National Case Studies Manual

Prickly acacia

Natural Heritage Trust
Helping Communities Helping Australia
Queensland Government
Natural Resources, Mines and Energy
National Prickle Bush Management Group
CSIRO
Northern Territory Government
NSW Agriculture
Department of Agriculture
Government of Western Australia

Prickly acacia

National Case Studies Manual

Approaches to the management of prickly acacia (*Acacia nilotica* subsp. *indica*) in Australia

May 2004

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Foreword

Prickly acacia is one of Australia's worst weeds. While it already infests over six million hectares of the Mitchell Grass Downs of Queensland, it has the capacity to threaten a further 50 million hectares of native grassland ecosystems.

Although the problem may be daunting in some areas, much can be learnt from the experience of those who have already taken on the task of combating this weed—their achievements provide both inspiration and a realistic appreciation of the challenges involved.

The National Prickle Bush Management Group recognises that only through the combined efforts, diligence and commitment of all affected landholders, community and catchment groups, agencies and others, will we effectively gain ground on prickly acacia.

It is hoped that this manual, like its companion publication, the *Prickly Acacia Best Practice Manual*, will become an invaluable reference tool, further equipping land managers with the skills and knowledge for achieving their individual and collective goals.

I recommend the manual to all landholders affected by prickly acacia. Further, I commend all those who have been responsible, both directly and indirectly, for its production.

Louise Moloney
Chairperson
National Prickle Bush Management Group

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Introduction

Prickly acacia—a Weed of National Significance

Prickly acacia (*Acacia nilotica* subsp. *indica*) is an exotic plant, which, due to its invasiveness and its ecological, economic and social impacts, has been recognised as a Weed of National Significance (WONS).

Its impacts on landholders include reduced pasture production, undesirable changes in pasture composition, stock hygiene problems, and mustering and watering difficulties. The thorns may also damage vehicle tyres. These effects are compounded by environmental impacts such as loss of wildlife habitat, decline in soil structure, erosion, loss of native pastures, decline in biodiversity and provision of a refuge for feral animals.

However, prickly acacia is not a new problem—it was introduced into Queensland in the 1890s and declared a noxious weed in 1957. Since then, it has periodically expanded its range during high rainfall years and now affects over six million hectares of Mitchell Grass Downs in Queensland. The establishment of infestations within the Northern Territory and Western Australia and occurrences in South Australia have been aided by transport of stock to these areas.

A national approach

To tackle the current and potential threat, a national strategy with the vision that 'Prickly acacia is confined and its impacts reduced to a minimum' was launched in 2001. The desired outcomes of the strategy are:

1. Prickly acacia is prevented from spreading.
2. The adverse impacts of established prickly acacia infestations are minimised.
3. National commitment to prickly acacia is maintained.
4. Prickly acacia management is coordinated at the national level.

The National Prickle Bush Management Group is leading implementation of the strategy. This group, consisting of agency and community representatives from throughout Australia, is also responsible for overseeing and monitoring the implementation of the national WONS strategies for mesquite and parkinsonia.

'Vision: Prickly acacia is confined and its impacts reduced to a minimum.'

Use of this manual

This publication is a companion to the *Prickly Acacia Best Practice Manual* released in July 2000, which presented a technical overview of prickly acacia ecology and the 'tool box' of available management strategies and control options.

This manual goes one step further—it shows how landholders, community and industry groups, local governments and agencies have applied these tools and strategies in different situations, and shows the approaches being taken by land managers to contain, eradicate or prevent the spread of prickly acacia.

Case studies from across the geographic distribution of the weed—from core infestation areas in western Queensland to outlier infestations across northern Australia—are presented. Many innovative ideas and solutions are detailed, together with examples of the often sheer hard work and commitment needed to manage prickly acacia.

While the manual should be used as an information and ideas resource, professional advice should always be sought when planning control and management.

Members of the National Prickle Bush Management Group at a meeting in Karratha, WA. From left to right: Nathan March (National Coordinator - Department of Natural Resources, Mines and Energy, Qld), Noel Wilson (Department of Agriculture, WA), Dr Rieks van Klinken (CSIRO), Dr Shane Campbell (Department of Natural Resources, Mines and Energy, Qld), Louise Moloney (Chairperson), David Barton (Pilbara Mesquite Management Committee), Phil Maher (Department of Natural Resources, Mines and Energy, Qld), Peter Gray (Department of Agriculture, NSW), Damian Collopy (Department of Agriculture, WA) & Alice Beilby (Department of Infrastructure, Planning and Environment, NT). Absent: Nora Brandli (Desert Channels Queensland) and Jenny White (Australian Agricultural Company).

Prickly acacia—ecology and threat

section 1

Section 1

Prickly acacia—ecology and threat

Nathan March

Taxonomy

Prickly acacia, *Acacia nilotica*, is a highly variable species consisting of nine subspecies found from South Africa to the Middle East, Pakistan and India. The populations found in Australia are *A. nilotica* subsp. *indica*, which originates from Pakistan and India (Parsons & Cuthbertson 2001).

Description

Prickly acacia is a thorny shrub or small tree that usually grows to 5 m but occasionally to 10 m. The tree has an umbrella-shaped canopy and is usually single-stemmed but may be multi-stemmed at the base, particularly if damaged by fire or frost. Bark on the saplings often has an orange and/or green tinge. Mature trees have a rough, brown to black bark. The tree has a very deep taproot and several branching lateral roots close to the soil surface.

Leaves are finely divided and fern-like with pairs of stout thorns growing at the base. The flowers, which are ball-shaped, golden-yellow and about 1 cm across, grow on the stems with two to six flowers per group. The grey-green pods are a very good distinguishing feature—they are flat, 6–25 cm long, with narrow constrictions between the seeds. They usually contain 8–15 brown, rounded seeds with a very hard seed coat.

Nathan March

▲ Tree

Nathan March

▲ Bark on sapling

Nathan March

▲ Thorns and foliage

Nathan March

▲ Seedling

Nathan March

▲ Pods with characteristic constrictions between the seeds

Nathan March

▲ Flowers

Distinguishing between the 'prickle bushes'

Prickly acacia may be confused with other prickle bushes such as mesquite (*Prosopis* spp.), parkinsonia (*Parkinsonia aculeata*), mimosa bush (*Acacia farnesiana*) and mimosa (*Mimosa pigra*). These plants, with the exception of mimosa bush, are also Weeds of National Significance.

It is possible to tell the difference between the prickle bushes by examining the flowers and pods. If neither of these is available, they can be distinguished by their tree shape, leaves, bark or branches. However, as this can be difficult, a local weeds officer should be consulted.

The major differences between the prickle bushes are listed in Table 1.

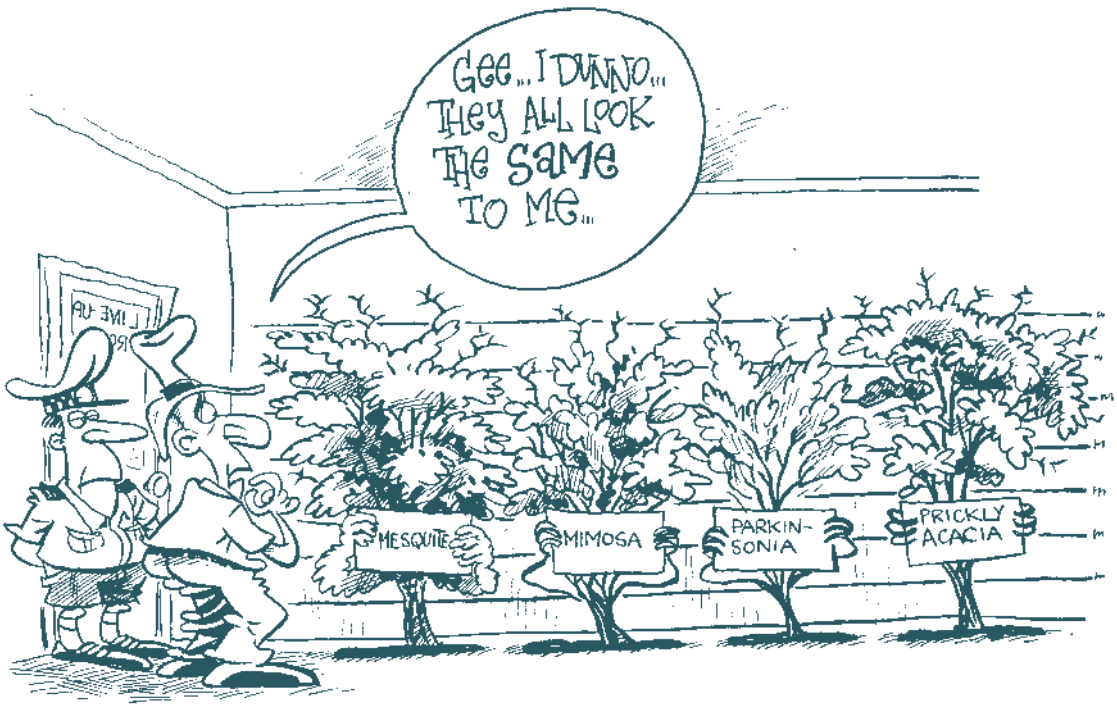

Table 1: Differences between prickle bushes

	Mesquite *Prosopis* spp.	**Prickly acacia** *Acacia nilotica*	**Parkinsonia** *Parkinsonia aculeata*	**Mimosa** *Mimosa pigra*	**Mimosa bush** *Acacia farnesiana*
Pod shape	Up to 20 cm long; slight constrictions between seeds; straight or slightly curved	Up to 23 cm long; constrictions between seeds	Up to 10 cm long; thin constrictions between seeds; straight	3–8 cm long; one-seeded, bristled segments, which fall away from the pod leaving a skeletal outline	Cigar-shaped; up to 6 cm long; slightly curved
Pod colour, hairiness	Straw-coloured, sometimes purple; no hairs	Blue-grey; fine hairs	Straw-coloured; no hairs	Brown when mature; covered with dense bristles	Brown to black; no hairs
Flowers	Cylindrical, greenish-yellow spike, 5–8 cm long	Ball-shaped, golden yellow, about 1 cm across	Five petals, mainly yellow, one with an orange spot	Round, fluffy, pink or mauve balls, 1–2 cm across	Ball-shaped, golden yellow, about 1 cm across
Leaves	Fernlike; 1–4 pairs; often with a gap between leaves	Fernlike; 4–10 pairs; often overlapping	Long, flattened leaf stalk with tiny oblong leaflets along each side	Central leaf stalk prickly; 20–25 cm long. Each leaf contains about 15 opposite segments, 5 cm long and divided into pairs of leaflets that fold up when touched or injured	Fernlike; 2–4 pairs; with a gap between leaves
Leaflets	6–18 pairs	10–25 pairs			8–18 pairs

Table 1 (continued)

	Mesquite *Prosopis* spp.	**Prickly acacia** *Acacia nilotica*	**Parkinsonia** *Parkinsonia aculeata*	**Mimosa** *Mimosa pigra*	**Mimosa bush** *Acacia farnesiana*
Tree shape	Variable—either a multi-stemmed shrub to 5 m, or a spreading tree to 15 m	Spreading tree to 10 m	Small tree or shrub usually to 5 m	Multi-branched shrub to 5 m	Usually rounded shrub to 3 m
Bark	Rough, grey; smooth dark red or green on small branches	Tinge of orange and/or green on saplings; dark and rough on mature trees	Smooth and green; straw-coloured and lightly textured at base of older trees	Stems green at first; becoming woody; initially covered with thick hairs	Grey, with prominent white spots
Branch shape	Zigzagged	More or less straight	Slightly zigzagged	More or less straight	Zigzagged

Different features of the prickle bushes

Mesquite	Prickly acacia	Parkinsonia	Mimosa	Mimosa bush

Preferred habitat

Prickly acacia prefers tropical and subtropical regions where it is found in woody grasslands and savannas (W. Palmer, 2003, pers. comm., 21 Nov). It prefers heavy, cracking clay soils such as those found on the Mitchell grasslands of northern Australia. However, it will also grow on heavy coastal clays, basalt soils and occasionally on lighter soils and sands. It requires 250–1500 mm of rainfall annually (Mackey 1998).

Life cycle

Seeds germinate after significant rainfall in late spring and summer. Seedling growth can be rapid, and trees flower and set seed within two to three years after germination under ideal conditions with unlimited water (e.g. along bore drains).

'Some individual trees have produced more than 175 000 seeds annually.'

Flowering generally begins in late February and continues through to June. Pods ripen and fall from late October through to January. Trees growing in association with a permanent or semi-permanent water source such as a bore drain, dam, drainage line, creek or river tend to produce a large number of flowers and pods annually, while those on the open downs produce low numbers except in high rainfall years. Trees along a bore drain have been recorded as producing 30 000 seeds annually (Mackey 1998), while some individual trees have produced more than 175 000.

Although seeds may remain viable in the soil for seven years (Bolton, Carter & Dorney 1987), most seeds germinate or are destroyed within two years. As it can survive for 30–60 years, prickly acacia is a relatively long-lived tree (Carter 1994).

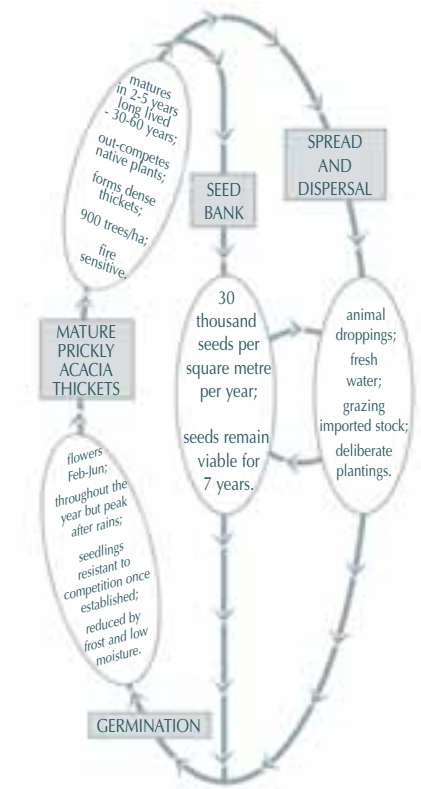

Figure 1: The life cycle of prickly acacia
(adapted from Prickly Acacia National Strategic Plan)

Dispersal

Stock, particularly cattle, are the main agents for dispersing prickly acacia seed. Cattle pass about 80 per cent of ingested seed in their faeces, and about 40 per cent of these remain viable (Mackey 1998). The faeces also provide an environment that promotes germination and survival (Harvey 1981). Since seed takes about six days to pass through the digestive tract, stock moved by road transport can disperse viable seed over large distances.

In comparison, sheep pass few viable seeds in their faeces but spit out about 35 per cent of

them during ingestion and regurgitate about a further 15 per cent as viable seed (Carter & Cowan 1988). Sheep and goats generally excrete most seed within three to four days, but some can be excreted up to nine days after ingestion.

Water may also disperse pods containing seed downstream during flooding. However, as most pods are grazed soon after they drop from trees, this is usually only a minor factor in spread. A very small proportion of seeds may also be spread in mud sticking to the hooves of stock or on machinery and vehicles.

Spread of prickly acacia has been dominated by episodic mass establishment events, which require a succession of above average wet season rainfalls (Thompson 1992). Given that soil seed reserves and cattle stocking are now constants over many areas infested with prickly acacia, a further succession of rainfall events such as those in the 1950s and 1970s would result in both geographic expansion and increased density of infestations.

History of spread

Prickly acacia was first introduced into Queensland in the 1890s. Until 1940, the species was believed to be *Acacia arabica* (Hill 1940). By the 1920s it was grown extensively as a shade and ornamental tree in the Bowen and Rockhampton districts. In 1926 the Department of Agriculture and Stock recommended it as a suitable shade tree for sheep in western Queensland—though even then, there were suggestions of its weed potential.

These underlying warnings went unheeded, and prickly acacia was planted extensively around homesteads, bore drains and dams during the second quarter of this century—not only for shade but also for fodder, because of its protein-rich pods and leaves. By the 1930s it was well established across the Mitchell grasslands of western Queensland and in several coastal localities (Thompson 1992). In 1957, prickly acacia was declared a noxious weed in Queensland.

Dramatic 'explosions' of prickly acacia occurred across the northern Mitchell Grass Downs landscape during the mid-1950s and 1970s in response to a series of high rainfall years. Major catalysts of this invasion were the change from stocking sheep to cattle, and the effectiveness of cattle as dispersal agents of the seed. The change in the proportion of cattle to sheep was due to the wool price crash, while the increase in cattle numbers was due to poor cattle prices. This led to the widespread expansion of prickly acacia throughout the northern downs and the establishment of dense, impenetrable thickets.

'Road transport can disperse viable seed over large distances.'

'*Acacia arabica* (now *nilotica*) as a fodder'

… the tree will be of great value in the Western country where sheep are depastured, as it should do well there, it will provide a grateful shade for sheep and afford a useful forage in the pods which are shed in late October, November and December, when pasturage is usually in poorest supply.

There, is, however, a drawback to this tree in cattle country, in that cattle consume the pods, the seeds are not masticated and pass whole through the digestive tract, thus causing numbers of young trees to appear where they are not wanted. The expense thereby entailed has caused the Bowen Local Authorities to regard the tree with little favour. Sheep and goats, however, masticate the seeds, and so the danger of too great a spread need not be anticipated.

Queensland Agricultural Journal, 1 April 1926

Current and potential distribution

Large, established infestations of prickly acacia occur in western Queensland in an area roughly bordered by Aramac, Barcaldine, Winton, Julia Creek and Hughenden. The core area covers over six million hectares, with the heaviest infestations along bore drains, watercourses and drainage lines. There are also isolated infestations across a broad area of northern Australia as shown in Figure 2.

