

## Integrated control methods for bellyache bush (*Jatropha gossypifolia* L.) in northern Queensland: preliminary results

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**Summary** In northern Queensland, an integrated trial has been established to determine the most cost effective combination of primary and secondary (follow-up) treatments for the control of bellyache bush (*Jatropha gossypifolia* L.). This paper reports on the effectiveness of the primary control techniques that were applied: control, burning, foliar spraying (using metsulfuron (Brush Off<sup>®</sup>)), stickraking (using a D7 Dozer) and slashing (using a tractor-mounted slasher). Measurements undertaken included mortality of juvenile (up to 20 cm height), mature (20–100 cm height) and old (>100 cm height) bellyache bush plants, and post-treatment seedling recruitment and pasture response. Both slashing and the application of herbicide caused 100% mortality, irrespective of the size of plants. Fire was most effective on smaller plants (96% mortality), with efficacy decreasing with increasing size of plants. In contrast, stickraking was most effective on the largest plants (99% mortality). The natural mortality (control) was 38%.

For every plant killed by spraying, slashing, stickraking and burning, 20, 97, 74, and 69 plants were recruited from the seed bank, respectively. For every plant that died naturally, 74 were recruited from the seed bank. The impact of primary treatments on pasture yield varied between treatments. Brush Off increased pasture yield 17% when compared with the control whereas slashing, stickraking and burning reduced pasture yield 37%, 24% and 40%, respectively. Results suggest that foliar spraying of bellyache bush with metsulfuron was the best singular control method in terms of kill effectiveness, level of post-treatment seedling recruitment and sustainability of pasture yield.

**Keywords** Bellyache bush, *Jatropha gossypifolia*, weed control, north Queensland.

### INTRODUCTION

Bellyache bush (*Jatropha gossypifolia* L.) is currently one of the major exotic weeds invading the rangelands of northern Queensland (Bebawi *et al.* 2002). It is present to varying degrees in riparian and sub-riparian habitats of the Burdekin, Walsh, Palmer, Flinders and Gregory Rivers (Csurhes 1999, P. Davies pers. comm.). In western Queensland, it is found in the headwaters of Lake Eyre Basin.

Bellyache bush forms dense, impenetrable, mono-specific thickets, which reduce pasture productivity, hinder mustering and obscure fence lines (Miller and Pitt 1990, Csurhes 1999). It is unpalatable to stock and its seeds are toxic to insects, stock and humans (Chatrtee *et al.* 1980, Parsons and Cuthbertson 2001).

This paper reports preliminary results from a large-scale trial currently being undertaken to develop integrated control strategies for bellyache bush. It reports impacts of singular treatments of burning, foliar spraying, stickraking and slashing on bellyache bush plant mortality, post-treatment seedling recruitment and pasture yield responses.

### MATERIALS AND METHODS

The study site comprised four large blocks (approx. 1000 m by 100 m) located at Southern Cross Creek (20°01'38"S, 146°01'55"E), 12 km north west of Charters Towers, north Queensland. All blocks were fenced to exclude cattle. Vegetation at the field site was open woodland with a canopy dominated by *Eucalyptus* spp., a mid-storey dominated by bellyache bush and false sandalwood (*Eremophila mitchellii* Benth.), and an under-storey dominated by buffel grass (*Cenchrus ciliaris* L.) and native couch (*Brachyachne convergens* (F.Muell.) Stapf). Long-term annual mean rainfall for this region is 658 mm per annum (Bureau of Meteorology 1988). The daily temperature range in summer (November to April) is between 27° and 37°C and in winter (June to August) between 15° and 18°C (Bureau of Meteorology, 1988).

A 5 × 4 factorial experiment replicated four times, using a randomised complete block design, was implemented at the experimental site. Factor A comprised five primary control techniques: control (do nothing), foliar spraying (using metsulfuron at 6 g 100 L<sup>-1</sup> (Brush Off<sup>®</sup>) plus wetting agent (Uptake 3 mL L<sup>-1</sup>)), slashing (using a tractor-mounted slasher), stickraking (using a D7 Dozer – 7 m blade), and burning. Factor B was four secondary (follow-up) control methods: control, foliar spraying, slashing, and burning. Brush Off was selected because it is one of the recommended foliar chemicals for controlling bellyache bush (Csurhes 1999).

