CONTROL OF CHINEE APPLE, *ZIZIPHUS MAURITIANA*, WITH RESIDUAL HERBICIDES

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Summary: A trial was set up to determine the response of chinee apple, *Ziziphus mauritiana*, to 5 rates each of karbutillate and tebuthiuron, and one rate of hexazinone. Karbutillate and tebuthiuron were markedly more effective on sandy loam soil than on clay. Where various sizes of chinee apple plants were growing in the same plot, the larger plants died more readily. Large chinee apple plants required 4.0 kg/ha of karbutillate on the sandy loam, but 16.0 kg/ha on clay for 90% kill or better, and 2.5 kg/ha of tebuthiuron on the sandy loam, compared with 3.0 kg/ha on the clay. The rate response on medium sized chinee apple plants was erratic. Most of the seedlings appeared unaffected by the herbicides, when compared with the natural mortality at the site. Hexazinone was ineffective on chinee apple at 2.0 kg/ha on both soils. Pasture damage was very severe on the sandy loam with all rates of karbutillate and tebuthiuron at 2.0 kg/ha or greater. Pasture damage was very severe on the clay with karbutillate at 12.0 kg/ha or greater, and with tebuthiuron at 1.5 kg/ha. Thus, karbutillate is unsuitable for control of chinee apple in pastures; further work with tebuthiuron on chinee apple may be warranted, especially in wetter years.

INTRODUCTION

Chinee apple, Chinese apple or Indian jujube, *Ziziphus mauritiana*, is a large shrub or small spreading tree up to 8 m tall. It is now well established around many old mining sites where native timber was removed, but spread and thickening occurs mainly in the Charters Towers-Townsville-Bowen region (1).

The CSIRO "Lansdown" pasture research station (mean annual rainfall: 707 mm (3)) is situated on the coastal plain 45 km south of Townsville. A long term program is underway to manage the chinee apple infestation which interferes with pasture establishment and animal production experiments. Control is achieved by basal barking large plants, or overall spraying regrowth with 2,4,5-T ester/picloram in diesel. Bulldozing is also effective.

An established tebuthiuron trial at a slightly drier site (G. Harvey, pers. comm, 1986) indicated good kills of chinee apple at high rates. A range of lower rates were thus selected for a trial at Lansdown, with a view to possible registration for aerial application. Other matters of interest in the trial were effectiveness of the herbicide according to size of the weed, damage caused to the pasture, and other possible woody weed herbicides.

METHODS

Crabbe's Paddock (19°38'S, 146°51'E) on "Lansdown" is used as a holding paddock for cattle, and was subject to light grazing during this trial. Twelve 10 x 20 m plots were pegged out around older trees; various saplings and seedlings were also present (Block 1). Another twelve 10 x 20 m plots were set out on nearby multistemmed growth, which had lower maximum heights (Block 2). Soils were a Gilligan clay (Block 1) and Glenoaming sandy loam (Block 2) (6,7). Both blocks had native pastures, predominantly blue grasses, *Bothriochloa decipiens* and *Dichanthium fecundum*, and kangaroo grass, *Themeda triandra*, with some introduced species such as sabi grass, *Urochloa mosambicensis*.

Three herbicides were used: karbutillate (200g/kg pellets), tebuthiuron (400g/kg pellets) and hexazinone (250g/L liquid). Hexazinone was distributed over the 10 x 20 m plot as 40 Spot Gun squirts of 4 ml each onto bare soil. Five rates each of karbutillate and tebuthiuron pellets were preweighed and mixed with horse pellets before hand spreading on 20 January 1987. A full set of treatments (herbicides, rates and an untreated control) were randomized within each Block. Insufficient herbicide was on-hand for further replication.

Subjective assessments of pasture biomass reduction were made 2, 12, and 33 months after treatment. Additionally, all woody plants (mostly chinee apple) were measured (number of stems, height and diameter or circumference 30 cm from the ground) 12 and 33 months after treatment. Each plant was categorized as ALIVE versus DEAD after 33 months. For each chinee apple, plant diameters and circumferences were converted to total basal area (the best measure of the plant's 'physiological age'), and thence to a diameter as if the plant had a single stem. Plants in each plot were allocated to 3 size classes, according to 'single-stem diameter', viz: <1.0 cm, 1.0 to 5.0 cm and > 5.0 cm. Percentage kill was computed for each size class in each plot using 1989 data (with 1988 data to approximate the 'initial' situation).