Potential distribution in Australia has been predicted using CLIMEX (a computer modelling program) and the ecoclimatic characteristics of the areas of Pakistan and India where the weed is currently growing. This has been further interpreted using soil types, transport corridors, watercourses and bore drains to produce a predictive model of prickly acacia distribution (Figure 3). The major areas under threat include the Mitchell grasslands, Barkly Tableland, Channel Country, Gulf Plains, Queensland Central Highlands, parts of the Kimberley, western New South Wales and some coastal localities. Major transport corridors, particularly for the cattle live export trade, are also susceptible to the establishment of prickly acacia.

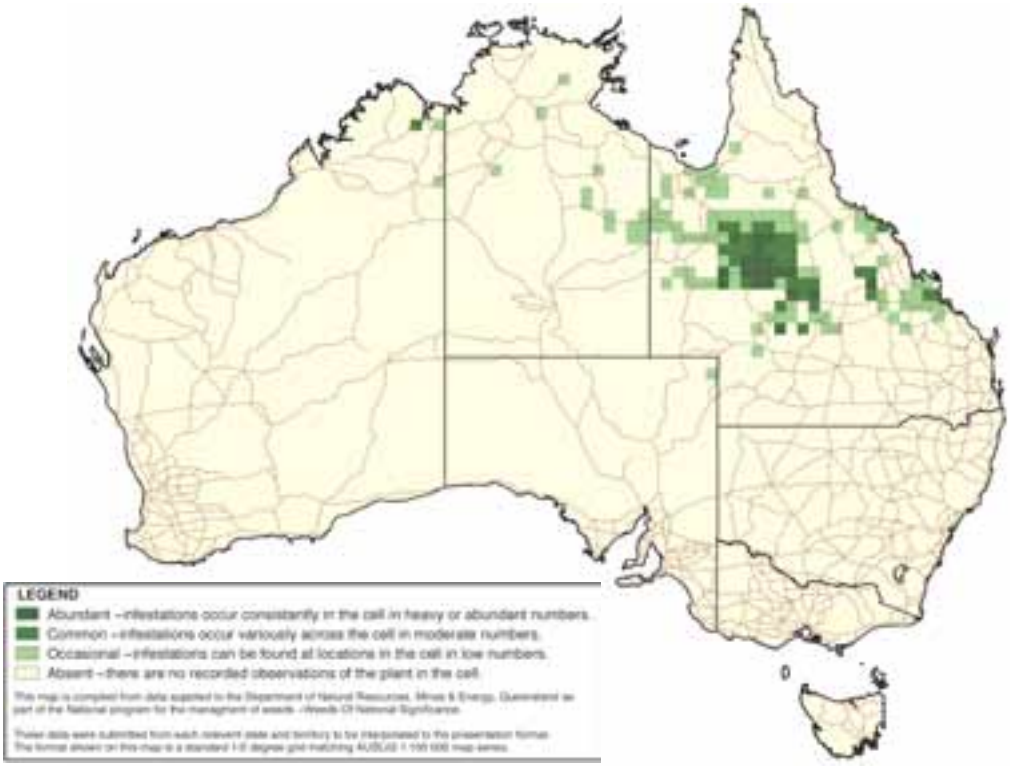

Figure 2: Map of national prickly acacia distribution

Impact on primary industry

While prickly acacia *at low densities* can increase stock productivity by providing shade and fodder, most landholders view it as undesirable because of its invasive potential and its effect on primary production. Dense infestations reduce pasture production, increase soil erosion, increase mustering costs, impede stock movement, restrict access of stock to water, increase the cost of maintaining bore drains and damage vehicle tyres.

Of these impacts, two of the most significant are the loss of pasture and increased mustering difficulty. Under normal grazing pressure a 25–30% canopy cover (the proportion of ground covered by the canopy of trees) of prickly acacia reduces pasture production by 50% compared with acacia-free pasture (Carter 1994) and pasture growth is virtually prevented by a 50% canopy cover (Carter pers. comm., 1995 in Mackey 1998). This loss of pastures will directly affect the potential carrying capacity of affected properties.

Mustering becomes increasingly difficult as prickly acacia increases in density and the associated costs may increase by up to ten-fold (Mackey, 1996). The failure to conduct clean musters also has implications for stock hygiene as the remaining stock may harbour diseases and parasites. Additional expenses also include the cost of clearing droving lanes and erecting new fences so that stock handling and mustering can be better managed.

'Mustering becomes increasingly difficult as prickly acacia increases in density and the associated costs may increase by up to ten-fold.'

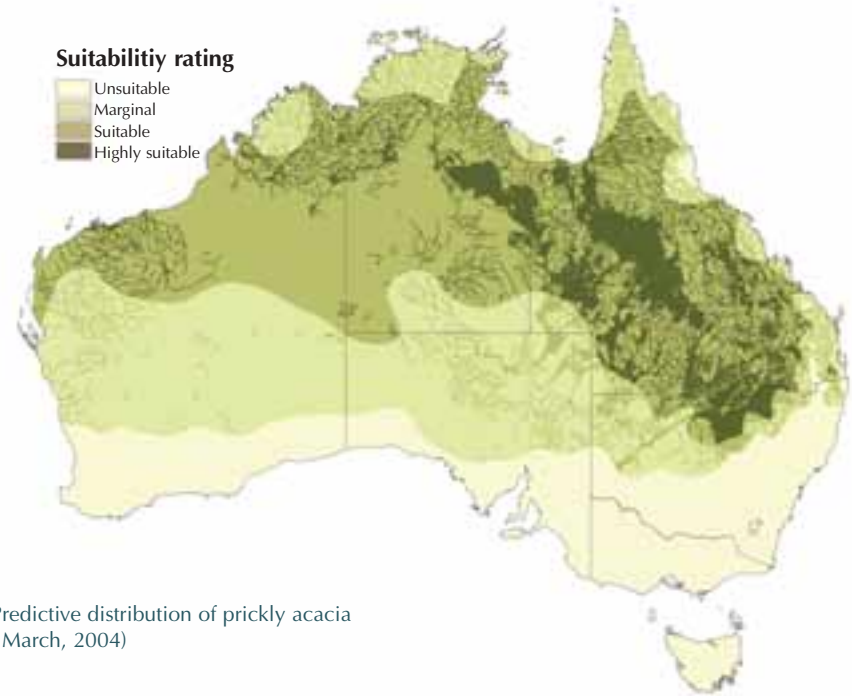

Figure 3: Predictive distribution of prickly acacia (Calvert & March, 2004)

It has been estimated that prickly acacia costs landholders from $4m to $9m per year in reduced beef and wool production, control costs, increased mustering costs and the cost of repairing damaged tyres. While some production benefits accrue from use of the leaves and pods as fodder and from higher lambing percentages as a result of increased shade, the detrimental effects of the weed more than outweigh these benefits (E Miller 2004, pers.comm., 9 Feb).

The environmental impacts of prickly acacia are discussed in section 6.

Nathan March

▲ Prickly acacia can have a significant impact on pasture production

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Developing strategies

Section 2

Developing strategies

Development and adoption of best practice—the research years

Peter Jeffrey

Introduction

I was very pleased when asked to write this case study as it gives me a chance to highlight the incredible amount of cooperative research that was undertaken in developing the methods currently available for managing prickly acacia. Those involved included research staff at the then Department of Lands and at the Tropical Weeds Research Centre (TWRC), together with a host of property owners and managers from across the geographic range of prickly acacia in Queensland. Often these property owners not only provided research sites, funding, labour, machinery and accommodation, but also expressed their ideas, needs, plans and aspirations, thereby giving the research direction.

I take this opportunity to thank my former departmental colleagues and the agrochemical companies for their help and support in this project.

The chemical solutions

When I arrived at the TWRC in 1985, the only chemical registered for control of prickly acacia was 2,4,5-T for use in basal bark or cut stump treatment. As this was to be phased out over the next two years, finding a replacement was our first priority.

The initial trials involved testing a range of herbicides (supplied by agrochemical companies) for their suitability for basal spray, cut stump or soil application techniques at four sites across the range of prickly acacia (Bowen, Aramac, Winton and Maxwelton). As a result, 2,4-D ester, Starane® and Garlon® were registered as basal bark treatments, and Velpar L® registered for spot gun application. More importantly, this work introduced the research team to landholders dealing with prickly acacia, and gave us an insight into what situations required technical solutions.

Landholders needed to reduce the amount of prickly acacia around bore drains and turkey nest dams as it made the facilities difficult to manage—it was causing leaks in dams and making mustering difficult in the dense growth around the water points. It was also making the delving of drains difficult and expensive and, by using up water, was shortening their effective length.

The first step was to develop the use of diuron. This gave excellent results, and the methodology and herbicide were registered for use in 1987. This research was not without its dramas and would not even have been possible without the help of Frank and Sandra Richards on Clareborough at Richmond, and Graham and Jo Thompson on Olive Downs at Maxwelton. Both families supplied machinery, accommodation, funding and labour—the Richards also lost some garden trees and a nice little grove of coolibahs in a creek at the end of a drain. The first rule of adaptive research is that we learn from our mistakes and, thankfully, the Richards family were forgiving.

NRM&E

▲ Conducting diuron trials in the Richmond area

Research into the use of basal bark and soil applied herbicides continued with trials into the timing of application. This coincided with ecological studies into the life cycle of prickly acacia and the effects of environmental conditions on its growth. New herbicides such as Access® were registered for use. Extension efforts, also beginning to take effect, culminated in a large field day at Olive Downs in September 1989. Here we demonstrated foliar application to control seedling regrowth—necessary because large numbers of seedlings had emerged after the death of mature trees treated with diuron. This led to the registration of Starane® as a foliar treatment for seedling regrowth in the early 1990s.

Though the Department of Lands provided vehicles, office space, staff wages and other support for this research, the project was conducted on a very limited budget—from as little as $1500 in 1985, to no more than $10 000, at any stage, till completion of the project in 1992. Results would have been far more modest without the support of the agrochemical companies from whom we begged product, and the cooperating landholders from whom we begged and borrowed most of the other resources we required. We did not steal—borrowing without the hope of repaying is just sharp business!

The profile of prickly acacia had risen remarkably in this period, and alternative

methods of control, especially mechanical, were being trialled. Stock and land management techniques were also used. The project was expanded to include researching these other techniques and expanding the herbicide work into integrated management of prickly acacia.

With a revitalized budget and additional resources, we took to the air in an attempt to deal with some broadacre problems. The research yielded promising results but failed to achieve a practical solution. Though it led to registrations, these have not been adopted by landholders or pursued with any vigour by the agrochemical companies—probably because they supplied a solution to only a limited number of situations. Perhaps there is a place for aerial control in the future, but for now everyone seems to be fairly satisfied with the control techniques available.

The mechanical solutions

All three mechanical solutions researched came from landholders with the insight to realize that more than a chemical solution was required, and that waiting for a 'silver bullet' biological control method was impractical. Basically, the research involved monitoring the effectiveness of these mechanical methods and getting this information to the extension network.

When a technique works reasonably well in the first instance—particularly when it has been developed and demonstrated to be effective by one of their own—landholders will adopt, review, improve and adapt it to their specific circumstances faster than a researcher can monitor or altogether explain.

When I first started research into prickly acacia, the golden rule was to keep machinery away from it or it would turn a bad situation into a nightmare. Hence my respect for the courage and insight of the three people who first approached me for help in further developing the mechanical techniques they were using to control prickly acacia.

In 1990, Graham Thompson, who had built a grubber attachment for his four-wheel drive tractor was the first to approach the TWRC for help. The method proved to be cost-effective, equivalent to basal bark treatment of scattered to medium-density infestations, and nowhere near as physically demanding. The results of this research were published at the *Queensland Weeds Symposium* in 1992 and the technique is now used relatively widely.

Frith Fysh from Acacia Downs, Muttaburra was the next to approach us to investigate the pulling of prickly acacia. The results were spectacular—especially in an area that was double chain-pulled. The results of this research were also published at the *Queensland Weeds Symposium* in 1992.

This turned out to be an incredible opportunity for the TWRC—with the cooperation of the Fysh family the project evolved into a commercially sized study of the integrated management of prickly acacia. Ecological studies, pasture reclamation, aerial treatment, and stock and property management techniques were applied and studied. The work culminated in the 'Integrated management of prickly acacia' field day held at Acacia Downs in 1998.

Peter Jeffrey

▲ Chain pulling trials on Acacia Downs

This was the first adaptive management trial for the control of a weed undertaken by the TWRC.

The third to approach us was Bill Ferguson of Politic, Aramac, with his root rake. Bill had been using this stick rake, with cutting blades between the tines, to clear fence lines, management points and strategic infestations. We began measuring the efficacy of the treatment, regrowth of seedlings and pasture recovery in 1992. The results were excellent, and the technique has been widely adopted across Northern Australia for the control of woody weeds (e.g. for controlling *Acacia farnesiana* on the remote Mistake Creek station on the Northern Territory – Western Australia border). A bonus is that pasture can be sown while even the densest infestation is treated—in fact Bill's dozer and rake were used for a trial on Acacia Downs, and also to delineate the research plots for the trial work to be conducted for the adaptive management project. The Fysh family on Acacia Downs also built a similar rake and used it for quick and successful control of prickly acacia.

One of the most important outcomes of our research was the understanding we developed of the importance of timing mechanical control. To achieve the best kills, control work should be done during the mid to late dry season (July to October). Prickly acacia pods at this time but as the seed is immature there will be little risk of spread. The plants are also suffering from moisture stress and there is less

chance of their surviving any significant root damage. The other great benefit is to stock—by undertaking mechanical control at the height of the annual protein drought, a weed is converted to a valuable fodder supplement.

'Timing of control is extremely important.'

If this work is carried out in the second year of a drought cycle, the effects of control and the importance of prickly acacia as fodder are increased. It doesn't hurt to remember that if you have had to sell stock due to the drought that this supplementary feeding using prickly acacia is also weed control and therefore 100 per cent tax deductible in the year of expenditure.

Property management solutions

In thirteen years of researching prickly acacia, I encountered many practical solutions to problems—either by managing infestations or overcoming individual constraints to control techniques. Solutions included fencing off part of a heavily infested paddock to prevent stock access to large numbers of seed pods, or pulling prickly acacia before seed set to provide fodder during a drought.

The Stacey brothers of Lilyvale, Richmond, developed an innovative solution to weed management. In the first year of a broadscale basal bark program, they realised that getting close enough to the acacia trunks to apply the herbicide accurately cost both time and herbicide.

Before treating an acacia-infested paddock the next year, they stocked it heavily with sheep, which browsed the plants to a height they could reach. This just happened to be a comfortable height for anyone basal spraying and, with the obstructing thorns removed, the herbicide could be applied quickly and accurately with little threat of injury to the operator, making the whole operation easier and more economical. Word got around and I believe many people now do likewise.

The best tip I can give to anyone with a prickly acacia problem is that timing of control is extremely important. Control activities undertaken after a run of dry years will give better long-term results because soil seed banks will be lower and subsequent regrowth will be less.

I would like to offer my good wishes to all those who continue the research and adaptation of management techniques for prickly acacia.

Integrated management

Nathan March and Peter Spies

Since the explosion in the spread of prickly acacia during the wet years of the 1970s, landholders have risen to the task of finding ways to combat it. From an early, almost complete, reliance on basal bark spraying they have developed methods of control that are useful in almost all situations. This toolbox was presented in the *Prickly Acacia Best Practice Manual*, and readers are encouraged to review this information when managing prickly acacia on their properties.

However, even the right tools will not always guarantee success if used in isolation.

Effective control of prickly acacia often requires *complementary* use of management and control actions used sequentially or concurrently within a well-developed plan. An example of such integrated management is double chain pulling of a dense infestation (during the dry season or in drought), followed by the use of goats to strip the fallen trees and control the seedlings, followed by use of herbicide to control any remaining prickly acacia. Other complementary combinations of control and management actions are detailed elsewhere in this manual.

'Effective control of prickly acacia often requires complementary use of management and control actions'.

NRM&E

▲ An integrated approach is usually required to address prickly acacia

Control options

Nathan March and Peter Spies

The current control options for prickly acacia are:

- chemical (herbicide)
- physical (mechanical and cultural e.g. fire)
- biological (including use of browsing herbivores).

The selection of 'best bet' control options will depend on a paddock-by-paddock assessment of:

- infestation characteristics (area, density, growth stage)
- available resources
- accessibility of infestation to machinery
- pasture competitiveness and quality
- land value

Most prickly acacia occurs:

- on flat or undulating plains
- along the banks of creeks and rivers
- around dams
- along bore drains.

Control options for these situations are presented in Table 2.

Table 2: Control options for prickly acacia

Control option	Situation						
	Flat/undulating plains			Creeks/ rivers[4]	Dams	Bore drains[5]	Seedlings
	Low density[1]	Medium density[2]	High density[3]				
Basal bark spraying	✓✓✓	✓✓	✓	✓✓	✓✓	✓✓	✓✓
Soil applied herbicides	✓✓✓	✓✓	✓			✓✓	✓✓
Cut stump	✓✓	✓	✓	✓✓	✓✓	✓	
Overall spraying							✓✓✓
Bore drain application						✓✓✓	
Grubbing – dozer pushing	✓✓✓	✓✓	✓				
Grubbing – wheel tyred tractors	✓✓✓	✓					
Grubbing – stickraking		✓✓	✓✓				
Double chain pulling		✓✓	✓✓✓				
Fire							✓✓
Best management suggestion	Basal bark spraying; soil-applied herbicide; dozer pushing; wheel tyred tractors	Basal bark spraying, soil applied herbicides, dozer pushing, stick raking, double chain pulling	Double chain pulling	Basal bark spraying, cut stump	Basal bark spraying, cut stump	Bore drain application	Overall spraying

Where (✓✓✓) indicates that suitability of the method is high; (✓✓) indicates that it is moderate; (✓) indicates that it is low, based on its effectiveness, efficiency (cost) practicality and legality.

