Stem injection: a control technique often overlooked for exotic woody weeds

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Summary In the rangelands of northern Australia, basal bark, cut stump, hand applied residual herbicides and foliar spraying have traditionally been the main herbicide techniques for control of individual exotic woody weeds growing within scattered to medium density infestations. In this paper we report on the preliminary results of stem injection as an alternate technique for the control of yellow oleander (*Cascabela thevetia* (L.) Lippold), a woody weed that is difficult to kill. A randomised complete block experiment comprising 12 herbicide treatments (including a control) and three replicates was undertaken. Two rates of triclopyr + picloram, hexazinone, glyphosate, 2,4-D + picloram and metsufuron methyl and one rate of imazapyr were tested. At 15 months after application, triclopyr + picloram, glyphosate, 2,4-D + picloram and imazapyr all recorded high mortality (>90%) for at least one application rate. These results suggest that stem injection warrants further investigation as a control technique for other exotic woody weeds growing in rangelands.

Keywords Yellow oleander, stem injection, herbicide control techniques.

INTRODUCTION

In the rangelands of northern Australia, basal bark, cut stump, hand applied residual herbicides and foliar spraying have traditionally been the main herbicide techniques for control of individual woody weeds growing within scattered to medium density infestations (van Klinken and Campbell 2001, Bebawi *et al.* 2007, Vitelli *et al.* 2008, van Klinken *et al.* 2009). Basal bark and cut stump applications predominantly use diesel as a carrier to apply the chemical. Increased fuel prices and greater regulations on the use of chemicals in sensitive environments (such as riparian areas) have seen a renewed interest in herbicide application techniques that do not require diesel as the carrier.

Stem injection is a technique that has been widely used for native woody vegetation control in Queensland (Scanlan *et al.* 1991), while being largely overlooked for control of exotic woody weeds in rangelands.

In this paper we present preliminary results from a stem injection trial for control of yellow oleander. Yellow oleander is a declared Class 3 species in Queensland under the *Land Protection (Pest and Stock Route Management) Act 2002*. Infestations mainly occur along drainage lines. Once high densities are reached, yellow oleander can outcompete native species, including trees, for nutrients and water. Eventually a near monoculture of yellow oleander can occur.

In the past, recommendations in Queensland for the control of yellow oleander have generally been to foliar spray using triclopyr + picloram (300 g L^{-1} + 100 g L^{-1} at 99.9 g + 33.3 g a.i. 100 L^{-1} of dilution with water), or basal bark and cut stump using triclopyr + picloram (240 g L^{-1} + 120 g L^{-1} at 400 g + 200 g a.i. 100 L^{-1} of dilution with diesel). These options are permissible under a minor use permit for the control of environmental weeds in non-crop areas (APVMA permit – PER11463). Anecdotally, yellow oleander has been difficult to kill using these herbicides and control methods, resulting in suggestions that it is a hard plant to control.

The absence of an effective control technique combined with its preference for riparian habitats made yellow oleander a good candidate to test the selective stem injection technique. If high mortality of yellow oleander can be achieved, further investigation of stem injection on other rangeland woody weeds would be warranted.

MATERIALS AND METHODS

The stem injection trial was undertaken along Will Creek (19°149'S, 146°33'E), approximately 60 km east of Charters Towers, Queensland, Australia. The site is on part of a cattle grazing property where the dominant woody vegetation comprises yellow oleander along with scattered black tea tree (*Melaleuca bracteata* F.Muell.), blue gum (*Eucalyptus tereticornis* Sm.), Moreton Bay ash (*Corymbia tessellaris* F.Muell.), poplar gum (*Eucalyptus platyphylla* F.Muell.), Burdekin plum (*Pleiogynium timorense* (DC.) Leenh.) and paperbark tea tree (*Melaleuca fluviatilis* Barlow).

A randomised complete block design with three replicates was used. Each plot contained 20 plants with a minimum basal diameter of 21 mm measured at 20 cm above the ground. Plants were tagged and their position mapped (distance and direction) from a starting point.

Herbicide treatments were applied in February 2007. In total, 12 treatments were trialled, comprising five herbicides at two rates, one single rate herbicide and a control (Table 1). A spray adjuvant (paraffinic oil 582 g L^{-1} + alcohol alkloxylate 240 g L^{-1}) at 2.91 + 1.2 g a.i. L^{-1} was also added to all herbicide mixtures.

A cut was made at 7 cm centres into the sapwood using a Tomahawk axe angled slightly (10–20°) off the stem of the yellow oleander. Immediately after each cut was made, 1 mL of mixture was applied to each cut using a Phillip's stem injector gun. All cuts were made below the first lateral branch.

