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SOME STUDIES INTO THE CHEMICAL CONTROL OF DAWSON GUM OR BLACKBUTT (EUCALYPTUS CAMBAGEANA)

Part II—Stem Injection of Sapling Trees

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SUMMARY

This paper is the second in a series on the chemical control of Dawson gum (*Eucalyptus cambageana* Maiden). Results of experimental work into the control of sapling trees by stem injection are discussed.

Stem injection using picloram plus 2,4,5–T resulted in kills in excess of 90% following treatments in the winter, spring and autumn. Picloram plus 2,4–D was less effective while 2,4,5–T treatments were significantly poorer than treatments with the picloram-based chemicals. Treatments in the moderately wet winter were significantly better than treatments in the dry spring and dry autumn, but this was largely due to the reduced effectiveness of the 2,4,5–T treatments under the drier conditions.

Applications of chemicals to the trunk at intervals of 10 cm at waist height and at the base were equally effective. The picloram-based chemicals with dose rates of 2% picloram at 1 ml per cut were marginally better than dose rates of 1% picloram at 2 ml per cut.

I. INTRODUCTION

The first paper in this series (Johnson and Back 1974) dealt with the control of virgin trees, defined as trees exceeding 60 cm in circumference at waist height. Stem injections using various techniques and chemicals were tested but all treatments were imposed only in a summer of average rainfall. In the trials discussed in this paper, similar techniques were tested on single stemmed saplings but an attempt was also made to evaluate the influence of seasonal conditions.

II. MATERIALS AND METHODS

EXPERIMENTAL AREA. The trial was established on the Brigalow Research Station, 32 km north-west of Theodore. The single-stemmed saplings averaged 3 to 7 m in height and resulted from the clearing or disturbance of brigalow (*Acacia harpophylla*)—Dawson gum open forests. The average basal circumference of the sapling population was 26 cm and the range 13 to 61 cm. The average circumference at waist height was 17 cm and the range 7 to 46 cm. The soils are loamy, duplex soils mainly Db.1.43, Dy2.43 and Dd1.43 (Northcote 1971).

CHEMICALS AND RATES OF APPLICATION. Three chemicals were used in the experiment—

1. Picloram + 2,4,5–T amine (Tordon 105) containing 5% a.e. picloram and 20% a.e. 2,4,5–T both present as the triethylamine salts;
2. Picloram + 2,4–D amine (Tordon 50D) containing 5% a.e. picloram and 20% a.e. 2,4–D both present as the triisopropanolamine salts; and
3. 2,4,5–T amine (Farmco TA 20) containing 20% a.e. 2,4,5–T present as the dimethylamine salt.

Details of rates of application are given in table 2. With each chemical, two dose rates were injected but in both cases the same amount of active ingredient was used. For example, with picloram + 2,4,5–T amine, 2 ml of a 1% picloram solution and 1 ml of a 2% picloram solution were used. This was done to determine whether the injection cuts in the smaller saplings would hold the higher volumes without spillage.

METHOD OF APPLICATION. Two different injection heights were used: waist-high (1 m) and basal (0 to 10 cm). Waist-high cuts were made with a small axe and an automatic vaccinator syringe was used to inject the chemical. Basal injections were made with a tree injector spear (JKL gun) but, because the dosage regulator was not reliable enough for trial work, the chemical was dispensed with a vaccinator syringe.

In both cases, the spacing of the cuts did not exceed 10 cm (centre to centre).

TIMES OF APPLICATION. Applications were made at three times—

1. 17 July 1968, moderately wet winter;
2. 11 November 1968, dry spring; and
3. 22 April 1969, dry autumn.

EXPERIMENTAL DESIGN. Two experimental blocks were selected.

Block 1. This contained regrowth which established following the ringbarking of a brigalow—Dawson gum—wilga (*Geijera parviflora*)—sandalwood (*Eremophila mitchellii*) forest (Community C4—Johnson 1966).

Block 2. This contained regrowth which followed the pulling of a brigalow—Dawson gum—wilga forest (Community C6—Johnson 1966).