Notes:

[1]Low density <50 plants/ha

[2]Medium density 50–150 plants/ha

[3]High density 150 plants/ha

[4]Refers to infestations growing in association with a watercourse or water body (i.e. on the banks or in the dry bed, but not growing in the water itself). Any application of herbicides to trees growing in association with a watercourse or water body must comply with the herbicide manufacturer's specifications. Due to the potential for high seedling emergence, the risk of soil erosion and other catchment protection issues, mechanical control is not recommended in these situations. Under the *Water Act 2000 (Qld)*, any mechanical works within the bed and banks of a watercourse require authorisation from the Department of Natural Resources, Mines and Energy.

[5]Only herbicides registered for such use (e.g. Diuron 900Wg ®) should be applied directly to the empty bore drain. In the table above, references to basal bark spraying and applying herbicide to the soil in a bore drain situation refer to individual plant treatment as per herbicide label directions.

Prickly acacia density standards

Peter Spies

Low density <50 plants/ha

15 plants/ha

50 plants/ha

Medium density 50–150 plants/ha

100 plants/ha

150 plants/ha

High density >150 plants/ha

250 plants/ha

650 plants/ha

Management strategies

Nathan March

The best and most economical way to control weeds is to prevent or reduce their spread, and the right actions undertaken early may dramatically reduce the costs of control in the future. Effective management strategies for control often relate to the biology and/or ecology of the plant such as the means of seed dispersal as discussed in section 1.

To control prickly acacia, the following strategies should be considered:

Landholders

- To prevent plants maturing and setting seed in previously clean areas, learn to identify prickly acacia at the seedling and sapling stages.
- Identify the most likely means of spread to, and within, your property and minimise the risk.
- In clean paddocks, monitor susceptible areas for prickly acacia (and other weeds).
- Use Weed Hygiene Declarations when transporting or supplying contaminated 'things' (i.e. fodder, grain, seed, livestock, gravel, sand, soil, mulch, packing material, machinery, vehicles or water). In Queensland, declaration forms are available from your local government weeds officer or the local office of the Department of Natural Resources, Mines and Energy.

Stock

- Don't let stock graze where mature pods are available (pods ripen from about late October to January).
- As seed may take about six days to pass through their digestive tract, quarantine cattle when moving them from infested paddocks or properties (with pods) to clean areas.
- As sheep graze seedlings more heavily and do not spread seeds as readily, if possible, run them instead of cattle in prickly acacia infested paddocks. However, paddocks and properties running sheep can still be seriously infested with prickly acacia in the long term.
- Consider the strategic use of alternative browsing stock (e.g. goats, camels) to reduce seed production or complement control efforts.

Infrastructure

- Fence off infestations or major seed source areas from susceptible country. Combined with managing stock movement, this is the cheapest way to contain prickly acacia.
- Replace open bore drains with piped water, as prickly acacia trees along bore drains are a major seed source.
- Use other means of shade where possible (e.g. shade plots or artificial shade structures).

Pasture management

- Conserve perennial grasses to reduce establishment and growth of prickly acacia seedlings.
- Reintroduce native pasture to mechanically treated areas by managing stocking rates and/or sowing pasture.

Control

- Control least infested paddocks first to ensure the maximum area treated per dollar spent.
- Maintain bore drains and dams free of prickly acacia to reduce seed production.
- Strategically control key infestations to improve property management (e.g. develop mustering lanes through dense prickly acacia).
- Don't try to mechanically control prickly acacia from October to January when the pods are mature. This may lead to distribution of seeds by stock at a time of year when rainfall is imminent, resulting in high germination rates.

Treatment of bore drains will reduce prickly acacia seed production and spread

Developing a weed control plan

Nathan March

As controlling prickly acacia can be expensive, it is important to optimise efforts by developing a weed control plan that is integrated into overall property management. Such a plan can be developed using the seven-step approach provided below:

Step 1: Define the problem

- Draw a property map showing paddock boundaries, watering points, creeks and rivers.
- Indicate areas of weeds with notes on the size, density and species of each infestation.
- Identify and indicate land types.

Base maps can include aerial photographs, satellite imagery or hand drawn sketches—the greater the accuracy of the map, the greater its usefulness in estimating the costs of control. The use of separate overlays (plastic transparencies) for each of the components of the plan is also often useful.

Step 2: Determine priorities

- Determine priorities for control on both a paddock and property basis
- Assessments should be made of:
  - areas that may pose management problems
  - areas that may be a significant seed source
  - risks
  - productivity of affected paddocks
  - legal and ethical responsibilities (e.g. threat of prickly acacia to neighbouring properties).

Step 3: Determine control and management options

- Identify management strategies that will reduce or prevent the spread of the weed.
- Identify currently available or affordable resources (e.g. labour, machinery, spray equipment).
- Determine the methods required to address all three phases of the control program—initial treatment, follow-up and ongoing monitoring.

Effective strategies may reduce future costs of weed control. Refer to page 23 for details of various strategies. Usually an integrated approach using a combination of control techniques will be required.

Step 4: Develop a financial plan

- Estimate costs of management or control for each of the priorities identified.
- Compare the costs of control with those of other operations being undertaken on the property. Identify the availability of financial incentives including tax concessions, low interest loans or labour programs.
- Integrate control costs into short-term and long-term budgets.

Control costs must be considered in conjunction with evaluation of priorities and control options. Before committing a large amount of money, conduct small-scale trials or seek advice from a professional weeds officer.

Step 5: Schedule activities

- Consider the effectiveness of different control methods at different seasons and balance this with the time available.
- Prepare a timetable for weed control activities throughout the year.

Weed control should become an annual part of station management if weeds are, or could become, a major problem. As it is perilous to treat a larger area than you will have time to treat again in the next year or two, consider the level of follow-up required in advance.

Step 6: Monitor progress

- Check treated areas for regrowth or seedling emergence.
- Regularly inspect 'at risk' areas for new outbreaks.
- Document the resources invested in control and assess the effectiveness of each method.

Monitoring is critical to the long term success of your efforts.

Step 7: Follow-up what was started

- Identify areas for follow-up control from your monitoring program.
- Implement management and control options according to the situation.

Follow-up control is crucial. No control method will result in a 100% kill rate and the germination of seedling is to be expected.

Conclusion

A weed control plan is useless without implementation. If it's difficult to start planning because of the size of the problem or lack of experience, start on a smaller scale and seek professional advice.

Developing a weed control plan and staying committed to using it are essential for effective long-term control. Such a plan should be structured but flexible enough to allow for changes brought about by uncontrollable external influences such as drought and fluctuating commodity prices. It should also be reviewed annually to assess how effective and efficient the chosen strategies and methods of control have proved to be.

Case studies—property management approaches

Section 3

Case studies—property management approaches

Prickly acacia management on Zara

Peter Spies with Charles Reddie

Background

Charles and Brenda Reddie purchased their property, Zara, in 1991. The 21 340-hectare property (with an additional 1300 ha of stock route) is located on the upper Landsborough Creek, south of Hughenden. Zara is mainly Mitchell Grass Downs, with some gidyea and boree country bordering the downs and running up to low escarpments. There are no bore drains on the property—water is piped from two bores on Landsborough Creek.

The Reddies purchased Zara knowing that it was infested with prickly acacia—about 8900 ha of low density, about 1600 ha of medium density, and a further 800 ha of high density infestations. The latter severely hindered mustering and greatly reduced pasture production.

According to Charles, 'Prickly acacia was thickest along the creek… with big trees.' Lighter, more open infestations were found further away from the creek, on the Mitchell Grass Downs, and to the edge of the escarpment. The weed was not restricted to the heavier clay soils—there were some heavier infestations on the lighter, loamy soils

Peter Spies

▲ Recently treated prickly acacia seedlings in Gidyea country

of the gidyea and boree country on top of small rises. 'It loves that sort of country. It doesn't go into the scrub that much but does go into the scattered scrub', he said.

The Reddies run approximately 800 cattle and 4000 sheep on the property, with about one third of the income currently derived from sheep. 'Before we bought this place it was nearly all sheep… they spread the seed, but not as well as cattle. Cattle are worse …they pass most of the seeds—you notice six to eight prickly acacias come up from the one cowpat. They don't digest a great lot… they pass most of it', Charles said.

When asked how prickly acacia was introduced to Zara, Charles said he believed it had originally been planted there prior to his ownership.

The Reddies quickly realised that prickly acacia had to be managed to:

- make mustering easier and reduce costs
- contain and then reduce the level of infestation
- reclaim heavily infested areas for pasture production
- prevent or minimise infestation of unaffected or lightly infested areas
- preserve and increase property value
- reduce costs of damage to vehicle tyres—$500 per year at the time.

The Reddie family has invested significantly in managing prickly acacia over the past decade. Though initially large, this investment now requires only minor financial and labour input to safeguard it.

History of control

Since purchasing the property, the Reddies have undertaken a major control program that has involved pulling or pushing the larger areas of prickly acacia. With the help of contract labour and 'labour barter' days, they have also carried out initial chemical and follow-up control using basal bark spraying, cut stump and soil application techniques. They have also trialled aerial spraying in conjunction with the Tropical Weeds Research Centre.

'Cattle are worse …they pass most of the seeds—you notice six to eight prickly acacias come up from the one cowpat.'

Charles' priorities were to reduce seed production and contain the prickly acacia in the dense infestations. Concurrently, he aimed to clean up the open downs country where the plant was fairly scattered and then to work back to the dense infestations. 'Where prickly acacia was seeding around dams, we got the big trees at the same time', Charles said.

Basal bark spraying began in April 1991 around the yards, the shed and nearby Landsborough Creek. The heavier infestations near the creek were treated with Access® and diesel, or Starane® and diesel, and some cut stump application. Velpar® was used in the more open infestations away from the creek. 'I had good results with basal bark spraying with Starane and diesel', Charles said. 'I cut a lot of trees down, in the drought years in the '90s with a chainsaw, around the creek, that have not returned… and treated with Starane and diesel…you would be struggling to see a tree there now…we've pretty well beaten the problem.'

'I cut a lot of trees down, in the drought years in the '90s with a chainsaw.'

In 1992 a contract team was hired to carry out a major herbicide control program in the three western paddocks (Mitchell Grass Downs). Large trees around stock camps had contributed to a massive seed build-up around water points, which had resulted in very dense infestations. Trees were shading out the grass and water was then eroding the area. This was happening more on the black soil areas… 'Prickly acacia was a nuisance around gates… we paid contractors $13 000 and they were only able to get over 1600 to 2000 ha of the thicker infestations', Charles said. The contract team undertook 48 days of spraying.

2,4,5-T® and Velpar L® were used with good results. As 2,4,5-T® became unavailable, Charles switched to using Garlon 600®, followed by Starane® and then Access® and diesel for basal bark spraying. The three western paddocks are now virtually free of prickly acacia and require only one to two days' follow-up control per year.

Charles believes that seed has survived in the soil for up to 10 years. 'In one paddock there hasn't been a seeding tree for 10 years; there may have been the odd one but that would be all. Seedlings are still coming up where the seed would have been real thick. Stock aren't bringing it in.' The Reddies do not shift stock from paddocks containing prickly acacia seed pods without first quarantining them in a holding paddock.[1]

While follow-up remained the priority, control of prickly acacia on Zara centred on improving station management as a whole by basal bark spraying along fence lines and waterways. Charles also integrated his prickly acacia control program with drought management and supplementary feeding of stock. Benefits gained from this have gone some way toward offsetting control costs, and Charles has occasionally been able to avoid agisting or selling stock because of it. It is useful, however, only when there is leaf on the acacia, which is often not the case during drought.

Throughout the dry years from 1992–95, over 530 hours were spent mechanically pushing prickly acacia for feed using a 70 Hp TD9 Dozer. According to Charles, 'You only have to start the machine up and the cattle get right into it… they follow the machine along.' As well as providing feed, this treatment results in a kill of approximately 95 per cent. Small trees to four metres were relatively easy to remove, while larger trees (to seven metres) created difficulties. Charles purchased a larger Fiat Allis HD11 dozer (140Hp) in 1995, and also hired a 200Hp dozer to continue pushing prickly acacia. He has noted that there is more erosion in areas where prickly acacia has been chemically controlled than where it has been pushed, because the dozer tracks act as mini ponds and the hollows left by the blade help pasture to re-establish. Charles tries to doze on the contour to maximise these benefits.

Starane® and water were sprayed from a helicopter[2] in an attempt to control dense thickets of prickly acacia on creeks and drainage lines. The results of the trial were not good—the average kill rate was approximately 30 per cent. Another trial, which involved foliar spraying small, very dense infestations with Starane® and diesel using a mister did not work too well either.

[1]Stock should be quarantined for at least six days to empty themselves of seed.
[2]These trials were conducted in conjunction with the Tropical Weeds Research Centre, NRM&E.

Nathan March

▲ Joe Rolfe (DPI&F) and Charles Reddie inspect double chain pulled prickly acacia

In February 1994, two D9, 410 Hp dozers were used to pull some of the thickest areas of prickly acacia on Zara. 'You could hardly ride a motorbike or horse through it… it was that dense', Charles said. That year, $10 200 was spent treating an area of about 500 ha where the density ranged from about 500 to several thousand trees per hectare. As there was virtually no pasture in these areas prior to pulling, buffel grass was lightly sown with the dozers. Poor rainfall ensured a good kill rate and low survival of prickly acacia seedlings in the treated area.

As a result of seedling growth, the area has been sprayed up to three times since—some with Velpar®, some with Access® and some with diesel. 'Initial pulling cost was $8.00/acre ($20/ha) and it hasn't been a big expense since … we've only been over it two or three times. Mitchell grass is coming back through it… hopefully we'll lock this up through the wet.' Charles has found double pulling to be the most economical form of clearing, 'About a quarter of the cost', he said.

Either a quad bike, or a two-wheeler bike with a spot gun is used to apply Velpar® for mop-up operations. The quad bike is equipped with a pressure sprayer… 'It carries more chemical… it serves its purpose when basal barking… it's quick to get from one tree

'I eradicate them… that's my ambition… eradicate them.'

to the next.' Charles believes it is cheaper to basal bark spray than to use the cut stump technique, mainly due to greater labour costs. When infestations are away from other trees and not very dense, Velpar® has proved to be the cheapest chemical treatment because of the savings in time and labour.

Charles also experimented with using fire after pulling, when there was a good fuel load in the gidyea and boree areas. He found that it was reasonably successful in bringing 'a lot of seedlings up in a hurry' and 'it got rid of a lot of rubbish on the ground as well.' He said, 'We thought we'd try fire to get rid of some of the suckers… it didn't. A lot of them shot from the base again. It didn't seem to be a hot enough fire. It wasn't real successful.'

The Reddies have funded their own control of prickly acacia, over the last 10 years, with the assistance of neighbouring landholders through 'labour barter' days and some in-kind technical assistance from the local land protection officer.

Future direction of prickly acacia management on Zara

Charles does not tolerate prickly acacia—there are presently only about 80 ha left to be treated on the property. He does not even keep a few around as a drought resource, 'I eradicate them…that's my ambition… eradicate them. We spent too many dollars controlling them. We've got enough trees without having any of this. I wouldn't have them on the open downs country, I'd have something else.'

Nathan March

▲ The Reddies are achieving their vision of a prickly acacia free property

Nathan March

▲ Effective prickly acacia control is protecting the upper Landsborough catchment on Zara

Charles believes the shift from sheep to cattle has resulted in an increase of prickly acacia on the downs and that new landholders who purchase Mitchell grass blocks should be made aware of their responsibility to control or manage prickly acacia by 'a nice courteous letter from someone.'

To control grazing pressure and allow wet season spelling, Charles intends to fence his creek frontage along Landsborough Creek, according to land type. 'We intend to fence-off the creek out of the flood line and hopefully lock it up now and again—still allow grazing though…you can't see prickle trees through there now… you wouldn't believe it.'

Control of prickly acacia at Tarcombe

Craig Magnussen

Background

The Tarcombe and Guilford Park properties, located about 100 km south-west of Longreach, are owned by the Lamond family. They incorporate approximately 15 000 ha of predominantly Mitchell Grass Downs, with some flooded alluvial country and frontage to the Thomson River. The properties became infested with prickly acacia after intentional plantings by the Lamonds in the 1950s.

'We'd planted a handful of trees on the sand ridge down from the house in the early '50s after the DPI were promoting them.[3] During dry times we'd cart water to them to keep them alive. The trees never looked like becoming a problem until a run of good seasons … then they just exploded! We've been battling them ever since', Mrs Lamond said.

The main prickly acacia infestation is on an unnamed creek that runs from east to west through the Tarcombe block. However, as a result of cattle spreading pods away from a central dam, there had also been a considerable migration of the pest onto the surrounding Mitchell Grass Downs flats. The same level of seed migration and establishment did not occur on the Mitchell grass flats surrounding the other three dams along this creek, as those areas were stocked predominantly with sheep.

There are three other main areas of infestation; on the Tarcombe block, one is centred around twin dams and another on the Bimerah dam and associated creek line running to the north; on the Guilford block, the infestation is centred on two dams and an interconnecting creek. Other less significant infestations have occasionally appeared on both blocks, but those outlined above have been the main focus of control efforts over the past six years.

In 1997, the infestations on Tarcombe and another along the Barcoo River represented the southern extremity of the range of prickly acacia in the Lake Eyre Basin. Because of the proximity of Tarcombe to the Thomson River, and the fact that its infestation was the southern-most prickly acacia in the Longreach Shire, the 'Bridge to Bridge' program was initiated by the Longreach Landcare Group. The aim of the program was ultimately to eradicate prickly acacia from the area between Longreach Bridge and the Lochern Bridge to the south, on the Thomson River. It was decided that the most practical and cost-effective way to achieve this considerable undertaking was to begin at the bottom of the Thomson system within the shire and work northwards[4].

The Department of Natural Resources and Mines' Strategic Weed Eradication and Education Program (SWEEP) began in earnest at Tarcombe in 1997 with a team of six men spraying for five months. Basal bark spraying, mechanical control, foliar spraying and burning have been used in a further six control campaigns since then. The technique is chosen based on how appropriate it is for the current stage of the plant's life cycle.

