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A STUDY OF VARIOUS METHODS AND HERBICIDES IN EUCALYPTUS REGROWTH CONTROL

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SUMMARY

Methods of controlling suckering which follows the ringbarking of bloodwood (*Eucalyptus dichromophloia*) in subcoastal southern Queensland were investigated.

The most effective control resulted from the use of 2,4,5-T butyl ester applied into a continuous frill cut at or very near ground level. Diesel distillate proved much more effective than water as a carrier for 2,4,5-T butyl ester. The effectiveness of treatment was independent of the season of application and of the topography and soil types on which bloodwood occurs.

The disadvantages of this method of treatment and the possibilities of applying 2,4,5-T butyl ester as a bark spray are discussed.

I. INTRODUCTION

In the grazing areas of coastal and subcoastal southern Queensland, which were for the most part open eucalypt forests, the problem of sucker and seedling regeneration following ringbarking is serious. Considerable controversy exists among primary producers as to the best method and season for ringbarking. Factors which are said to affect the degree of suckering following ringbarking include: the species treated, seasonal conditions, topography, soil type, method of ringbarking, time of treatment and subsequent burning practices.

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Fox and Johnson (1957) in 1953 and 1954 applied various derivatives of 2,4-D and 2,4,5-T to waist-high frills, cut stumps and foliage of bloodwood (*Eucalyptus dichromophloia* F. Muell.) at "Brian Pastures" Pasture Research Station, Gayndah, in subcoastal southern Queensland. They concluded that hormone-type herbicides, whether applied to the frill or to the foliage, were ineffective in controlling bloodwood regrowth in the concentrations used and under the environmental conditions of the experiments.

A fresh series of investigations was commenced by the author in the same locality in 1957 to test the effectiveness of various herbicides and methods of application in tree regrowth control. Almost all of the experimental work was with bloodwood.

II. METHODS AND RESULTS

In this paper several experiments are described. Unless otherwise stated, treatments were applied to bloodwood trees approximately 20 ft high with a diameter of 4-6 in. at waist height and with clean, single-stemmed boles (Young 1961). Individual trees were selected at random and identified with metal tags. Trees were judged to be killed when the main trunk had shed all bark and no post-treatment suckering was noted.

(a) Experiment 1: Effect of Various Herbicides and Methods of Application

In the initial experiment of the series, which was designed to screen a number of herbicides, four methods of application were also examined:—

1. A complete frill at waist height, in which all axe cuts overlapped; designated "normal frill".
2. A complete frill at or very close to ground level; designated "basal frill".
3. Similar to 2, but without overlapping of axe cuts; designated "basal axe cuts".
4. Boring with a $\frac{3}{8}$-in. auger 4–6 equidistant sloping holes approximately 2 in. deep in the trunk at ground level; designated "basal holes."

The treatments are listed in Table 1. There were 4 replications of 4 trees per treatment plot. To obtain some assessment of the effect of season of application, the treatments were applied in September 1957, when new season growth was noted; in mid February 1958, at flowering; and in August 1958, during a period of slow growth.

Tree mortality in experiment 1, averaged for the three treatment application times, is shown in Table 1.

TABLE 1

EXPERIMENT 1: PERCENTAGE MORTALITY OF BLOODWOOD 16 MONTHS AFTER VARIOUS TREATMENTS

Treatment	Normal Frill	Basal Frill	Basal Axe Cuts	Basal Holes	Mean
1. Control	8	8	0	0	4
2. 2,4,5–T butyl ester (2% a.e.) in diesel distillate	75	100	58	75	77
3. 2,4,5–T butyl ester (2% a.e.) in water	17	42	0	0	15
4. Trichlorbenzoic acid (ACP–M–177) in diesel distillate, 0·2 lb/gal ..	11	42	0	0	13
5. ACP–M–177 in water, 0·2 lb/gal ..	17	67	0	8	23
6. Trichlorbenzoic acid (Benzac 103A) in diesel distillate, 0·2 lb/gal ..	25	33	0	0	15
7. Benzac 103A in water, 0·2 lb/gal ..	0	58	17	8	21
8. Ammonium sulphamate, 5 lb/gal ..	25	83	25	67	50
9. Amino triazol, 5 lb/ac	25	50	25	17	29
10. Diesel distillate	8	58	0	17	21
Mean	21	54	13	19	

Application in a basal frill was clearly the superior method. The normal method of frilling resulted in very poor percentage kills.

The most effective herbicide was 2,4,5-T butyl ester carried in diesel distillate. Water proved an ineffective carrier for this herbicide in this experiment. Ammonium sulphamate showed some promise, but further work with this chemical was not carried out in view of the degree of control achieved with 2,4,5-T. Although quite good kills were recorded with normal frilling using 2,4,5-T, the application of this herbicide in basal frills resulted in a 100% kill at each period. The degree of control achieved with any treatment was not greatly influenced by the season of application.