Within each block, trees were selected at random for treatment. A 3 (times of application) X 6 (chemical treatments) X 2 (methods of injection) factorial design was used. Trees with injection cuts at waist height and at the base but without chemical injection were used as controls.

After treatments had been applied at the first time of application, it became obvious there were insufficient trees remaining in block 2 to complete the trial. A third block was then selected for the remaining treatments.

Block 3. This contained regrowth of unknown origin growing in association with small brigalow trees in a disturbed brigalow—Dawson gum—wilga community (Community C6—Johnson 1966). Because the saplings tended to be taller and less branched than those in block 2, and the soil was more clayey, it was felt that results from the first time of treatment in block 2 were not directly comparable with those at subsequent times in block 3.

DATA COLLECTION. All selected trees were tagged and the circumference at waist height and at the base measured before treatment.

Two interim counts were made 6 months and 12 months after treatment and a final assessment was undertaken 18 months after treatment. Dead and live trees were noted and percentage defoliation recorded on all live trees using six class intervals, 0–5, >5–25, >25–50, >50–75, >75–95, >95–100.

Rainfall and soil moisture were monitored at a site about central to the trial areas. The soil at the monitoring point, a gilgaied dark cracking clay (Ug5.24, Ug5.25, Northcote 1971), was not the same as at the trial sites. The soil moisture data do, however, reflect the relative soil moisture at the three times of treatment.

III. RESULTS

Rainfall and soil moisture data are presented in table 1.

Because block 2 contained too few saplings to complete the trial and a third block had to be selected for the last two times of treatment, three separate analyses were undertaken.

A 3 (times of application) X 6 (chemical treatments) X 2 (methods of injection) analysis for block 1 revealed no significant differences between waist-high treatments (84.9%) and basal treatments (83.5%) and results have been pooled in table 2. Results following the winter treatments were significantly better than those following the spring treatment.

TABLE 1

RAINFALL AND SOIL MOISTURE AT 3 TIMES OF TREATMENT

Rainfall (mm)			Date of Treatment	Soil Moisture		
Days	Before Treatment	After Treatment		Depth (cm)	Gravimetric Measurement* (%)	
0–30	33	49		0–15	21·27	27·00
				15–30	17·94	22·74
31–60	7	36	17 Jul 68	30–60	18·41	19·77
				60–90	18·71	19·70
61–90	164	7		90–120	16·85	19·82
				120–150	17·56	19·89
0–30	7	82		0–15	11·23	
				15–30	14·20	
31–60	10	41	11 Sep 68	30–60	14·95	
				60–90	16·05	
61–90	61	95		90–120	17·77	
				120–150	18·68	
0–30	40	44		0–15	13·14	
				15–30	14·05	
31–60	9	23	22 Apr 69	30–60	15·04	
				60–90	16·09	
61–90	22	2		90–120	16·17	
				120–150	17·76	

* Soil moistures at first date of treatment measured 7 days before and 7 days after treatment.

TABLE 2

PERCENTAGE KILL IN BLOCK 1 (3 x 6 x 2 FACTORIAL)
(RESULTS POOLED OVER 2 METHODS OF APPLICATION)

Chemical Treatments			Date of Treatment			Means
Chemicals	Conc (%)	Vol (ml)	Jul 68	Nov 68	Apr 69	(Chemicals)
Picloram + 2,4,5-T	1+4	2	100 (1·571)*	90 (1·249)	97 (1·401)	97 (1·407)
	2+8	1	97 (1·410)	97 (1·410)	100 (1·571)	99 (1·464)
Picloram + 2,4-D	1+4	2	85 (1·178)	71 (0·997)	90 (1·249)	83 (1·141)
	2+8	1	85 (1·178)	85 (1·178)	95 (1·339)	89 (1·232)
2,4,5-T	5	2	95 (1·339)	44 (0·727)	35 (0·632)	61 (0·900)
	10	1	70 (0·991)	60 (0·888)	32 (0·604)	54 (0·828)
Means (Dates)			92 (1·278)	77 (1·075)	82 (1·133)	