[3]Prickly acacia was declared a weed in 1957 (Queensland).
[4]Weed control principles usually advise control start from the top of the catchment and work down. However, within the Lake Eyre Basin, many rivers flow slowly and spread out, thereby reducing the risk of long-range water based prickly acacia seed spread.

The SWEEP team hasn't been alone in the fight against prickly acacia at Tarcombe. Other vital contributors include Longreach Shire Council, Longreach Landcare, Queensland Parks and Wildlife Service, Barcoo Shire Council and, of course, the Lamond family.

The process

Basal bark spraying

The first comprehensive chemical treatment, which focussed solely on the Tarcombe block, involved basal bark spraying using only Starane® and diesel at a rate of 1:60. The mix was applied to the plant stems from a hand-held spray bottle. All parts of the plants above ground were sprayed up to about 30 cm (higher for larger trees).

The main creek through the property was targeted first, starting from the Thomson River in the west and working towards the higher country in the east. The dam backwater, with extremely thick seedling prickly acacia, was the first major obstacle encountered. It was extremely hard going as plants had come up 'like the hairs on a dog's back.' They were about 2 m high, and the infestation was sometimes as much as 50–100 m across. Treating the rest of the area, although still a lengthy operation, was relatively easy by comparison.

Craig Magnussen

▲ SWEEP control operators, Scott Mitchell and Bruce Shailer in backwater of dam. Note the extremely thick infestation.

Craig Magnussen

▲ Foliar spraying

'It was extremely hard going as plants had come up "like the hairs on a dog's back".'

Foliar spraying

Though basal bark spraying with Starane® and diesel had proved very successful, a better option to treat the backwater would have been to foliar spray with Starane® and water (with wetting agent added) at a rate of 200:1—the method that was subsequently employed at Tarcombe. In drier areas, this rate was also effective on seedlings and smaller trees (up to shoulder height). It should be noted that good leaf cover is essential when foliar spraying.

'It should be noted that good leaf cover is essential when foliar spraying.'

When foliar spraying was first used at Tarcombe it was hoped that the previous good season would result in a high germination rate of the large prickly acacia seed bank. In theory, this would have meant less seedling recruitment and consequently less herbicide used in subsequent control efforts. Though this proved correct, above

average rainfall over the next two seasons also resulted in extremely high levels of seedling recruitment.

Mechanical control

A thick patch of a couple of hundred hectares of prickly acacia was earmarked for trying out a mechanical control method. The machine used was a Volvo 150C (equivalent to a Cat 966F) rubber-tyred loader. Anecdotal evidence suggested that such a machine would disturb the soil less than a tracked machine, resulting in less seedling recruitment. The method proved extremely effective and efficient. The operator would lift the bucket as he hit the trees, pulling the taproot out of the ground or breaking it off beneath the surface (both methods kill plants outright). The job was finished within 40 hours at $115 per hour (now about $130/hour). Seedling recruitment was quite low, with good regeneration of native pasture in the ensuing years.

Fire treatment

The infestation was basal bark sprayed once before it was decided to try fire treatment in the following season. The likely effect of fire on the existing prickly acacia seedlings or seed bank was unknown. Once weather conditions were favourable, a fire was put through the patch, which was by then covered, in varying degrees, with Mitchell grass and wiregrasses. Though the fire did not burn well in some parts, overall it exceeded expectations. Some seedlings were killed and a lot of the dead material on the ground (from the machinery work) was incinerated, paving the way for easier control in the future using motorbikes or other vehicles. The fire didn't seem to promote germination, as subsequent

Craig Magnussen

▲ Fire treatment of prickly acacia seedlings

seedling recruitment was minimal. A further round of basal spraying was carried out in the following season, and minimal attention has been required since.

In the ensuing years, only relatively small control projects have been undertaken in an attempt to kill new seedlings and thus prevent any trees from reaching maturity and producing seed. SWEEP teams, mostly basal spraying from four-wheeled motorbikes, have been used for these projects in the more scattered, open areas. More concentrated areas of new seedlings have been treated with foliar spray.

Weedbuster days

In conjunction with visits by the SWEEP teams, the Longreach Landcare Group has held several 'Weedbuster days', the first of these only a couple of weeks after the project began in 1997. A considerable stretch of creek line with thick mature trees was selected beforehand. In a very long day that ran till after sundown, an excellent roll up of about 30 people worked extremely well to knock over the infestation. Those who

attended were mostly local landholders, with others from NR&M, DPI, QPWS and the Longreach and Barcoo shire councils. The kill rate was excellent, despite the fact that many of those attending had never sprayed prickly acacia before. This day really kicked off the Longreach Landcare Group's 'Bridge to Bridge' project, and several more Weedbuster days have been held along the Thomson River since. At present there are no infestations between the two bridges on the Thomson River that are not already controlled, or being controlled.

Control of prickly acacia at Tarcombe is now at a stage where all seeding trees have been killed—virtually no seed has been produced in the past few years. It now requires only a handful of volunteers (landholders, Longreach Shire Council and officers from NR&M) working for one or two days a year to clean up any emerging seedlings.

Since 1997 approximately $250 000 has been spent, excluding the Lamonds' considerable contribution which would have easily equalled this since control operations began. This amount includes the cost of about 54 000 L of diesel and about 900 L of herbicide.

The result

As a result of these efforts, country that was formerly heavily infested with prickly acacia has gradually reverted to open Mitchell Grass Downs, and the clean country to the south in the Cooper Creek catchment has been safeguarded, ultimately protecting the clean status of Lake Eyre. All those involved are to be congratulated on their efforts, most of all the Lamond family for their unwavering commitment to the project.

Craig Magnussen

▲ Craig Magnussen inspects the results of control efforts

Prickly acacia management on Audreystone

Damian Byrne and Bill Ford

'Bill quickly came to the conclusion that the prickly acacia would have to go.'

Introduction

In 1998, Bill Ford purchased Audreystone which, at the time, consisted of 2800 ha of relatively clean Mitchell Grass Downs pasture, 1600 ha of dense prickly acacia forest, and another 1600 ha of medium to light density prickly acacia. After attempting to muster sheep, Bill quickly came to the conclusion that the prickly acacia would have to go. Ever since, he has been a man on a mission to control and eventually eradicate prickly acacia from his property.

Despite multiple setbacks that would have reduced most to tears, Bill has persevered to the point where today no standing forested acacia remains on his property. In its place there are now open Mitchell Grass Downs divided into several goat paddocks. Though many landholders have successfully removed mature trees, few can boast of 'taking the scalp' of seedling regrowth, especially over larger areas.

Audreystone is a great example of what can be achieved by someone with the drive and determination to overcome the pest. Though better techniques and alternative methods are available, they are ineffective without persistent follow-up control. In the past four years, like the prickly menace, Bill has been down several times, but he has always got up without hesitation, and got into it with new ideas.

Control methods

Control methods such as fencing, restricting cattle movement, selling the cattle herd, moving watering points, controlling grazing of sheep and goats, cropping, and using more traditional chemical and mechanical methods have been used on Audreystone.

Mechanical control

Before purchasing the property Bill was a dozer contractor, so it was not surprising that he chose mechanical control as one of his main tools against the pest.

Table 3 shows details of the main mechanical methods used on Audreystone to date—pulling, raking, blade ploughing, and 'crocodile seeding.' Each method has had its place, though there have been some standout performers.

Table 3: Results of mechanical control methods

Method	Outcome
Single pull and goats (fenced)	• Best results achieved • <5 per cent regrowth—incredible result! • Large number of goats fenced into area when pulled; a small number left in paddock for months after the pull. Continual pressure of residual goats appears to have had a large impact in only one paddock—replications have never been quite as good, although still better than other methods
Single pull without goats	• Larger percentage of seedlings established than when goats are present, but still quite good • Resulted in a higher survival rate of adult trees than when double pulled. (This will not be a problem if goats are to feed on the remaining mature trees as they soon die as a result of this grazing • Cheapest method of getting dense infestations onto the ground
Double pull	• Very few adult trees survived • Resulted in establishment of a larger percentage of seedlings than single pull
Raking	• Large percentage of seedlings established • Few seedlings destroyed • Gave a tidy result • Good preparation for blade ploughing • Cheap
Blade plough	• Large percentage of seedlings established • Soil seed bank depleted quickly • Good crop establishment • 100% kill of seedlings • Storm runoff reduced • Expensive
Crocodile seeder	• Excellent for re-establishing Mitchell grass • Caused limited damage to seedling acacia • Reduced storm runoff by gouging large holes in the ground • Resulted in good crop establishment • Cheap

'The best outcome resulted from combining mechanical control with use of grazing animals.'

Nathan March

▲ Crocodile Seeder at a field day on Audreystone

Damian Byrne

▲ Chain pulling

Peter Spies

◀ Pulled country followed by control by goats

Single pull and goats

As the table shows, the best outcome resulted from combining mechanical control with use of grazing animals. Single pulling and grazing with goats produced incredible results that still amaze local land protection officer Damian Byrne each time he enters the paddock to reassess it. In comparison with that from all other methods used, regrowth is virtually negligible. Though it is difficult to determine exactly why it was so successful, the following is a detailed description of what was done:

1. A 100 ha paddock of medium- to high-density mature acacia was fenced and stocked with 800 goats.
2. Within a few days the goats had eaten all available foliage up to 2 m and were eating the bark off the trees as well. They were also attempting to get out of the paddock to find more available acacia foliage.
3. During the dry season, trees were then single pulled after seven days of stocking with goats.
4. Goats immediately began browsing on acacia as it was pulled.
5. They were left to browse in the paddock for eight weeks.
6. One hundred goats were left in the paddock for six months.
7. After six months, about 20 per cent of the mature trees were still alive but they all died eventually after continual goat attack.

Important factors to note from this were:

- paddocks must be fenced to ensure the required browsing pressure on the acacia
- single pull allows mature trees to die slowly (if attacked by goats), which prevents an immediate and massive emergence of seedlings throughout the entire paddock
- a residual number of goats can control seedlings as they emerge.

Goats as prickly acacia control agents

Using goats to control prickly acacia came as a totally new challenge to Bill, but as there were plenty of feral goats roaming on the property (due to the abundance of prickly acacia), and they keep a steady market value, he decided to put them to work. As there was already a fully electrified goat paddock on the property (from past prickly acacia trials in the mid-nineties), it was easy to start trialling them.

It immediately became obvious that the goats were highly efficient at destroying prickly acacia, which they preferred to everything except Bathurst burr. They also paid little attention to the pasture. Most of the foliage was removed and the bark stripped on all trees under 2 m. Though they killed only a small percentage of the plants, they prevented them from growing, keeping them about 1–2 m high. This allowed more time to be spent on other control work in any particular paddock.

Bill has rotated sheep and goats through several smaller 100 ha paddocks. Having the sheep eat the grass and the goats browse on the acacia has worked quite well, though the stocking rate of goats needs to be high to have an impact—Bill has found that 12/ha works best for him.

Peter Spies

▲ Goat browsing prickly acacia

Fencing and waters

When Bill arrived at Audreystone there weren't many fences or watering points—all stock came to water in the centre area of the property, and this had led to severe degradation. The area had become bare, eroded and densely covered in prickly acacia. A netting fence running north–south on the property divided the relatively clean downs area from the infested country, thus preventing further spread of prickly acacia.

'A netting fence running north–south on the property divided the relatively clean downs area from the infested country.'

Today, the watering points are well dispersed across the property and there are many new paddocks. This means that the goats and sheep can be concentrated in areas requiring control and can be rotated through these paddocks, which also benefit from being spelled. This has enabled the central area to recover and has given Bill greater control over his stock, pasture management, and acacia.

Sheep and cattle

Bill is a cattleman and until he purchased Audreystone had had little experience with sheep. He was particularly proud of the cattle breed that he had been developing for about 20 years. However, he reluctantly decided to sell his whole herd as he realised that as long as he had cattle on the property he would have a problem with prickly acacia.

Crossbred sheep are now his forte. They have a slight impact on acacia, particularly on seedlings of less than 15 cm. Bill still agists some cattle on the property—they are mostly kept in the clean area, or in with the acacia when there are no pods on the trees.

Chemical control

Chemical control also has its place on Audreystone, and areas of scattered prickly acacia trees are treated this way.

Cropping

Bill has had a bit to do with cropping, having originally come from the Roma area. He thought he would try some forage sorghum on Audreystone by just throwing out seed while blade ploughing prickly acacia. The rainfall was favourable and an excellent crop came up, which went a long way towards paying for the blade ploughing. The crop also seemed to compete with acacia seedlings; however, once it died off, the acacia seedling regrowth came back very aggressively.

Since then Bill has blade ploughed the area again and there seems to be very little seedling germination, but it is still too early to make any real assessment of this.

Bill has had four such crops since he has been on Audreystone and only one has failed due to drought. As the main benefit is financial, it makes sense to throw out some oats or sorghum when blade ploughing when there is a good chance of rain. In Bill's experience, the crops have not hampered the regeneration of native pastures and the areas that have been cropped have grassed up very well.

Two large contour banks have also been developed on the property to prevent erosion and to assist in cropping along their topside where soil moisture is higher.

Damian Byrne

▲ Forage sorghum crop in pulled and blade ploughed paddock—once dense prickly acacia

Peter Spies

▲ Prickly acacia 'black forest' at Audreystone, 1999

Regeneration of native pastures

Right across the property where prickly acacia has been taken out, the native grasses have come back well. This was very surprising, as Bill didn't think there would be any grass seed in the soil because of the lack of grass under the prickly acacia. In some areas, only herbage came up in the first year, but beautiful grass paddocks have now developed.

Greening Australia realised the benefit of Bill's project to the Mitchell Grass Downs ecosystem and supported his work with two rounds of financial assistance. This helped to pay for fencing smaller paddocks and supplying water.

Summary

Good management has made Audreystone a successful property and Bill has taken a whole property management approach to controlling prickly acacia. Most day-to-day activities—whether moving stock to another paddock, blade ploughing or fencing—have had an impact on its management. Country that was once unproductive is now some of the best in the area. Control hasn't been an economical burden, but has turned profits in Bill's favour, and has increased the carrying capacity and resale value of the property.

However, Bill's great determination and desire to beat prickly acacia has been the main reason for his success.

'Where prickly acacia has been taken out, the native grasses have come back well.'

Damian Byrne

▲ Native pasture regeneration in the area formerly known as the 'black forest.' January 2002

Prickly acacia management on Bibil

Chris and Louise Moloney

'Their aim is to contain and manage prickly acacia'.

Introduction

Bibil station, owned by Chris and Louise Moloney, is a property on the edge of what is known as the Desert Uplands and Mitchell Grass Downs, 65 km north of Muttaburra in central western Queensland. Bibil consists of two leasehold blocks, both of which are about 9100 ha.

Bibil has a variety of land types, including Mitchell Grass Downs, gidyea woodland, spinifex, open ironbark woodland, plateau-type country and the Tower Hill Creek channels. The property runs both sheep and cattle, although wool is the main source of income. On average, about 8000 sheep (including 4000 ewes) are run with about 150 shorthorn cows.

Since the Moloney family purchased the property in 1981 they have tried to control prickly acacia, which they cut and herbicide treated and used for stock fodder during the dry years of the 1990s. They recognised prickly acacia's shade value to the Mitchell Grass Downs. They also recognised its invasive nature, but have decided just to live with the pest, and hopefully turn it to their advantage.

Management aims

Their aim is to contain and manage prickly acacia rather than attempt eradication, which may not be feasible. If used as stock fodder during dry periods it can add to productivity. The Moloneys are even investigating its use as craft wood for giftware and fine furniture.

Peter Spies

▲ Prickly acacia regrowth on bore drain prior to re-treatment with Diuron

Prickly acacia prefers watercourses and bore drains, and heaver soil on the edge of the pebbly gidyea country, but also occurs on the open downs. It can't compete with gidyea (especially the suckers), though some acacia seedlings will emerge where the gidyea has been pulled. There is still a medium infestation on some areas of the downs, while other paddocks have been cleaned up and now are virtually free of prickly acacia; however, to maintain this advantage, yearly follow up will be required.

The Moloneys use an integrated program of running Diuron® along bore drains, using camels, cut-stump spraying, and drought feeding to contain and manage the plant. These drains, which were the worst affected areas, are now essentially under control. This has been achieved by treating with Diuron® every two years and basal spraying any regrowth or seedlings that emerge on the

edges of the drains. In dry times prickly acacia is cut as fodder using a chainsaw, thus allowing stock access to the green (immature) pods and leaves. In one paddock, camels are used to contain or control prickly acacia. Though they won't eradicate it completely, they eat the pods and flowers, and generally strip the trees of any foliage within their reach.

Diuron®

When the Moloney family took over the property in 1981, prickly acacia was already growing along both sides of the 30 km of bore drains. This made it hard to delve and drive along drains and, when the Moloney children started to drive and ride bikes, it became a nightmare for tyres!

Prickly acacia was not really regarded as a problem in the early 1980s and landholders had not really started to control it. During the mid '80s the Moloneys put a grader along both sides of the bore drain – 'to get rid of the prickly acacia and clean it up…nobody really knew much back then, but looking back this was one of our worst mistakes. Today we never put a grader or disturb the ground along the drain unless really necessary. Then we had to reclaim at least one side of the drain so we could drive along it and delve', Louise said.

In the early 1990s, use of Diuron® was suggested as it was used in irrigation ditches. It proved a quick and easy way to protect bore drains from becoming overgrown by prickly acacia. 'Using liquid diuron, a herbicide product by Nufarm, was better than using the powdered or granular forms. Depending on the type and aggressiveness of the prickly acacia, this product can be used annually—and this can be stretched to every two or even three years in some places along the drain', Louise said.

The Moloneys have found that there is no best time to apply Diuron®, except in summer in dry years when trees are relying solely on the drain for water. 'Last year, when we had three inches of rain for the year, we got 100 per cent kill along the drain', Louise said.

