THINNING TROPICAL WOODLANDS WITH CHEMICALS

J. A. ROBERTSON*

ABSTRACT

The use of chemicals for reducing tree densities in tropical woodlands was studied near Townsville, north Queensland (lat. 19°S). Mature trees of Eucalyptus alba *(poplar gum),* E. papuana *(cabbage gum),* E. dichromophloia *(red-barked bloodwood),* E. brownii *(Reid River box),* E. drepanophylla *(narrow-leaved ironbark),* Melaleuca viridiflora *(broad-leaved tea tree) and* M. nervosa *(narrow-leaved tea tree) were killed by injections between bark and wood with either* 2,4,5-T *or mixtures of picloram with* 2,4,5-*T or* 2,4-*D. Chemical application to the ironbark was by cuts 1 m above ground level made with a modified axe blade, but all other species were injected close to ground level with a tree injector.*

The picloram mixtures were generally better than amine 2,4,5-*T, the effectiveness of which varied with species and to some extent with time of application. At all four test periods between March* 1968 *and March* 1971, *2 ml of* 1.0% *picloram (approximately* 0.1 *g per tree) in mixtures with either* 2,4,-*D or* 2,4,5-*T* (0.4 *g per tree) killed more than* 95% *of the treated trees of the seven species tested.*

Results from ringbarking 1 m from ground level varied with species but were generally inferior to injections with picloram mixtures.

INTRODUCTION

The Tall Grass Grazing Lands of dry tropical woodlands frequently have high densities of trees (Moore 1970). The common species and their approximate distributions have been described by Moore (1972), Moore, Condon and Leigh (1970) and Moore and Perry (1970). Attempts are currently being made to thin tropical woodlands to promote grass growth or to establish introduced legumes such as Townsville stylo (*Stylosanthes humilis*). Many of the eucalypt and other tree and shrub species of tropical woodlands are capable of regeneration from the base after felling or ringbarking. Problems of reducing tree densities and of controlling their regeneration on lands used for grazing have been outlined by Moore (1972). Stem injection with chemicals has been shown by Robertson and Moore (1972) to be an effective way of thinning *Eucalyptus populnea* shrub woodlands. This paper gives results of experiments in which the same commercial formulations of 4-amino, 3,5,6-trichloropicolinic acid (picloram) and of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), effective on *E. populnea*, were tried on *Eucalyptus alba, E. papuana, E. dichromophloia, E. brownii, E. drepanophylla, Melaleuca nervosa* and *M. viridiflora*, all of which are common in dry tropical woodlands.

EXPERIMENTAL METHODS

The experiments were conducted on the C.S.I.R.O. Pasture Research Station "Lansdown" situated 30 miles west of Townsville at approximately 19°S lat. The soils are solodic but highly variable. The average annual rainfall is 860 mm, but during the period treatments were applied (March 1969 to 1971) it varied from 350 to 550 mm.

Only single-stemmed eucalypts 60-90 cm and tea trees 30-40 cm basal circumference were used in the experiments.

*Woodland Ecology Unit, Division of Land Use Research, C.S.I.R.O., Cooper Laboratory, Lawes, Queensland, 4345.

Chemicals were applied in water to all species, and, excepting to *E. drepanophylla*, at intervals of 12.5 cm as close to the base as practicable with a Marino Tree Injector‡ (blade width 2.5 cm) calibrated to deliver 2 ml per injection. The tree injector does not easily penetrate the thick, fibrous bark of the ironbark and pockets for the injection of this species were made 1 m from ground level by an axe with a blade ground to the shape and size of that of the tree injector. The number of injections was equivalent to one every 12.5 cm of basal circumference. The chemicals were then applied to the ironbark with a vaccomatic syringe, calibrated to deliver 2 ml per injection.

Control trees of all test species were "speared" with injector or modified axe without applying chemical or carrier. The heights and intervals between cuts were similar to those of the chemical treatments. As further controls, other trees of all test species were ringbarked 1 m above ground level without applying chemicals.

Toxicities of Tordon 105 "Treekiller" (5% picloram + 20% 2,4,5-T)+, Tordon 50D "Weedkiller" (5% picloram + 20% 2,4-D)+ and Amine 2,4,5-T to all species were compared. Treatments were applied in March and August 1969 and repeated in March 1970 and March 1971.

Trees were considered dead if following browning of leaves and twigs there was no resprouting at least 18 months after treatment.

The experimental designs were randomized blocks of two replicates.

EXPERIMENTAL RESULTS

In Table 1 data are pooled for species, times and replicates (56 test groups of 25-15 trees).

TABLE 1

Kills of north Queensland trees following chemical injection and ringbarking treatments (Pooled data for seven species, four times of application and two replicates).

Treatments	Number of test groups in which kills at September 1972 were:	
	>95 per cent	<95 per cent
1% picloram + 4% 2,4-D	55	1
1% picloram + 4% 2,4,5-T	55	1
4% Amine 2,4,5-T	35	21
Ringbarked	27	29
Control	0	56
Contingency test (control excluded)	DF 3, χ^2 59.2 P<.001	

Compounds containing picloram and either 2,4-D or 2,4,5-T were highly toxic and more effective than 2,4,5-T alone or ringbarking. In only two groups of 25 trees treated with picloram were kills below 95 per cent and in these the kills were 92 and 94 per cent. Kills of 100 per cent were recorded in 49 of the 56 groups. As it is clear that the compounds containing picloram were toxic to all species on all occasions, analyses of time effects and species differences were confined to Amine 2,4,5-T and to ringbarking (Table 2).

