture was the most efficient rate and the most efficient herbicide to use.

It was considered that by 1964 there would be no amitrole effect left in the amitrole-atrazine mixture, and that any long term effect would be entirely due to the atrazine component, which was exactly the same as on the straight atrazine plots.

It was planned to apply in 1964 three rates of atrazine-amitrole mixtures viz. 0.9, 1.8 and 2.7 kg/ha a.i. on the 1963, atrazine-amitrole, and atrazine plots early and late, or May and September. One set of each was left as a control.

From the two year's work the following was evident -

1. Time of spraying is important. Early (May) spraying requires more herbicide per unit area to produce bare earth in October than does June/July spraying. Although there is less vegetation in May to kill and be rotted by winter rains, the lower rates of herbicide are no longer effective and seedlings begin to appear and perennials recover by September. By spraying in July there is still enough wet weather to rot the vegetable matter, although it is more abundant than in May, and secondary growth does not appear. Spraying in September or October is too late for rotting, but there is now so much killed dry grass that this can safely be burnt while the surroundings are green.

2. For the second year not less than 1.8 kg/ha a.i. atrazine-amitrole mixture is needed, 2.7 kg/ha a.i. is preferable, 0.9 kg/ha a.i. is definitely not enough.

3. A programme of "bare earth" year after year will lead to an invasion of weeds (fumitory, sorrel, dandelion, milk thistle etc.) which are present but unimportant in the adjoining pasture. Perennial grasses, except ryegrass (at higher herbicide rates) will take advantage of the excess nitrogen and moisture due to the removal of the annuals. Perhaps an occasional burn, following a September spraying may be necessary to prevent a weed buildup.

1.2 Bracken Control

Bracken occupies large areas of the higher rainfall countr . It is a summer fire hazard and burning promotes its growth. Slashing and cultivation need to be very carefully timed to reduce it, and it was decided to see whether herbicides could provide an effective and economical control.

In 1964 a trial was laid down at three different sites - Mount Compass, Bray and Furner using six different herbicides at three different concentrations. Sprayings were duplicated and were done in February and October/November.

Only two herbicides showed any promise 4.48 kg a.i./ha of picloram, and dicamba at 16.80 kg a.i./ha which produced a 90% or more kill of bracken for two years but at a very high cost.

From the differences observed at the three sites there was a hint that the effectiveness of the herbicides may depend upon the state of growth of the bracken at the time, which would depend on such factors as climate, defoliation, damage by grazing animals to emerged fronds with subsequent stimulus to further frond emergence.

It may be that at the point when the frond has completed its growth and before it tends to photosynthesise to any great extent, it will have reduced the reserves in its rhizome segment to their lowest and it may then be most susceptible to herbicide action.

In November 1964, trials were carried out at Bray and Mount Compass using dimethylsulphoxide (DMSO) alone and with three other herbicides to see if the DMSO could overcome the block in the spread of herbicides in bracken. Very little effect from the use of the DMSO was noticed, either alone or in combination with the other herbicides.

1.3 Ground Cover Plants

In conjunction with experiments to find the long term effects of herbicides on unwanted vegetation, it was desired to introduce certain plants with the object of replacing flammable grasses with species likely to provide a permanently green cover of low flammability.

A total of seventeen species were planted in 1963 in June and September and in 1964 at eleven different sites at Turretfield, Mount Bold, Shepherd's Hill, Karoonda, Forster, Struan, Wandillo, Hatherleigh, Furner and Bray.

They were watered twice in the first summer, mulched with gravel, and in some cases fenced.

Of the species tested, survivals to August, 1968, were Eriocephalus at five sites, Arctotis, Myoporum, Mesembryanthemum at three sites.

Geranium, Dimorphotheca, Satureia at two sites.

Rosemary, Erica, Lantana at one site.

At a sand hill at Forster only two species were tried, Arctotis and Mesembryanthemum, and the Arctotis was still healthy in December 1970, when the sites was required for road relocation. One large clump was dying out in the centre, but smaller clumps were thriving. Mesembryanthemum was only just alive.

At Karoonda in May 1968, when all the trial plants were dead, just outside the fence on the roadside there was some very healthy pigface.

Six species of eucalypts (twelve plants) had been planted at Forster in 1964. Eight had died out by 1968 and were replanted but only three species were left by 1970 viz. E. gracilis, E. calycogona, E. gardneri. None of the replanted eucalypts survived to 1970.

1.4 Clare District

Following the serious Clare fire in 1965 it was decided that a trial showing how herbicides could provide safe roadsides and break the fence line "fuse", instrumental in spreading the recent fire, would be useful publicity.

In June 1965, a trial was put down on T. Edwards' and C. Northcott's properties using 4.48 kg/ha of atrazine - amitrole mixtures under the fence lines in a 2.4m strip using a side jet.

On the road side opposite T. Edwards' property a 20.1m strip was sprayed using three rates of atrazine and two rates of bromacil.

An assessment in September 1965, showed that the high rate of atrazine, and the atrazine-amitrole mixture had produced bare earth in most cases and bromacil had left healthy salvation Jane.

Results suggested that bromacil might be cheaper than atrazine-amitrole mixtures, and the manufacturers claim that it resists breakdown by sunlight.

It seems that this could be followed up by spraying both herbicides in summer and winter and comparing results.

This idea was adopted by the second appointee in Trial 3, W.E. 101, atrazine-amitrole mixture versus bromacil. Comparison Trial, on Page 11 of this report.

Overall bromacil was more effective but usually at a higher cost than atrazine-amitrole mixtures, partly due to the greatly reduced price of the latter herbicide.

1.5 Mount Crawford Roadside

Roadsides in the Adelaide Hills carry a heavy growth of annual and perennial grasses and other growth which eventually dries off and becomes a fire hazard. Herbicides could help to reduce this build up.

A roadside between Rundle and Cowell's property at Mount Crawford was sprayed to a width of 6.7m by side jet in May-June 1965 with atrazine and simazine at three rates and atrazine-amitrole mixture at two rates. An assessment in August 1965, showed that the highest rates of atrazine and simazine had performed very well but the atrazine-amitrole mixture had not performed as well as expected.

This seems to indicate that atrazine-amitrole mixtures may not be as effective in high rainfall areas possibly due to more resistant species. The roadside was resprayed in 1966 confirming the results from 1965.

