Developing additional herbicide control options for rubber vine (*Cryptostegia grandiflora* R.Br.)

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Summary Herbicide control of rubber vine (*Cryptostegia grandiflora* R.Br.), a Weed of National Significance in Australia, can be effectively achieved in most situations using a range of chemicals and various techniques, including basal bark, cut stump, foliar and aerial applications. Nevertheless control in areas with poor access and with native vegetation still poses difficulties for some land managers, particularly doing so in a cost effective manner.

The successful incorporation of low-volume high-concentration herbicide applications into control programs for several woody weeds in recent years prompted further testing of this technique for control of rubber vine. The efficacy of single rates of four herbicides plus a combination of two herbicides was compared against an untreated control. The herbicide treatments tested contained the active ingredients aminopyralid/metsulfuron-methyl (375/300 g a.i. kg^{-1}), metsulfuron-methyl (600 g a.i. kg^{-1}), metsulfuron-methyl + glyphosate (600 + 360 g a.i. kg^{-1}), triclopyr/picloram (300/100 g a.i. kg^{-1}) and triclopyr/picloram/aminopyralid (200/100/25 g a.i. kg^{-1}).

Two years after application, triclopyr/picloram was the only treatment to have given 100% mortality, but statistically it was not significantly different ($P > 0.05$) to aminopyralid/metsulfuron-methyl, metsulfuron-methyl or triclopyr/picloram/aminopyralid, which averaged between 82–91% mortality. The metsulfuron-methyl + glyphosate treatment performed poorly (49% mortality): this appears to be associated with some antagonistic effect given that metsulfuron-methyl on its own performed much better. Based on these results, two more trials have been initiated to refine rates for metsulfuron-methyl and triclopyr/picloram and to compare low-volume high-concentration applications against traditional foliar spraying using the same herbicide (triclopyr/picloram) (in terms of efficacy and cost).

Keywords Chemical, splatter gun, weed.

INTRODUCTION

Rubber vine (*Cryptostegia grandiflora* R.Br.) is one of the most problematic weeds in northern Australia which has led to its declaration throughout Australia, along with its classification as a Weed of National Significance (Doak and Deveze 2004). A large body of research has been undertaken into the impacts, ecology and control of this weed over the last 30 years (Tomley 1995, Grice 1996, Palmer and Vogler 2012). This has resulted in the identification of effective control options for different densities and situations, including the individual and integrated use of biocontrol, chemical, and mechanical techniques and the use of fire (Doak and Deveze 2004, Palmer and Vogler 2012).

In recent years low-volume high-concentration herbicide applications (e.g. splatter guns) have become increasingly used in Queensland as an effective option for controlling some other woody weeds in difficult to access areas, such as lantana (*Lantana camara* L.), bellyache bush (*Jatropha gossypiifolia* L.) and Siam weed (*Chromolaena odorata* (L.) King & Robinson) (Somerville *et al*. 2011, Brooks *et al*. 2014). The use of low-volume high-concentration applications has been tested previously (1980s) on rubber vine using sprinkler sprayers, with two chemicals found to be effective (picloram/2,4-D and dicamba) (Harvey 1987). Despite its effectiveness, this technology was not widely adopted by landholders for control of rubber vine, with a preference for other options such as the use of fire, foliar spraying, cut stump and basal bark applications and ground applied residual herbicides where permissible (Doak and Deveze 2004). With an increased range of herbicides and advances in technology since then, a screening trial commenced in 2014 to evaluate the use of splatter guns for applying low-volume high-concentration herbicide applications on rubber vine.

MATERIALS AND METHODS

A randomised complete block experiment was implemented on a cattle property about 20 km east of Mount Surprise, north Queensland. The site comprised a light to medium density infestation of mainly free standing rubber vine (i.e. not climbing up trees) growing in open eucalypt woodland on basalt derived soil.

There were six treatments in total each replicated three times using a randomised complete block design. Single rates of four herbicides plus a combination of two herbicides were compared against an untreated control (Table 1). Experimental units comprised clusters of 15 medium-sized rubber vine plants. All selected plants were of the shrub form with those growing as vines (i.e. climbing up neighbouring trees) excluded. Selected plants were also a minimum of 4 m apart from each other to minimise the risk of spray drift.

On the day before treatments were implemented, the height, basal diameter and width of the canopy of all tagged rubber vine plants was measured. An estimate of the percentage leaf cover and whether plants were flowering and/or podding was also recorded. The rubber vine plants were on average 2.02 ± 0.03 m high, with a basal diameter of 6.4 ± 0.2 cm and a canopy width of 2.19 ± 0.04 m. Leaf cover averaged 80 ± 2% and 99% and 56% of the plants were flowering and podding, respectively. There was no evidence of a leaf rust (*Maravalia cryptostegiae* (Cummins)) being present at the time.