Mortality assessments were undertaken 15 months after treatment application with plants receiving two wet seasons during this period. Plants were considered dead if they had no live tissue present both above ground and from a root sample.

Data are presented as percent mortality and were transformed (arcsine) prior to statistical analysis and later back-transformed for ease of interpretation. GenStat (Version 11) was used for statistical analyses.

RESULTS

All herbicide treatments except metsulfuron methyl exhibited 100% brown-out at the initial 3 month assessment. Plants treated with metsulfuron methyl treatments looked similar to control plants at this time.

At 15 months after application, five herbicide treatments gave >90% mortality. The triclopyr + picloram, glyphosate, 2,4-D + picloram and imazapyr treatments were significantly different from the control (Table 1), with greater than 95% mortality recorded for at least one of the application rates.

The cost of spray solutions for the respective treatments is also presented in Table 1 and ranged from \$0.08 to \$13.92 L^{-1}, depending on the herbicide and rate applied.

DISCUSSION

The screening trial showed that high mortality of yellow oleander can be achieved using the stem injection technique with the herbicides triclopyr + picloram, glyphosate, imazapyr and 2,4-D + picloram.

Stem injection also has the potential to reduce the volume of herbicide required to kill a noxious weed compared to other methods. Vitelli *et al*. (2008) found that to basal bark or cut stump a 100 mm basal diameter calotrope plant (*Calotropis procera*), 177 mL or 41 mL of mix were required, respectively. In this trial, a 100 mm basal diameter tree would have required five incisions resulting in the use of 5 mL of mix. Although the herbicide mix for stem injection is more concentrated, and thus more expensive, less mix is used per plant. With these rates Vitelli *et al*. (2008) costed each plant as \$0.32 for basal barking and \$0.07 for cut stump application using triclopyr + picloram (200 + 100 g a.i. 100 L^{-1} diesel). The highest rates of triclopyr + picloram and glyphosate used in this study would cost \$0.067 and \$0.033, respectively, to treat a 100 mm basal diameter plant.

Table 1. The effect of stem injection treatments on yellow oleander mortality and the cost of the respective spray solutions. Mortality values followed by the same letter are not significantly different (P >0.05).

Treatment (active ingredients)	Rates applied (g a.i. L^{-1})	Mortality (%)	Cost (\$ L^{-1}) spray solution [A]
Triclopyr + picloram (200 + 100)	50 / 25	100 a	13.39
Triclopyr + picloram (200 + 100)	25 / 12.5	80.8 bc	6.69
Hexazinone (250)	125	46.4 cd	13.92
Hexazinone (250)	62.5	49.5 cd	6.96
Glyphosate (360	358.2	99.4 ab	6.6
Glyphosate (360)	179.1	93.3 ab	3.3
2,4-D + picloram (300 + 75)	109.09 / 27.27	98.2 ab	9.42
2,4-D + picloram (300 + 75)	52.17 / 13.04	60.1 cd	4.5
Imazapyr (250)	62.5	96.3 ab	N/A
Metsulfuron methyl (600)	0.6	31.5 d	0.16
Metsulfuron methyl (600)	0.3	3.3 e	0.08
Water		0 e	0

[A] Cost does not include adjuvant.

In addition to the herbicide cost, stem injection is less labour intensive than cut stump and basal bark spray application due to stem injection being easily done by one operator and quicker than basal bark application on larger woody species. Stem injection equipment is cheaper and lighter than cut stump and basal bark spray application gear making it easier to carry and manoeuvre.

Stem injection eliminates off target damage (WoNS 2007), uses less herbicide, is less labour intensive than other herbicide control methods (Wingrave 2004), does not require diesel as a carrier and has no direct contact with soil. For controlling weeds in very sensitive areas such as riparian zones, stem injection appears to satisfy all requirements to minimise environmental impacts.

To continue the work on stem injection of yellow oleander, two rate response trials using triclopyr + picloram and glyphosate have been initiated. Imazapyr and 2,4-D + picloram, although very effective, were not considered for further experimentation due to treatment cost and potential off target effects of the former. Trials will evaluate the most appropriate herbicide rates, best time of year for application, most effective cut height and the benefit, if any, of using an adjuvant

The results achieved on yellow oleander also provide justification to include the stem injection technique in future herbicide research on other priority rangeland weeds. We have commenced similar trials on chinee apple (*Ziziphus mauritiana* Lam.), prickly acacia (*Acacia nilotica* (L) Willd. ex Del.) and calotrope (*Calotropis procera* (Aiton) Aiton f.).

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