1.6 Induced Feeding

Overseas work has shown that firebreaks can be prepared by spraying attractants on pasture and inducing sheep to selectively graze sprayed strips and produce firebreaks.

At Kybybolite in 1960 molasses was sprayed on a strip in a paddock grazed by wethers, and their grazing habits noted by day and night, but no selective grazing was noted.

At Struan and Turretfield in 1964, low rates of diuron were sprayed on strips across a paddock to induce a chemical fallow, but partly due to weather conditions, the trial was a failure.

It seems that this method is successful in summer rainfall areas, where sheep are looking for feed in the winter and are much more likely to look for a change in diet.

2. DEMONSTRATION PROGRAMME

Heavy phalaris growth occurs on many roadsides in the higher rainfall areas, especially in the South East. It is a traffic hazard reducing visibility, and a fire hazard in late summer. Some practical methods of reducing this threat and if possible converting the area to a commercial use were demonstrated.

2.1 Penola Road, Opposite Cemetery

In 1964, a phalaris control demonstration was laid down in co-operation with the Penola District Council opposite the Cemetery and Rymill's Road.

One area was burnt in May. Two adjoining areas were cultivated, one being sown to lucerne and the other to strawberry clover. A further area was slashed in August. Hay was cut in December from the burnt area and the two sown areas. The hay yield was the same from each treatment being 40 bales worth $10. As the costs of ground preparation and seeding the lucerne and strawberry

clover was $28.40 there was a net loss of $18.40. But, on the burnt plot the outlay was only $4.00 for super cutting and baling, yet the return was the same.

The area slashed in August was two metres high by March.

This trial could have continued producing for some time, but it was ruined by road relocation over the lucerne plot in 1965.

Three phalaris strips were sprayed by Penola District Council in heavy rain at the end of October 1964, using atrazine-amitrole mixture at 5.60, 11.20, 16.80 kg/ha - the highest rate "burnt" the phalaris back. Another strip using 11.20 kg.ha atrazine-amitrole mixture plus 2.10 litres/ha activated amitrole cut the phalaris to the ground.

By April 1965 a few green shoots were visible amongst the phalaris, but a one metre high red gum and numerous paspalum plants were undamaged.

2.2 Kingston -Millicent Road, near Clay Wells, District Council of Beachport

With the co-operation of Mr. John Lea and his manager, Mr. Milton Stewart, about 600m of the roadside adjoining the Kingston-Millicent road was worked up and sown to lucerne in 1964.

The lucerne established reasonably well but when examined in November 1965, it was stunted and in need of cutting and baling. The phalaris also needed cutting. The lucerne looked well until 1971 when the signs were taken down from the plot. It is still being mowed annually but in summer it is now mainly a phalaris roadside instead of lucerne patch.

Some herbicides were tested in strips on adjoining high phalaris with the object of desiccating it sufficiently to burn before December. It was possible to produce a strip suitable for burning with 4.1 to 4.8 kg/ha of 2,2-DPA plus 4.55 litres/ha of activated amitrole.

2.3 Clay Wells - Penola Road

Roadsides with natural and introduced grasses, clover and broad leaves are also a summer fire hazard and can be improved by herbicide treatment.

Both sides of the Penola road from Clay Wells corner were boom sprayed with the co-operation of Mr. J. Lea and Mr. J. Andre in September 1964. Herbicides used were diuron, activated amitrole, and atrazine - amitrole mixtures. Only the atrazine-amitrole mixtures at 4.37 kg/ha proved satisfactory and even this was not adequate against kangaroo grass and section rush.

2.4 Ross Plains Road

Herbicides can be particularly useful in controlling growth amongst hard to get at situations, such as along drain spoil banks and hard to cultivate and stoney areas.

Nine plots, 200m x 6.0m were sprayed by side jet along the spoil bank of the drain along the Ross Plains Road in September 1964.

Herbicides used were atrazine-amitrole mixtures, activated amitrole, and activated amitrole plus 2,2-DPA. An excellent kill was obtained with 4.14 kg/ha atrazine-amitrole mixtures but not so good with other treatments but all were burnt in November with varying results.

In November, 1965 the atrazine-amitrole strip was invaded by vigorous spear thistle, wild oats and other weeds showing that resistant or invading weeds following baring of the ground will need appropriate treatment.

A fence line sprayed in June showed a good chemical fallow effect - probably the rate was too low but three other strips showed excellent results in November 1965. Some planned grading of stones by the District Council had not been done.

2.5 Murray Bridge - Tailem Bend Road

This area was developed by the Mobilong District Council and the Highways Department and is showing results.

SECOND APPOINTEE

3. TRIAL WORK

3.1 Eucalypt Regrowth Control - W.E. 102, 103, 1/70, 2/70

After land clearing along roadsides, access tracks and fencelines, eucalypt regrowth is often a hazard, and its removal by manual or mechanical means is time consuming and expensive.

It was decided to carry out trials to see if herbicidal control would be more efficient and economical than traditional methods.

a. High Volume

To test the effect and economics of eucalypt regrowth control on roadsides and fencelines by the use of Tordon 50-D(R) Tordon 50-T(R), ester 2,4,5-T and mixed esters of 2,4-D + 2,4,5-T at high and medium rates, sprayed at high volume. Ten replications of nine treatments plus control were sprayed at Flinders Chase, Kangaroo Island, Warooka and Keith. The Warooka plot was sprayed twice. The regrowth treated was mainly 0.6-1.2m high, to 1.8m at Keith, and of mixed mallee species.

Results showed that 5.71 litres of Tordon 50-D(R), per 455 litres of water was the most effective and the only treatment to kill the leathery leaved E. incrassata. 1.7 litres of ester 2,4,5-T plus 4.6 litres of distillate was the most economic. Narrow leaved mallees were the most susceptible.

It is recommended that 2.3 litres ester, 2,4,5-T plus 4.6 litres distillate be used for general spraying, and 4.6 litres Tordon 50-D be used where resistant species are present.

b. Low Volume

A start was made at misting application at Warooka, but owing to mister breakdown was abandoned, though results were much better in the few trees treated than in the corresponding high volume work.

c. Basal Bark

A pilot trial at Warooka in January 1970, using Tordon 255(R) in distillate applied as basal bark and overall treatments gave most encouraging results with the former treatment.

