CONTROL STRATEGIES FOR MADEIRA VINE (*ANREDERA CORDIFOLIA*)

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ABSTRACT

Madeira vine is an environmental weed with both aerial and subterranean tubers, and is listed as a Surveillance Plant Pest by Manawatu-Wanganui Regional Council. A field trial showed mature vines and their attached tubers were best controlled using metsulfuron-methyl, although reasonable control was also provided by a triclopyr/picloram mixture and by glyphosate. The control of regrowth from buried tubers was investigated in a glasshouse trial. Herbicides that gave good control of 3-month-old plants included the above herbicides and also tribenuron-methyl, fluroxypyr and amitrole. For eradication purposes, treatments were assessed for destroying aerial tubers collected from isolated plants. Tubers were killed by freezing, by heating to temperatures of 80°C or above for 24 h or by boiling for a few minutes, but any pulverisation techniques needed to be thorough. Tubers immersed momentarily in high concentrations of picloram, triclopyr or fluroxypyr did not regrow after burial.
Keywords: Madeira vine, control, environmental weed, herbicides, *Anredera cordifolia*.

INTRODUCTION

Madeira vine (*Anredera cordifolia* (Ten.) Steenis), also known as mignonette vine, is a perennial, climbing vine grown as an ornamental species, but has naturalised to become an environmental weed (Starr et al. 2003). Madeira vine affects terrestrial forest and shrub ecosystems by halting the regeneration and succession processes (Prior & Armstrong 2001; Auckland Regional Council 2003). It is classified as a "Regional Surveillance Plant Pest" in the Manawatu-Wanganui Region of New Zealand and their Pest Management Programme has the objective of gathering more information on its distribution and control (Horizons Regional Council 2001). Madeira vine is difficult to control successfully with herbicides (West 1996) due to the persistence of numerous viable aerial and subterranean tubers that remain after herbicide treatment and re-infest treated sites (Department of Conservation 2000; Blood 2001). Aerial tubers may persist in the soil for 2–5 years (Prior & Armstrong 2001; Muyt 2001), and on severed vines in the canopy for up to 5 years (Buchanan 1989). However, Madeira vine appears not to produce seed in New Zealand (Department of Conservation 2000).

Some information already exists on herbicides for controlling Madeira vine (e.g. Prior & Armstrong 2001) but efficacy is mainly anecdotal. This paper describes three trials conducted to obtain further knowledge on the control of this species. Herbicides were assessed for controlling mature vines and for controlling regrowth from tubers. Techniques for destroying tubers were also assessed.

MATERIALS AND METHOD

Trial 1

Mature Madeira vine infestations in various locations around Wanganui were sprayed with metsulfuron-methyl (Escort), glyphosate (Roundup Renew Xtra), clopyralid

(Versatill) and triclopyr/picloram (Tordon Brushkiller) to assess their relative effectiveness on the weed. The extensive vine-like growth of Madeira vine made it desirable to treat discrete individual plants or clusters of plants as experimental units, with most being at least 25 m^2 in size. Although many "plots" were at different locations around Wanganui, treatments were allocated to plots by blocking sites for similarity of soil type, location and size. Thus a randomised block design was used with four replicates, and treatments were compared with an untreated control. The herbicides were applied by knapsack as a foliar spray to run-off over the entire plant on 12 December 2003. Pulse Penetrant (organo-silicone polymer) was added at recommended rates to aid uptake of all the herbicides. Sites were inspected at regular intervals for more than a year after treatment and scored for plant health. Three months after herbicide application, ten aerial tubers were collected from each plot and propagated in a shade-cloth covered tunnel house. Subsequent emergence of tuberling plants was recorded.

Trial 2

On 24 November 2003, aerial tubers of Madeira vine obtained from St John's Hill, Wanganui, were planted into PB3 planter bags containing a peat-based potting mix in a plastic-covered tunnel house. The resulting tuberling plants were allocated to treatments within a randomised block trial design based on plant size and thrift. There were 34 treatments, including an untreated control, and five replicates of each. Most herbicides were applied to run-off with a hand-held, 500 ml sprayer on 23 March 2004. One treatment involved picloram gel (Vigilant), which was weighed before being applied to the larger leaves with a spatula. Pulse Penetrant was added at the rate of 2 ml/litre to treatments of triclopyr/picloram, fluroxypyr (Starane), glyphosate, triclopyr (Grazon), asulam (Asulox) and amitrole (Amitrole ATA 40) and at the rate of 1 ml/litre to metsulfuron-methyl, metsulfuron-methyl/glyphosate, primisulfuron (Beacon), thifensulfuron (Harmony), chlorsulfuron (Glean), tribenuron-methyl (Granstar) and glufosinate (Buster).

The young plants were monitored at regular intervals for 12 months after treatment. Scores were assigned for plant damage at each assessment using a system based on appearance of the vines, foliage, flowers and tubers in the leaf axils.