RESULTS AND DISCUSSION

Although 1987 was a very dry year at Lansdown, 15 mm of rain fell four days after treatment. This was probably adequate to dissolve the pellets although not sufficient to fully activate the herbicides. Two months after treatment, the leaves of all treated chinee apple trees were chlorotic to varying degrees; a small percentage of lower leaves on control plants were also chlorotic. Rainfall was also below average in 1988, but was above average in 1989.

Effect on Chinee Apple. Percentage kill in each of three single stem diameter size classes was analysed separately over the whole trial. Percentage kill differed significantly (P=0.05) only in the seedlings, whereas the block effect became more significant with increasing plant size class. The block effect probably relates to different soil types of Block 1 and 2, as evident from (6). It was thus decided to report raw results rather then average results across the two soil types.

On the clay (Fig 1a), 20 kg/ha of karbutillate was needed to kill medium and large plants. Seedling control was only moderate. On the loam (Fig 1b), karbutillate gave good kills of large trees at 4 kg/ha, and of medium plants at 12-16 kg/ha. Perhaps large trees are easier to kill because of higher respiratory loads. The large variation in percentage kill with size class (Fig. 1) would suggest that other herbicide workers should stratify percentage kill into appropriate plant size classes.

On the clay (Fig 1c), tebuthiuron gave good kills of seedlings and large trees only at the highest rate (3.0 kg/ha). However, control of medium sized plants at this rate was inferior to that provided by 2.5 kg/ha. On the loam (Fig 1d), tebuthiuron gave good control of large trees at 2.5 kg/ha (and heavier), but control of medium plants was quite erratic. This may have been due to small scale soil differences such as in organic matter or clay content. Coverage of the medium sized plants' root systems may have been inadequate, with the 40% formulated pellet. Indeed, control of seedlings above the natural morality of 77% appeared non-existent, although two of the plots had no pre-existing seedlings (Fig 1d).

Poor control of otherwise susceptible shrubs or small trees, for example false sandalwood, *Eremophila mitchellii*, has sometimes been found where that species is growing under a taller (often eucalypt) tree stratum (Bolton, pers. obs.). Perhaps the larger root systems of the taller trees take up most of the herbicide. Further trials with tebuthiuron on chinee apple should include the common situation where chinee apple is an understorey to other trees. Tebuthiuron 'selectivity' seems mainly for the tallest trees, whereas many exotic woody weeds first become a problem as understoreys to native timber. Removal of native timber at a site merely provides further opportunities for exotic woody weeds to invade in the long term.