Consequently a larger trial was laid down at Warooka and Keith in November, 1970, using Tordon 255(R) at 0.05, 0.1, 0.2% in distillate and ester 2,4,5-T at 1.0, 2.0, 3.0% in distillate basal bark, applied by knapsack and knapsack mister methods.

A final inspection in 1972 (after two years) showed -

1. Spraying at Keith was more effective than at Warooka and more economical in terms of the cost of trees killed.

2. Tordon 255(R) was more effective than ester 2,4,5-T.

3. Misting was more effective than knapsack treatments.

4. Of the species treated, susceptibility increased from E. incrassata, to E. foecunda, to E. diversifolia, to E. oleosa var angustifolia, to E. dumosa.

5. It pays to use the high rate in each case as the kill is highest with the high rate.

Note that E. dumosa was not sprayed high volume and that E. incrassata was the most resistant species to high volume sprays.

On Kangaroo Island where the trees were sprayed in May, 1971, the knapsack application was better than the mister, and ester 2,4,5-T more effective than Tordon 255(R). Mortality of most species was lower in 1972 than 1971 but on the resistant E. dumosa there was an improvement with the Tordon 255(R) sprays.

3.2 Furze Control, Gumeracha

Furze is a very aggressive plant, and is very undesirable on access tracks, fencelines and roadsides as it burns fiercely even when green. Its mechanical removal is expensive and it was decided to test if herbicide control would prove efficient and more economical than other means.

About 1.1km of a furze lined access track near the Lower Hermitage Road was sprayed in fine mild weather, using the Bushfire Research Committee's spray unit and a twist grip wand at 207.0 kpa, in November, 1967.

On one half of the track the furze had been burnt in May, but not on the other half which carried much bigger furze.

At the time of spraying, although the furze had finished flowering and seed pods were "popping" freely, the plants were still growing.

Treatments used were:-

Tordon 50-D(R) at two rates plus white oil, and two rates plus wetting agent.
Ester 2,4,5-T at one rate plus white oil and one rate plus wetting agent.
Tordon 50-D(R) plus ester 2,4,5-T at one rate plus white oil and one rate plus wetting agent.

Assessments were made in March and November, 1968.

a. Burnt Plots

All the Tordon 50-D(R) treatments gave a good initial effect on the furze, but by the second assessment the percentage apparent kill had been seriously reduced. The rates of Tordon(R) at 3 litres and 6 litres per 460 litres water were high and either this or the wetting agent may have burnt the leaves off too quickly, and allowed regrowth from the base of the plants.

With 2,4,5-T the initial effect was similar to Tordon 50-D(R). On the second assessment, the final kill was much better with white oil, and better still with wetting agent, which was the cheaper treatment. The white oil may have burnt the leaves, but the wetting agent evidently gave excellent wetting, and did not burn the leaves too soon, permitting good translocation to the roots.

The Tordon 50-D(R), 2,4,5-T mixture gave intermediate results, not so good initially, but better than Tordon 50-D(R) at later assessments.

Burning the plots gave poor results with Tordon 50-D, excellent results with ester 2,4,5-T and reasonable results with the mixture.

b. Unburnt plots

All treatments gave good initial effects on the furze, around 70% apparent kills. On the second assessment, all treatments but the mixture with wetting agent gave much improved results, up to 95% kills. The apparent kill of the mixture with wetting agent, however, decreased.

From these results it would seem there is no advantage in burning the furze before spraying. There may even be a disadvantage as the smaller burnt bushes would present a reduced leaf area to the spray. The greater the leaf area available to intercept the herbicides the more that is likely to be absorbed and translocated to the roots.

In this demonstration the most effective treatment was the cheapest namely 1.1 litres of 80% ester 2,4,5-T plus 4.5 litres wetting agent per 550 litres of water.

3.3 Comparison of atrazine-amitrole mixtures and bromacil W.E. 101

To confirm the opinion of T. Quinlan-Watson that bromacil sprayed in summer was more effective as a fire-break than atrazine-amitrole mixtures, a trial using four rates of each herbicide, replicated six times and randomised was laid down in June, 1969.

Sites were located at Turretfield Research Centre, at the Monarto Railway Siding, opposite the Greenacres Motel at Murray Bridge and at Kybybolite Research Centre.

Plots used were 0.0004 ha and the trial was repeated on adjoining sites in February, 1970. Spraying was done with a hand boom and the Bushfire Research Committee's spray unit.

With winter treatment in the short term, atrazine-amitrole treatments at 4.48 kg/ha gave the most economic results as far as bare earth was concerned. Increasing the rate did not increase the bare earth percentage to make the extra cost worthwhile. If a longer period of bare earth is required, the increased cost of using bromacil must be faced.

In general in the long term, bromacil was more effective than atrazine-amitrole mixtures, resulting in more bare earth, less medic and clover, less storksbill, capeweed and long fruited turnip.

Atrazine-amitrole gave more effective control of grass and salvation Jane except at Turretfield and Monarto.

Overall, winter treatments were more effective than those applied in autumn.

In summer treatment bromacil was more effective in all cases except in the control of salvation Jane.

3.4 Phalaris Control Trials, Roadsides W.E. 104, K/A_2 K/A_2 Extension

Phalaris tuberosa, because of its rank growth, is a distinct fire hazard on roadsides in late summer and by its effect on visibility at corners is also a traffic hazard. Traditionally it has been controlled by mowing and grazing. With improved pastures, the area of roadside infested is increasing, but in modern farming any form of control that has a high labour content has become impracticable. In many areas because of difficult terrain mowing is not feasible.

With the aim of investigating if any economic herbicide treatment could be found, a three year trial was laid down in 1971 using four herbicides at various rates and growth stages. Spraying was carried out in April and December, 1971. Plots were 3.6 metres x 80.5 metres and sprayed by boom spray by Bushfire Research Committee's spray unit. Herbicides used were 2,2-DPA, diuron, bromacil and activated amitrole.

In June, 1971, the phalaris on the 2,2-DPA plots had collapsed but by February, 1972, the plants had fully recovered except that a minor reduction in height was apparent. As no other worthwhile effects were produced it was decided to stop the trial, and carry out some small plot trials closer to Adelaide.