Trial 3

Aerial tubers were collected from Wanganui (St John's Hill) and Palmerston North (Bledisloe Park), weighed and exposed to a range of treatments on 8 April 2004 before being potted up in a peat-based potting mix in PB3/4 planter bags and placed in a shade-cloth covered glasshouse. There were 40 treatments, including an untreated control, with five replicates of each treatment. Tubers were blocked for weight and source within a randomised block design. Physical treatments included exposure for 24 h to heating (56, 80 and 100°C), chilling (7°C) or freezing (-24°C); boiling for 1, 5 and 10 min; pulping (heavy, medium and light pulverization with a hammer) and scorching with a soldering torch. Chemical treatments were applied to tubers in two ways: (1) by immersion for specified intervals of time in weak or strong concentrations (equating to standard spray mixtures and undiluted herbicide respectively) or (2) as a spray to run-off from a handheld sprayer, with or without Pulse Penetrant. After treatment, successful emergence from tubers was recorded. Any tubers that had not emerged by 18 weeks were dug up and assessed for viability using a scoring technique, based on the extent of necrosis present. They were then re-buried for a further 32 weeks and periodically checked for emergence.

Data for all three trials were tested for significant differences between the means using analysis of variance with the SPSS statistical package.

RESULTS

Trial 1

Mature vines were effectively controlled using metsulfuron-methyl, and tubers collected from treated vines 3 months after treatment had only 2% viability (Table 1). There was almost no regeneration from vines or tubers attached to vines at sites monitored for nearly 14 months after treatment with metsulfuron-methyl. A reasonable level of initial control of mature vines was also provided by triclopyr/picloram and by glyphosate, though

the sites did not remain as free of the weed as areas treated with metsulfuron-methyl. This was mainly due to re-establishment from both underground and aerial tubers and lateral encroachment. However, the tubers collected from the triclopyr/picloram plots were significantly less viable than those from the glyphosate-treated plots. Plots treated with clopyralid were not significantly different from the untreated control except in the viability of the tubers.

TABLE 1: Plant health score and viability of tubers from mature Madeira vines that had been treated with herbicides. Plant health measurements were made 34 and 154 days after treatment (DAT), and the proportion of aerial tubers still viable was assessed 3 months after treatment.

	Rate	Plant health score[1]		% of tubers
Treatment	(g ai/litre)	34 DAT	154 DAT	viable
untreated	-	0.2	1.5	95
metsulfuron-methyl	0.3	5.7	10.0	2
glyphosate	7.3	7.5	6.3	62
triclopyr/picloram	1.5 + 0.5	7.7	9.5	30
clopyralid	3.7	2.2	3.0	67
LSD (P=0.05)		1.5	3.1	24

[1]0–10 score, where 0=healthy and 10=dead.

Trial 2

Metsulfuron-methyl, glyphosate, a metsulfuron-methyl/glyphosate mixture, triclopyr, picloram, the triclopyr/picloram mixture, tribenuron-methyl and fluroxypyr successfully killed 3-month-old plants (Table 2). Plants treated with amitrole underwent a continued cycle of dieback and regeneration from the subterranean tubers, which presumably would eventually end in starvation of the plant when the tubers were depleted because the amitrole appeared to be stored within the plant. The plants appeared to have been killed by 2,4-D/dicamba (Banvine) after 14 weeks, but they later regrew again from the tubers. Other herbicides including 2,4-D (Pasture-Kleen), asulam, chlorsulfuron, dicamba (Banvel), glufosinate-ammonium, MCPA (DowElanco MCPA), mecoprop-P (Duplosan KV), primisulfuron and thifensulfuron-methyl did not give lasting control. Only some of the 34 treatments have been presented in Table 2, as results from lower rates of unsuccessful herbicides and higher rates of successful herbicides are not presented.

Trial 3

As the tubers were not treated until autumn, most did not regrow until the following spring, including all the untreated control plants, presumably due to seasonal dormancy. However, tubers chilled at 7°C or damaged by moderate pulverization with a hammer did regrow immediately. By 50 weeks after treatment, no regrowth had occurred from tubers that were frozen, heated to temperatures of 80°C or above for 24 h, boiled for more than 1 min or thoroughly pulverized (data not presented). Any pulverisation techniques needed to be thorough (tubers almost like a paste), as the regrowth from tubers that received light to medium pulverisation was not significantly different from the untreated control. Tubers that were momentarily immersed in high concentrations of picloram (50 g/kg gel), triclopyr (300 g/litre), triclopyr/picloram (150 + 50 g/litre) or fluroxypyr (100 g/litre) did not regrow. Dunking or spraying with lower rates of triclopyr (2.4 g/litre) or fluroxypyr (2 g/litre)(with or without Pulse Penetrant) was not effective for killing tubers, although spraying them prior to burial with a triclopyr/picloram mixture (1.8 + 0.6 g/litre) without Pulse Penetrant at these lower rates gave a significant reduction in emergence but not full control. Tubers treated with the sprout inhibitors propham (0.16 g/kg; Propham Potato Dust) and maleic hydrazide (24 g/litre; Spray Mow) and the soil sterilant dazomet (1.03 g/kg; Basamid) eventually regrew. Burying tubers to a depth of 150 mm and scorching the surface with a soldering torch were also ineffective means of preventing re-growth from buried tubers.

