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Practical considerations when rogueing *Acacia tortuosa* and *A. macracantha* in pastures

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Acacia tortuosa **and** ***A. macracantha*** **are the most noxious woody plants in U.S. Virgin Islands pastures, infesting 90% of the fields and decreasing utilizable pasture area by up to 26%. These** ***Acacia*** **species are well adapted to the semi-arid climate and the calcareous soils of the Virgin Islands. Cattle grazing also creates conditions suitable for** ***Acacia*** **development by enhancing seed dispersal and reducing the competitive ability of preferred forages. Populations of the** ***Acacia*** **species can be suppressed by the natural environment, by pasture and grazing management, and by rogueing. Mechanical and chemical methods have been evaluated in St Croix. Preliminary studies suggest that extensive** ***Acacia*** **rogueing using hand tools is not practical or economical. Rogueing by bulldozer is not economical and ad-versely affects the physical condition and botanical composition of pastures. Basal herbicide applications are more effective and more economical than foliar applications. When basally applied, hexazinon and tebuthiuron are equally effective and more economical than picloram at labeled rates.**

Keywords: Acacia spp; Herbicides; Hexazinon; Tebuthiuron; Trychlopyr

Introduction

Acacia tortuosa and *A. macracantha* are the most noxious woody plants in the U.S. Virgin Islands pastures, infesting 90 percent of fields and decreasing utilizable pasture area by up to 26 percent (Michaud and Michaud, 1987). They also affect the entry of light machinery into infested areas. Areas invaded by these *Acacia* species quickly become colonized by other persistent, woody plants. To ensure productive pastures, these species must be controlled.

Acacia tortuosa and *A. macracantha* are successful in the Virgin Islands because they can tolerate the semi-arid climate, irregular rainfall and calcareous clay soils that are typical of the islands. Both species are successful pasture weeds because they are not eaten by cattle, except for seed pods and the youngest shoots. This is due, in part, to their long, sharp spines which lignify with age. These *Acacia* species withstand mechanical shredding and can colonize overgrazed or degraded pastures. Mechanical rogueing methods and selective ruminant foraging enhance *Acacia* seed dispersal while reducing the competitive ability of desirable forages.

Both *A. tortuosa* and *A. macracantha* are copious seed producers (Little et al. 1974). The seeds have a very hard seed coat and can survive long periods in the soil. Viable seeds can also pass intact through the digestive system of ruminants (P.J. Michaud, pers. comm.)

The objectives of this study were to characterize local *Acacia* destruction methods and to research alternatives. Mechanical and chemical *Acacia* control has been studied before in St Croix under different economic conditions, testing control efficacy of different herbicides (Oakes, 1958; Oakes, 1970). Results of studies conducted in St Croix since 1983 are reported here. These results support and augment earlier findings.

Control of *Acacia*

Forage producers suppress *Acacia* populations by changing pasture utilization from grazing to hay production, managing grazing frequency and destroying residual plants. The environment also exerts some control pressure on *Acacia* species, e.g., by pest attack, plant competition, drought and flooding.

Traditional *Acacia* Control

Local pasture managers destroy *Acacia* plants individually. Individual plant destruction, or rogueing, is not practiced until the plant has matured to the seeding stage, since before this stage is reached, the young plants cannot reproduce themselves and so increase the population; some will die of natural causes and small, young plants do not represent a major problem in pastures.

In the Virgin Islands, there are two common *Acacia* rogueing methods: 1) Grubbing, or severing and un-earthing *Acacia* plants from below the first set of lateral roots; and 2) Applying diesel oil to the basal buds.

Mechanical grubbing is carried out using hand tools and heavy machinery. The process is simplified when the plant has one central stem and when the soil is dry rather than wet, because dry soil physically supports the plant better than would damp soil when the plant is being severed.

Hand rogueing is effective for small areas but impractical for larger fields because of high costs and a shortage of willing labour. Hand tools most commonly used for *Acacia* rogueing are the pick and mattock. Tractors and bulldozers are used for mechanical rogueing, the latter being the preferred machine. The government subsidizes agricultural rental of a bulldozer, the subsidized hourly rate being US$ 30.00 including operator and fuel. A bulldozer can remove from three to seven *Acacia* plants per minute, depending on soil texture and moisture, plant density and operator skill and persistence. This results in costs generally exceeding US$ 0.14 per plant.

One disadvantage of using bulldozers for rogueing is that it adversely affects the physical condition of pasture land. Areas where plants have been removed are less level, and therefore interfere with the passage of machinery, particularly hay cutting, raking and baling equipment. Another disadvantage is that vegetation is destroyed on up to 1.5 square metres and soil is disturbed to a depth of 0.3 m when plants of 3.8 cm basal diameter are cleared by use of a blade 2.7 m long. To decrease the amount of damaged area, some producers add a steel gouge, 0.1 m wide, extending down 0.15 m from the lower edge of one end of the blade. Effective manipulation of this extension requires greater operator skill than the use of the blade alone.