A site was selected at Mount Compass where a range of single and split application rates of 2,2-DPA could be tried.

Ten other herbicides considered potentially useful, were tried in logarithmic strips and one small plot of dichlorothiobenzamide granules were all applied in October, 1972, on a sandy site. The 2,2-DPA plots and one boom sprayed plot of glyphosate were repeated at Inman Valley on a heavy site.

An inspection in July 1973, showed that the single 2,2-DPA sprayings were not satisfactory, the split application plots were worth repeating elsewhere, the dichlorothiobenzamide granules would be worth trying in situations inaccessible to ordinary spray equipment, and five of the chemicals in logarithmic strips showed worthwhile control. Only the glyphosate showed promise at Inman Valley.

Four of the chemicals in the logarithmic strips produced barren patches, particularly at high rates. Glyphosate gave phalaris control nearly as satisfactory, but allowed vigorous annual grass and clover to re-establish which would be a much better result in most situations.

As a result, it was decided to return to Glenroy with two rates of 2,2-DPA rates applied in split applications and three rates of glyphosate, bromacil and karbutilate.

Three replications of these treatments were sprayed on 3.6 metre x 20.1 metre plots in October 1973.

An inspection in May, 1974, showed that the 2,2-DPA plots after a promising start had failed completely except for an inhibition in flowering and a reduction in height. Glyphosate was outstanding, assessed by the amount of dry phalaris and lack of regrowth. Karbutilate was nearly as satisfactory and even superior in one replication, but bromacil was well behind.

A further assessment should be made in December, 1974.

At first sight it seems that an economical herbicide control of phalaris has not been found. If the price of glyphosate when it is released is competitive with karbutilate or bromacil there could be a big future for this herbicide in phalaris control. It is safe to use near trees and shrubs and it allows other useful plants to invade and to assist in suppression. Karbutilate and bromacil besides being dangerous to trees and shrubs leave a "sterile desert" effect which accelerates erosion, and could be invaded by a plant much harder to control.

For successful control, use glyphosate at 2.02 kg a.i./ha (5.61 product/ha), or karbutilate at 5.38 kg a.i./ha (6.72 kg product/ha) around posts, culverts or corners. Large scale control must still be based on mowing or slashing.

4. DEMONSTRATION PROGRAMME

4.1 Fence Line Demonstration - Kangaroo Island

In many districts fires have been spread by burning along the fence line "fuse" of dried vegetation, and thus by passing otherwise "safe" areas, to start again in unprotected country. On Kangaroo Island this fence line often consists of flammable shrubs which will burn on a bad day.

The fence line at Flinders Chase, was covered by a "fuse" of growth 1.2m wide x 1.5m high of several different shrubs, but dominated by banksia and casuarinas, with some eucalypt shoots. In 1967, 3.8km were sprayed with ester 2,4,5-T and Tordon 50-D(R) but the rates used were too low, and little result was achieved.

In May 1971, a demonstration was laid down using three rates of Tordon 255(R) and ester 2,4,5-T im distillate, applied by both knapsack and mister as a basal bark spray.

Also an overall foliage spray Tordon 255(R) in distillate Tordon 50-D(R) and ester 2,4,5-T, ester 2,4,5-T + 2,4-D and Tordon 255(R) in water plus surfactants were used.

After two years banksias had succumbed to most of the treatments tried, but only six treatments gave kills of 80% or better on casuarina. The highest kills of casuarina of 90% plus were the three overall foliage sprays of Tordon 255(R) in distillate. The other high casuarina kills were basal bark sprays of ester 2,4,5-T in distillate. Adenanthos sp. was resistant to the sprays used, but was not a dominant species on the fence line.

4.2 Firebreak demonstration - Lochaber Lane B.F.R.D. 1/68

In the medium to high rainfall areas the roadsides support a considerable volume of flammable material, which will not dry off naturally before the surrounding country. Trials were designed to produce either bare earth or green firebreaks over summer, or to dry the vegetation off so it could be burnt while the rest of the country was green and burning was safe.

At the request of the Naracoorte and Lochaber Lane Fire Fighting Association a three year demonstration was laid down on the Lochaber Lane in June, 1968, with the following aims:-

1. To achieve economical long term vegetation control using herbicides on a site dominated by annual grasses and phalaris.

2. To show that high initial rates of soil sterilant are uneconomic.

A two stage programme was planned using:-

1. Three rates of atrazine-amitrole mixtures sprayed in June with rates (equivalent in cost) of diuron, bromacil, 2,2-DPA, activated amitrole, and 1.1 litres of paraquat plus suitable wetting agent on the north side of the Lane.

2. Lower rates of atrazine-amitrole mixture and others sprayed in October to be followed by burning while the rest of the country was green and burning was safe.

Plot size was 4.9m x 140.2m. Spraying was done with the Bushfire Research Committee's spray unit and there were three replications. Assessments were by visual rating of the vegetation present. Water use was initially 675 litres/ha, later 1010 litres/ha. Plots were to be retreated if necessary to reduce fire hazards or to control undesirable weeds.

a. Winter Treatment June 1968

Herbicides used were atrazine-amitrole mixture at 3.4, 4.5, 5.6 kg/ha and diuron, bromacil, 2,2-DPA and activated amitrole at similar cost rates. Very high rates of atrazine-amitrole mixture at 22.4 kg/ha and bromacil at similar cost rates to last five years were also tried.

An assessment in February, 1969, showed that atrazine-amitrole mixtures were a little ahead of diuron on bare earth and as a firebreak, and both were more effective than bromacil, with 2,2-DPA and activated amitrole far inferior.

Paraquat which was by far the cheapest treatment, had left a pure strawberry clover break in August, but by February grasses had come through and reduced its efficiency - a second spraying in October would help here. The two very high rates had left more than 96% bare earth, and were a very effective firebreak.

The highest rate of activated amitrole had left a wire weed "lawn" effect which would not burn.

June 1969

In 1969, the activated amitrole plots were sprayed as in 1968, and the paraquat plots were sprayed at the same rate but resprayed in October. In the atrazine-amitrole plots the two lower rates were sprayed at 2.2 kg/ha but the high rate plot was not sprayed. The other herbicides were again applied at equivalent cost rates. Also, a strip not sprayed in 1968 was treated with alternate plots of paraquat and a high rate of activated amitrole. To control a severe spear thistle invasion, the area was spot sprayed in August with ester 2,4-D at a dilution of 1 in 400.