Diuron® will kill any trees (both weed and desirable native or planted species) that use water from the drain, with the exception of false sandalwood (*Eremophila mitchellii*), which seems to be resistant. The Moloneys recommend that to protect 'any areas, like your homestead, that rely on the drain, stop spraying about 1.5 or 2 km up as Diuron® will carry a distance in the drain. It is advisable to divert water before it reaches the homestead or any trees you want to keep, for a couple of weeks.'

'Mixing rates of diuron are tricky as the labels all use farming or broad acre terms and we spot spray. So, it has taken a bit of trial and error to get the rates right.' They apply Diuron® using a 12-volt diaphragm pump set up in the back of a vehicle, with the driver spraying out the window.

'An integrated program of running Diuron® along bore drains, using camels, cut-stump spraying, and drought feeding.'

Louise Moloney

Treating bore drain with Diuron

'Up to 140 trees of various sizes can be cut with a chainsaw in an hour.'

'Sound of a starting chainsaw or a vehicle is enough to have cattle running towards the action.'

After spraying, the drain is left for two days before the bore is turned back on at, half its flow; this is gradually increased to full flow after a few days. Any small prickly acacias that appear subsequently are basal or foliar-sprayed with AF Rubber Vine Spray® and diesel before they get too big. This can be done up to twice a year depending on the season.

Use of Diuron® is not a once-off treatment, as seedling prickly acacia will reappear and grow again. The Moloneys usually repeat the treatment when the regrowth has reached a fair height, as 'a poor kill rate may result' if [this] is done when the trees are only small', according to Louise.

Cut stump spraying

On Bibil, prickly acacia is usually cut for feed during dry times, as both the leaves and green pods have high fodder value. A lot was cut with a chainsaw for this purpose in the '90s and again in 2002. As the plant defoliates during drought when it is needed most, the trees with the best foliage are found along drains or watercourses, or around dams.

Up to 140 trees of various sizes can be cut with a chainsaw in an hour. A smaller chainsaw—usually one with a 14 to 18-inch bar—is preferable as it is easier to carry. As the direction of fall of prickle trees is unpredictable, it is advisable to wear protective clothing including a hardhat and protective chaps. After a tree has been felled, the diesel and herbicide mix must be applied to the entire surface of the stump within 30 seconds, after which the tree re-seals itself, rendering the herbicide less effective. Starane®, Access®, or AF Rubber Vine Spray® are all suitable, but the Moloneys have found the latter the cheapest. Using a household plastic bottle with a pump is recommended for application.

Peter Spies

▲ Cattle grazing on cut prickly acacia along bore drain

The Moloneys report that after a few days of cutting, the sound of a starting chainsaw or a vehicle is enough to have cattle running towards the action! The stock soon learn to eat their way through the available foliage and small branches, but they especially like the seed pods and flowers. If the trees are cut when the pods are green, the seeds will not germinate. As any leaf left by the cattle is soon cleaned up by the sheep, there is very little residue the next day. One disadvantage of the process is that there is some risk of weak cattle becoming bogged if prickly acacia is cut along drains.

Louise Moloney

◀ Chris Moloney cut-stumping prickly acacia

Camels

In December 1999, the Moloneys purchased 11 camels from 350 km south-west of Birdsville to 'see if they were as good as the word said they were for containing prickly acacias… Never having seen camels before, I was excited to see the truck arrive with these animals with their long necks sticking over the top of the crate. It took quite a while to unload just 11 camels, as each time they started to go down the race they would hit their humps on the top of the cattle-unloading race', said Louise.

The camels were kept in the yards for about 10 days and were fed hay and cut prickly acacia to familiarise them with the weed as feed. When they were finally let out, the Moloneys expected them to be like a mob of weaner cattle and rush about forming 'rugby scrums.' Instead, they just walked out in their arrogant way in single file.

The camels were released into a 1820 ha paddock containing a mix of gidyea, desert spinifex, and open downs with prickly acacia, all enclosed in a standard 6-wire fence. Apart from the occasional escapee that has had to be put back in, the camels have never caused any problem with fences. Neither have they had any trouble breeding—their numbers had doubled by December 2002.

For the first year or two, the camels had no noticeable effect on the prickly acacia. However, in, 2002 the Moloneys noticed that 'they don't seem to kill [it], but really attack the flowers, seed pods and any leaves…. In the paddock where they have had the most effect, they have taken the worry out of our having to contain the pest ourselves. In fact, we have had to move cattle from this paddock, during the recent dry, as there is now no prickly acacia left with leaves for us to cut as cattle fodder', Louise said.

The Moloneys realise that though camels will not eradicate the prickly acacia, they will, hopefully, stop the continuous spread of the seed.

'Camels will not eradicate the prickly acacia, they will, hopefully, stop the continuous spread of the seed.'

Peter Spies

▲ Camels browsing prickly acacia at Bibil

The economic costs of prickly acacia on Wyangarie

Elton Miller and Peter Spies with David Carter

Introduction

Wyangarie, owned by David and Jane Carter, is a 20 000 ha property near Richmond in north-west Queensland. The predominantly cattle fattening property, which is all Mitchell Grass Downs, has been in the family since 1910. On it, the Carters run about 2500 head, and used to aim at turning off 3–3.5 year old steers in August–September each year.

After a series of wet years beginning in 1974, prickly acacia spread very rapidly. From practically no trees, there is now a medium to heavy infestation on much of the property and in some places there are isolated patches. The 30 km of bore drains are also heavily infested. Various means of control (mostly chemical) have been trialled, but what was once prime Mitchell Grass Downs is now a prickly acacia shrubland. Table 4 shows estimates of current densities.

Table 4: Estimate of current prickly acacia density on Wyangarie

Density	Area (ha)	% of property
Nil	-	-
Isolated	4000	20
Light	-	-
Medium	6000	30
Heavy	10000	50
Total	**20000**	**100**

Peter Spies

▲ Medium density infestation on Wyangarie, Richmond

Control methods

Chemical control

The excessive cost of currently available methods prohibits the full control of prickly acacia on Wyangarie, and it is presently managed only at key sites (e.g. Diuron® is run along thickly infested bore drains, and quad bikes are used to mop up strategic areas). David states he 'doesn't get too excited' about prickly acacia and, because of the scale of the problem, believes there is not much value in just 'throwing chemicals' at it. He does believe, however, that any attempt to control the pest must begin with an attack on the big seed-producing trees.

Double pulling

In 1996, David 'chained' about 500 acres (200 ha) to assess the effect of knocking the plants over to make them available as stockfeed. He believed that the feed or nutrient benefit gained might partially offset the costs of control.

Since then, about 1000 acres (400 ha) have been pulled. The results of double pulling (pulling first one way, then back in the other direction two to three weeks later) have been good. According to David, the cost of clearing this way depends on the size of the machines and the length of chain—especially if there is a large machine in the middle and large machines on either side pulling 300 m of chain.

Mitchell grass has come back into areas that have been pulled. David believes this is because grass seed that has been lying in deep cracks has germinated in the wet years.

Costs and benefits

In this assessment, all costs and benefits have been converted into their dollar value in 2003 to take account of inflation. They are as follows:

- Labour—$15 per hour
- Average diesel price—50c/L (incorporating rebate).
- Price of Starane®—$496.00/20 L (at 25 June 2003).
- Robinson R22 helicopter:
  - dry hire—$325.00/h
  - AvGas—$350/200 L (consumed by an R22 at about 33 L/h).
- Cattle prices at 26 June 2003:
  - live export (finished steers)—400 kg at $1.30/kg.
  - larger steers for the domestic trade into meatworks—$1.38/kg live weight.

'Any attempt to control the pest must begin with an attack on the big seed-producing trees.'

Costs

Control costs: Current yearly control costs are approximately $17 500, including about $12 700 for chemical control and associated labour, and about $4800 for mechanical control and labour. Basal-bark spraying with Starane®, which is about 90 per cent effective, has been found to be the best way to date to treat smaller areas. Each year, to better manage general farm costs rather than trying to overcome the prickly acacia problem, maintenance spraying is carried out along roads, fences, bore drains and in the house paddocks.

Capital expenditure: The purchase and use of equipment adds to the cost of control. It includes the initial purchase price (and any subsequent repayments and interest costs), the cost of repairs and maintenance, running costs and depreciation. The cost of using

general farm vehicles such as utilities and motorbikes has not been included in this assessment. Details of equipment purchased for prickly acacia control are provided in table 5.

Table 5: Equipment costs for prickly acacia control on Wyangarie

Item	Replacement value ($)[1]	Acquisition price ($)[2]	Year purchased	% usage[3]
1 x D5 Caterpillar dozer	350 000	60 000	1991	30
1 x Yamaha 350 4-wheeler	10 000	6 500	1994	20
5 x backpack sprayers	800	na	Various	100

1 Estimated replacement value in 2003
2 Price originally paid
3 Average percentage of total use of item spent on prickly acacia control

'There have also been significant changes in pasture composition'

Extra fencing: (related to capital expenditure): To help reduce mustering costs and to keep cattle out of prickly acacia infestations, an extra 15 km of standard 3-barb fencing was erected on Wyangarie between 1975 and 1992. In 2003 dollars, the total material and labour costs of this have been valued at $26 650.

Grass production: In a 3400 ha paddock of prickly acacia on Wyangarie, the pest has reached densities where it is significantly affecting grass production. Not only has the amount of grass been reduced, but there have also been significant changes in pasture composition—in medium to dense infestations, pastures previously dominated by Mitchell grass are now dominated by annuals such as Flinders and button grass.

Before prickly acacia reached high densities, David could turn off 400–500 head of three-and-a-half-year-old heavier bullocks at a live weight of 550–600 kg. In an average year, this has now been reduced to 400–500 head of 2.5–3-year-old steers with a live weight of about 400–420 kg.

Though it must also be taken into account that marketing strategies have changed over the same period, with a greater emphasis on live export, this still represents a significant drop in the carrying capacity of the property. It also has implications for property management. As a very rough estimate of lost beef production, assume that production has decreased by 165 kg per beast for 450 head; this equates to 74 250 kg valued at $1.38/kg live weight, giving an average annual loss of income of $102 465. A realistic price range for live weight beef would be $1.20 to $1.50/kg, giving a range of $89 100 to $111 375 in gross beef production losses per year. Net losses could be calculated by

subtracting the variable costs of beef production from the gross losses.

Though the Carters face variations in income from other causes (such as droughts and fluctuating commodity prices), which have a greater influence on profitability than woody weeds, this loss is still substantial.

Impacts on management:
On Wyangarie, prickly acacia has:

- made it more difficult to grow out Jap Ox bullocks on the property, thus reducing the Carters marketing options—they now target their product to the feeder steer or live export market
- increased mustering costs
- prevented the Carters from keeping cattle in the same paddock for more than a year—the rogue cattle that remain become more difficult to muster and may eventually have to be shot, or they can corrupt new cattle moving into the paddock and make them more difficult to muster
- created a harbour for kangaroos, which not only eat valuable pasture but also impede cattle mustering.

The time and money spent in controlling prickly acacia, and the extra time needed to muster paddocks could be spent undertaking other activities on the property.

Mustering costs: Dense infestations of prickly acacia on Wyangarie have increased mustering costs. These can be quantified by comparing the cost of mustering a clean paddock with that of an infested one.

It takes seven stockmen half a day, and five hours with a helicopter to muster the infested 8500 acres (3341 ha) 'finishing paddock.' At $525 for on-ground mustering costs, and $1914 for the helicopter and fuel, this amounts to $2439 per muster. It costs only about $380 to muster a paddock of a similar size that is free of prickly acacia.

In similar sized paddocks with medium density infestations it takes five or six stockmen half a day, and four to five hours in an ultralight to muster. The cost of labour is about $413 and that of the ultralight is about $972, giving a total of $1385 per muster. Based on the above costs and the current densities of prickly acacia on Wyangarie, it is estimated that a single annual muster costs about $9940, compared with the $2210 it would cost to muster clean paddocks. The difference of $7730 per year can be attributed to prickly acacia.

Based on the above figures, costs per hectare of mustering are approximately:

- 71c in densely infested paddocks
- 40c in medium infestations
- 11c in paddocks free of prickly acacia.

The respective savings of 60c/ha and 29c/ha that would be made by eliminating infestations are not insignificant.

Maintenance of station vehicles: On Wyangarie, prickly acacia thorns are responsible for about one punctured tyre per week. Assuming that one hour per week is spent on vehicle maintenance (changing tyres, replacing tubes and pumping up slow leaks), the labour cost of this is estimated as $780 annually. The additional cost of replacement tubes and repair kits would increase this to over $870 per year.

Medical attention: Though someone from Wyangarie requires medical attention every year or two to have a thorn removed from a knuckle joint or something similar, no serious injuries have occurred to date, so this cost has not been valued.

Property value: David is sure that the value of Wyangarie has been reduced by the presence of prickly acacia, but he is not sure by how much. Though this cost was not valued, it is directly related to the effect of reduced beef production from the property.

Benefits

While some marginal benefits may be gained by using leaf and pods as cattle fodder, they are not a substitute for Mitchell grass, and do not compensate for the lost grass production caused by medium to high density infestations of prickly acacia. As this results in lost beef production (factored into the Carters' new reduced stocking rate), it is not appropriate to value leaf and pods.

Conclusion

In light of the above, the Carters estimate that the presence of prickly acacia on Wyangarie is responsible for about $128 000 annually in lost income and increased costs. Other costs, such as its impact on station management are difficult to estimate, but exist nevertheless. As the financial position of Wyangarie has not been disclosed, this analysis does not take account of the tax implications of control, but they must be considered when determining the true financial impact of prickly acacia.

As they knew the full extent of the costs involved in controlling prickly acacia, when they bought another Mitchell Grass Downs property in the early '90s, the Carters first ensured it was free of the pest, and say they would not buy infested land again.

Money, rather than time, is the main constraint on the control effort. David would like to see research undertaken on biological control and dieback, which occurred on prickly acacia in some areas of the property in 1987. As the pest has not grown back in these areas, he believes that encouraging dieback may be an efficient way to control infestations.

David is concerned about prickly acacia in river systems and believes there is a real need to 'attack prickly acacia from the start of the catchment and work down… there would be plenty of it in the rivers and creeks.' The problem is compounded because Diuron® cannot be used in areas where there are coolibahs and other riparian vegetation. Without control, David is convinced of the potential of prickly acacia to spread much further than its current distribution because it now occurs on the watershed of river systems flowing south into the Lake Eyre basin and north into the Gulf country. Specifically, on substantial sections of the Flinders River, the riverbanks are heavily infested with prickly acacia and rubber vine, both of which will inevitably spread each time the river floods.

Because of the size of the problem, David believes a coordinated, catchment-based approach, education and/or biological control are necessary. An attempt to form a regional group to eradicate prickly acacia from the McKinlay, Richmond, Flinders, Winton and Aramac shires failed because of lack of funding from both state and federal governments, and the inability of industry to fund such a large-scale program.

'David believes a coordinated, catchment-based approach, education and/or biological control are necessary.'

The Carters would not consider borrowing money to control woody weeds, but David says he would undertake more control if chemical and employment subsidies were available. He is not keen on employment schemes because he believes that people employed in these schemes can be ineffective and inefficient. Likewise, incentives such as 150 per cent tax deductibility of weed control costs are not much use if landholders are not paying personal income tax. Government efforts should first be directed towards cleaning and controlling areas of light or scattered infestations, as these are easier to control.

▲ Prickly acacia infestations in the Hughenden area, north-west Queensland

Case studies—
community and government initiatives

section 4

Case studies—community and government initiatives

Strategic prickly acacia control at a coastal infestation

Peter Spies with Gordon Smith and Steve Matheson

Introduction

Clarina station, owned by Gordon and Mavis Smith, is a 285 ha property on a highly fertile alluvial floodplain in the Don River delta near Bowen in north Queensland. 'It's said that the block was a saltpan that is now covered with at least a metre or two of silt. It's become more fertile ever since the Don started to break its banks during the big floods and flow over this way in the late '40s', Gordon said. The property is managed as a Brahman stud running about 400 head of cattle, 200 of which are bulls. The property is now established to guinea, green panic, para and Rhodes grasses, although 60 ha are cultivated for stockfeed and Callide Rhodes grass is baled for hay. As the land is on a floodplain, Gordon said 'Prickly acacia probably first got on to the property in a flood… It's been here since I've been here…60 years… but it's just got worse and worse.'

Steve Matheson

Prickly acacia 'forest' at Clarina, Bowen

The infestation

According to Steve Matheson, Land Protection Officer with the Department of Natural Resources, Mines and Energy, 'Prickly acacia was planted here (in the Bowen area) way back in the early '30s… and as word has it, a lot of seed was taken from here and planted further west.' When the Don River floods it spreads prickly acacia seed from properties further up the catchment; and within properties like Clarina, most seed is spread by cattle. Before control efforts began in earnest, about 200 ha of the property was heavily infested with prickly acacia, and the rest had scattered trees. 'In 1946 the flood broke through and ever since, in any big flood, the Don River floods over the area, and that has made the acacias worse. Once you've got them and you let the trees seed there's no need for anything else to spread it, cattle will do it for you… [They] will just eat everything that falls off it…The seeds are very nutritious, though you are better off with the grass', Gordon said.

On the coast, infestations are far denser than those out west on the Mitchell Grass Downs, and densities in excess of 1500 stems per hectare (stems/ha) are commonplace. In the Bowen area, about 1200 stems/ha is considered a heavy infestation, while about 150 stems/ha is considered very light. The infestation on Gordon's property was 'similar to the infestations found on the bore drains

out west', Steve said. 'It was not uncommon to get bigger trees, to a metre in diameter.'

According to Gordon and Steve the prickly acacia trees are very salt tolerant and will grow right on the saltpans and almost into the mangroves, especially where the pans are slightly raised and there is some salt couch growing.