TABLE 2: Plant health scores of 3-month-old herbicide-treated Madeira vines at 4, 14 and 52 weeks after treatment (WAT).

Treatment	Rate (g ai/litre)	Plant health[1] 4 WAT	14 WAT	52 WAT
2,4-D	0.36	6.4	2.6	0.9
2,4-D + dicamba	1.2 + 0.6	3.1	8.2	6.0
2,4-D + dicamba	2.4 + 1.2	3.6	10.0	6.6
amitrole	8.0	4.0	8.0	9.0
asulam	2.0	4.2	5.4	3.4
chlorsulfuron	0.3	2.9	5.8	5.9
dicamba	0.6	2.4	8.0	3.8
fluroxypyr	0.5	8.8	10.0	10.0
glufosinate-ammonium	2.0	9.5	9.2	1.1
glyphosate	1.8	8.9	10.0	10.0
glyphosate+metsulfuron-methyl	3.6 + 0.15	8.5	10.0	10.0
MCPA	3.8	6.2	6.0	4.9
mecoprop-P	6.0	6.3	9.8	5.6
metsulfuron-methyl	0.2	3.0	8.2	10.0
metsulfuron-methyl	0.3	3.8	10.0	10.0
picloram (gel)	25 mg/plant	6.9	10.0	10.0
primisulfuron	0.3	3.0	7.7	3.0
thifensulfuron	6.0	3.4	9.9	7.2
tribenuron-methyl	0.3	4.2	10.0	10.0
triclopyr	0.6	8.9	10.0	10.0
triclopyr + picloram	0.5 + 0.2	8.8	10.0	10.0
untreated control	-	2.2	1.9	3.6
LSD (P=0.05)		1.5	1.6	2.6

[1]0–10 score where 0=healthy and 10=dead.

DISCUSSION

Metsulfuron-methyl was the most effective herbicide for controlling mature plants of Madeira vine. The herbicide appeared to translocate along vines to untreated parts of a site better than glyphosate and the triclopyr/picloram mixture, at the commonly used application rates for weed clearance used in this trial. Thus metsulfuron-methyl achieved more permanent control of the vines with the very good control of tubers preventing re-establishment of the weed.

For control of regrowth from tubers, a reasonably selective treatment was sought to minimise non-target damage of species planted into sites cleared of Madeira vine. Although metsulfuron-methyl, glyphosate, triclopyr, picloram and amitrole all appear effective at killing regrowth from tubers, it is possible that fluroxypyr and tribenuron-methyl may be less damaging to some non-target species. These results confirm the findings of Prior & Armstrong (2001) regarding the effectiveness of glyphosate and fluroxypyr on Madeira vine. For the other treatments assessed in the present trial, these are the first published trial results, although West (1996) has reported some of them as being effective from anecdotal evidence.

The most effective way of destroying tubers collected from plants during eradication schemes is by putting them in a freezer or oven for 24 h, or by boiling them. As Madeira vine appears not to seed in New Zealand, the use of metsulfuron-methyl on mature vines, coupled with follow-up spraying of tuber regrowth with metsulfuron-methyl, triclopyr/picloram, glyphosate, tribenuron-methyl, fluroxypyr or amitrole has been shown to be

effective. Along with destruction of any tubers collected from remaining isolated plants, this should allow effective management of this species.

REFERENCES

Auckland Regional Council 2003. Pest facts sheet number 32: Madeira vine. Auckland Regional Council, Auckland. 2 p.

Blood K 2001. Environmental weeds: a field guide for Southeast Australia. CH Jerram & Associates, Mt Waverly, Victoria. 228 p.

Buchanan RA 1989. Bush regeneration: recovering Australian landscapes. TAFE Student Learning Publications, Sydney. 259 p.

Department of Conservation. 2000. Weed manager: a guide to the identification, impacts and management of conservation weeds of New Zealand. Department of Conservation, Wellington. 242 p.

Horizons Regional Council 2001. Regional plant pest management strategy. Manawatu-Wanganui Regional Council, Palmerston North. 174 p.

Muyt A 2001. Bush invaders of south-east Australia. RG& FJ Richardson, Meredith, Victoria. 304 p.

Prior SL, Armstrong TR 2001. A comparison of the effects of foliar applications of glyphosate and fluroxypyr on Madeira vine, *Anredera cordifolia* (Ten.) van Steenis. Plant Protection Quarterly 16: 33–36.

Starr F, Starr K, Loope L 2003. Plants of Hawaii – *Anredera cordifolia*. Haleakala Field Station, Maui, Hawai'i. http://www.hear.org/starr/hiplants/reports/html/anredera_cordifolia.htm (Updated January 2003).

West CJ 1996. Assessment of the weed control programme on Raoul Island, Kermadec Group. Science and Research Series No. 98, Department of Conservation, Invercargill. 100 p.