An assessment in December, 1969, showed that the plots initially sprayed at the highest rate but not sprayed in 1969, had failed. Atrazine-amitrole sprayed 3.4 + 2.2 kg/ha gave 50% bare earth, while 5.6 kg/ha sprayed in 1968 and nil 1969 gave 10% bare earth. Similar results were obtained with the other herbicides.

Atrazine-amitrole mixture and diuron were again very similar in results, a little ahead of bromacil.

The paraquat plots resprayed in October controlled the grass but could not control some vigorous phalaris.

The very high rate of atrazine-amitrole in one replication failed completely and was covered with 60% vigorous ryegrass, wild oats and strawberry clover, and nil bare earth compared to the previous year's 95% bare earth.

The bromacil plot was also down to 30% bare earth, with heavy phalaris, wild oats, ryegrass and strawberry clover.

The August spraying of spear thistle was effective. The alternate strips of gramoxone and the high rate of activated amitrole produced short stands of strawberry clover and ryegrass which would retard fire.

1970 spraying

In 1970, the rates for activated amitrole and paraquats remained the same, while the two lower rates of atrazine-amitrole mixture were reduced to 1.7 kg/ha, and the top rate, not sprayed in 1969, was sprayed with 2.2 kg/ha, the other herbicides were applied at similar cost rates.

An assessment in February, 1971 showed that the 1.7 kg/ha rate of atrazine-amitrole mixtures and rates of equivalent cost of other herbicides were too low, confirming T. Quinlan-Watson's work, as they all gave reduced proportions of bare earth. The 2.2 kg/ha rate and equivalents on the high rate plots not sprayed in 1969 had increased the proportion of bare earth, but not back to its original level.

Atrazine-amitrole mixtures were the most effective herbicides both on bare earth and firebreak rating, diuron was second and bromacil third.

Activated amitrole was slightly more effective than 2,2-DPA as it gave about the same amount of bare earth, with less flammable material; however better phalaris control was obtained with 2,2-DPA.

Spring spraying November 1968

In November, 1968, the south side of the Lane was sprayed with atrazine - amitrole mixtures at 2.2, 3.4 and 4.5 kg/ha, and with diuron, bromacil, 2,2-DPA activated amitrole, paraquat and diquat at similar cost rates.

The idea was for the herbicides to desiccate the sprayed area so it could be burnt while the rest of the country was green and burning was safe.

As assessment in February, 1969 showed that the spraying was done too late. Only one replication was burnt, as, at firing the rest were too green and later the country was too dry. The area was later mown. The demonstration was a failure but it showed spring spraying must be carried out early enough to dry out the vegetation while the remainder of the country is green and burning is still safe.

Paraquat proved the most effective herbicide as assessed by the proportion of bare earth and as its efficiency as a firebreak. Activated amitrole was next and atrazine-amitrole mixture was third.

1969 Spraying

The 1969 spraying was done early in October, rates used were the same as 1968. Surfactants were added to all sprays. Diquat and paraquat were sprayed three weeks later to produce more even desiccation.

The Lane was burnt in November, 1969, and as assessment in December showed that atrazine-amitrole was by far the most effective both as to the proportion of bare earth obtained and its efficiency as a firebreak, bromacil and activated amitrole were next with the others about the same. The diuron plots carried a heavy phalaris crop. The burn was successful as nearly all ground cover grasses were burnt. Phalaris was rarely burnt to the ground but was weakened near ground level and lying over badly, and would have carried a fire later in the summer.

Mowing would probably be necessary as a second burn would be difficult with the ground cover gone.

1970 Spraying

In 1970 the same rates were used on the 1st and 29th October.

Owing to the peculiar spring in the South East, a wet November and December after a dry October, only 12 plots were burnt.

The atrazine-amitrole mixture was again the outstanding firebreak, well ahead of bromacil, activated amitrole and diuron.

On the 2,2-DPA sprayed in steady rain, the phalaris was considerably damaged. No other plot showed comparable damage, nor did the remaining 2,2-DPA plot sprayed next day in fine weather.

Summary

If a spray programme is being considered and bare earth is required, use atrazine-amitrole mixtures at 4.5 kg/ha in June, followed for the next three years by 3.3 kg/ha, and then down to 2.2 kg/ha. If clovers predominate and bare earth is not essential use 1.1 litres of paraquat plus suitable surfactant.

If possible avoid late spraying as weather conditions in late spring are so variable. If a satisfactory burn cannot be obtained, then mowing, grazing or cultivation are the main alternatives.

If a late spraying is necessary, use 4.5 kg/ha of the atrazine-amitrole mixture or paraquat at 7.0 l/ha.

4.3 Demonstration of Six Years Amitrole - Atrazine Mixture Spraying Extension to B.F.R.D. 1/68

At the conclusion of the main Lochaber Lane roadside firebreak demonstration, it was decided to continue spraying appropriate plots to demonstrate the effect of six years atrazine-amitrole mixture treatments.

June Spraying

Two replications of three plots were sprayed with 2.24, 4.5 kg/ha 1971, and with 3.4, 4.5, 5.6 kg/ha 1972, 1973. An assessment in December 1973, revealed more than 90% bare earth on all plots but one and a firebreak rating of 5 or better on a 0 completely ineffective -5 excellent scale.

The vegetation remaining consisted of odd ryegrass plants and strawberry clover, couch grass and wire grass.

A typical plot received 3.4 kg/ha in 1971, 1972, 1973, had 30% bare earth, a firebreak rating of 3+ and carried some strawberry clover, star thistle, phalaris and ryegrass.

October Spraying

Plots were sprayed each year with 2.2, 3.4, 4.5 kg/ha except for one replicate which was not sprayed in 1972. This replication had no bare earth and a firebreak rating of 0, but would have burnt well, as all grass was killed and phalaris damaged. Other plots carried 10-70% bare earth, a firebreak rating of 2-4 and some couch, strawberry clover, phalaris and some very short grass and odd dock.

4.4 Herbicide Firebreaks beneath Eucalyptus camaldulensis

Red gum roadsides in developed areas usually carry a fairly large volume of grass and other herbage which creates a fire hazard in summer. It was decided to set up two trials to see if this herbage could be controlled by herbicide without damage to the red-gums. The presence of the trees themselves make cultivation difficult.

