HERBICIDE SELECTION FOR WANDERING JEW (*TRADESCANTIA FLUMINENSIS*) CONTROL

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ABSTRACT

Wandering Jew (*Tradescantia fluminensis*) prevents the regeneration of native forests in New Zealand. The herbicide triclopyr effectively controls this weed, but is damaging to many native plant species. To identify alternative herbicides, 16 active ingredients representing eight chemical groups were applied to container-grown wandering Jew plants of various ages in three experiments. In Experiment 1, triclopyr killed all plants (3 months old), while amitrole caused substantial damage to plants. In Experiment 2, amitrole, terbutylazine, metsulfuron-methyl and triclopyr provided excellent control of 2 month-old plants. In Experiment 3, on 4 month-old plants, wandering Jew was highly susceptible to triclopyr, metsulfuron-methyl, fluroxypyr, glyphosate + fluroxypyr, metsulfuron-methyl + triclopyr and picloram + triclopyr. These herbicides were evaluated in a subsequent field trial and all except metsulfuron-methyl gave similar levels of control to Experiment 3. Further investigation of these chemicals is required to determine their optimal use rates and safety for native plants.

Keywords: herbicide, control, triclopyr, amitrole, metsulfuron-methyl, terbutylazine, glyphosate, fluroxypyr.

INTRODUCTION

Wandering Jew is an environmental weed that is currently listed in the National Pest Plant Accord in New Zealand by Biosecurity New Zealand (<http://www.biosecurity.govt.nz/pests-diseases/plants/accord/overview.htm>) and it is also listed in the Department of Conservations' Strategic Plan for Managing Invasive Weeds (DoC 2000). It is a perennial mat-forming groundcover with succulent stolons that readily break off and have the ability to root at each node, enabling it to spread easily around waterways, pathways and by human activity. The plant inhabits shady areas and is often found in native forest understory where dense infestations prevent the establishment of native plants (Kelly & Skipworth 1984a; Standish 2002).

The herbicide triclopyr has been shown to effectively control this weed although it is considered to be damaging towards many native plant species (Standish 2002; Champion et al. 2008). Despite this, triclopyr appears to have been widely used by regional authorities and the Department of Conservation for control of wandering Jew. There is little information available on alternative herbicides that may be less damaging to native plants (A.I. Popay, pers. comm).

Native forest understory usually contains a diversity of both dicotyledonous and monocotyledonous native plants that are likely to vary substantially in their sensitivity to herbicides. For example, Harrington & Schmitz (2007) in an experiment with eight active ingredients on ten native species, showed that amitrole was tolerated by one *Coprosma* species but was very damaging to five other native dicotyledonous shrubs.

Also, terbutylazine was moderately tolerated by five shrub species in that experiment but metsulfuron-methyl was quite damaging to all of the natives tested.

The aim of the experiments reported here was to screen herbicides representative of eight chemical groups to determine if any had efficacy on wandering Jew.

METHODS

Experiment 1

This experiment was conducted in a shadehouse at Lincoln. Wandering Jew stolons were sourced from Lyttelton and Purakanui (South Island, New Zealand) in July 2007 and were cut into sections about 75 mm long, each with two nodes, and planted into bark/sand potting mix in 0.5 litre pots. When they were treated, 3 months later, the plants had grown to each have about five stolons up to 300 mm in length.

There were ten chemical treatments (Table 1), and an unsprayed control, each with ten replicate plants, in a randomised block design. The treatments were applied on 29 October 2007 using a gas powered sprayer with a Teejet® 8004 fan nozzle. The wandering Jew foliage was sprayed to the point of run-off.

Experiment 2

For this experiment, also at Lincoln, the stolons were sourced from Diamond Harbour, Canterbury, New Zealand, in early September 2007 and these were prepared in the same way as before. The treatments and design were the same as for Experiment 1 (Table 1), and the treatments were applied when the plants were 2 months old, on 9 November 2007.

Experiment 3

Experiment 3 was conducted in a glasshouse at Ruakura. The wandering Jew stolons were sourced from Hamilton, New Zealand, in August 2007 and grown in 400 mm × 400 mm trays until about 4 months old and were well established. There were 16 treatments (Table 1) with four replicates of each, plus an untreated control, in a randomised block design. All treatments were applied on 13 December 2007, using a hand pump sprayer with a variable cone nozzle. The wandering Jew was sprayed to the point of run-off as before, except for Organic Interceptor, which was sprayed until the herbicide mix was running freely down the stolons to ensure that every part of the plant was thoroughly wet.

Experiment 4

The wandering Jew in this field trial was long established in a large copse of totara (*Podocarpus totara*) trees at Te Pahu, New Zealand, and formed a dense mat of stolons about 300 mm deep. There were seven treatments (Table 1) selected as being the most effective compounds from Experiment 3. These treatments were applied to 2 × 2 m plots, with 4 replicates of each, in the same way as for Experiment 3, on 7 February 2008. The rates of application differed from the glasshouse experiment because of the higher density of wandering Jew in the field plots. The experimental design and replication was also the same as for Experiment 3.