The Don River has a steep gradient and is fast-flowing—apparently the second-fastest flowing river in the southern hemisphere, and floodwater can be two metres deep over the property. During the 1980 floods, floodwater was two metres deep over the property. 'We have lost 40–50 cattle through floods', Gordon said. 'We can get [them] out quicker now that prickly acacia is cleared…. If there's heavy rainfall in the headwaters of the Don (halfway to Collinsville), you probably have about 12 hours before it reaches the property', he added, 'In 1970, following a cyclone we got 1250 mm in 36 hours at the head of the Don—the next day it was here—that was an exceptionally high flood.'

Due to their sheer size, trees on the coast can produce up to several hundred thousand seeds and, since 1996, Gordon has spent about $200 000 on control of prickly acacia. Currently, he spends from $2000–$3000 annually.

Strategic Weed Eradication and Education Program (SWEEP)[5]

Gordon said 'We've been trying to control prickly acacia for forty years. We've owned the place since 1956, but it wasn't until SWEEP came along with mechanical pulling in 1996 that we were able to get on top of it—until then we were fighting an uphill battle.' SWEEP demonstrated to the local landholders that prickly acacia could be controlled.

Control was achieved by first pulling 160 ha of very heavily infested country with double-link chain, followed by stick raking. Under the SWEEP program, the state government paid for the pulling and about 15 per cent of the stick raking, and Gordon paid for the balance of the stick raking and the cost of chemical and diesel for follow-up control. The $83 000 spent on initial mechanical control of this infestation—$70 000 by the landholder and $13 000 by the government—helped Gordon 'kick-start' his follow-up control program.

'Prickly acacia trees are very salt tolerant and will grow right on the saltpans and almost into the mangroves.'

Steve Matheson

Steve Matheson

▸ Stickraking prickly acacia

[5]SWEEP—The Department of Natural Resources (now NRM&E) Strategic Weed Eradication and Education Program.

A further 120 ha was chemically treated. Steve said that 'We found that [landholders] wanted to see the tree dead, so we had to cut-stump…This used about a third of the amount [of chemical and diesel] that we used in basal bark operations.'

Steve says it was hard to get landholders to embrace something new at the start. 'They were just coming out of drought', he said. 'Mechanical pulling was the way to go because the results were visible and follow up control could be achieved.' There were, however, a few failures when some of the beneficiaries did not meet their obligations for follow up, 'People still need money and inclination to control weeds', Gordon said. 'You can't expect governments to keep coming to the party, but if they do come in with assistance, landholders should embrace it and take full advantage—but you need follow up control.'

'Mechanical pulling was the way to go because the results were visible and follow up control could be achieved'.

Mechanical control

'The trees out west would pull a lot easier than the ones in Bowen, as the roots would not be as far down', Steve said. 'A lot of the big trees in the silty soil went at least 2 m or more down before you actually found the crown of the plant… that was a real drama when you were pulling because when you came across some big old trees you quickly lost traction with the dozer tracks in the softer silty soils.'

The machines used were undersized for the size of the trees and Steve said that 'If we were to do the job again we would use at least a pair of late-model D8s…We used a 30-year-old D6 and a D7. The machines needed to be in close to minimise the drag, because of the size of the trees and the silt. Many of the trees were up to 1 m in diameter and there were plenty of them.'

Steve Matheson

▲ Pulling prickly acacia at Clarina

Steve Matheson

▶ Pulling prickly acacia at Clarina

Steve Matheson

▲ SWEEP team undertaking follow-up control at Clarina

For stick raking, a D7 with a very heavy 8 m blade fitted with a smaller cutter bar welded approximately 8 cm up between the teeth of the rake was used to help drag the smaller plants out properly with roots intact. 'When a lighter blade was used, the results were not as good. In most cases a couple of runs with the blade were needed over the same area to drag the roots out properly. A real big heavymongrel is needed (the heavier the better) to drag trees out of the silty flood country.' The smaller 'whip stick' acacia did not pull over that well, and probably increased the cost of the operation stick raking. To compensate for this, we added a large ripper tyne to the drag of the chain to keep it from riding over the smaller trees.

It wasn't necessary to sow grass seed after clearing prickly acacia because 'There were still some good clumps of panicum grass left prior to pulling. The chaining may have helped spread some seed and prepare a seedbed, and the rain during pulling may have helped stimulate grass growth. Along with reduced stocking… it all came together to help pasture establishment' said Steve.

'It surprises me how little seed we get coming up now.'

Chemical control

Together with the mechanical control, rain that fell during the pulling helped to stimulate some of the prickly acacia seed. 'It looked nasty…but that quick germination reduced the seed bank quickly', Steve said. Gordon had a team working for six months on follow-up control in the first 18 months after pulling, as this was a critical time, and 200 L of Starane (12 000 L of diesel mix solution) were used annually. After two years, he switched to using Access and diesel to control chinee apple and parkinsonia as well as the prickly acacia. 'It became a holistic management approach', Steve said.

In 1997–98 Gordon had five or six people doing control work for about six weeks. However, from 1999 onwards, he has had only one person working on it for two months a year, and follow-up control now takes only a couple of weeks annually. 'For the past four years we have controlled it with chemical—spraying a bit in each paddock…It surprises me how little seed we get coming up now. Though we still get a fair bit around the boundary fence and after a flood. In the main, we're on top of it', he said.

Steve Matheson

◂ Using a brushcutter to cut-stump prickly acacia trees

A combination of basal bark and cut stump methods has been used. Basal bark spraying was considered the way to go when the infestation was very dense. 'You need to spray up to just above the first fork, on any tree… so you get coverage and not just brown out[6]. When basal bark spraying very large trees, Gordon and Steve found that it could take 7–12 L of herbicide mix to ensure sufficient coverage to waist height, so they changed to cut-stump method to reduce herbicide costs. With this technique, however, 'you had to be careful that the trees or the stems were not coming down on you', Steve said. 'The trees in some cases were up to a foot apart… you had to be right behind the operator on the chainsaw to apply chemical so that none of the stumps would be missed.' 'Its harder to find the smaller stems when they are covered with foliage.'

Steve explained that when cut-stumping it's important to avoid problems from the remaining stumps. 'We were cutting 5–8 cm from the ground—people cutting at 15–30 cm are using too much herbicide and it is not good for landholders with stock—or for vehicle tyres.'

[6]Steve Matheson explained that brown out is when insufficient coverage has occurred and there is an initial burn-off of foliage, but a few weeks later green shoots appear. The tree does not die—spraying has caused leaf damage only.

Follow-up control on Clarina is now carried out by basal bark spraying with Access® and diesel. Operators walk around with a 7 L hand-spray unit. 'That way you can keep going till the end of the day and are not struggling by ten o'clock with one of those big, heavy spray units on the shoulders', Steve said.

He has found the 7 L spray unit more economical, because, 'when you're paying a bloke to spray, he's keen to get that 20 L unit off his back, and tends to spray it out quicker', so chemical from a small hand-held spray unit may go almost as far. Landholders are mindful of the amount of diesel that might go out on the ground. 'You are worried about the drift of diesel burning all the grass around the stems and there is a lot less chemical used.'

Graslan® was also tried on Clarina in the late '80s, but 'it was a complete failure', Gordon said. 'The country is so fertile and the root systems are so big… Graslan just couldn't cope with it. We suspect that was the problem. The roots may have been too far down to get the chemical.'

Other weeds that were in the infestation, such as chinee apple and parkinsonia, are probably causing more of a problem now that the country has been opened up. 'When you take out one weed, you need to consider the other weeds as well', Steve said.

Gordon believes that, rather than trying to tackle too much at once, producers on larger properties should control prickly acacia 'paddock by paddock', and should quarantine cattle that have been in infested paddocks for at least five to seven days, to prevent the spread of seed from their dung. 'The main criteria to get rid of them (prickly acacia) is to get rid of every tree that seeds', Gordon said. 'Most of the seed input [on Clarina] now is from floods and overhanging trees from neighbouring blocks.' The stock eat seeds from acacia along the boundary fence and spread it.

'I reckon we have won the battle', said Gordon, 'its been long and costly one but now we can look out and not see the country covered with weeds. It's getting harder to find one on Clarina—I didn't think you would ever hear me saying that', said Gordon.

'Producers on larger properties should control prickly acacia "paddock by paddock", and should quarantine cattle.'

Strategic prickly acacia control on Molongle

Peter Spies with Trevor Davies and Steve Matheson

Introduction

Molongle station, owned by Trevor and Gloria Davies, is a 4033 ha property on Molongle Creek at Gumlu, between Bowen and Ayr in north Queensland. The Davies have been on the property since 1963. The country is a coastal plain, with a few kilometres of the coastline, and has some slight ridges and drainage lines. It is predominantly flood-free with only shallow sheet flow after periods of heavy rainfall. 'The immediate coastal country was probably a mangrove flat or saltpans once, and over the years Molongle Creek has probably silted it up', Trevor said. The Davies run about 1200 head of cattle, including 300 breeders, and turn off 200–250 head of steers or heifers for the domestic trade each year (dressing ~ 300 kg).

Molongle includes some fertile alluvial country along Molongle Creek, part of which used to be three or four vegetable farms. 'It grows good grass this fertile country…but it also grows good weeds… the country can grow anything, just look at the vegetable farmers', Trevor said. Prickly acacia favours the black soil country rather than the harder ridges.

The infestation

'Prickly acacia was here on the place before we came. My wife, who grew up just up the road used to talk about it when they were kids… it's been here a long, long time. It's possible that it was planted here originally', Trevor said. Before control efforts initiated by SWEEP and the Davies family, approximately 200 ha were densely infested with prickly acacia, and a further 2800 ha with either scattered or isolated plants. 'We did next to nothing for years and then we looked around and realised the problem. We did attempt to keep prickly acacia to an area. We weren't

Peter Spies

▲ Prickly acacia infestation at Molongle, Gumlu

Peter Spies

▲ Prickly acacia infestation at Molongle, Gumlu

making ground, but not losing ground to it either…We were getting areas that we were keeping clean. However, it took that real big concerted effort to break its back so that we could say we'll go from here', Trevor said. 'Prickly acacia just gradually increased, rather than exploded.'

As Molongle does not get the seed input from floods as areas near Bowen in the Don delta do, not much production was lost as a result of prickly acacia because, 'we hadn't reached that stage', Trevor said, 'it was just an inconvenience—we would have eventually had problems, but we were just on that verge.' Steve added, 'There were plenty of smaller trees about 1–1.5 m high coming through everywhere. A lot of hours were put in to cover the country.' The infestation was a lightly scattered infestation with some dense areas. 'What we call light infestations, fellas out in the west call medium to dense infestations', Steve said.

Strategic Weed Eradication and Education Program (SWEEP)

Trevor had controlled prickly acacia on several areas prior to SWEEP control efforts, 'but there are only so many hours in a day and you just can't get to all the areas', he said. 'Without SWEEP we would still be in the position we were in… with one sweep they broke the back of the problem and provided the incentive.'

After SWEEP's initial control program, there was a fair bit of seed germination and follow-up was required, fortunately, not nearly as labour intensive. Trevor can now control the prickly acacia around the property within a two-week period, with one person on a four-wheel bike. According to Trevor, '[SWEEP] puts the landholder in far better position where there's a better chance of controlling prickly acacia.'

'Prickly acacia just gradually increased, rather than exploded.'

'You haven't got to relax too long and you are back to where you were.'

Steve Matheson

▲ SWEEP team

Control efforts and seed germination

'There is no easy way of getting rid of prickly acacia in my opinion. It's no good clearing 4 ha in the corner of a 240 ha paddock… a 20 m buffer around large infestations does not help stop the spread of prickly acacia', Trevor said. Control efforts have been aimed at targeting prickly acacia over the whole property in one hit. 'You haven't got to relax too long and you are back to where you were. You could leave it a year, but give it five or six years and it would be back nearly as bad', Trevor said.

Though the Davies did not have the area to quarantine cattle, Trevor said 'Cattle may spread a lot of seed, but conditions have to be perfect for them to germinate, otherwise we'd have millions of them…You can sometimes see where a heap of cow manure has had 10–15 seeds come up in it.' However, not all cowpats are affected and Trevor suggested that germination might depend on 'whether it rained that day.' He said that 'If the cow manure is sitting on moist ground… away they go (the seedlings), but if the cow manure is on dry ground… well they just die out.' 'The seeds can last for five years', Steve added. 'Heat can crack them, and then when it rains you get germination.'

Chemical control

SWEEP used the cut-stump technique and Starane® at the ratio of 1:60 Starane/diesel to control prickly acacia at Molongle, which was only the second property it had targeted in the Bowen area. They (up to 15 men at a time) used a total of 25 000 L–30 000 L of diesel (1400 L–1600 L on a big day), and learned the importance of good operators who are economical with chemicals and do not miss plants.

'The cut stump method, with an experienced operator on a decent chainsaw or brushcutter, is not that far behind basal bark spraying said Steve. This is because when basal bark spraying 'Getting in and around the trees takes time', he said, and 'It takes a long time to saturate a tree', Trevor added.

Given the price of herbicide and diesel, Steve believes the cost of initial control may have been about $60 000, with about $20 000 spent annually on follow-up in the first couple of years after SWEEP. Trevor now uses Access® and diesel for follow-up control as this takes care of the chinee apple and some parkinsonia plants at the same time.

Mechanical control

Trevor has carried out about $40 000 on mechanical control using a small machine. Though he has valued neither his own time nor depreciation on machinery, which could add up to about $70/hr. He also hired a large 400 Hp Komatsu dozer with a bull-blade to control a larger, dense infestation. 'It rattled along at 5–6 km/hr windrowing big trees as it went. It just smashed the trees and pulled the roots out', Trevor said. However, the Davies had to carry out chemical follow-up control on the patch. 'You never want to go small with machinery', Steve said. 'Larger machines can do five times the area as smaller units in the same timeframe and that makes the bigger machines cheaper per hour to hire.'

The Wokingham Landcare Group

David Ogg and Peter Klem

Introduction

The Wokingham Landcare Group Inc. comprising owners of nine neighbouring properties situated north-west of Winton was formed in 1991, principally to eradicate prickly acacia. Because of the rapid spread of the pest in this area, simply living with it was not an option.

According to the secretary, David Ogg, the small size of the group has contributed to its great success in combating the problem. 'Our group has flourished over the years because it is limited to nine properties and, apart from the annual general meeting, discussions and decisions are made by phone. A meeting can cost approximately $800 in travel and lost wages, so the telephone is the most cost-effective way of making decisions.' The larger the group, the harder it is to put together a meeting, he believes.

Because the group is incorporated it has been able to get direct funding which it can access as required, unlike neighbouring groups whose funds are held in trust by the Winton

Nathan March

▲ Prickly acacia control demonstration site

Shire Council. This self-sufficiency has enabled the shire to dedicate more time and resources to neighbouring groups. The group does its own recording and reporting, and keeps track of allocated funds. Though a number of applications have been rejected, the group has collated a great deal of information on preparing budgetary figures for particular funding rounds. It has kept the goal of controlling prickly acacia in its sights, and much has been achieved.

The group has spread its influence by supporting neighbouring groups, thereby protecting their own area from re-infestation and greatly adding to the total area treated. 'Rather than enlarging our group we have helped in forming two neighbouring groups with the same agenda. Any innovations pass between groups', David said. This, in turn, has furthered the goal of the Winton Shire Council Pest Management Plan, and has benefited the Diamantina catchment and, ultimately, the Lake Eyre Basin.

Control

Without committed follow-up spraying (for up to eight years), the results of initial control work on prickly acacia can be lost. Where large trees have been treated, the group spends the next two to three years controlling accelerated regrowth. It has been found that most trees in the 3–4 m range have a regrowth factor of nine seedling trees per adult tree cleared in the first year. The group has also controlled parkinsonia and mesquite.

David says, 'We have used various control methods, but have relied mainly on the use of chemicals.' Machinery, such as front-end loaders and dozers, has also been used around dams where the thick infestations make mechanical control viable. Camels and low numbers of goats have been used on two of the properties, Weston and Amelia.

The following is a list of chemicals that have been used and a brief summary of their success:

- Starane® in diesel has been the main chemical used. The best kill has been achieved when the sap has been flowing, particularly after summer rainfall.
- Starane®, water and a wetting agent has been disappointing, resulting in too much regrowth.
- Access® has had limited use due to its cost, but was found to be particularly effective on mesquite.
- Diuron® has been used around turkey nest dams and watering points but, as it is not completely water soluble, has a wearing effect on spray equipment.
- Reclaim®[7] applied by helicopter, was used on seven of the properties with success on only one. This product has been successful in open downs country, but it is believed it failed here mainly because of the clay type soils and the subsoil moisture in drainage lines and dam catchments.
- Graslan® has proved useful, particularly in thick areas and along roads in borrow pits where prickly acacia is a recurring problem.
- Velpar® has also been successful. It can be used in areas that cannot be accessed by four-wheelers. Like Graslan®, it must be applied at the base of each tree to affect the large taproot.[8]

Note: These statements are based on observations from Wokingham Landcare Group trials and other trials may produce different results.

[7]Reclaim is no longer available for use

[8]Always refer to the herbicide label for specific use restrictions. Particular cane must be taken with soil-applied herbicides to restrict off-target damage.

The commitment of the Wokingham Group to the community has been to encourage all users of chemicals to handle them safely. Though the hot climate often deters users from using adequate personal protective equipment, members believe gloves, a gas-rated respirator and periodical renewal of respirator filters are essential.

Future directions—biological control?

A meeting at Farewell Station two years ago highlighted the problem of finding suitable biological agents to control prickly acacia. Dr Bill Palmer, a research scientist with the Department of Natural Resources, Mines and Energy in Queensland, brought a group of research scientists, including Arne Witt from the department's South African Field Station near Pretoria in South Africa, out to meet landholders. They pointed out that as prickly acacia is related to more than 900 Australian native acacias, there would be few insects available that would not also attack native species. It would therefore be more likely that a biological agent that could increase management options might be found, rather than one that was capable of killing all the prickly acacia. In the meantime, the onus remains on landholders and governments to remain vigilant and continue controlling with the best methods currently available.