Red Gums B.F.R.D. 1/71

Atrazine-Amitrole Mixture

A demonstration was set up in June, 1971, at the Big Brim Water hole, Naracoorte to show the tolerance of mixed aged red gum trees to annual applications of atrazine-amitrole mixtures applied to the vegetation under the trees for bushfire protection.

Strategic firebreaks were sprayed by means of a side jet on the Bushfire Research Committee's spray unit to a width of 4.9m, at 4.5 kg/ha.

Also the area surrounding the bases of selected trees of mixed ages were sprayed with 4.5, 9.0, 13.4, 17.9 and 22.4 kg/ha. Spraying was done in June, 1971, 1972, 1973.

At the final assessment in December, 1973, firebreaks carried 50-90% bare earth, vigorous English dandelion, phalaris and reeds. Wild oats and other grasses had been eliminated. Firebreak efficiency was 3+ on a 0 completely ineffective -5 excellent scale.

There was no visible effect on the red gums even at the highest rate used.

Although the red gums received herbicide up to 22.40 kg/ha annually for three years without any visible damage, this high rate is not recommended, but the normal fire protection rate of 4.48 kg/ha under these conditions must be considered safe.

Red Gums B.F.R.D. 2/71

Atrazine-Amitrole Mixture, Paraquat, Diuron-Amitrole Mixture

To show the tolerance of red gum trees of various ages to bushfire protection, applications of amitrole-atrazine mixtures, and paraquat, and their greater sensitivity to diuron-amitrole mixtures applied annually to the vegetation under the trees, a three year

demonstration was laid down in July, 1971, on the Edenhope and Kybybolite roads near Naracoorte.

The plots were 80.5m x 4.9m. The volume of application was 1120 l/ha, at a pressure of 207 kPa sprayed by side jet with the Bushfire Research Committee's spray unit.

Herbicide rates used were:-

1. Atrazine-amitrole mixtures at 3.4 kg/ha plus 0.7 litres/ha of a suitable wetter.

2. Paraquat at 1.4 litres/ha plus 1.4 litres/ha suitable wetter.

3. Diuron - amitrole mixture at 5.6 kg/ha plus suitable wetter.

Four replications were sprayed in 1971, 1972, 1973. At the final assessment in December, 1973, there was no noticeable effect on the red gums from any of the treatments.

Atrazine-amitrole mixtures gave 98, 75, 98, 95% bare earth, a firebreak rating of 5, 3, 5, 5 and residual growth of odd lucerne, ryegrass, wild oats, pussy tail, thistle, millet grass, phalaris, couch grass, and in one case vigorous phalaris.

Paraquat treatments gave bare earth of 40, 50, 5, 5% with firebreak ratings 2, 3, 3, 1 and residual growth of couch grass, phalaris, wild oats, hop clover, plantain, pussy tail, briar, wild sage, dock, thistles, ryegrass, wild turnip.

Diuron-amitrole mixtures gave bare earth of 99, 95, 60 and 5% with a firebreak rating of 5, 5-, 2 and 3+. Residual growth was couch grass, clover, wild oats, phalaris, plantain, thistles, fat hen, wireweed, lucerne, dock.

For fire protection under red gums the atrazine-amitrole mixtures are preferred to diuron-amitrole mixtures. In this demonstration atrazine-amitrole gave 25% more bare earth and though no spray damage to the red gums was noted, the mixture containing diuron would be much more likely to cause damage.

Paraquat would be most likely to clean up a grassy clover patch.

4.5 Firebreak Demonstration - Cleland Conservation Park

The roadsides surrounding Cleland Conservation Park are occupied by either dense woody perennials or grassy annuals, both of which are a serious fire hazard in summer. It was decided to demonstrate that herbicides could assist with this problem.

In 1968, two firebreak demonstration were put down.

At one site, woody perennials predominated and mixed esters of 2,4-D and 2,4,5-T were used. Unfortunately heavy rain immediately after spraying caused poor results.

At the other site, on Greenhill Road, grassy annuals predominated, and 4.5 kg/ha of atrazine - amitrole mixture gave good results in 1968, 1969, 1970.

4.6 Milang

In the irrigation areas, herbage is very dense along fencelines and reeds in the drains can greatly impede the flow of water. Both of these problems can be alleviated by herbicides.

Demonstrations were laid down at the Milang Irrigation Centre on fence lines, dock, kikuyu grass, and reeds in the inlet drain using amitrole-atrazine mixtures, dicamba, amine 2,4-D and 2,2-DPA in 1967.

In 1968 successful demonstrations for fire control were laid down along fence lines and ditches using 2,2-DPA against annual grasses and kikuyu grass.

4.7 Result Demonstration, Roadsides

The control of unwanted roadside vegetation is a continuing problem throughout the State, as it can become a serious fire hazard in summer. Control demonstrations were laid down in varied districts to show how this problem can be relieved.

In 1969, 1970, 1971 result demonstrations using atrazine-amitrole mixtures were laid down on roadsides at Mount Gambier, Lucindale, Mundalla, Strathalbyn, Second Valley, Tumby Bay, Yeelanna, Minnipa and Kimba. Results were good.

In 1972 a roadside at Lucindale was sprayed with 2,2-DPA at 44.80 kg/ha to control Phalaris, and later with 2.80 l/ha of ester, 2,4-D to control Buchan weed which had become a problem following atrazine-amitrole spraying. Results were variable.

4.8 Result Demonstrations, Georgetown, Crystal Brook

Over contour banks and under pipe-lines cultivation for fire protection is very difficult and it was decided to demonstrate the use of herbicides in these inaccessible situations.

In August, 1967, two result demonstrations were laid down at Georgetown and Crystal Brook, using atrazine-amitrole mixture at 4.48 kg/ha, 2.74m wide by means of boom spray and side jet.

Spraying was done on internal and external fence lines, under pipelines, and over several drain banks. Results were good.

5. INVESTIGATIONS

5.1 Herbicide Damage to Trees and Shrubs

The Department of Agriculture and the Bushfire Research Committee were very concerned that valuable trees and shrubs had been damaged or killed with herbicide treatments used for removing unwanted vegetation for fire protection or other reasons. In some instances, death or damage may have been due to incorrect application techniques or by the choice of herbicides unsuitable for the situation.