Plots were approximately 8 m × 65 m in size, with each plot surrounded by a 5 m firebreak to ensure

identity and integrity of plots. Bellyache bush density per plot averaged 58,000 plants per hectare (SE  $\pm$  15,000). The trial was initiated in April–May 2002 with follow-up treatments in 2003.

**Plant mortality** Prior to the application of primary treatments, 20 live bellyache bush plants of three different life-stages that included juvenile (up to 20 cm height), mature (20–100 cm height) and old (>100 cm height) plants were marked with numbered pegs. Live plants could be readily identified as they exuded colourless latex when struck with a sharp knife at the base of the stem, and the characteristic colour of the internal parts of the cut bark was green.

Plant mortality was determined a year later, before the onset of the wet season and application of secondary treatments.

**Seedling recruitment** Twelve months after the implementation of primary treatments, seedling counts were recorded within 80 systematically placed 50  $\times$  50 cm quadrats per plot. To avoid errors arising from edge effects, measurements were not taken within 1 m of plot boundaries.

**Pasture response** Within the same quadrats used to record seedling densities, the yield and composition of the pasture was visually estimated using the comparative yield method (Botanal) (Haydock and Shaw 1975, Tothill *et al.* 1978).

**Data analysis** For all parameters measured, analysis of variance was performed to detect differences between control methods. Percentages were arcsine-transformed prior to statistical analysis and later back-transformed.

RESULTS

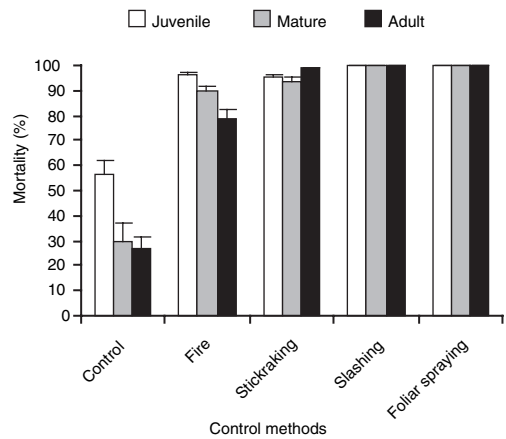
**Plant mortality** Significant ( $P < 0.01$ ) control method  $\times$  life stage interactions occurred for mortality of bellyache bush plants (Figure 1).

Some natural attrition of bellyache bush occurred irrespective of treatment (as measured within control plots), with seedlings the most susceptible life stage (56% mortality). Both slashing and the application of herbicide caused 100% mortality, irrespective of the size of plants. Fire was most effective on smaller plants (96% mortality), with efficacy decreasing with increasing size of plants. In contrast, stickraking was most effective on the largest plants (99% mortality).

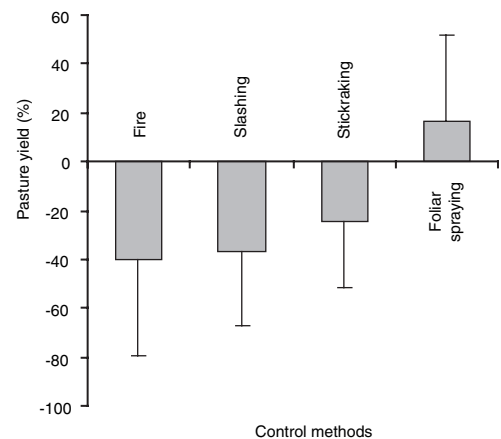
**Seedling recruitment** Control methods significantly ( $P < 0.05$ ) affected seedling recruitment the following year. For every plant killed by spraying, slashing,

stickraking and burning, 20, 97, 74, and 69 plants emerged from the seed bank, respectively. For every plant that died naturally, 74 regrew from the seed bank.

**Pasture yield** Highly significant ( $P < 0.01$ ) differences in pasture yield were detected between control techniques (Figure 2) 12 months after the application of treatments. Pasture yield within foliar sprayed plots was 17% higher than that within controls (Figure 2). In contrast, fire, stickraking and slashing reduced pasture yield 40%, 37%, and 24% respectively, when compared with the control (Figure 2).



**Figure 1.** Mortality of juvenile, mature and adult bellyache bush plants as affected by primary control methods. Bars indicate the SE of the mean.



**Figure 2.** Pasture yield responses to primary control methods compared with the control. Bars indicate the SE of the mean.

