Growth and control of Chilean flame creeper (*Tropaeolum speciosum*)

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Summary Chilean flame creeper (*Tropaeolum speciosum*) is a perennial vine with slender stems which coil around objects, allowing the plant to climb. It has delicate five-fingered leaves and scarlet, spurred flowers that are about 4 cm across, followed by blue berries. It also has an underground structure of rhizomes which can spread widely through the loose topsoil of forest floor and emerge as new shoots in late spring, dying back each autumn. With the ability to climb up to 5 m and smother small trees, this weed is a threat to native forests, particularly small reserves and regenerating bush. The ripe fruits are attractive to birds and this vector can spread the seed deep into forested areas.

Management of Chilean flame creeper in New Zealand has been mostly by foliar applications of triclopyr applied annually. However, after several years this management practice has had little or no impact on the abundance of Chilean flame creeper at infested sites.

Alternative herbicides for use as foliar sprays were investigated, along with alternative application technologies. These demonstrated that there are more effective ways to manage this weed without increasing the collateral damage to desirable species. Of the foliar treatments, aminopyralid caused the least damage to other plants while picloram applied as a gel to the cut stump or hand pulling of the vines were least damaging overall.

Keywords Chilean flame creeper, herbicides, rhizomes, triclopyr, aminopyralid.

INTRODUCTION

Chilean flame creeper (*Tropaeolum speciosum* Poeppig. et Endl.) is a climbing, smothering plant with an annual growth habit. Despite its annual growth, it can still grow several metres to the forest canopy where its smothering ability limits light to the supporting vegetation. It regrows from an extensive underground root system. The new shoots of Chilean flame creeper usually emerge in October/November and flowers appear early in the new year. Its bouquets of bright red flowers made it attractive to gardeners who spread it widely. In addition, the fleshy fruit ripen blue and are spread by birds.

There is little published data on control of this weed. Anecdotal evidence indicates this plant is very difficult to control, with annual applications of various herbicides having little effect on subsequent regrowth in the following year. For this reason biological control was investigated and despite Chilean flame creeper being a good candidate with no native Tropaeolaceae in New Zealand, there were no reported agents in the international literature (Harman 2006).

This paper reports on trials evaluating several herbicide options and postulates why control with herbicides has proven difficult.

MATERIALS AND METHODS

This study consisted of two field trials and an indoors investigation. Trial 1 was located on the outskirts of Raetihi on State Highway 4 to Whanganui. For this investigation, 16 plots were marked out and sprayed in the bush margin on 17 January 2008. The plots have a range of 6–10 m wide and 5–10 m long depending on the level of weed infestation. There were well in excess of 100 emerged stems in each plot and these ranged from 0.3 to 3.0 m high. The foliage was plentiful, green and lush at the time. The treatments were randomly assigned to plots in each of two replicate blocks. The herbicide treatments (Table 1) were applied when the temperature was 25–27°C, and it was sunny and dry. All herbicides were applied by hand with a pressurised, 6 litre capacity sprayer fitted with an adjustable nozzle. For the low-growing plants the sprayer nozzle was set to a wide angle while the vines growing through the trees were treated with a confined jet (nozzle set to a narrow angle). The sprays were applied to ensure all the visible weed plants were thoroughly wet (except for the glyphosate treatments) while trying to reduce overspray to the surrounding vegetation. The glyphosate-containing treatments received a lighter spray to just wet the foliage. All treatments included Pulse adjuvant at 0.2%.

On 25 February 2009 the same treatments (Table 1) were re-applied to any Chilean flame creeper regrowth in the plots. The amount of spray mix used in each plot was recorded. On this occasion the temperature was 20–21°C and the sky overcast but no more rain fell for the rest of the day. It had rained in the previous 24 h.

Trial 2 was located in the Dress Circle Scenic Conservation Reserve on Mangoira Road, east of

Mangaweka. The treatments (Table 2) were applied to two replicate plots on 12 January 2011 when the weather was sunny and 24°C. For the cut and paste treatment, the picloram gel was applied directly from the dispensing tube as a blob slightly larger than the diameter of the stump. The plots of the hand pulling and cut stump treatments were deeper into the bush reserve where the plants were smaller while the foliar treatments were all located on the bush margin. Application of the foliar treatments was as for Trial 1 except for the paraquat/diquat treatment which was applied only to the lower stems of the Chilean flame creeper with the aim of desiccating the stems and starving the top foliage.

Assessments of the control of Chilean flame creeper and of damage to the native species present were made on several occasions by either one or two observers.

Table 1. Percent brown-off and number of regrowth stems after herbicide application in year 1, amount of herbicide used, percent brown-off and regrowth in year 2 and percent damage to native flora for Trial 1.