Often there is just not enough information about the particular herbicide being used. It was thought that there must be amongst spray operators, District Councils, chemical companies and others a large amount of information on this subject of both successful and unsuccessful treatment.

In order to gain as much information as possible two questionnaires were prepared and sent out to all District Councils, City Councils and Corporations, Research Centres of the Department of Agriculture, Forest Reserves, chemical companies, spray operators and golf clubs.

From the 263 questionnaires sent out, a total of 95 replies were received. Of these 49 claimed no knowledge of any damage, and some of these were from Councils with quite active spraying progammes.

Replies were received from 49 out of 138 Local Government bodies.

Atrazine-amitrole mixtures caused the most trouble, which is not surprising as they would probably be the herbicides most commonly used for fire protection or footpath clearing. In most cases, they were used too close to trees, or at too high a rate. Duranta sp. hedges are evidently susceptible especially where they receive the runoff from footpaths. Spraying outside the drip line of trees and shrubs is a wise precaution.

Species killed included pines, eucalypts, wattles, sheoaks, albizzia, lavender, duranta, apricots and plums - all could be successfully sprayed around with sufficient care.

Ester 2,4-D caused damage on eight occasions including death to poplars and some eucalypts. These were mainly seedlings in off-target damage from aerial spraying. In one case, navel oranges were damaged but other orange varieties were not affected. Tordon 50-D(R) caused death or damage to sugar gums up to 6m away from the spraying site. Norfolk Island pines were also killed or very severely damaged 2m from spraying site.

Diuron used to sterilise drains caused severe damage and death to eucalyptus, pines, hakeas, and oleanders planted up to 5m from the drains. Pepper trees and Canary Island pines planted in similar positions were not affected. Damage was also apparent up to 700m down the drain from the sprayed area. Diuron was also suspected of killing many red gums along a road after firebreak spraying.

Bromacil, ground sprayed for grass control, killed or damaged 27 pines, 5 fruit trees, 8 almonds, 3 shrubs, 7 pepper trees. At another location red gums, blue gums and tamarisks were killed or damaged. Bromacil should be kept 30m away from any tree except citrus.

Borascu caused damage and death to several trees due to storm water runoff from treated areas. Weedex Granules (paraquat and diquat) were used around up to 100 trees and shrubs with no damage, at times right up to the tree.

MCPA killed a pincushion hakea and 6 lagunarias from drift. Ester 2,4,5-T caused drift damage to various trees and vines.

2,2-DPA was sprayed around various trees with no resulting damage.

Simazine caused death to three trees of Eucalyptus spatulata when a spray tank was emptied and washed out, 3-13m from them.

Atrazine killed Auracaria excelsa, and various eucalypts when sprayed around them. Probably the rate used was excessive. Activated amitrole damaged four pines but they recovered and Weedazol T.P.(R) damaged three trees, but these also recovered.

Erase(R) granules were blown by north winds from an area to be covered by rubble to vegetables and shrubs. Vegetables were killed and shrubs damaged.

Karbutilate sprayed in error caused death and damages to many trees and shrubs. Karbutilate, and bromacil should be kept 30m from trees and shrubs. Picloram and diuron should be kept back at least 15m.

Plants are much more susceptible when a water source was treated where their roots could be feeding.

The recommended rate should not be exceeded when spraying near trees, and shrubs, and the safest policy is to keep outside the drip line of the crowns unless simazine is used.

5.2 Fire Fuel Investigation, Cleland Conservation Park

A heavy accumulation of combustible fuel in summer is a serious roadside and internal problem at Cleland Conservation Park. So is the spread of African daisy. Preliminary assessments were made with a view to fuel reduction and daisy control.

An assessment was made in 1972 of the available ground fuel in the above Park, in preparation for a proposed prescription burning scheme. Variations of fuel quantity and slope have been recorded.

5.3 South African Daisy Investigation, Cleland and Horsnell's Gully Conservation Parks

A preliminary investigation was made into the occurrence and intensity of African daisy in the above Parks in 1971. It is thought that there is a correlation between fire intensity and African daisy infestation.

6. FUTURE WORK

Further to the work reported here, it appears that more research could be profitably carried out in the following areas:-

1. Glyphosate

   Further tests with glyphosate on phalaris on other roadside vegetation, combined with burning, mowing or cultivation.

2. Channel Banks

   These areas among others, commonly carry very dense vegetation creating a visibility hazard for traffic and a fire hazard in autumn. More information is needed to cope with these particularly dense infestations which require an effective but non leaching treatment.

3. Ecological Studies

   As suggested in T. Quinlan-Watson's report to the Chairman of the Bushfire Research Committee, it would be desirable to carry out ecological studies of vegetation burnt at various times of the year, to see what desirable species were lost and undesirable species came in, and erosion of the site.

4. Further demonstration and publicity work. Even the information gained to date might be profitably demonstrated in other areas.

7. PUBLICATIONS

T.A.F. Quinlan-Watson (1966-67)

"A New Look at Roadsides" - First published in S.A. Journal of Agriculture, December 1966, March 1967. Leaflet 3862, 1967.

L.T. Jacobs (1972)

"Chemical Control of eucalypt regrowth on fire access tracks and under fence lines" - Dept. Ag. Special Bulletin, No. 9.72.