## DISCUSSION

Several primary control techniques proved effective in killing bellyache bush, with highest mortality achieved using foliar spraying and slashing. Seedling recruitment over the ensuing wet season occurred in all treatments, but was generally least in foliar sprayed plots and highest in those that had been slashed.

The results achieved by the fire and slashing treatments are consistent with findings from previous studies on bellyache bush (Bebawi and Campbell 2002a, b). Vitelli and Madigan (2002) also found Brushoff to be an effective foliar herbicide when applied aerially, but they emphasised the need for follow up control to treat the large-scale seedling regrowth that may occur following initial treatment.

The higher pasture yield in foliar sprayed plots is most probably attributable to the removal of competition from bellyache bush in a manner that caused minimal disturbance to the herbaceous vegetation, due to the selective nature of the herbicide used. All other treatments implemented would have caused some level of disturbance to the herbaceous vegetation.

Whilst the application of herbicides appears the most promising technique at this stage, final recommendations need to be deferred until secondary control options are implemented. Efficacy data will then be considered in combination with the costs of treatments in order to identify effective control strategies that not only remove initial infestations but also treat subsequent regrowth.

No single recommendation will be applicable for all situations where bellyache bush grows. For example, slashing may be feasible in open woodlands with a flat terrain but not in riparian habitats where the vegetation is generally dense and the terrain rough.

Other research being undertaken in conjunction with this integrated trial includes studies into the longevity of soil seed banks of bellyache bush. This information will identify how long follow up control will need to be implemented. Biological control options for bellyache bush have also been investigated and one agent (the jewel bug *Agonosoma trilineatum* Fabricius) is currently being mass reared and released on infestations in northern Queensland and the Northern Territory. This bug feeds on the fruits of bellyache bush and if effective should reduce the quantity of viable seed entering the soil seed bank.

It is envisaged that on completion of the ecological and agronomic research currently being undertaken on bellyache bush, effective integrated strategies will be available to assist landholders with management of this highly invasive and noxious weed.

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## REFERENCES

- Bebawi, F.F. and Campbell, S.D. (2002a). Impact of fire on bellyache bush (*Jatropha gossypifolia*) plant mortality and seedling recruitment. *Tropical Grasslands* 36, 129-37.
- Bebawi, F.F. and Campbell, S.D. (2002b). The response of bellyache bush (*Jatropha gossypifolia*) plants cut off at different heights and seasonal times. *Tropical Grasslands* 36, 65-8.
- Bebawi, F.F., Campbell, S.D. and Stanley, T.D. (2002). Priority lists for weed research in the wet- and dry-tropics of north Queensland. *Plant Protection Quarterly* 17, 67-73.
- Bureau of Meteorology (1988). 'Climatic averages Australia.' (Department of Environment, Sport and Territories, Commonwealth of Australia).
- Chatterjee, A., Biswanath Das, N., Adityachaudhury, N. and Debkirtaniya, S. (1980). Note on the insecticidal properties of the seeds of *Jatropha gossypifolia* Linn. *Indian Journal of Agricultural Science* 8, 637-8.
- Csurhes, S.M. (1999) 'Bellyache bush (*Jatropha gossypifolia*) in Queensland – pest status review series – land protection.' (Queensland Department of Natural Resources, Brisbane).
- Haydock, K.P. and Shaw, N.H. (1975). The comparative yield method for estimating dry matter yield of pasture. *Australian Journal of Experimental Agriculture Animal Husbandry* 15, 663-70.
- Miller, I.L. and Pitt, J.L. (1990). Is *Jatropha gossypifolia* the next *Mimosa pigra*? *Australian Weeds Research Newsletter* 39, 1-6.
- Parsons, W.T. and Cuthbertson, E.G. (2001). 'Noxious weeds of Australia', 2nd edn. (CSIRO, Collingwood).
- Tohill, J.C., Hargreaves, J.N.G. and Jones, R.M. (1978). BOTANAL – A comprehensive sampling and computing procedure for estimating pasture yield and composition. 1. Field sampling. CSIRO Australia Division Tropical Crops and Pastures, Brisbane, Queensland, Tropical Agronomy Technical Memorandum 8.
- Vitelli, J. and Madigan, B. (2002). Is aerial control of bellyache bush effective? Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd, and J.H. Moore, pp. 169-72. (Plant Protection Society of Western Australia, Perth).