AERIALLY APPLIED HERBICIDES SELECTIVELY CONTROL BITOU BUSH GROWING IN COMMUNITIES OF INDIGENOUS PLANTS ON SAND DUNES

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Summary. Bitou bush (*Chrysanthemoides monilifera* spp. *rotundata* (L.) T. Norl.) is a perennial South African shrub that was planted extensively during the 1950's and 1960's to stabilise coastal sand dunes in eastern Australia. By the late 1960's it was recognised as an invasive weed. Experiments in 1985-86 tested herbicides to control Bitou bush at Bherwerre Beach, in the (now) Jervis Bay National Park on the south coast of NSW, Australia. Six herbicides were applied by hand to assess their relative toxicity to Bitou bush and to seven native plant species which had been planted in the 1960's to stabilise the beach. Glyphosate (Roundup 36% a.i.) and metsulfuron methyl (Brush-off 60% a.i.) excelled. Bitou bush was most susceptible to the herbicides during and just after peak flowering (May through August), when the native species were least susceptible. These findings led to aerial application of Roundup® at 3, 6 or 9 L/ha or Brush-off® at 50, 100 or 150 g/ha in 60 L of water per ha during August 1989. All rates of both chemicals killed Bitou bush without harming the native plants. Experiments are continuing using lower herbicide rates.

INTRODUCTION

Bitou bush is a woody perennial native to South Africa. Weiss reviewed the records of occurrence of C. *monilifera* in various countries, including Australia (10). He concluded that information on the subspecies *rotundata* (Bitou bush) was vague, with the earliest records being for a specimen collected in the Stockton area near Newcastle, presumably from *'ballast dumped on the north bank of the Hunter River by South African ships. No other records exist until 1950 when a specimen was collected from the experimental area of the Soil Conservation Service of N.S.W. at Port Macquarie'*.

Weiss (10) continues *'Seed was sown extensively by the Soil Conservation Service of N.S.W. from 1946 to 1968 ..... (and by companies extracting titanium from beach sands) from 1950 to 1970'*. As a consequence of these activities and of the natural mechanisms of propagation and dispersion, Bitou bush occurred along 660 km of the N.S.W. Coast and was dominant along 220 km, by 1982 (4). The density and extent of the infestation has not since been resurveyed; however, both are reputed to have increased substantially. This is consistent with an evaluation of the bioclimatic potential of Bitou bush (3). By the mid 1960's Bitou bush had been recognised as a threat to the flora and fauna of over 20 National Parks and Nature Reserves. Planting and seed distribution for stabilisation purposes ceased during the 1970's and investigation into control began. Control efforts were focussed from three directions. First, community groups were encouraged to recognise the plant and remove it. Secondly, a systematic search was commenced for biocontrol agents. Thirdly, the potential for selective chemical control was examined. This article is an account of part of the latter stream of research.

Between 1985 and 1989 we conducted two series of experiments using an LPG powered spraygun (8). The first series tested the relative selectivity of the herbicides Ciba-Geigy Code No. GGA-131036, dichloropicolinic acid (Lontrel), fosamine (Krenite), glyphosate (Roundup),

metsulfuron methyl (Brush-off) and tricolpyr (Garlon) on Bitou bush, *Casuarina glauca, Leptospermum laevigatum, Leucopogon parviflorus, Acacia longifolia var. sophoral, Banksia integrifolia, Monotoca elliptica and Lomandra longifolia.* Only glyphosate and metsulfuron methyl proved sufficiently selective to warrant further study (6). Similar results were obtained by McMillan (5). The second series explored times and rates of herbicide application to maximise selectivity and minimise herbicide dose. This work is continuing, but by 1989 had progressed to the point where a window of opportunity had been demonstrated (7). This occurred in winter, after peak flowering of Bitou bush. Finally, Anderson reported successful control of Bitou bush, using 8 L of Roundup in 122 L of water per hectare from a helcopter, without damage to (unspecified) native vegetation (1). Armed with this information we undertook our first aerial herbicide applications in winter 1989.

METHODS

The site was at the northern end of Bherwerre Beach in the (now) Jervis Bay National Park. This beach had been destabilised by repeated grazing and burning over the previous 60 years. It was reshaped and stabilised during the 1960's. The species planted included: *Acacia longifolia var. sophorae, Banksia integrifolia, Leptospermum laevigatum, Leucopogen parviflorus, Lomandra longifolia, Monotoca elliptica*, and (~ 300 tubestock of) Bitou bush. Despite attempts to contain the Bitou bush infestation by hand spraying with herbicides, Bitou bush had become the dominant species over much of the 7 km of the beach by 1989 and was invading adjacent woodland.

The treatments were four rates of glyphosate applied as Roundup (36% a.i.) at 0, 3, 6 and 9 L/ha and three rates of metsulfuron methyl applied as Brush-off (60% a.i.) at 50, 100 and 150 g/ha. The latter treatments were applied with nonionic wetter (BS 1000) at 1 mL/L and the 50 and 150 g/ha rates were repeated without wetter. All treatments were applied in 60 L of water per hectare using conventional spray nozzles fitted to a boom attached to a helicopter flying at ~ 100 km/hr.