'The onus remains on landholders and governments to remain vigilant.'

Labour barter—Upper Landsborough Catchment Landcare Group

Peter Spies and Nathan March

The Upper Landsborough Catchment Landcare Group is undertaking an innovative labour barter scheme involving up to 36 landholders. The scheme works by sharing labour (and sometimes other resources), in a social setting, to treat prickly acacia infestations on properties within the group. Each barter day focuses on one or more properties, with other properties 'getting a turn' on subsequent barter days.

'You can do more work with seven people in one day then you can do yourself over seven days.'

This is proving to be one of the most effective ways to control prickly acacia on a broad scale. Charles Reddie, owner of Zara and a member of the group believes that 7–9 people are ideal for labour barter days. 'Normally we get more than half a dozen. You don't want too many (more than 12) unless you have it well coordinated… you've got to know where you're going and where you've been and where you haven't been.

'Last one we had seven people and used dye with the Velpar to mark where we'd been, so we weren't doing trees other people had done. We started about seven, had smoko and dinner and knocked off about 4.30 pm. You can do more work with seven people in one day then you can do yourself over seven days. It's not nearly as monotonous… It's hard having to turn up for seven days. We did at least 4000 ha—two and a half paddocks—using bikes and Velpar in light, scattered infestations. They were fairly big paddocks.'

The following are some of their comments on the benefits of these days:

- 'The labour scheme helps get you started.'
- 'It facilitates an exchange of techniques and ideas.'
- 'It increases community concern for the problem.'
- 'Weed control is a less daunting task.'
- 'There is increased camaraderie … having a beer at the end of the day.'
- 'It makes a boring job more enjoyable.'
- 'The standard of work is high—you do it as though you were working on your own place.'

Controlling isolated prickly acacia in Dalrymple Shire

Marie Vitelli and Nathan March

Dalrymple Shire in north Queensland encompasses an area of 68 000 km^2 and has a strong pastoral industry based on about 550 000 cattle. Land types in the region include box country, silver-leafed ironbark woodlands, mixed eucalypt tablelands open basalt woodlands and acacia woodlands (e.g. brigalow and gidyea scrubs). Core prickly acacia infested properties are located about 250 km west of the shire; however, there are also some smaller established infestations in the Bowen area about 150 km to the east.

Dalrymple Shire's proximity to core prickly acacia areas, cross-ownership of properties in both areas, and transport of cattle for agistment or sale means that prickly acacia is an ever-present threat. The Flinders Highway, which traverses the central part of the shire, is the main conduit for road transport of cattle from western areas. Likewise, a major rail line, also used for stock transport, runs parallel to the highway.

Landholders, Dalrymple Shire Council and the Dalrymple Landcare Committee aim to eradicate the small infestations that are already present in the shire and prevent further establishment where possible. Some of the issues and tips to achieving this, as documented by the Dalrymple Landcare Committee, are:

- **'The trick is finding the isolated plant AND remembering where it is'**

Graziers generally stumble across an isolated prickly acacia or parkinsonia plant while doing other jobs around the property (mustering, checking fence lines, etc.) Unless they have a granular herbicide such as Graslan® with them to treat on the spot, it is often difficult to come back to the same place later. Neither does Graslan® work on all soil types and, if rain falls after plants have been treated, uptake of the herbicide may be affected.

- **'Isolated weeds are sometimes noted when helicopter mustering, but you are not down on the ground'**

Very few landholders have GPS units to mark weed sightings and/or assist with relocation of the weeds at a later date.

- **'If the weed turns up in a swamp, it is difficult to access for most parts of the year'**

While the logistics of control are difficult, not doing so will result in the establishment of infestations that are a source of seed for other areas.

- **'The main source of new outbreaks of prickly acacia is from dung kicked out of passing road trains, and from cattle on agistment'**

Graziers need to be vigilant and monitor areas of their properties adjacent to transport

'Graziers need to be vigilant and monitor areas of their properties adjacent to transport corridors.'

corridors. Plants must be found and controlled before they seed—generally two to three years for prickly acacia.

As there are potential issues of public liability and insurance if a landholder stops to treat isolated plants on the verge of a main road, such plants should be marked with flagging tape so shire council staff can follow up with treatment later. Landholders can more readily treat isolated plants alongside shire-controlled roads without issues of public liability.

Correct identification of prickle bushes is still an issue and it is often difficult to distinguish between mimosa (*Acacia farnesiana*), prickly acacia (*A. nilotica)* and other acacia species, or to know what parkinsonia looks like. (See identification guide on pages 5-7).

- **'Mapping of isolated plants is not straightforward'**

Landholders respond differently to requests by the Dalrymple Shire Council for property weed maps (as per Shire Pest Management Plan). As it is difficult to map 'pinpoints', most landholders don't provide details of isolated plants, though some pencil in an area with a comment that isolated plants occur within it. Accurate mapping has implications for both shire and regional planning, but the difficulty of reporting means that the position of known isolated plants is not generally mapped.

Incentive programs such as the Natural Heritage Trust and the Burdekin Rangelands Reef Initiative—Woody Weed Project, have stimulated landholders to focus attention on isolated outbreaks of woody weeds. Where there has been a genuine interest in controlling prickly acacia and preventing its spread into neighbouring properties, landcare groups have made a concerted effort at achieving management across subcatchments.

Prickly acacia in the Northern Territory

Alice Beilby

In the Northern Territory, outbreaks of prickly acacia are being managed, with the eventual aim of total eradication. There are four known infestations—two on pastoral properties on the Barkly Tableland (Avon Downs and Rockhampton Downs), another at Bulman, an Aboriginal community in southern Arnhem Land, and another on Cattle Creek station in the Katherine region. Compared with those in Queensland, the infestations are relatively small, with the most recent recording being 200 plants.

In 2003 the Western Australian Department of Agriculture also discovered a single prickly acacia plant 6 km off the Northern Territory border at a site adjoining the Victoria River region. In the Katherine region, isolated prickly acacia seedlings have been discovered and destroyed on pastoral properties that had recently transported cattle from Queensland—seedlings had emerged from the manure after cattle had been unloaded into yards.

Prickly acacia was first recorded on Avon Downs in November 1981 when a single plant was destroyed at Shakespeare Creek, along the verge of the Barkly Highway. Seeds from the plant had spread 5 km downstream, and to areas adjacent to the creek. All outbreaks have been confined to one 322 km^2 paddock.

Regular control has been carried out since and at the last inspection over three hundred

'Only by vigilant control and inspection practices will eradication be guaranteed.'

Nathan March

▲ John McMahon, former DIPE officer, inspecting prickly acacia adjacent to the Barkly Highway

juvenile plants were treated. It is evident that major germination of dormant seed is accelerated after good wet seasons. The number of viable dormant seeds remaining in the creek is not known and only by vigilant control and inspection practices will eradication be guaranteed.

In 2002, the Commonwealth Government made funding available in the form of National Weeds Program monies, allocating $57 000 to the Barkly region for eradication of prickly acacia. As a result, control programs in the region were accelerated, and the basal-bark technique was found to be the most effective. However, as there is a bank of viable seeds in the Shakespeare Creek catchment on Avon Downs, there is some uncertainty about when the pest will be eradicated.

At Rockhampton Downs the majority of trees (adult and juvenile) in a one-hectare outbreak were found to be affected by a stem-girdling insect. In some cases, entire branches were dead or dying. However, the impact of these native insects was not significant. At the Bulman community, all trees have been treated to date and regular surveys will be conducted in conjunction with the Community Rangers to ensure that emerging seedlings are treated. Ongoing treatment and surveys are being carried out in the Victoria River region to control 200 plants found on Cattle Creek station.

Over the 2002–03 wet season, an education and awareness program was conducted. 'Weed packs' containing extension material supplied through the WONS National Prickle Bush Committee have been sent to all pastoral properties in the Northern Territory. The packs include a weed identification book entitled *Weeds of the Wet/Dry Tropics*, identification stickers, fridge magnets and brochures for parkinsonia, prickly acacia and mesquite.

Nathan March

▲ Inspecting a prickly acacia infestation on a Barkly Tablelands property

Prickly acacia in Western Australia

Noel Wilson

The first recorded prickly acacia plant was discovered in Western Australia in November 2002. It was spotted by Nathan March from the Queensland Department of Natural Resources and Mines (now Natural Resources, Mines and Energy) just west of the border with the Northern Territory at the edge of the table drain on the Buntine Road that comes into the state south of Kununurra and ends at Halls Creek.

The plant was estimated to be about three years old and just beginning to flower. Its late detection emphasizes the problem of differentiating this weed from *Acacia farnesiana* when small, and the fact that most Western Australian agency officers and landholders are not familiar with prickly acacia.

The place where it was found also highlights the potential for spread of prickly acacia via livestock transport. Livestock transporters and machinery coming into Western Australia through the Kununurra checkpoint are usually consigned under quarantine to our wash-down area. They are cleared from here only when they have been declared clean and this has helped prevent the introduction of declared weed seeds into the state. However, as there is no checkpoint on the Buntine road, trucks do not wash down until they reach Halls Creek, some 200 km into Western Australia.

About 12 months after the original find, another single plant was discovered on land near the quarantine cattle yards on the outskirts of Kununurra. It was estimated to be about six years old. The surrounding area was inspected and no further plants were discovered. The specimen discovered was used to familiarise government agency officers with the appearance of prickly acacia and then destroyed.

'Highlights the potential for spread of prickly acacia via livestock transport.'

Noel Wilson

First prickly acacia plant found in Western Australia

Noel Wilson

Prickly acacia in the Quarantine Yards—Kununurra

'The good quarantine on the Western Australian – Northern Territory border has helped to prevent the introduction of many weeds into the state.'

Shortly after this, staff from the Department of Agriculture discovered an outbreak of prickly acacia in an isolated area, while carrying out routine surveillance in the North Kimberley. The infestation was in the Durack River area and the plants were spread over more than 3000 ha and had obviously been there for quite some time—possibly about 20 years according to some of the traditional owners who live in the area. This is still an isolated infestation and no other plants have been found outside this main site. A long-term management plan will have to be put in place to control (and hopefully eventually eradicate) this infestation and prevent spread of the pest.

The good quarantine on the Western Australian – Northern Territory border has helped to prevent the introduction of many weeds into the state. Current and future extension activities on the identification and reporting of prickly acacia and other priority weeds will help to complement these efforts.

As prickly acacia can look very similar to *Acacia farnesiana*, which occurs throughout the region, it may not be reported as a new problem. These latest finds in the Kimberley emphasize how important it is to get good identification material to all people in the rangelands.

There appears to be no link between the three areas where the plants have been observed, and they are all several hundred kilometres apart. This indicates that prickly acacia may be entering the state by a number of pathways and, from the age of the plants in the latest find, has been doing so for a number of years. This plant has the potential to take over large areas of the rangelands and is one that Western Australian authorities need to be extremely aware of.

Noel Wilson

▲ A large, established infestation was found in the Kimberley Region in 2003

Case studies—innovations in management

Section 5

Case studies—innovations in management

Australian Agricultural Company—weed seed spread protocol

Jenny White

Overview

Australian Agricultural Company (AACo) operates 19 stations throughout Queensland and the Northern Territory spanning 6.6 million ha of prime cattle country running approximately 360 000 head of cattle. The land is one of the company's greatest assets, but some of it is potentially threatened by highly aggressive, exotic woody weeds such as prickly acacia.

AACo has been active in its identification and treatment of exotic weeds across its stations, implementing integrated systems to control and manage existing infestations and prevent further spread. This protocol has been developed to protect the substantial investment of time, effort and money AACo has made in weed control.

Problem

AACo purchases livestock from outside vendors and, because of the spatially diverse nature of AACo stations, transporting cattle between stations poses a considerable threat of inadvertently distributing weed seed. As prickly acacia has appeared in new locations after livestock have been transported from infested areas to clean ones, AACo has recognised cattle as one of the main vectors of its spread. To protect clean stations from potential incursion of spreading prickly acacia, AACo has developed its own Weed Seed Spread Policy.

Nathan March

▲ Outbreaks of prickly acacia at Rockhampton Downs, NT—now treated

Stock management

The Weed Seed Spread Policy was developed specifically for prickly acacia, mesquite, chinee apple and, to a lesser extent, parkinsonia. To ensure that ingested seed is not transported to weed-free locations, any livestock that have been exposed to podding plants are quarantined for a minimum of 8 days prior to transport to a new destination. This is necessary because seed can pass through the digestive tract of an animal and still remain viable once excreted (43 per cent of ingested seed in the case of prickly acacia). AACo generally follows this protocol for both internal and external movements of cattle.

AACo stations infested with prickly acacia have allocated holding paddocks adjacent to

main trucking yards dedicated to the quarantining of livestock. These holding paddocks are weed free and are monitored regularly for any establishment of exotic weed seedlings.

As well as preventing weed seed spread, keeping cattle in a holding paddock prior to transportation has the additional advantage of reducing carcass shrinkage caused by stress and time off feed. Trials conducted by AACo over four years have shown that carcass shrinkage can be reduced by 10–12 per cent by keeping livestock in a holding paddock for a minimum of 36 hours prior to transport.

AACo has developed alternative options for transportation of livestock if they cannot be quarantined before leaving a station (e.g. because of weather concerns or other unforseen circumstances). In these situations the cattle are quarantined:

- on arrival at the new destination
- at a suitable alternative location.

It's simple

A significant financial investment is not required to build extra holding paddocks and, in AACo's experience, this is eventually offset by savings in time, effort and money spent on weed control.

AACo's stock hygiene protocol has been implemented successfully without hindering the normal station routine. A typical eight day quarantine period includes:

- 1 day muster
- 1 day drafting
- 5 days in quarantine holding paddock
- 1 day mustering and trucking to destination.

Manager's experience

Sam Graham, manager of Dalgonally, a property 80 km north of Julia Creek in north-west Queensland says 'This protocol is no big deal to our operation, as we can see the benefits and have just implemented this strategy as another property management requirement.'

Nathan March

▲ Stock hygiene protocols reduce the risk of transporting weed seed

Minimising other vectors of spread

Livestock are not the only vectors of weed seed spread—other unsuspecting carriers include:

- contractors employed by stations (e.g. earthmovers, bore drillers, fencing and mustering contractors)
- machinery shared between stations (e.g. dozers, road trains and other vehicles)
- hay products—AACo stations that produce hay for distribution need to be extremely diligent in ensuring it is free of weed seeds
- fodder or grain
- soil and gravel—relocation of these materials on a station can result in a weed outbreak in a new location
- feral animals—as they are possible vectors, they need to be controlled
- humans—people entering stations for tourism and recreation may inadvertently bring weed seeds with them.

AACo is monitoring all these potential vectors, and its managers use the information acquired to assess the risk of contamination by exotic weed species.

Under AACo guidelines, in some instances vendors and/or contractors must declare if machinery or feedstuffs have been exposed to exotic weed infestations and, if so, what has been done to prevent the spread of these seeds.

Mechanical control of prickly acacia on Lydia

Peter Klem with Cameron and Shaun Waltman

Introduction

Lydia, owned by Cameron and Shaun Waltman, is an 8100 ha property comprising gidyea country and flood channels of Lydia Creek. It is located 33 km south-west of Winton in central western Queensland. The Waltmans have been on Lydia for nearly five years and their main business is cattle and sheep breeding and fattening.

Prickly acacia was brought onto the property with stock many years ago to provide protein and to provide shade on open downs. It spread rapidly in 1999–2001 after three years of above average rainfall. During the last two years (2002–03), which have been dry, there hasn't been much progress in the spread of acacia, and a small percentage of it has died.

Control efforts

In early 2002, the Waltmans decided to start controlling prickly acacia because it was taking over their good country and, as the property is small, they needed to be able to use it all. 'We treated approximately half of the prickly acacia on Lydia in the last 12 months.' They clean specific paddocks initially and in others treat scattered trees first, and leave the denser areas until last. They find that by doing a little bit all the time, control doesn't become a big issue. According to the Waltmans, 'The drier the weather is, the better, but you also have to be financial to do this.'

Chemical control

'We use a 4-wheeler motorbike with a 200 L tank in a trailer to spray Starane®, water and a wetting agent over any bush up to head height, as a mixture of Starane® and diesel is far too expensive to use on regrowth. We obtained a 95 per cent kill with this method even when it was dry and the trees had very little leaf on them.' Trees must be wetted properly, with foliar spraying, and to avoid hot weather, treated early in the morning or late in the afternoon—not in the heat of the day.

'Trees must be wetted properly, with foliar spraying, and to avoid hot weather, treated early in the morning or late in the afternoon.'

Mechanical control

Grubbing with a 135 hp John Deere 4WD wheel tractor with a 4-in-1 bucket is the main method of mechanical control used by the

Peter Klem

▲ Spray tank and quad bike setup at Lydia

Peter Klem

▶ Tractor and 4-in-1 bucket

Peter Klem

▲ A modified bucket is proving effective in controlling prickly acacia

Waltmans during the dry and when time allows. When the bucket is opened up, it becomes a blade with a cutting edge (2 foot long and 1 foot deep) attached. Only the cutting edge is used to slice the root or lift out the plant. If the full width of the blade were used, the tractor would need greater horsepower. The tractor is also used for other property work and maintenance (e.g. pulling a fire plough and digging post holes).

'According to Cameron and Shaun, "the regeneration of native grass has been enhanced by the holes left after mechanical grubbing."'

Large mature trees are pushed over with the tractor blade up high. The cutter bar is most effective on trees to 3 m in height. Anything with a trunk over 15 cm in diameter is too big for the tractor. The tree is pushed over with the front of the 4-in-1 bucket and the hydraulics are used to lift or cut the root off below ground.

The Waltmans have found that with the machine they can clear, in one hour, an area that would take all day to basal bark spray. They achieved a 95 per cent kill in the drier part of 2002, and a rate of about 70 per cent when the weather was wetter. Very little regrowth has appeared on plants that were cut off below ground level or lifted out, whereas experience has shown that if a tree is cut off at ground level, regrowth will occur.

