EFFECTS OF RATE OF APPLICATION OF TRICLOPYR ON WANDERING JEW (*TRADESCANTIA FLUMINENSIS* VELL.)

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ABSTRACT

Wandering Jew (*Tradescantia fluminensis* Vell.) is a common weed in canopy-depleted indigenous forest remnants in New Zealand. In this study triclopyr was applied to dense stands of wandering Jew at a range of rates in each of two experiments (Diamond Harbour in the South Island and Te Pahu in the North Island) to determine its effects on the weed and subsequent regrowth. The cover of wandering Jew was initially reduced by 80–100% with herbicide application. At about 1 year after application of the herbicide, the wandering Jew had regrown to about 3–50% cover, depending on the rate of triclopyr applied, and some indigenous seedlings had begun to appear. However, the survival of these seedlings was minimal.

Keywords: herbicide, weed control, totara, kahikatea, *Coprosma*, *Pittosporum*, *Podocarpus*, *Dacrycarpus*, *Sophora*.

INTRODUCTION

Wandering Jew is a serious environmental weed that infests canopy-depleted remnant native forests where it interferes with succession by suppressing native seedlings (Esler 1962; Kelly & Skipworth 1984; Timmins & Williams 1991; Standish et al. 2001; Standish 2002). It is rated as one of the most threatening environmental weeds in Northland (McCluggage 1998), the urban Auckland area (Esler 1988), Wellington and Taranaki (Timmins & Mackenzie 1995) and Manawatu (Esler 1962). Wandering Jew does not produce seed but is spread by movement of vegetative fragments in waterways or by human activity such as the dumping of garden waste (Sullivan et al. 2005). It is commonly found in forests and reserves in and around populated places (Timmins & Williams 1991).

In a previous study comparing several herbicides for the control of wandering Jew (Hurrell et al. 2008), triclopyr (Grazon 600 EC) was found to be the most effective, giving 98–100% control when it was applied to runoff at rates of 0.18 and 0.39% ai in three glasshouse experiments and at 0.72% ai in a field experiment. In other studies triclopyr has been shown to be similarly effective when applied to runoff at 0.42 and 0.84% ai (McCluggage 1998), at between 0.2 and 0.8% ai (Brown & Rees 1995) and at 0.4% ai (Standish 2002). The application rates in the field are often varied due to variations in the depth of the mat of wandering Jew and repeat applications are usually made to control regrowth (McCluggage 1998; Standish 2002).

Triclopyr can influence the emergence of regenerating plants because it has soil residues that persist for some time (Standish 2002; Champion et al. 2008). The residual half-life of triclopyr in soils has been variously determined to be anything from 10 days to 107 days, depending on the rate applied and other environmental factors. The half-life of triclopyr, when applied at 3.9 kg ai/ha on a New Zealand pastoral soil, was found to be

97–107 days (Wilcock et al. 1991) and was similar in a Northern USA forest ecosystem when applied at 6.5 kg ai/ha (Ganapathy 1997). However, in another study the half-life of triclopyr, when applied at 3.0 kg ai/ha in forest soils was determined to be only 20 days (Ganapathy 1997).

The aims of the study reported here were to determine the impact of varying the rate of triclopyr on wandering Jew, to estimate the interval after spraying until regrowth occurs and re-spraying would be required, and to observe native seedling re-generation. The results are discussed along with suggestions for improving weed management outcomes.

METHODS

Experiment 1

This experiment was conducted in a moderately dense infestation of wandering Jew on public reserve land at Diamond Harbour (Banks Peninsula) occupied by lowland native *Coprosma*, *Myoporum*, *Pittosporum* and *Sophora* species and some nearby tagasaste (*Chamaecytisus palmensis*) and pine trees. There were three herbicide treatments, triclopyr applied once at concentrations of 0.12, 0.18 and 0.36% ai, and an untreated control. The herbicide was applied to run-off using a nitrogen-gas powered sprayer with spray volumes of approximately 1000 litre/ha resulting in applied active ingredient rates of 1.2, 1.8 and 3.6 kg/ha, respectively. These treatments were applied on 12 November 2007 onto 2 m × 2 m plots, with four replicates of each treatment in a randomised block layout.