(b) Experiment 2: Effect of Various Concentrations of 2,4,5-T

In 1958 the effectiveness of three concentrations of 2,4,5–T butyl ester was examined, using three methods of application. The herbicide at 1%, 2% and 3% acid-equivalent of active constituent, carried in diesel distillate, was applied into basal holes, basal axe cuts and a basal frill. Four replications of each treatment were applied, using 20 trees per plot.

The results are shown in Table 2. Basal frilling was again the superior method of treatment and no differences between concentrations of 2,4,5-T were measured with this method of application.

TABLE 2

EXPERIMENT 2: PERCENTAGE TREE MORTALITY WITH VARIOUS CONCENTRATIONS OF 2,4,5–T BUTYL ESTER

Treatment Method	Percentage Concentration 2,4,5–T			Mean
	1	2	3	
Basal holes	39·8 (0·683)	60·3 (0·889)	98·7 (1·455)	71·6 (1·009)
Basal axe cuts ..	60·5 (0·891)	65·1 (0·939)	60·3 (0·889)	62·0 (0·906)
Basal frill	94·7 (1·339)	98·7 (1·455)	98·7 (1·455)	97·6 (1·416)
Mean	68·1 (0·971)	79·0 (1·094)	91·0 (1·266)	

Necessary differences for significance	5%	1%
Main effects**	(0·181)	(0·245)
Treatment combinations**	(0·313)	(0·424)

Inverse sine values in parentheses

(c) Experiment 3: Effect of Time of Application

As the season of application was popularly considered to influence the degree of regrowth which develops subsequent to normal ringbarking, a trial was designed to examine the effect of time of application on the efficacy of 2,4,5-T butyl ester in preventing suckering when applied in a basal frill.

TABLE 3

EXPERIMENT 3: EFFECT OF TIME OF APPLICATION ON PERCENTAGE TREE MORTALITY

Treatment Time	2,4,5–T	Control
1960—		
Jan.	100	32
Feb.	96	12
Mar.	88	20
Apr.	100	16
May	100	4
June	96	Nil
July	100	Nil
Aug.	96	4
Sept.	92	8
Oct.	84	4
Nov.	100	Nil
Dec.	96	Nil
1961—		
Jan.	100	4
Feb.	100	Nil
Mar.	100	4
Apr.	92	Nil

For a period of 16 months from January 1960 to April 1961, bloodwood was treated by this method in the first 7 days of each month. On each occasion 100 trees were completely frilled at the base; 2,4,5-T butyl ester at 2% concentration carried in diesel distillate was applied to 50 of the trees. Five replications were arranged with 10 trees per plot. No real seasonal difference was measured in the percentage kill recorded 16 months after each application. The mean mortality over the whole period during which 2,4,5-T was used was 96% for the 2,4,5-T treatment (Table 3).

(d) Experiment 4: Effect of Paraquat and Diquat

In a further experiment, the two plant desiccants paraquat and diquat (now named "Gramoxone" and "Reglone"), diquaternary ammonium compounds, were applied to basal frills at concentrations of 2% and 5% in water, with or without wetting agent (0·1% "Agral"), in all combinations; 2% 2,4,5-T in diesel distillate was included as a standard. The experiment was arranged with 6 replications of the 9 treatments, with 5 trees per plot.

All treatments resulted in an excellent kill with no post-treatment suckering; mean percentage mortality ranged from 90 to 100%. Water proved to be an effective carrier. However, at the time of application, the costs of applying diquat or paraquat in water exceeded the cost of applying 2,4,5-T butyl ester in diesel distillate.

(e) Experiment 5: Effect of Various Carriers

In an attempt to reduce costs, experiments were conducted to examine the efficacy of carriers other than diesel distillate alone for 2,4,5-T butyl ester. Five treatments were applied with 6 replications of 10 trees per plot, using 2% 2,4,5-T butyl ester applied in a basal frill.

The results are shown in Table 4. In this experiment the dilution of diesel distillate with sump oil reduced the effective kill from 85·4 to 71·4%. Carriers of diesel distillate-water emulsions and of water alone proved ineffective.