Treatments were implemented between the 10–12 March 2014. They were applied using a manually operated 'Forestmaster' applicator (N.J. Phillips®) set to deliver 20 mL shots via an 'adjustable cone' nozzle. For each experimental unit, two litres of solution was prepared, which included the selected chemical (Table 1) plus 2 mL per L of the non-ionic wetter/spreader/penetrant Pulse® (Nufarm) (1020 g L^{-1} polyether modified polysiloxane) and 1 mL per L of red Spraymate™ Spray Marker Dye (150 g L^{-1} Rhodamine B).

Spraying was undertaken in accord with the herbicide labels for Picloram + Triclopyr 400 and Stinger™, with 10 mL of mixture applied per metre squared of surface area of the plant. On average, each plant received 36 ± 1.5 mm of herbicide mixture.

RESULTS

Two years after application, triclopyr/picloram was the only treatment to have given 100% mortality, but statistically it was not significantly different ($P > 0.05$) to aminopyralid/metsulfuron-methyl, metsulfuron-methyl or triclopyr/picloram/aminopyralid, which averaged between 82–91% mortality (Figure 1). The metsulfuron-methyl + glyphosate treatment performed poorly (49% mortality). Some mortality (9%) of control plants was recorded but this tended to be smaller plants and was still significantly less than any of the herbicide treatments (Figure 1).

DISCUSSION

In this study, low-volume high-concentration applications of triclopyr/picloram were able to provide 100% mortality of medium sized rubber vine plants that were growing in the shrub form. Although the equipment and herbicide used was different, the findings are consistent with an earlier study by Harvey (1987) who achieved high mortality using a sprinkler sprayer to apply low-volume high-concentration applications of 2,4-D/picloram and dicamba. Surprisingly, the metsulfuron-methyl + glyphosate treatment performed poorly (49% mortality) and appears to be associated with some antagonistic effect given that metsulfuron-methyl on its own performed significantly better (82% mortality).

Since this initial study, two other trials have been initiated to refine rates for triclopyr/picloram and metsulfuron-methyl and to compare low-volume high-concentration applications (in terms of efficacy and cost) against traditional foliar spraying using the same herbicide (triclopy/picloram). In the rate refinement trial, triclopyr/picloram has been included to

Table 1. Herbicide treatments implemented on rubber vine using low-volume high-concentration applications.

Herbicide trade name	Active ingredient (g a.i. kg^{-1} or L^{-1})	Herbicide mix rate	Active ingredient rate (g a.i. L^{-1})
Brush-Off®	metsulfuron-methyl (600 g kg^{-1})	2 g L^{-1}	1.2
Brush-Off® + Weedmaster® Duo	metsulfuron-methyl (600 g kg^{-1}) + glyphosate (360 g L^{-1})	2 g L^{-1} + 100 mL L^{-1}	1.2 + 36
Picloram + Triclopyr 400	triclopyr/picloram (300/100 g L^{-1})	50 mL L^{-1}	15/5
Stinger™	aminopryalid/metsulfuron-methyl (375/300 g L^{-1})	4 g L^{-1}	1.5/1.2
Tordon™ RegrowthMaster	triclopyr/picloram/aminopyralid (200/100/25 g L^{-1})	50 mL L^{-1}	10/5/1.25
Control			

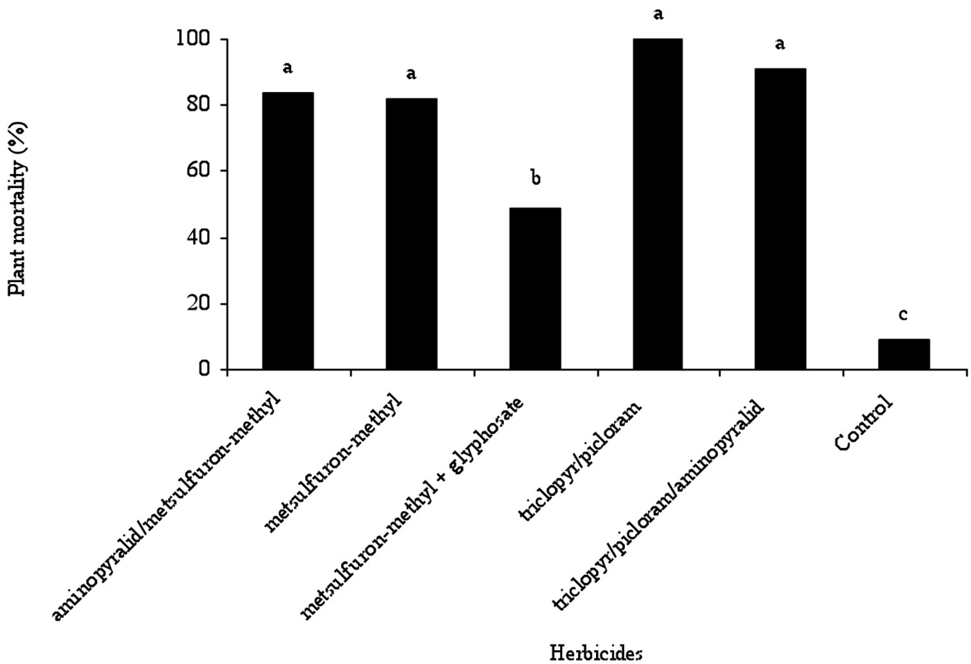

Figure 1. Effect of herbicide treatments on plant mortality (%) of rubber vine 24 months after treatment. Vertical bars with the same letter are not significantly different from each other (P >0.05).

see if lower rates than that used in the current study will still provide high efficacy. Given its low cost, metsulfuron-methyl was also included to determine whether slightly higher rates would increase mortality.