Data collection and analysis

Assessments of the treatment effects for all experiments were by visual estimations of the proportion of leaf area damaged, carried out by two people on two or three occasions after the treatments were applied. The dates of the assessments are given in Tables 2–4. These data were analysed using ANOVA (GenStat 10th Ed.) to separate the means and calculate the least significant differences (LSD, $P < 0.05$).

TABLE 1: Active ingredients, trade names and concentration of active ingredient of herbicide products applied to wandering Jew in the four experiments.

Herbicide active ingredients (ai)	Trade name	ai (g/kg or g/litre)	Expts 1 & 2	Exp. 3	Exp. 4
triclopyr	Grazon	600	X	X	X
amitrole	Amitrole 4L	400	X	X	X
metsulfuron-methyl	Escort	600	X	X	X
terbuthylazine	Gardoprim	500	X	X	
glyphosate	Roundup Transorb	540		X	
glyphosate	Roundup Renew	360	X		
paraquat	Gramoxone	250		X	
flumetsulam	Preside	800	X	X	
clopyralid	Versatill	300	X	X	
aminopyralid	Tordon Max	30		X	
fluroxypyr	Starane	200		X	X
dichlobenil	Prefix-D	67.5	X		
haloxyfop	Gallant	100	X		
2,4-D butyl ester	Hi ester 2,4-D	720	X		
glyphosate+carfentrazone	Roundup Transorb/ Hammer	540/240		X	
glyphosate+fluroxypyr	Roundup Transorb/ Starane	540/200		X	X
metsulfuron-methyl/ triclopyr	Ultimate	25/75		X	X
picloram/triclopyr	Tordon Brushkiller	100/300		X	X
pine oil extracts	Organic Interceptor	680		X	

RESULTS

Experiment 1

In this experiment, on 3- month-old plants, all of the individual wandering Jew plants treated with triclopyr were killed (Table 2), while out of the other chemicals, only amitrole gave substantial control. The level of damage caused by the treatments did not markedly change between the two assessments at 5 and 10 weeks after treatment (WAT).

Experiment 2

In contrast to the first experiment, amitrole, terbuthylazine, metsulfuron-methyl and triclopyr all provided excellent control of the 2-month-old plants, with the latter two chemicals killing most or all plants (Table 2). This time, the amount of damage did increase markedly from 4 WAT to 9 WAT, particularly for amitrole, terbuthylazine and metsulfuron-methyl.

TABLE 2: The proportion of leaf area damaged (%) at 5 and 10 weeks (Experiment 1) and 4 and 9 weeks (Experiment 2) after treatment (WAT) to container-grown wandering Jew plants.

Herbicide	Rate (% ai)	Experiment 1		Experiment 2	
		5.12.07 5 WAT	8.1.08 10 WAT	5.12.07 4 WAT	8.1.08 9 WAT
triclopyr	0.39	99	100	97	98
amitrole	0.8	61	69	57	81
metsulfuron-methyl	0.03	49	38	78	100
terbuthylazine	1.2	29	53	66	95
glyphosate	0.18	45	51	47	57
clopyralid	0.15	4	8	4	6
2,4-D ester	0.47	38	24	40	22
dichlobenil	0.74 g/m ²	14	24	21	71
flumetsulam ¹	0.01	10	11	22	13
haloxyfop ²	0.015	7	6	6	9
untreated		0	0	0	0
LSD (P<0.05)		10.2	10.8	11.7	12.6

¹Plus Pulse at 0.1%.²Plus Citowett at 0.1%.

Experiment 3

In this experiment, using trays of older plants, triclopyr, fluroxypyr and the three mixtures containing one or other of these chemicals, were all effective in killing wandering Jew (Table 3). Metsulfuron-methyl, and to a lesser extent amitrole, also caused substantial damage. The damage was apparent earlier from fluroxypyr and triclopyr treatments, than was the case for metsulfuron-methyl and amitrole, which were both slower acting. In contrast, paraquat and Organic Interceptor gave high levels of desiccation to plants at 2 WAT but the plants had recovered by later assessments.

Experiment 4

In the field trial (Table 4), the same five treatments that gave the highest levels of damage to plants in the glasshouse in Experiment 3 (Table 3), caused similar amounts of damage when applied to plots. But in contrast, metsulfuron-methyl caused less damage in the field plots than was the case in the glasshouse (44% and 90% respectively).

DISCUSSION

The results from the three glasshouse experiments and one field trial reported here show that there are at least three herbicides, in addition to triclopyr, that may be useful for the control of wandering Jew by killing or severely suppressing the weed. However, there is little evidence that any of these would be better tolerated by native plants than triclopyr. Triclopyr, picloram and metsulfuron-methyl are used to control woody species and are therefore likely to damage many of the tree and shrub species that would replace wandering Jew after they were used. A study using the triethylamine (TEA) formulation of triclopyr (Champion et al. 2008) found that nursery plants of kahikatea (*Dacrycarpus dacrydiodes*) had completely recovered from early damage resulting from a 0.5% (v/v) application of this herbicide but higher rates caused more lasting damage. Amitrole

TABLE 3: The proportion of leaf area damaged (%) at 1, 2 and 7 WAT to wandering Jew plants in Experiment 3.