		Treatments	Main Effects (Dates)	Main Effects (Chemicals)
Necessary differences for significance	1%	0·619	0·253	0·357
	5%	0·435	0·178	0·251

* Inverse sine transformation used for analysis

The picloram treatments were significantly better than the 2,4,5–T treatments. Treatments with picloram plus 2,4,5–T were superior to the picloram plus 2,4–D treatments though only the 2% picloram plus 8% 2,4,5–T at 1 ml per cut was shown to be significantly better than the 1% picloram plus 4% 2,4–D at 2 ml. With both picloram formulations, the 2% picloram applied at 1 ml per cut was marginally better than the 1% picloram applied at 2 ml per cut.

Results for a 6 (chemical treatments) X 2 (methods of injection) analysis for blocks 1 and 2 at the first time of application are given in table 3.

No significant difference was recorded between the two methods of application, though as in the previous analysis the higher cuts gave marginally better results. Results following the six chemical treatments were in the same order as in the first analysis but in this case due to higher standard error, a lower level of significance among treatments was achieved.

Results of a 2 (times of application) X 6 (chemical treatments) X 2 (methods of injection) analysis for blocks 1 and 3 are given in table 4. No significant differences were recorded among times of application or between the two methods of injection. Again, the respective chemical treatments produced similar results to those shown in the two previous analyses.

The effect of sapling size, as measured by circumference at waist-height, can be seen in table 5. The percentage kills recorded were obtained by pooling the results for each chemical treatment. With the picloram plus 2,4,5–T formulation, a decline in effectiveness was recorded with saplings larger than 30 to 40 cm circumference at waist-height when mean kill was reduced from 99% to 82%. In contrast, kills following treatment with the 2,4,5–T formulation showed a decline with saplings more than 20 to 30 cm at waist height. The picloram plus 2,4–D gave intermediate results.

TABLE 3

PERCENTAGE KILL IN BLOCKS 2 AND 3 TREATED IN JULY 1968
(2 x 6 FACTORIAL)

Chemical Treatments			Height of Application		Means (Chemicals)
Chemical	Conc (%)	Vol (ml)	Waist	Base	
Picloram + 2,4,5-T	1+4	2	95 (1·339)*	95 (1·339)	95 (1·339)
	2+8	1	97 (1·410)	95 (1·339)	96 (1·374)
Picloram + 2,4-D	1+4	2	75 (1·049)	68 (0·967)	72 (1·008)
	2+8	1	80 (1·107)	77 (1·068)	78 (1·087)
2,4,5-T	5	2	77 (1·075)	66 (0·946)	72 (1·011)
	10	1	55 (0·838)	60 (0·888)	58 (0·863)
Means (Heights)			82 (1·136)	79 (1·091)	

		Treatments	Main Effects (Heights)	Main Effects (Chemicals)
Necessary differences for significance ..	1%	0·708	0·289	0·500
	5%	0·501	0·205	0·355

* Inverse sine transformation used for analysis

IV. DISCUSSION

An overall assessment of the three analyses indicates the varying importance of the three factors tested.

TIME OF APPLICATION. The results from the winter treatments were better than those following the spring and autumn treatments (table 2). This may reflect the moister soil conditions at the time of the winter application (table 1).

Johnson and Back (1974) showed that the effectiveness of 2,4,5–T as a foliage spray for the control of brigalow (*Acacia harpophylla*) improved with increase in soil moisture and this also could apply in this trial. With picloram plus 2,4,5–T, the effect of time of application did not have great practical significance. Even under the driest conditions, kills in excess of 90% were recorded. With 2,4,5–T, however, the drier conditions in the spring and autumn resulted in markedly reduced kills.

Robertson and Moore (1972) also obtained kills in excess of 90% at four different times of the year when using stem injection with picloram plus 2,4,5–T to thin *Eucalyptus populnea* woodlands. With picloram plus 2,4–D, they showed a trend towards poorer results following injections during the warmer months of the year. In this trial, kills with picloram-based chemicals were marginally poorer following treatments in November, the warmest of the three times of application. As suggested above, the better kills in winter in this trial could also be explained in terms of increased soil moisture conditions.