APPENDIX 1

BOTANICAL GLOSSARY

Acacia spp.	Wattles
Adenanthos	*Adenanthos spp.*
Albizia lophantha (Willd.)Benth.	Crested wattle or Albizia
Almond	*Prunus amygdalus* L.
Apricot	*Prunus armenaica* L.
Arctotheca calendula (L.) Levyns	Capeweed
Arctotis	*Arctotis stoechadifolia* Berg.
Aristida spp.	Wiregrasses
Araucaria heterophylla (Salisb.) Franco	Araucaria or Norfolk Island Pine
Avena fatua L.	Wild oats
Banksia	*Banksia ornata* (FvM)
Bracken	*Pteridium esculentum* (Forst.f.) Nakai
Brassica tournefortii Gouan	Wild turnip
Briar	*Rosa canina* L.
Capeweed	*Arctotheca calendula* (L) Levyns
Carpobrotus spp.	Pigface (erroneously termed "mesembryanthemum")
Casuarina	*Casuarina spp.*
Centaurea calcitrapa L.	Star thistle
Chenopodium album L.	Fat hen
Cirsium vulgare Ten.	Spear thistle
Citrus sinensis L.	Orange
Clover	*Trifolium spp.*
Clover, Hop	*Trifolium procumbens* L.
Clover, Strawberry	*Trifolium fragiferum* L.
Clover, Subterranean	*Trifolium subterraneum* L.
Couch	*Cynodon dactylon* Pers.
Cynodon dactylon Pers.	Couch grass
Daisy, African	*Senecio pterophorus* DC.
Dandelion, English	*Teraxacum officinale* Weber
Dimorphotheca	*Osteospermum jucundum* (Phillips) Norl.
Docks	*Rumex spp.*
Echium lycopsis L.	Salvation Jane
Erica	*Erica darleyensis* Bean
Eriocephalus	*Eriocephalus africanus* L.
Erodium spp.	Storksbill (erroneously termed "Geranium")
Erodium botrys (Cav.) Bertol.	Giant storksbill
Eucalyptus calycognna Turcz.	Square-fruited mallee
E. camaldulensis Dehnh.	Red gum
E. eladocalyx FvM.	Sugar gum
E. diversifolia Bonpl.	South Australian coastal mallee
E. dumosa A. Cunn	White mallee
E. foecunda Schaver	Slender leafed red mallee
E. gardneri Maiden	Blue mallet
E. gracilis FvM.	Yorrell
E. incrassata Labill	Ridge-fruited mallee
E. leucoxylon FvM.	Blue gum
E. oleosa var. angustifolia Maiden	Red mallee
E. spathulata Hook	Swamp mallet

APPENDIX I (Contd.)

Fathen	Chenopodium album L.
Fumitory	Fumaria spp.
Furze	Ulex europaeus L.
Gorse	Ulex europaeus L.
Grass, Couch	Cynodon dactylon
Kangaroo	Themeda australis (R.Br.) Stapf
Kikuyu	Pennisetum clandestinum Hochst ex Chiov.
Millet	Panicum miliaceum L.
Wire	Aristida spp.
Gum, Blue	Eucalyptus leucoxylon FvM
Red	E. camaldulensis Dehnh
Sugar	E. cladocalyx FvM
Hakea	Hakea spp.
Harestail grass	Lagurus ovatus L.
Hirschfeldia incana (L) Lagr. Foss.	Buchan weed
Juncus articulatus L.	Section or jointed rush
Lagunaria	Lagunaria spp.
Lagurus ovatus L.	Harestail grass or pussy tail
Lantana	Lantana montevidensis (Spreng.)Briq.
Lavender	Lavandula stoechas L.
Lolium spp.	Ryegrass
Lolium perenne L.	Perennial ryegrass
Lucerne	Medicago sativa L.
Mallee, Red	Eucalyptus oleosa var. angustifolia Maiden
Ridgefruited	E. incrassata Labill.
Slender, leaved red	E. foecunda Schauer
South Australian coastal	E. diversifolia Bonpl.
Square fruited	E. calycogona FvM
White	E. dumosa Cunn.
Mallet, Blue	E. gardneri Maiden
Swamp	E. spathulata Hook
Medicago spp.	Medics
Medicago sativa L.	Lucerne
Mesembryanthemum (erroneously)	Carpobrotus spp.
Myoporum	Myoporum parvifolium R.Br.
Nerium oleander L.	Oleander
Oats, Wild	Avena fatua L.
Oleander	Nerium oleander L.
Orange tree	Citrus sinensis L.
Osteospermum jucundum (Phillips) Norl.	Dimorphotheca
Panicum mileaceum L.	Millet grass
Paspalum	Paspalum dilatatum Poir.
Pennisetum clandestinum Hochst. ex Chiov.	Kikuyu grass
Pepper tree	Schinus molle L.
Phalaris	Phalaris tuberosa L.
Phragmites communis Trin	Reed

APPENDIX I (Contd.)

Pigface	Carpobrotus spp.
Pine, Canary Island	Pinus canariensis C. Smith
Norfolk Island or Araucaria	Araucaria heterophylla (Salisb.) Franco
Plantain	Plantago spp.
Plum	Prunus domestica L.
Polygonum aviculare L.	Wireweed
Poplar	Populus italica L.
Prunus amygdalus L.	Almond
P. armenaica L.	Apricot
P. domestica L.	Plum
Pteridium esculentum (Forst.,f) Nakai	Bracken
Pussy tail	Lagurus ovatus L.
Radish, Wild	Raphanus raphanistrum L.
Reed	Phragmites communis Trim
Rosa canina L.	Briar
Rosemary	Rosmarinus lavandulacevs L.
Rumex spp.	Dock
Rumex angiocarpus Murb.	Sorrel
Rush, Jointed or Section	Juncus articulatus L.
Ryegrass	Lolium spp.
Ryegrass, Perennial	L. perenne L.
Sage, Wild	Salvia verbanaca L.
Salvation Jane	Echium lycopsis L.
Satureia	Satureia montana L.
Schinus molle L.	Pepper tree
Senecio pterophorus DC.	African daisy
She-oak	Casuarina spp.
Sonchus oleraceus L.	Milk thistle
Sorrel	Rumex angiocarpus Murb.
Storksbill	Erodium spp.
Storksbill, Giant	Erodium botrys (Cav.) Bertol.
Tamarisk	Tamarix spp.
Taraxacum officinale Weber	English dandelion
Themeda australis (R.Br.) Stapf	Kangaroo grass
Thistle, Milk	Sonchus oleraceus L.
Spear	Cirsium vulgare Ten
Star	Centaurea calcitrapa L.
Trifolium spp.	Clovers
T. fragiferum L.	Strawberry clover
T. procumbens L.	Hop clover
T. subterraneum L.	Subterranean clover
Turnip, Wild	Brassica tournefortii Gouan
Ulex europeaus L.	Furze or gorse
Wattles	Acacia spp.
Wattle, Crested	Albizia lophantha (Willd.)Benth
Wireweed	Polygonum aviculare L.
Yorrell	E. graxilis FvM

APPENDIX II

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APPENDIX III

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