TABLE 4

EXPERIMENT 4: EFFECT OF VARIOUS CARRIERS ON EFFICACY OF 2,4,5–T

Carrier	Percentage Tree Mortality
100% diesel distillate	85·4 (1·178)
50% diesel distillate: 50% sump oil ..	71·4 (1·007)
25% diesel distillate: 75% water ..	59·7 (0·883)
12·5% diesel distillate: 87·5% water ..	54·1 (0·827)
100% water	25·2 (0·525)
Necessary difference for significance 5%	(0·275)
Necessary difference for significance 1%	(0·375)

Inverse sine values in parentheses

In a subsequent experiment, the results of which may have been prejudiced by an accidental grass fire which burnt through the area, the use of sump oil: diesel distillate in a ratio of 2:1 as a carrier gave 67% mortality compared with 70% mortality using undiluted diesel distillate.

(f) Experiment 6: Effects of Topography, Soil Type, Herbicide Concentration and Method of Application

All experiments previously described were conducted on basaltic derived clay soils of heavy texture. Usually the treated trees were growing on moderate slopes in a soil of shallow depth. As topography and soil type were claimed by some primary producers to be factors influencing the degree of regrowth following normal ringbarking, an experiment was carried out with bloodwood growing on deep granitic sand flats and steep granitic ridges. Using three methods of application—basal frill, basal axe cuts, and basal holes—2,4,5-T butyl ester carried in diesel distillate was applied at 0%, 1%, 2% and 3% in all combinations, using 5 replications of 10 trees per plot.

Topography and soil type did not appear to influence the degree of kill. As in previous trials, basal frill was again the superior method, and when applied in this manner no differences between concentrations of the herbicide used were measured (Table 5). However, complete frilling at the base proved ineffective when no herbicide was applied.

TABLE 5

EXPERIMENT 6: PERCENTAGE TREE MORTALITY WITH VARIOUS CONCENTRATIONS OF 2,4,5-T BUTYL ESTER

Treatment Method	Percentage Concentration 2,4,5-T				Mean
	Nil	1	2	3	
Basal holes	0·0 (0·0)	28·8 (0·566)	14·4 (0·389)	41·0 (0·695)	16·1 (0·412)
Basal axe cuts	5·9 (0·245)	54·8 (0·834)	84·2 (1·162)	81·1 (1·121)	55·5 (0·840)
Basal frill	19·6 (0·458)	98·4 (1·442)	99·1 (1·478)	99·6 (1·506)	88·3 (1·221)
Mean	5·4 (0·234)	65·9 (0·947)	71·7 (1·010)	80·0 (1·107)	

Necessary differences for significance ..	5%	1%
Treatment method**	(0·143)	(0·191)
Concentrations**	(0·165)	(0·221)
Treatment combinations* ..	(0·286)	(0·382)

Inverse sine values in parentheses

III. DISCUSSION

Evidence from the experiments described in this paper indicates that post-treatment suckering of bloodwood can be effectively controlled by the use of 2,4,5-T butyl ester. The best control was obtained using 2% concentration of this herbicide in diesel distillate applied to a basal frill. Effective control using this method was independent of the season of application, topography and soil type. The need to apply the treatments to the base of the trunk at or near ground level was clearly demonstrated.

When normal frilling is practised with no herbicide added, trunk suckering commonly occurs immediately below the frill. When 2,4,5-T is applied to a waist-high frill, suckering in the area immediately adjacent to the frill is largely prevented. Considerable trunk suckering occurs as close as 4–6 in. below the frill, although basal suckering is more commonly noted. This evidence would suggest that 2,4,5-T applied to a waist-high frill is transported downwards over a very restricted distance. In property application of the method, incorrect basal frilling, in which the frill was cut 4–5 in. above ground level instead of at ground level, was noted from time to time. In these cases, suckering from ground level was sometimes observed, despite the use of 2,4,5-T at 2% concentration.

The necessity to frill at or very near ground level, and the ineffectiveness of water as a carrier in these experiments, pose practical difficulties.

In an attempt to obviate the necessity for frilling, methods of bark spraying were investigated. In a trial conducted in conjunction with experiment 1, the application to the basal bark of 2% 2,4,5-T butyl ester carried either in diesel distillate or in water resulted in a kill of less than 20%. Many of the treated trees were completely unaffected. Of the remainder, the majority were initially defoliated but quickly produced new foliage. Considerable basal suckering was noted. Apparently little of the applied herbicide penetrated the bark tissue.

Following recent work by de Jonge (personal communication), the use of the chemical dibutyl phthalate as an aid to the penetration of 2,4,5-T butyl ester through the bark tissue was investigated. While final results from this work are not yet available, initial trends suggest that dibutyl phthalate aids the penetration of 2,4,5-T through the bark tissue, resulting in rapid defoliation of the treated trees. When the herbicide is applied as a spray band waist-high, the aerial growth is rapidly killed but profuse trunk suckering occurs approximately 6 in. below the spray band. Application as a basal spray appears more efficacious, although some suckering from the region of the hypocotyl occurs. Further investigation of the potential of such penetrating agents is required.

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