TABLE 4

PERCENTAGE KILL IN BLOCKS 1 AND 3 AT TWO TIMES OF APPLICATION
(2 x 6 x 2 FACTORIAL)

Chemical Treatments			Height of Application	Date of Treatment		Means (Chemicals)
Chemicals	Conc (%)	Vol (ml)	Height	Nov 68	Apr 69	
Picloram + 2,4,5-T	1+4	2	Waist Base	97 (1·410)* 97 (1·410)	100 (1·571) 97 (1·410)	99 (1·448)
	2+8	1	Waist Base	97 (1·410) 100 (1·571)	100 (1·571) 100 (1·571)	100 (1·531)
Picloram + 2,4-D	1+4	2	Waist Base	95 (1·339) 89 (1·228)	97 (1·410) 97 (1·410)	95 (1·347)
	2+8	1	Waist Base	95 (1·339) 97 (1·410)	100 (1·571) 95 (1·339)	98 (1·415)
2,4,5-T	5	2	Waist Base	72 (1·017) 70 (0·991)	68 (0·967) 40 (0·683)	63 (0·914)
	10	1	Waist Base	66 (0·946) 75 (1·049)	71 (0·997) 37 (0·656)	63 (0·912)
Means (Height)			Waist Base		93 (1·296) 89 (1·227)	
Means (Dates)				91 (1·260)	91 (1·262)	

		Treatments		Main Effects	
			Dates	Chemicals	Heights
Necessary differences for significance ..	1%	0·536	0·155	0·268	0·155
	5%	0·395	0·114	0·197	0·114

* Inverse sine transformation used for analysis

TABLE 5

PERCENTAGE KILL FOLLOWING TREATMENT OF DIFFERENT SIZE CLASSES

Chemical	Circumference of Saplings (cm)			
	>0–10 (1 cut)	>10–20 (2 cuts)	>20–30 (3 cuts)	>30–40 (4 cuts)
Picloram +2,4,5-T	100	98	99	82
Picloram +2,4-D	89	94	85	75
2,4,5-T	68	68	56	44

CHEMICAL TREATMENTS. The picloram plus 2,4,5–T treatments were consistently better than the picloram plus 2,4–D treatments while results following treatment with 2,4,5–T were generally unsatisfactory. With both picloram formulations, higher concentrations at lower volumes of application were always slightly superior. Lower volumes also have practical advantages when treating large areas of regrowth by reducing the time involved in refilling applicators and the volume of carrier required.

METHODS OF APPLICATION. Applications at the base with a tree injector and vaccinator and at waist-height using an axe and vaccinator produced similar results. Because the spacing criterion was the same for both waist-high and basal injections and because the bole of the saplings tapered upwards, the quantity of chemical used per tree was slightly less for waist-high treatments.

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REFERENCES

JOHNSON, R. W. (1966).—"Vegetation Survey of the Brigalow Research Station". (Queensland Department of Primary Industries: Brisbane (mimeo).)

JOHNSON, R. W., and BACK, P. V. (1973).—Influence of environment on methods used to control brigalow (*Acacia harpophylla*). *Qd J. agric. Anim. Sci.* 30:199-211.

JOHNSON, R. W., and BACK, P. V. (1974).—Some studies into the chemical control of Dawson gum or blackbutt (*Eucalyptus cambageana*). 1. Introduction and stem injection of virgin trees. *Qd. J. agric. Anim. Sci.* 31:263-9.

NORTHCOTE, K. H. (1971).—"A Factual Key for the Recognition of Australian Soils". (Third edition, Rellim Technical Publications: Glenside, South Australia.)

ROBERTSON, J. A., and MOORE, R. M. (1972).—Thinning *Eucalyptus populnea* woodlands by injecting trees with chemicals. *Trop. Grasslds* 6:141-50.

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