Bulldozer rogueing also adversely affects the species composition of pastures. Turning soil and uprooting plants moves dormant seed to the soil surface, while the destruction of the vegetative cover provides a place for invader plants to colonize. Common noxious colonizers include species of *Asclepias*, *Crotalaria* and *Jatropha*. *Acacia* can also reinvade the area.

Local pasture managers also rogue *Acacia* plants by applying diesel oil to the basal buds of individual plants. This method is labour intensive and is not extensively used.

Chemical control of *Acacia*

The practice of applying chemical herbicides to kill *Acacia* plants had not been adopted by local pasture managers prior to the initiation of these trials in 1983. Studies evaluated herbicide applicators, herbicide application methods, control efficacy and the economics of control methods.

Herbicide applicators and application: Two herbicide applicators were used to apply herbicides to *Acacia* plant bases: a custom granular applicator and a custom liquid (Spotgun) applicator. Herbicide application rate varied over 20 percent with the granular applicator because of the size and distribution of herbicide pellets. Herbicide application did not vary appreciably with the liquid applicator. A backpack pump sprayer was used to apply herbicides to *Acacia* foliage.

Herbicides were applied to *Acacia* plants by two methods: basal and foliar. Basal herbicide application to plants of 2.5 to 3.8 cm base diameter was three to nine times faster than foliar application.

Herbicidal *Acacia* control efficacy: *Acacia* control efficacy evaluations were made using hexazinon (*Velpar* 2L), picloram (*Tordon* 10K and 22K), tebuthiuron (*Spike* 40P and 80WP), and triclopyr (*Garlon* 4). Application rates and methods are listed in Tables 1 and 2. Treated plants were from 1 to 2 m tall, with basal diameters in the range of 2.5 to 3.8 cm. Only plant deaths were recorded as successful control, the final evaluations being made up to one year after treatment.

Results for each herbicide are a compilation of the results of at least two different tests of over 40 targeted plants each. Not all herbicides or herbicide rates were tested at the same time, nor at the same location. Results of all tests were included to demonstrate the possible variability when applying herbicides to *Acacia* plants under local conditions.

Both picloram and triclopyr break down when exposed to ultraviolet light, making them less effective foliar herbicides (WSSA, 1983). In addition, although herbicides were applied when weather conditions were conducive to rapid plant growth, these conditions did not always persist, causing targeted plants to be less receptive to herbicide uptake than they would have been had weather conditions remained stable.

Herbicides applied at the base of *Acacia* plants are more persistent than those applied to the foliage. Hexazinon and tebuthiuron are inherently more persistent in the environment than picloram and triclopyr (WSSA, 1983). Herbicides applied at the base of *Acacia* plants persist until good rains provide conditions conducive to their uptake.

Preliminary evaluations of chemical rogueing efficacy suggest that basal applications of hexazinon, pelleted picloram and tebuthiuron are more effective than are foliar applications of picloram and triclopyr (Tables 1 and 2). These data also suggest that basal applications of hexazinon and tebuthiuron are equally effective, and more economical than basal application of picloram (Table 2). Pelleted picloram is no longer available, and liquid picloram is not labeled for basal application.

Table 1 Herbicides applied to the foliage and under the canopy of *Acacia* plants

Herbicide plus surfactant	Formulation	Application Rate Product (ml/l)[1]	AI/plant avg. (g)	Control (%)
picloram	22K, liquid	5.6	0.22	73
	22K, liquid	7.5	0.33	45
triclopyr	4, liquid	1.9	0.15	33
	4, liquid	3.8	0.30	42
	4, liquid	7.5	0.60	61

1) ml of product per litre of solution.

Table 2 Herbicides applied at the base of *Acacia* plants

Herbicide	Formulation	Application Rate Product	AI/Plant (g)	Cost[1] US$	Control (%)
hexazinon	2L, liquid	2.0 ml	0.48	0.029	100
(*Velpar*)	2L, liquid	4.0 ml	0.96	0.057	100
picloram	10K. pellet	3.5 g	0.35	0.025	0
(*Tordon*)	10K, pellet	4.7 g	0.47	0.039	95
	10K, pellet	7.1 g	0.71	0.050	95
tebuthi-uron	40P, pellet	1.1 g	0.44	0.025	97
(*Spike*)	80W, slurry	2.0 ml	0.69	0.032	100
	80W, slurry	4.0 ml	1.38	0.065	95
	40P, pellet	3.6 g	1.44	0.083	99

1) Cost of herbicides (in US$)

Velpar 2L, $54.00 per 3,785 ml
Tordon 10K 3.20 per 454 g
Spike 40P 10.50 per 454 g
Spike 80W 17.00 per 454 g (432 g of product plus water to make 1 litre of slurry)

Conclusions

U.S. Virgin Islands pasture managers need an economical, efficient *Acacia* rogueing method that can be utilized at any time of the year. Results of this study indicate that basal applications of the chemical herbicides hexazinon or tebuthiuron satisfy this need.

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