Differences in species reaction to ringbarking and to injection with 4 per cent 2,4,5-T are shown in Table 3.

‡Manufactured by Marino Industries Pty. Ltd., Brisbane, Queensland.
+Registered trade names of Dow Chemical (Australia) Ltd.

DISCUSSION

The results show that Tordon 105, Tordon 50D and Amine 2,4,5-T applied in water between bark and sapwood of stems will kill mature single stemmed trees of the five eucalypts and two tea trees listed. Injection of the thick bark species, *Eucalyptus drepanophylla* with Tordon compounds at a height of 1 m above ground level gave results comparable to those from basal injections. Picloram with 2,4-D (Tordon 50D) and picloram with 2,4,5-T (Tordon 105) were equally effective on all species at all times (Table 1). Amine 2,4,5-T was better on some species than others and gave good results on *E. brownii* and the two species of *Melaleuca*. It was less effective at the dosage rate used, on the other species of eucalypts, due largely to relatively poor results from applications in March 1969 and August 1969. There is no simple explanation of the differences in results from injections in March 1970 and March 1971, and those from March 1969.

TABLE 2

Effect of time of application on kills by Amine 2,4,5-T and ringbarking. (Pooled data from seven species and two replicates).

Times	Number of test groups in which kills were: >95 per cent		<95 per cent	
	2,4,5-T	Ringbarked	2,4,5-T	Ringbarked
March 1968	7	9	7	5
August 1969	6	5	8	9
March 1970	11	8	3	6
March 1971	11	5	3	9
Contingency test:				
2,4,5-T DF	3	χ^2	P<0.1	
Ringbarking DF	3	χ^2	N.S.	

In contrast to species such as *E. populnea* which commonly resprout (Moore 1972) *E. drepanophylla* and *E. brownii* were relatively easy to kill by ringbarking. Ringbarking the other species gave high percentage kills on some occasions but not on others; all *E. papuana* ringbarked in March 1970 died but only 44% died after ringbarking in March 1971.

TABLE 3

Effects of Amine 2,4,5-T and of Ringbarking on seven tree species. (Pooled data for four application times and two replicates.)

Species	Amine 2,4,5-T		Ringbarked	
	Number of test groups in which kills were: >95%	<95%	>95%	<95%
Eucalyptus populnea	4	4	2	6
Eucalyptus dichromophloia	3	5	0	8
Eucalyptus alba	3	5	4	4
Eucalyptus brownii	7	1	5	3
Eucalyptus drepanophylla	3	5	6	2
Melaleuca nervosa	8	0	6	2
Melaleuca viridiflora	7	1	4	4
Contingency test:	DF 6		DF 6	
	χ^2 16.0		χ^2 11.5	
	P < 0.05		P < 0.1	

Rainfall was below average from 1969 to 1971 and soils were dry at the time trees were treated in the main experiments. A fall of rain exceeding 100 mm during late March 1970 provided an opportunity of observing the effects of injection at high soil moisture levels. Tordon 105 and Tordon 50D were each applied to 40 trees of each of the seven test species one week after the rain had fallen; kills were greater than 95% and similar to those following treatment in the dry conditions of the several experiments.

To sum up: The evidence is that injections every 12.5 cm of basal circumference with 2 ml of one per cent picloram and either four per cent 2,4-D or four per cent 2,4,5-T will kill mature trees (58-76 cm basal circumference) of the five species of *Eucalyptus* rested. Amine 2,4,5-T alone was less certain on all eucalypts except *E. brownii* but was equally as consistent and effective as picloram compounds on the two species of *Melaleuca*.

The decision on which compound to use will depend on availability, price and other factors. Picloram persists for a long time when applied to soils but there is no evidence of subsequent toxicity to herbaceous plants following stem injection of trees. Townsville stylo (*Stylosanthes humilis*) was growing among treated trees but showed no obvious signs of being affected by proximity to injected trees. In general, grasses and herbage appeared to grow faster and to be more productive under chemically injected than under ringbarked trees which took longer to die. The reliability of picloram compounds gives them obvious advantages on operations such as woodland thinning which has a high component of labour.

ACKNOWLEDGEMENTS

I am indebted to Messrs. C. Pedersen, G. Woodward and P. Harland for assistance in all phases of the field work and to Mr. R. Sandland of the Division of Mathematical Statistics for statistical analysis. The co-operation of the farm manager and staff of the C.S.I.R.O. research station "Lansdown" is greatly appreciated.

Picloram compounds were donated by Dow Chemical (Aust.) Ltd.

REFERENCES

MOORE, R. M. (1970)—Australian Grasslands. *In* "Australian Grasslands" (Ed. R. Milton Moore). A.N.U. Press, Canberra.

MOORE, R. M. (1972)—Trees and shrubs in Australian grazing lands. *In* "Plants for Sheep in Australia: A review of pasture, browse and fodder crop research 1948-70". (Ed. J. H. Leigh and J. C. Noble'. Angus and Robertson, Sydney.

MOORE, R. M., CONDON, R. W., and J. H. LEIGH (1970)—Semi-arid woodlands. *In* "Australian Grasslands". (Ed. R. Milton Moore). A.N.U. Press, Canberra.

MOORE, R. M., and PERRY, R. A. (1970)—Vegetation. *In* "Australian Grasslands". (Ed. R. Milton Moore). A.N.U. Press, Canberra.

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

(Accepted for publication January 30, 1974)