		% brown-off	Number of regrowth stems	Volume to retreat (L)	% brown-off	Number of regrowth stems	% damage to native herbaceous flora in the spray zone	
Treatment[1]	Rate (%)	19.2.08	13.12.08	25.2.09	28.3.09	26.3.10	13.12.08	26.3.10
Triclopyr	0.36%	100	>100	2.5	100	>150	70	60
Metsulfuron + glyphosate	0.03 + 0.22	90	8	0.5	100	40	90	100
Aminopyralid	0.6	98	60	1.5	100	120	10	10
Glyphosate + carfentrazone	0.22+0.005	100	>100	1.9	90	100	90	70
Glyphosate + fluroxypyr	0.22 + 0.02	100	>100	1.5	100	125	90	70
Triclopyr + metsulfuron	0.075 + 0.025	100	6	0.5	100	125	100	90
Triclopyr + picloram	0.18 + 0.06	100	13	0.9	100	>150	90	70
Untreated		0	>100	–	0	>150	0	0
LSD 5%		9	56	–	8	43	19	22

[1] All treatments included Pulse adjuvant at 0.2%.

Table 2. Percent brown-off, number of regrowth stems and percent damage to native flora for Trial 2.

		Number of plants treated	% brown-off	Number of new stems	
Treatment	Rate (%)	12.1.11	9.2.11	4.12.11	20.3.12
Hand pulled		51	100	16	8
Cut + picloram	≈ 0.0025 g	43	100	10	5.5
Clopyralid + picloram[1]	0.225 + 0.15	–	100	1	12
Triclopyr + aminopyralid[1]	0.02 + 0.03	–	100	26	31
Paraquat + diquat	0.15 + 0.025	–	80	39	54
Pine oil extract	20.0	–	60	60	70
Untreated		–	0	50	55
LSD 5%			7.0	18.9	22.2

[1] Treatment included Pulse adjuvant at 0.2%.

After the final assessment in Trial 1 many of the surviving Chilean flame creeper plants were dug up to determine herbicide effects on the root system. Rhizome material was evaluated for re-growth potential by planting into trays of potting mix and placing in an outdoor enclosure. Re-growth was assessed in September 2010.

All the data were subjected to ANOVA to separate the treatment means. The least significant differences (LSD) for the means were calculated and are presented in the tables.

RESULTS

As expected, the Chilean flame creeper proved a difficult weed to control. The results from Trial 1 showed that several herbicides gave 100% brown-off of the foliage after the first application. However, the level of brown-off appeared to have little bearing on the amount of regrowth the following year (Table 1). Due to treatments having different amounts of regrowth, the quantity of herbicide used in re-treating the plots varied considerably (Table 1). The level of brown-off from the second application was again very high, but despite this only one treatment, metsulfuron + glyphosate, resulted in a significant reduction in regrowth 1 year after the second application (Table 1). Unfortunately this treatment also caused maximum damage to the surrounding (native) vegetation (Table 1). Aminopyralid caused the least damage to the surrounding vegetation (Table 1) but only slightly reduced the regrowth of Chilean flame creeper one year after the second application. All the rhizomes collected from the various treatments proved viable and sprouted into healthy plants.

In Trial 2 also, most of the foliar applied treatments resulted in high levels of brown-off in the months after application (Table 2). The paraquat + diquat treatment resulted in limited brown-off as it was targeting the stems. However, the stems proved tolerant of the spray and most of the plants remained healthy in these plots. The pine oil extract caused the fastest brown-off and also a moderate level of defoliation of the surrounding native species, but both the Chilean flame creeper and the native plants quickly produced new foliage from the stems.

At one year after application, results from the various treatments differed considerably. The number of Chilean flame creeper plants in the pulled and cut stump treatments was significantly lower compared to the number prior to treatment. However, in the foliar treatments regrowth was plentiful. There was considerably less damage to the native vegetation in the paraquat + diquat and pine oil extract treatments but these two treatments were also largely ineffective against Chilean flame creeper. There was less regrowth in the clopyralid + picloram and the triclopyr + aminopyralid plots but unfortunately more damage to the native vegetation.

Diagrams of the root structure under surviving Chilean flame creeper plants are presented in Figures 1 and 2. It was found that a rhizome could run for more than a metre before the growing tip turned towards the surface and emerged as a new shoot. In all cases it was noted that the plants had transferred stored nutrients into new rhizomes about the time of or just prior to the emergence of the new shoot. All the rhizomes found were white or pale yellow, brittle and lacked a fibrous or protective skin layer.