While still in the early stages, preliminary observations of these trials suggest that mortality will be lower than the initial study. Differences in plant density may be a contributing factor and will be explored further if this trend continues.

The level of infection from a leaf rust (*M. cryptostegiae*) will need to be monitored by land managers interested in using low-volume high-concentration applications for control of rubber vine. The rust was released as a biological control agent in Australia in the 1990s and in many areas it has proven very effective at reducing the vigour and reproduction of rubber vine plants (Palmer and Vogler 2012). However, the infection of leaves by the rust has been shown to reduce the efficacy of high-volume foliar spraying (Vitelli and Madigan 1999) and it is likely that low-volume high-concentration applications could be equally affected.

Whilst not formally tested at this stage, anecdotally it does not appear that the vine form of rubber vine (i.e. those plants that are growing up trees) will be able to be effectively controlled using low-volume high-concentration applications. Any plant material that escapes being sprayed, by being out of the reach of the sprayer and the equipment being used, does not appear to be affected allowing the plant to remain alive.

The results in this study are applicable to small to medium sized rubber vine plants that are not climbing up trees and where the infestation is still at a density where the whole surface of individual plants is assessable for spraying. In such situations, the findings from studies on other weeds (lantana and Siam weed) suggest that whilst the amount of herbicide used may be slightly higher (Thompson 2013) than high-volume foliar applications, the time taken to treat plants will be greatly reduced using this technique (Thompson 2013, Brooks *et al*. 2014). The labour efficiencies along with the portability of the application equipment make it an attractive option for difficult to access areas. Furthermore, there is also a wide range of equipment that can be used depending on the size and density of infestations, ranging from inexpensive drench guns to manual, gas-powered backpack and larger ATV-mounted units.

A minor use permit (PER82156) has recently been approved by the Australian Pesticides and Veterinary Medicines Authority (APVMA) for the use of chemicals containing triclopyr (300 g a.i. kg^{-1})/picloram (100 g a.i. kg^{-1}) (e.g. Picloram + Triclopyr 400, Conqueror®) and triclopyr (300 g a.i. kg^{-1})/picloram (100 g a.i. kg^{-1})/aminopyralid (8 g a.i. kg^{-1}) (Grazon™ Extra) to control rubber vine using low-volume high-concentration applications.

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REFERENCES

Brooks, S.J., Gough, K.L. and Campbell, S.D. (2014). Refining low-volume, high-concentration herbicide applications to control *Chromolaena odorata* (L.) King & Robinson (Siam weed) in remote areas. *Plant Protection Quarterly* 36, 459-67.

Doak, A. and Deveze, M. (2004). 'Rubber vine management: control methods and case studies'. Queensland Department of Natural Resources, Mines and Energy, Brisbane.

Grice, A.C. (1996). Seed production, dispersal and germination in *Cryptostegia grandiflora* and *Ziziphus mauritiana*, two invasive shrubs in tropical woodlands of northern Australia. *Australian Journal of Ecology* 21, 324-31

Harvey, G.L. (1987). Low-volume application of herbicides for control of rubber vine. Proceedings of the eighth Australian Weeds Conference, pp. 49-54.

Palmer, B and Vogler, W. (2012). *Cryptostegia grandiflora* (Roxb.) R.Br. – rubber vine. *In* 'Biological control of weeds in Australia', eds M. Julien, R. McFadyen and J. Cullen, pp. 190-7. (CSIRO Publishing, Melbourne).

Somerville, S., Somerville, W. and Coyle, R. (2011). Regenerating native forest using splatter gun techniques to remove lantana. *Ecological Management and Restoration* 12, 164-74.

Thompson, A. (2013). The importance of accurate surveying for implementing best practice weed control methods whilst working to external constraints. Proceedings of the twelfth Queensland Weed Symposium, pp. 39-42.

Tomley, A.J. (1995). The biology of Australian weeds 26 *Cryptostegia grandiflora* R.Br. *Plant Protection Quarterly* 10, 122-30.

Vitelli, J.S. and Madigan, B.A. (1999). Effect of rust on the efficacy of foliar applied herbicides on rubber vine. Proceedings of the twelfth Australian Weeds Conference, pp. 238-41.