Assessments of the treatment responses on the wandering Jew were made on six occasions: 12 December 2007; 15 January, 19 February, 9 April and 2 September 2008; and 26 January 2009 (30, 64, 99, 149, 296 and 448 days after treatment (DAT), respectively) by estimating its biomass. The biomass estimates were made by taking all the above-ground stem and leaf within a 30 cm × 30 cm quadrat placed in one of six pre-determined, randomly-selected locations in the central 1.5 × 1.5 m plot area, leaving a 0.25 m buffer around the plot margins. The harvested biomass was dried at 65°C for 48 h. Native tree seedlings were first observed on 26 January 2009 (441 DAT), prior to the last biomass sampling occasion, and these were counted over the entire plot area. A second count of seedlings was made on 25 March 2009 (490 DAT), but no biomass measurement was possible on that occasion because the sampling plot layout had only allowed for six destructive harvests.

Experiment 2

This experiment was carried out within a stand of mainly large totara (*Podocarpus totara*) and kahikatea (*Dacrycarpus dacrydioides*) trees at Te Pahu where long-established wandering Jew formed dense mats about 300 mm deep. There were five herbicide treatments and an untreated control. The treatments consisted of a single application of triclopyr at concentrations of 0.24, 0.36, 0.48, 0.72 or 1.44% ai applied to run-off using spray volumes of approximately 1000 litres/ha giving applied active ingredient rates of 2.4, 3.6, 4.8, 7.2 and 14.4 kg/ha, respectively. There were four replicates of each treatment except for 0.72% ai, which had eight replicates. These treatments were applied onto 2 m × 2 m plots using a hand-pumped knapsack sprayer on 7 February 2008.

Assessments of the response of wandering Jew to the herbicide were by visual estimations of percent control (brownoff) about 3-weekly until July 2008 and then by percent ground cover of regrowth measured on 16 October and 2 December 2008, and 9 January and 9 March 2009 (252, 299, 337 and 396 DAT, respectively).

Statistical analyses

The effect of triclopyr rate on wandering Jew biomass and native seedling number (Experiment 1) and percent control, ground cover and native seedling number (Experiment 2) were evaluated for each site separately by conducting an ANOVA (GenStat v10 and Minitab v15 for Experiments 1 & 2 respectively) with chemical rate as the treatment factor and each replicate as the block factor.

RESULTS

Experiment 1

The biomass of wandering Jew did not differ between the treatments and the control up until 99 DAT, but after that it declined significantly ($P<0.01$) with all triclopyr treatments having almost no wandering Jew by 149 DAT (Table 1). The biomass was significantly lower at all triclopyr application rates compared to the control at 295 and 448 DAT ($P<0.05$ and $P<0.01$, respectively). The amount of wandering Jew tended to become lower as the triclopyr rate increased, with the difference between 1.2 and 3.6 kg ai/ha being statistically significant at 448 DAT.

TABLE 1: Biomass of wandering Jew (g dry matter/m²) from 30 to 448 days after treatment (DAT) with triclopyr in Experiment 1.

Triclopyr rate (kg ai/ha)	Days after treatment:					
	30	64	99	149	295	448
Untreated	437	369	337	199	352	321
1.2	390	416	255	27	56	147
1.8	472	432	80	9	46	86
3.6	499	412	51	4	24	3
LSD ($P<0.05$)	271	524	302	78	259	123

The first appearance of native tree seedlings occurred in treated plots at about 14 months following the treatment application. The native seedlings were few in number (1.3/m² on average over all treatments) and were from four genera: *Coprosma*, *Myoporum*, *Pittosporum* and *Sophora*. In addition, tagasaste seedlings (*Chamaecytisus palmensis*) were found in some of the treated plots but these occurred only in scattered clumps and there were insufficient data for any analysis. No seedlings were found in any of the untreated plots. Native seedling numbers counted at 441 days did not differ significantly between the rates of triclopyr due to the high variability between plots. There were considerably fewer seedlings when counted again at 490 days (0.3/m² on average over all the treatments).