DISCUSSION

Results from Trial 1 appeared to show that good control of Chilean flame creeper with foliar applied chemicals could only be achieved at the cost of great collateral damage to the surrounding native vegetation. Results also showed that more than two repeat applications would be required to gain effective control of this weed. For repeat treatments, aminopyralid would likely be the best candidate as it provided 100% brown-off of top growth and minimal collateral damage whereas the most effective treatment killed everything else in the spray zone.

In the year after the first application of herbicides, Chilean flame creeper was slow to emerge in the treated plots. Normally it emerges in November/December, but the emergence was delayed until January in the herbicide treated plots, hence the later application time for the repeat application.

The reason for poor control of Chilean flame creeper in this experiment appears to be the early growth of new rhizomes (Figures 1 and 2). Most of the rhizomes were white and intact, without signs of decay or damage from foraging soil fauna, indicating that these were current season’s growth. They also show initiation of rhizome growth under newly emerged stems, i.e. new rhizomes are initiated about the time the new above ground stems emerge. The consequence of this is that by the time there is sufficient top growth (30–100 mm tall) to treat with herbicide, there is an equivalent length of new rhizome under the soil surface.

From these observations it is postulated that Chilean flame creeper completely replaces its rhizome structure on an annual basis in the same way californian thistle (*Cirsium arvense*) does (Bourdôt *et al*. 2000). Furthermore, it is postulated that the reason Chilean flame creeper is so difficult to control with herbicides is the transfer of stored nutrients into the new rhizomes before or very soon after the new

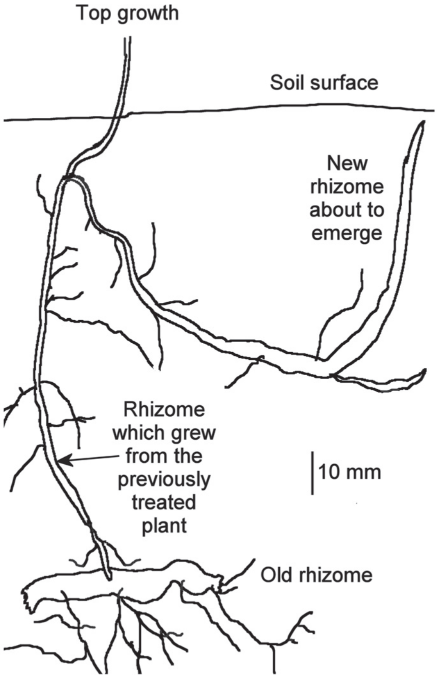

Figure 1. A single, large new Chilean flame creeper rhizome about to emerge 1 year after the first application.

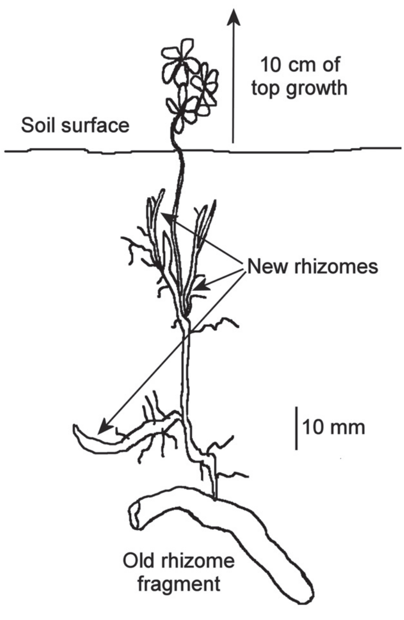

Figure 2. Multiple new rhizomes developing from below a very small Chilean flame creeper plant 1 year after the second application.

shoot emerges (Figures 1 and 2). The herbicides do not appear to readily translocate into these rhizomes possibly due to the physiology of the connection which is constricted and fragile.

Clearly, before stored nutrients can be transferred from one rhizome to another, these must first be accumulated from the foliage. Repeat defoliation would prevent this transfer in the same way it does in the control of californian thistle (Hartley *et al*. 1984). However, such defoliation is not as straightforward as it is for pastoral farmers due to the difficulty in locating and treating Chilean flame creeper plants, especially as the previous treatment can delay emergence for quite some time. The frequency of visits to the site and the time taken to find the small (<10 cm) plants would make control through this strategy very expensive.

Treatments that were potentially less damaging to the native flora were evaluated in Trial 2. If more selective herbicides were available, then the repeat applications required to kill this weed could be made more frequently and with less concern about damage to the natural environment. However, the treatments investigated in Trial 2 proved either to be ineffective against Chilean flame creeper or still too damaging to native species. The exception to this were the cut and stump paint with picloram and the hand pulling treatments which proved very effective although very time consuming to apply. Unfortunately, new seedlings of Chilean flame creeper were found in these plots, indicating that it might be difficult to find a simple, one-off treatment to control this persistent weed.

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