Each treatment was a single swath (~ 11 m wide and 280 m long). Treatments were separated by buffer strips (~ 19 m wide and 280 m long). Treatments were replicated twice and randomised within each of the two blocks. The buffer strip between blocks was ~ 38 m wide and 280 m long, resulting in an experimental area ~ 520 m x 280 m.

Before the treatments were applied we tagged eight individual plants per plot of each of the seven plant species that had been used to stabilise the beach. The tagged plants were scored for herbicide damage to the foliage (0 = no damage, 10 = foliage completely desiccated) during the following 12 months.

RESULTS AND DISCUSSION

Bitou bush. Bitou bush was more sensitive to both herbicides than anticipated from the results of hand spraying, with the lowest rates of both aerially applied herbicides causing very high mortality (Table 1). Consequently, the enhancement of metsulfuron methyl toxicity expected from the addition of wetting agent was evident only at the first time after spraying and then only at the lowest herbicide rate (Table 1).

Table 1. Bitou bush response to herbicides applied from the air in 60 L of water per hectare during Winter 1989

Herbicide treatment			Time after application (months)			
			0	2.5	5	7
Compound	Rate		Foliar damage score[1]			
Roundup	0 L/ha		0	0	0	0
(36% a.i.)	3 L/ha		0	9.7	9.9	9.9
	6 L/ha		0	9.9	10	10
	9 L/ha		0	10	10	10
Brush-off	50 g/ha	- wetter[2]	0	8.4	10	10
(60% a.i.)		+ wetter[2]	0	9.0	10	10
	100 g/ha	+ wetter[2]	0	9.7	10	10
	150 g/ha	- wetter[2]	0	9.5	10	10
		+ wetter[2]	0	9.6	10	10

[1] Scores of 0 and 10 equate to no damage and total desiccation of foliage respectively. Values are means for eight plants per replicate and two replicates per treatment.

[2] Wetter is BS 1000 at 1 mL/L of mixture.

We also recorded the number of Bitou bush seedlings in 50 cm x 50 cm fixed quadrats under the tagged Bitou bushes. Where glyphosate had been applied, there were >400 seedlings per square metre and the number was independent of the herbicide rate. This is consistent with low availability of glyphosate even from sandy soil (2). In contrast, metsulfuron methyl has a residual effect (9). This was evident as a depression in the seedling density to <200 plants per square metre, which lasted throughout the period of observation.

Native plants. It is conjectural whether the herbicides caused any measurable foliar damage to: *Acacia longifolia var. sophorae, Banksia integrifolia, Lomandra longifolia* and *Monotoca elliptica.* If any damage occurred it was ephemeral. Consequently data are not presented for these species. *Leptospermum laevigatum* and *Leucopogon parviflorus* were not affected by glyphosate and only slightly damaged by metsulfuron methyl (Table 2). Addition of wetting agent to metsulfuron methyl did not consistently modify its phytotoxicity, so we have presented averages for the ± wetting agent treatments (Table 2).

These results clearly demonstrate that Bitou bush can be killed using low doses of Roundup (3 L/ha) or Brush-off (50 g/ha) from the air in winter, without appreciable damage to the six native plant species studied. Experiments conducted in winter 1991 at Bherwerre Beach and in winter 1992 at two locations confirm these findings. Since none of the treatments failed to control Bitou bush, further reductions in herbicide rates should be possible.

The results also justify continued research on chemical control of Bitou bush. First, to assess the herbicide tolerance of a wider range of native plants and so establish the likely usefulness of aerial spraying against Bitou bush on sites supporting more diverse plant communities. Secondly, to assess the impacts of these herbicides in the dune environment. And thirdly, to facilitate integration of chemical and biological control strategies.

Table 2. Native plant species damaged by herbicides applied from the air in 60 L of water per hectare during Winter 1989

Herbicide treatment		Plant species	Time after application (months)			
			0	1.5	2.5	7
Compound	Rate		Foliar damage score[1]			
Roundup	0 L/ha	*Leptospermum*	0	0	0	0
(36% a.i.)	3 L/ha	*laevigatum*	0	0	0	0
	6 L/ha		0	0	0	0
	9 L/ha		0	0	0	0
Brush-off	50 g/ha ± wetter[2]		0	1.0	0.25	0
(60% a.i.)	100 g/ha + wetter[2]		0	2.0	1.0	0
	150 g/ha ± wetter[2]		0	2.0	1.0	0
Roundup	0 L/ha	*Leucopogon*	0	0	0	0
(36% a.i.)	3 L/ha	*parviflorus*	0	0	0	0
	6 L/ha		0	0	0	0
	9 L/ha		0	0	0	0
Brush-off	50 g/ha ± wetter[2]		0	1.8	1.0	0
(60% a.i.)	100 g/ha + wetter[2]		0	1.5	1.5	0
	150 g/ha ± wetter[2]		0	2.0	1.25	0

[1] Scores of 0 and 10 equate to no damage and total desiccation of foliage respectively. Values are means for eight plants per replicate and two replicates per treatment, except where the Brush-off data have been averaged across two wetter treatments.

[2] Wetter is BS 1000 at 1 mL/L of mixture.

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