Herbicide	Rate (% ai)	Adjuvant (%)	17.12.07 1 WAT	24.12.07 2 WAT	29.1.08 7 WAT
triclopyr	0.18	Pulse (0.1)	55	98	100
amitrole	0.6		5	5	70
metsulfuron-methyl	0.006	Pulse (0.1)	3	5	90
glyphosate	0.162	Pulse (0.1)	8	8	30
paraquat	0.05		72	75	40
flumetsulam	0.056		0	0	0
clopyralid	0.3		0	0	10
aminopyralid	0.009		4	2	30
fluroxypyr	0.04	Pulse (0.1)	35	96	99
glyphosate+carfentrazone	0.162+0.01		86	98	50
glyphosate+fluroxypyr	0.162+0.04	Pulse (0.1)	45	97	100
metsulfuron-methyl+triclopyr	0.1		32	97	100
picloram+triclopyr	0.08	Pulse (0.1)	30	92	100
Organic interceptor	13.6		70	70	20
untreated			0	0	0
LSD (P<0.05)			4.7	4.4	5.8

TABLE 4: The proportion of leaf area damaged (%) at 2, 5 and 9 WAT to wandering Jew in the field trial in Experiment 4.

Herbicide a.i.	Rate (% ai)	Adjuvant (%)	26.2.08 2 WAT	20.3.08 5 WAT	14.4.08 9 WAT
triclopyr	0.72	Pulse (0.1)	98	99	100
amitrole	1.2		35	55	69
metsulfuron-methyl	0.03	Pulse (0.1)	31	45	44
fluroxypyr	0.2	Pulse (0.1)	99	100	100
glyphosate+fluroxypyr	0.54+0.1	Pulse (0.1)	97	99	99
metsulfuron-methyl+triclopyr	0.15	Pulse (0.1)	97	95	95
picloram+triclopyr	0.24	Pulse (0.1)	96	99	99
untreated			0	0	0
LSD (P<0.05)			7.2	11.9	11.5

and fluroxypyr, in contrast, are used to control herbaceous weeds in some woody tree crops so they may possibly be more selective towards some native trees and shrubs than the other herbicides. However, amitrole, metsulfuron-methyl, paraquat and glyphosate have all been reported as damaging in varying degrees to the seedlings of native tree and shrub species (Kelly & Skipworth 1984b; Harrington & Schmitz 2007).

The chemicals that were shown to be most effective in these experiments have soil residual lives of varying length. For example, the soil half-lives of fluroxypyr and amitrole are both relatively short at 3 and 4 weeks, respectively; for metsulfuron-methyl and triclopyr it is about 5–6 weeks, while picloram has the longest soil half-life of about 14 weeks (New Zealand Agrichemical Manual 2007; ChemWatch MSDS 2008). A study by Standish (2002) found that native seedlings emerged between 4–6 months following application of triclopyr (at 100 ml/15 litres) corresponding to the observed decline in the soil herbicide residues. Therefore, the length of time that it would take for a native understory to regenerate after herbicide treatment, if indeed it does before the weed re-invades, will be determined largely by the choice of chemical and its rate of application. Consequently, the use of chemicals with shorter soil residual activity would be preferred if rapid re-vegetation with native species is the desired outcome.

Further investigation of each of these chemicals in native forest is needed. In particular, optimum use rates and tolerances of native plant species will need to be evaluated, before any recommendations for their use are made.

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REFERENCES

- Champion PC, James TK, Carney EC 2008. Safety of triclopyr triethylamine to native wetland species. *New Zealand Plant Protection* 61: 378–383.
- ChemWatch 2008. Materials data safety sheets. <http://full.chemwatch.net/chemgold/> (accessed 31 May 2008).
- Department of Conservation 2000. SPACE INVADERS A summary of the Department of Conservation's Strategic Plan for Managing Invasive Weeds. <http://www.doc.govt.nz/upload/documents/conservation/threats-and-impacts/weeds/space-invaders.pdf> (accessed 3 June 2008)
- Harrington KC, Schmitz HK 2007. Initial screening of herbicides tolerated by native plants. *New Zealand Plant Protection* 60: 133–136.
- Kelly D, Skipworth JP 1984a. *Tradescantia fluminensis* in Manawatu New Zealand forest: I. Growth and effects on regeneration. *New Zealand Journal of Botany* 22: 393–397.
- Kelly D, Skipworth JP 1984b. *Tradescantia fluminensis* in Manawatu New Zealand forest: II. Management by herbicides. *New Zealand Journal of Botany* 22: 399–402.
- New Zealand Agricultural Chemical Manual 2007. Agri Media Ltd, Christchurch, New Zealand. 596 pp.
- Standish RJ 2002. Experimenting with methods to control *Tradescantia fluminensis*, an invasive weed of native forest remnants in New Zealand. *New Zealand Journal of Ecology* 26: 161–170.