According to Cameron and Shaun, 'the regeneration of native grass has been enhanced by the holes left after mechanical grubbing.' When it rains, these holes retain water, which soaks into the ground and increases soil moisture thereby promoting the growth of natural grasses instead of prickly acacia. Apart from herbage, the main grasses found on Lydia are Mitchell, Flinders and button grasses, and buffel grass, which grows on the harder country and creek lines. To date, treated areas have not been seeded, though they do have plans to seed buffel in the harder country in the future.

The Waltmans said, 'We believe in mechanical control using a cutter bar and would advise others to use a similar set up and just make the cutter bar suit the size of their machine. You can treat prickly acacia in the hottest part of the day, in air-conditioned comfort listening to the radio, or you can basal bark spray.

'In 5–10 years we will still be digging trees because they will still keep coming up. We see emus as the biggest carters of seed between properties. We can control our stock, but we can't control the emu.'

Peter Klem

▶ Pasture regeneration after mechanical grubbing

Using goats and camels to control prickly acacia

Melissa Brien with David and Maree Jones

Introduction

The Grove, owned by David and Maree Jones, is a 10 522 ha property (including stock route), 46 km west of Winton. It was purchased in mid-2000 to use mainly as a sheep block, but also to run a few hundred cattle, together with 1000 goats and 13 camels to control prickly acacia. The mix of country on The Grove includes open Mitchell Grass Downs—some with red ironstone ridges—some gidyea country, and the alluvial channels of Wokingham Creek and the Western River.

Over most of the property, it is estimated there are 40 prickly acacia trees per hectare. While it provides increased shade, which can also improve lambing, prickly acacia makes stock handling very difficult and reduces pasture production. According to David and Maree, 'Mustering in prickly acacia is hard going. Grass doesn't seem to grow underneath the prickle trees and you are left with a substantial area with little fodder.' Prompt action was required to deal with the prickly problem.

Though the Jones first tried control with herbicides, they soon discovered that this was not the best option for the whole property, and use it now mainly near gates, around dams (where the plants suck up a lot of water) and other small problem areas.

Peter Spies

▲ Goats grazing on prickly acacia near dam

They have come to the realization that they cannot tackle the lot. They have purchased a skid loader so they can push large numbers of trees more quickly and take advantage of their fodder value.

'Grass doesn't seem to grow underneath the prickle trees.'

Melissa Brien

▲ A loader is being used to push prickly acacia

Camels and goats

Before they came to The Grove, the Jones had goats at Hughenden where they were used for controlling boree and gidyea regrowth. 'They opened up a lot of country for us there and we thought about using them down here, hoping it would work', David said. So, in early 2002 they were introduced on The Grove. Six months later, 13 camels were brought to work with them. 'When we sold our goats in Hughenden, we sold them to a bloke who was trialling using camels and goats together on prickly acacia. A few people around here have camels for prickly acacia also', David said.

'Working the camels and goats together ensures grazing pressure is exerted over the whole tree.'

Working the camels and goats together ensures grazing pressure is exerted over the whole tree—the goats eat the bottom half and the camels eat the top. They work together and they get on quite well. Goats and cattle also work well together as they don't compete for food—goats browse, while cattle graze. However, goats must be kept away from cattle lick blocks because they can't handle much urea—it can kill them pretty quickly. Goats can get on top of the regrowth, completely eating it off. 'They did that with the regrowth in Hughenden and it doesn't seem to come back. We don't know about prickly acacia yet, but we are hoping it does the same thing here. Both the goats and camel eat the seeds', David said. Unlike cattle and sheep, which pass viable seed, camels have a rumen that completely digests it, so they minimise the spread of prickly acacia.

Melissa Brien

▲ Goat damage to seedlings

Goat management

Running goats on a sheep property requires careful planning. As goats shed a lot of their hair, which may contaminate sheep wool, the Department of Primary Industries suggested that the Jones keep the sheep and goats completely separate on the property, as sheep were the main income. 'When we work the goats through the yards we have to make sure it is nowhere near where we are going to be shearing or working sheep, because the goats

Melissa Brien

◀ Camel browsing prickly acacia

shed so much hair. It's unreal… it gets everywhere—it's on the ground, in the air, it's everywhere. You have to [wait] for the hair to blow away before you can put your sheep through. If you could afford it, it would be ideal to have your own set of goat yards where you could handle them, or have a portable set where you could handle them separately', David said.

According to David, it's important to have your fences 'up to scratch' if intending to use goats, which he recommends buying fence-trained 'because they know how to stay inside.' He said that 'it's false economy' to try to use feral goats because 'the first thing they want to do is get out and they can travel a long way in a very short time… Camels may be the same. I think in a lot of cases wild camels can wreck your fences and can be hard to keep in. Our camels have been hand-raised and they are quiet.'

Plan of attack

The Jones first stock the smallest paddocks with goats and camels, then work up to the largest. This is a big job as the whole fence, including the gateway, must be electrified. Hinge-joint fencing can be used, but the cost is usually prohibitive for large paddocks. The Jones found it cheapest to run a hot wire at about 20 cm right around the bottom of the fence. David said 'It would be good to have three paddocks going at the one time, and be able to introduce the bucks back in and take them out, and then have a paddock for

Peter Spies

▲ Prickly acacia infestation at The Grove. Note fenceline effect. Goats and camels grazing on left.

weaning.' When it rains, the Jones plan to rotate the goats every year or to move them back into the paddocks as the prickly acacia comes back.

In the relatively short time that they have been on The Grove, the goats and camels have opened up a lot of country that was formerly dense prickly acacia infestations. The Jones have found that goats ringbark a large percentage of smaller trees with softer bark. 'We're waiting for a wet season now to find out whether those trees come back or not. Goats will climb up on a bush that's been pushed over and will eat everything that's there.' David said that camels break a lot of branches down and the goats sometimes get more feed from these. While it is still too early to gauge kill rates and responses, it is hoped that repeat stocking of paddocks over a number of seasons will gain results and 'buy' some time. This was David's experience in Hughenden, where repeated stocking with goats controlled boree regrowth, 'that was so thick you couldn't ride through it.'

'Goats and camels have opened up a lot of country that was formerly dense prickly acacia infestations.'

A further advantage in using goats to control prickly acacia is that, once the herd is fully established, the Jones plan to sell capretto (kid meat) and chevron (adult meat) in overseas markets. The feral nanny goats are put over Boer goat bucks, a breed from South Africa, 'because they are meat goats. The Boer kids put on weight very quickly and are ready in 6–10 months depending on the season and the market (for which they are being grown)', David said. 'We use the Boer bucks to beef the kids up a bit, and have them ready for sale earlier.'

'We don't think there is a great amount of money to be made; it's just that the goats are working away at the prickly bush. It is surprising how much of the tree they actually eat. We thought they would work on the regrowth, but we didn't expect them to eat the bark and to shred the tree so much. They have done better than we ever expected', said David …We would never go half goats on the place or anything like that. It's just a little sideline… more than anything, it cuts our chemical costs back. When you are putting herbicide out you are getting no return whatsoever and you have to make the time to do it, whereas the goats and camels are just there nibbling away at it the whole time while you're doing whatever else. Sometimes you wonder a bit about the safety of all the herbicides you are putting out. You can have gloves and all the rest of the safety stuff but you're still handling it. Goats and camels would have to be better for the environment, not polluting by pumping the chemicals into the soils' David said.

Melissa Brien

▲ Goats browsing prickly acacia

Technical updates

section 6

Technical updates

Controlling prickly acacia with soil applied herbicides

Mike Chuk

'The thickest and most intractable stands of prickly acacia are often found in drainage lines and dam backwaters, where there are often non-target, vulnerable native species.'

Soil applied herbicides, either in liquid or solid form have been available for the control of woody weeds such as prickly acacia for a number of years. They have been promoted as a cost-effective method of controlling the weed over large areas, or as a convenient means of spot treating scattered plants found when undertaking other management activities.

Cost, and the difficulty of ensuring even application have generally precluded the widespread use of the solid herbicides such as Graslan® and Reclaim® on prickly acacia. The liquid herbicide Velpar® on the other hand, has found favour in some areas for treating prickly acacia in open grassland where no other woody species are present. The significantly lessened labour costs compared with basal spraying, combined with logistical efficiencies (i.e. no drums or tanks of diesel to transport) have provided some incentive to use this method of control.

Disadvantages of use of soil-applied herbicides are:

- It can be difficult to measure the exact amount of herbicide required for a given tree size, which can be a problem in denser stands of trees. The tendency can be to over treat, which can result in non-target and off-site impacts.
- Depending on soil type and weather, it may be some time before results become visible, which may be a problem where payment for the job depends on results.
- Before adequate rainfall occurs, they can be blown away or disturbed by stock camping under trees.
- They are not sufficiently selective to permit their use in mixed communities of woody plants.
- Over application may result in temporary soil sterility. This may be useful in preventing regrowth, but can often result in loss of desirable pasture species and the resultant potential for soil erosion.
- They are not registered for use in streamline areas.[9]
- Away from streamlines, overland flow during heavy rain events can move the chemical down slope and adversely affect desirable native species.

In summary, soil-applied herbicides have proved beneficial in controlling prickly acacia on many properties where scattered trees are impacting on open grasslands. Unfortunately, however, the thickest and most intractable stands of prickly acacia are often found in drainage lines and dam backwaters, where there are often non-target, vulnerable native species that can be adversely affected. For example, coolibah along creek lines in the Mitchell Grass Downs of western Queensland —*Eucalyptus coolibah* has been badly affected where areas of prickly acacia have been treated with soil-applied chemicals.

[9]Always read and adhere to herbicide label directions when using soil applied or any other herbicide.

It is in these areas that basal bark and overall spraying, combined with selected mechanical control of thicker areas are preferred as control techniques.

As destruction of non-target native species is potentially an offence under legislation advice on this matter should be sought from appropriate departmental officers.

Nathan March

▲ Soil application of Velpar to prickly acacia

Biological control of prickly acacia

Bill Palmer

Biological control is the process of introducing the natural enemies of exotic weeds to reduce their growth and reproductive capacity, or to kill them. Biological control agents are the selected natural enemies (insects or diseases), which are used to keep weeds under control.

In 1979, the Department of Lands (now the Department of Natural Resources, Mines and Energy) began surveying potential biological control agents in Pakistan. Further research was initiated in Kenya from late 1989 and, in 1997, a preliminary survey of insect and pathogen fauna on prickly acacia in South Africa was undertaken. The South African survey found over 400 insect species on the trees. From this, a further group of promising insects was identified and a field station was established to assess potential control agents.

To date, research on possible biocontrol agents for prickly acacia has resulted in the introduction of five insects:

- a tip-boring moth *Cuphodes profluens*
- a seed-feeding beetle *Bruchidius sahlbergi*
- the leaf-feeding beetle *Homichloda barkeri*
- two leaf-feeding geometrid (looper) caterpillars *Chiasmia inconspicua* and *Chiasmia assimilis*.

It is anticipated that a sixth insect, *Cometaster pyrula,* a leaf-feeding caterpillar from South Africa, will be released in early 2004.

The tip boring moth, *Cuphodes profluens,* has not been detected in the field and probably did not become established.

The beetle, *Bruchidius sahlbergi*, established successfully and is now widespread. Though its level of predation on seeds can vary from 0 per cent to 80 per cent depending on the availability of mature pods, it appears to be having a minimal impact on the spread of prickly acacia. Populations of *Bruchidius* decline when pods are scarce due to stock grazing, floodwaters or climatic conditions, but there are higher insect populations when there is a permanent reservoir of pods. Seeds also 'escape' predation by the beetle by being eaten by stock.

The leaf-feeding beetle, *Homichloda barkeri*, was released from late 1996 to 1999 but, to date, establishment has not been confirmed.

The two leaf-feeding geometrid (looper) caterpillars (*Chiasmia inconspicua* and *Chiasmia assimilis*) from Kenya were released in late 1998 and June 1999 respectively. Though it's too early to know if these insects have established, there are some indications of establishment of *C. assimilis* in coastal areas.

Exploratory research in Africa has now concluded. However, as it has now been ascertained that the prickly acacia in Australia originated in India, it is hoped to undertake further work in that country over the next few years.

Landholders have been involved in the introduction of biological control agents through release programs conducted by the Department of Natural Resources, Mines and

Energy Tropical Weeds Research Centre. In particular, as insects have become available for release, landholders have helped with their distribution and/or monitoring on properties throughout the prickly acacia range.

NRM&E

▲ Host testing of prickly acacia biological control agents

Jeff Wright

▲ *Homichloda barkeri*

Marie Vitelli

▲ *Bruchidius sahlbergi*

Jeff Wright

▲ *Chiasmia* spp.

Environmental impacts of prickly acacia

Richard Johnson

'The Mitchell Grass Downs is the largest grassy ecosystem in Australia.'

Though the casual observer might think that the Mitchell Grass Downs are empty of wildlife, they are in fact full of animals—some of which are found nowhere else. While prickly acacia has long been recognised as having severe economic impacts on grazing production, little was known about its potential effect on the environment and whether it is a threat to the special wildlife of the Mitchell Grass Downs

To help answer that question, the Queensland Parks and Wildlife Service set up a small-scale study on two properties. We compared the fauna of five infested and six un-infested sites and found significant changes in the bird and reptile fauna.

Invasion of native grasslands by prickly acacia is a structural change characterised by loss of grass cover, increased bare ground and development of a shrub layer 2–6 m high. There also seem to be soil structure changes, with loss of the cracking characteristics of the clays. This might be made worse by the concentration of cattle around prickly acacia plants as they forage and seek shade.

In grassland sites there were several lizard species that relied on ground cover, which were absent from prickly acacia infestations. They appeared to have been replaced by a lesser number of lizard species adapted to open ground environments. This is a significant finding. The disappearing species included one found only on the Mitchell Grass Downs—the skink *Ctenotus agrestis*.

A similar pattern of replacement of grassland species by others more typical of woodlands was seen in the bird populations of the sites. Bird species lost included the singing bushlark, Australian bustard and little button quail.

Nathan March

▲ Richard Johnson studying the Mitchell Grass Downs fauna with the aid of pit traps

Why did these changes occur? We hypothesise that the loss of grassy cover affected the grassland lizards and birds in several ways. The loss of grass tussocks and litter may lead to a reduction in food resources derived directly from the plants (seeds, green material) or dependent on plants (insects). The loss of ground cover leads to a much higher ground temperature, which reduces the time that heat-sensitive lizards can spend searching for food. The loss of shelter provided by grass tussocks may lead to greater exposure to predators like hawks. In the case of the lizards, which shelter in soil cracks, the changes in soil structure are probably another problem. The grassland birds lost were ground-nesters. The loss of grasses would mean loss of nest sites in grass tussocks and loss of shade and camouflage for the nest and its contents.

The Mitchell Grass Downs is the largest grassy ecosystem in Australia, and one of the largest in the world. It supports the following unique fauna species:

- the Julia Creek dunnart
- an endemic form of the long-tailed planigale
- three lizards
- at least one snake.

It is also the major habitat for many other grassland animals, both at the state and national levels. All of these species have evolved with the grasslands and depend on their continued health. The overall change revealed in our small study was displacement of grassland-dependent birds and reptiles as the grassland was converted to shrubland. As it may render large areas unsuitable as habitat, invasion of the downs by prickly acacia is likely to be a severe threat to these species.

Nathan March

▲ Long-tailed Planigales live in the Mitchell grass downs

'The Mitchell Grass Downs are in fact full of animals'.

Courtesy of Tina Ball, QPWS

▲ Australian Bustard

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Further information

Section 7

Section 7

Further information

Contacts

Enquiries about declared weeds should be referred to your relevant local government or agency weeds officer. Weed information sheets are available from state and territory government agencies and from their web sites.

Table 6: State, territory and general contacts

Organisation/department	Contact details
New South Wales	
Department of Agriculture	Tel: 1800 680 244 to report 'Notifiable weeds' class W1 Web site: www.agric.nsw.gov.au
Department of Infrastructure, Planning and Natural Resources	Web site: www.dipnr.nsw.gov.au
Northern Territory	
Department of Infrastructure, Planning and Environment	Tel: 08 8962 4491 or 08 8973 8107 Web site: www.ipe.nt.gov.au
Queensland	
Department of Natural Resources, Mines and Energy	Tel: 1800 803 788 Web site: www.nrme.qld.gov.au
South Australia	
Department of Primary Industries and Resources	Tel: 08 8226 0222 Web site: www.pir.sa.gov.au
Western Australia	
Department of Agriculture	Email: enquiries@agric.wa.gov.au Web site: www.agric.wa.gov.au

Organisation/department	Contact details
General	
CSIRO	Tel: 1300 363 400 Email: enquiries@csiro.au Web site: www.csiro.gov.au
CSIRO Entomology	Email: entomology-enquiries@csiro.au Web site: www.ento.csiro.au
Weeds Australia	Web site: www.weeds.org.au
Weeds CRC	Tel: 08 8303 6590 Email: crcweeds@adelaide.edu.au Web site: www.weeds.crc.org.au

Declaration details in Australia

The following information on the declaration details of prickly acacia (*Acacia nilotica*) in Australian states and territories has been extracted from the respective agency web sites.

Table 7: Declaration status of Prickly acacia in Australia

State/Territory	Declaration details
Australian Capital Territory	Not declared
New South Wales	**W1** The presence of the weed on land must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.
Northern Territory	**Class A** To be eradicated **Class C** Not to be introduced into the Northern Territory
Queensland	**Class 2** • Without a permit it is prohibited to: introduce, feed, keep, release, take for commercial use, supply or supply things containing reproductive material and moving or transporting. • Landowners must take reasonable steps to keep land free of Class 2 pests. • May be subject to emergency quarantine notice.
South Australia	**Proclaimed weed** Sale prohibited
Tasmania	Not declared
Victoria	Not declared
Western Australia	**P1** The movement of plants or their seeds is prohibited within the state. **P2** Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.

References and further reading

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