Experiment 2

Over the range of rates used in this experiment, triclopyr caused 90% or more brown-off of wandering Jew from 3 weeks after application, and this effect persisted until regrowth began to occur in the following spring. When assessed on 16 October 2008 (Table 2) the percent cover of wandering Jew ranged from 13% to 0% of the control as the rate of triclopyr increased from 2.4 to 14.4 kg/ha. The cover increased over time and at 396 DAT was between 51% and 3% of the control over the same range of rates of triclopyr (Table 2). At each assessment the regrowth cover for all triclopyr treatments was significantly lower than control ($P<0.05$), and the cover tended to increase as the rate of the herbicide decreased. Differences between 2.4 and 14.4 kg triclopyr/ha were statistically significant ($P<0.05$) at all time points measured.

Seedlings of native plants appeared in the treated plots of this experiment about 1 year after the spraying was done. Although there were both mature kahikatea and totara trees at this location, only kahikatea seedlings were found, and these were few in number. The number of kahikatea seedlings to emerge did not differ significantly between any of the treatments and there was an overall decline in the number of kahikatea seedlings present between the two counts at 337 and 396 DAT (1.9/m² and 1.2/m², respectively, on average over all treatments).

TABLE 2: Percent cover of wandering Jew from 252 to 396 days after treatment (DAT) with triclopyr in Experiment 2.

Triclopyr rate (kg ai/ha)	Days after treatment:			
	252	299	337	396
Untreated	100	100	100	100
2.4	13	23	34	51
3.6	5	7	10	16
4.8	5	7	10	24
7.2	2	3	4	10
14.4	0	1	1	3
LSD (P<0.05)	4.7	8.9	15	26.1

The only other plant species found were the native grass *Oplismenus hirtellus* subspecies *imbecillis* (1.6/m²) and a few other weed species, including inkweed (*Phytolacca octandra*) and black nightshade (*Solanum nigrum*), but these were also few in number (0.4 and 0.7/m², respectively). No seedlings were found in the untreated plots.

DISCUSSION

The application of triclopyr to stands of dense wandering Jew in these experiments showed that a high level of weed control was possible with one application of the herbicide. However, regrowth of wandering Jew occurred, regardless of the rate of triclopyr and it was also evident that lower rates caused the regrowth to occur much sooner (Tables 1 & 2). These results suggest that one application of the herbicide would only give temporary control of the weed and the outcome may be reversion to the pre-treatment state if nothing further is done.

The herbicide treatments enabled the seedlings of some of the resident native plant species and some weeds to establish after about a year. There was no evidence from these experiments that the rate of triclopyr influenced the numbers of seedlings that arose or the timing of their emergence, but as seedling recruitment was highly variable within treatments detecting a significant effect would be difficult. In contrast, no seedlings arose in any of the untreated areas suggesting that, in the absence of control, regeneration would have been prevented. There are several possible explanations for the apparent delay of seedling emergence until the following summer. It is possible that this was due to conditions at these sites not being conducive for germination. This may have been the case at the Te Pahu site where climate records showed dry conditions had existed at times during this period, but is a less likely explanation for the delay at Diamond Harbour where rainfall and temperatures for the period had been normal. The delay could have also been due to the decomposing wandering Jew, although the biomass results from Experiment 1 suggest that the mulch had virtually gone by 149 days (Table 1). Another possibility for the delay may be a consequence of the residual life of triclopyr in the soil. Triclopyr has been shown by others to interfere with native seedling emergence. For example, Standish (2002) showed that the chemical apparently delayed seedling emergence by 6 months, which was 3 months longer than in a hand-weeded control. This hypothesis cannot be substantiated in the study reported here but is one that requires further investigation.

Considering that the emergence of the native seedlings coincided with regrowth of wandering Jew, follow-up spraying or some other method of control would be required if regeneration of native plants is the desired outcome. This is because the survival of seedlings would be unlikely if no further control measures were taken. According to Esler (1962), only native plants taller than 600 mm will survive within a wandering Jew infestation. Conversely, if triclopyr was re-applied as a follow-up, many new seedlings

would also be destroyed, as shown by Standish (2002) and Champion et al. (2008). This means that follow-up control of the weed using this herbicide should be by careful spot-spraying to preserve the seedlings, in order to achieve a beneficial outcome.

The search for alternative 'safer' herbicides has so far failed to produce any that equal triclopyr in efficacy. However, there are other herbicides that give some suppression of the weed, for example, amitrole and glyphosate (Hurrell et al. 2008), and in the case of glyphosate, there is no soil residue. These herbicides may be better options for follow-up spot applications. An even safer option for follow-up control would be manual removal of the weed where this is possible.

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