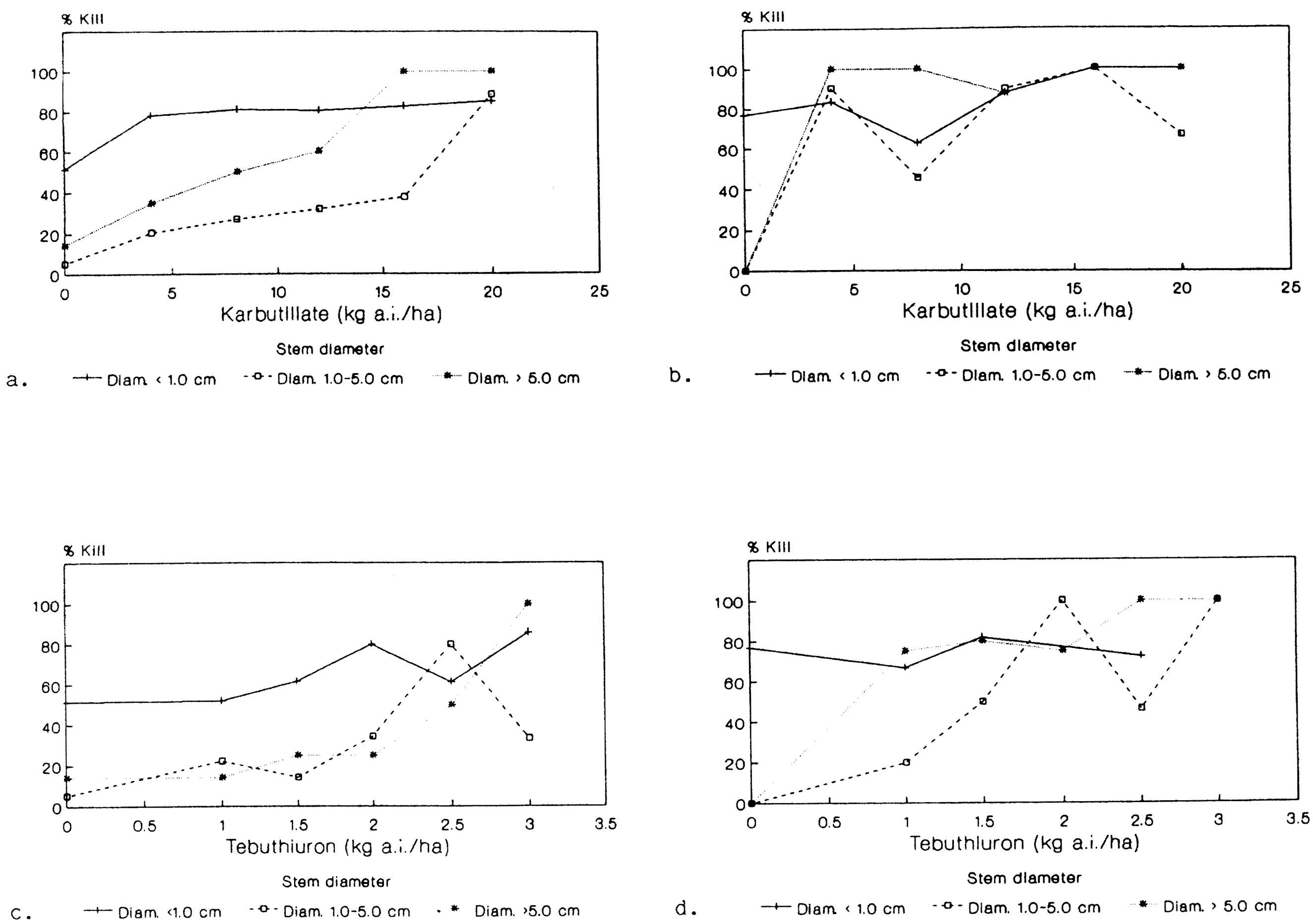

Figure 1. The effect of karbutillate (a,b) and tebthiuron (c,d) on chinee apple, *Ziziphus mauritiana* death on Gilligan clay (a,c) and Glenoaming sandy loam (b,d) at Lansdown.

Probit analyses (4) were performed on the response of each size class to each herbicide on each soil type. However, estimates of the lethal dose needed to kill 90% of plants (LD90) were usually of less value than inspection of Fig. 1 graphs. No statistical transformation would smooth the erratic responses in Fig. 1. Further replication on each soil type was clearly necessary.

Effect on Pasture. There was substantial pasture reduction in most karbutillate plots, and in the three highest rates of tebuthiuron (Table 1). The latter occurred only on Block 2, which had a much sandier soil than Block 1 (Glenoaming sandy loam versus a Gilligan clay (6,7)). This is consistent with other work on tebuthiuron activity in soils (2,5). Dr J. Williams (pers. comm, 1988) found that as pasture cover declines below 40%, the rate of soil loss from a red duplex soil increased markedly. Here, any pasture reduction rating greater than 2 could be regarded as giving a high risk of soil erosion. Pasture loss remained high after 12 months on all treatments except the lowest rate of karbutillate and tebuthiuron on the Gilligan clay (Table 1). Poor pasture cover was still evident 33 months after treatment. Karbutillate would appear totally unsuitable for chinee apple control in pastures, although there may be applications in the industrial situation. Tebuthiuron may have a place at low rates and in wetter years, where chinee apple kill may improve and pasture recovery may be faster. Pasture effects should be evaluated using dry weight (5), the BOTANAL system (9), and/or basal cover (8).

Table 1. Subjective biomass reduction assessments for pasture. (* = 2 independent assessments per plot.) A = Gilligan clay; B = Glenoaming sandy loam.

Herbicide	Rate kg/ha	Pasture Reduction Rating – Months after Treatment/Soil: 2		12		33	
		A*	B*	A	B	A	B
Karbutillate	4.0	2.5	3.0	1	5	2	2
	8.0	4.5	4.0	3	5	3	2
	12.0	5.0	4.0	5	6	2	4
	16.0	5.0	5.0	5	6	2	5
	20.0	5.5	5.0	5	6	2	4
Tebuthiuron	1.0	0.5	1.0	1	3	1	1
	1.5	1.0	1.5	4	2	4	2
	2.0	2.5	2.5	2	5	2	3
	2.5	2.0	2.5	3	4	2	4
	3.0	3.5	3.0	3	5	3	5
Hexazinone	2.0	1.0	1.5	1	3	1	2
Control	-	0	0	0	2	0	0

Biomass reduction rating scale: 0 = 0%, 1 = 1-20%, 2 = 21-40%, 3 = 41-60%, 4 = 61-80%, 5 = 81-95%, 6 = 96-100%.

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