

# Weed Control Methods in the Transitional City

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# 1 Introduction

There are two types of unwanted plant, firstly there are weeds and then there are pest plants. A weed can be defined as an unwanted plant in the wrong place, where as a pest plant has been listed on a Pest Management Strategy as per the Biosecurity Act 1993 due to its ability to have significant effect on the well-being of conservation or economic values (Christchurch City Council, 2010). Christchurch City Council was the second authority in the country to establish a Pest Plant Plan. Often the presence of weeds is regarded as untidy and can act as a trap for blown rubbish; this in turn attracts illegal rubbish dumping and eventually vermin. All of these factors can quickly transform attractive places into destinations that people avoid.

Since the 2010-2011 earthquakes there has been considerable upheaval in the Central Business District (CBD). Initially a cordon was placed around it which was later removed as the post-earthquake clean up started. This clean-up involved heavy machinery that was brought in from various areas outside of Christchurch. Along with this machinery came various seeds that had not previously been present in Christchurch. Since that time the CBD has dramatically changed with the removal of many buildings that were deemed unsafe, and even further removals still to be carried out. After buildings have been removed often the sites are levelled and gravel brought in to control the dust. This gravel has also been a source of seeds from plants that are not from the city nor are they wanted. Plants like Broom and Fleabane have jumped at the opportunity to establish themselves. In the case of Broom, the seeds can remain dormant in the ground for decades meaning that once it establishes itself it can be difficult to get rid of it.

This report looks at weed control methods that are currently employed in Christchurch and other locations within New Zealand or by authorities overseas and discusses the pros and cons of each method. In addition to current methods, possible future methods are investigated and evaluated. The final section of the report contains a survey that was carried out to ascertain the opinion of Christchurch residents on weed control in the city.

## **1.1 Christchurch**

Christchurch City is located on the east coast of the South Island of New Zealand at latitude 43.5°S. This produces a comfortable temperature for most of the year, apart from in winter when nights can drop below zero and frosts are likely. There are two distinct growing seasons with summer being warm and dry and winter being cool and wet. To the west of Christchurch lie the Southern Alps which run for 500km from the North to the South of the Island. The tallest peak is Aoraki / Mount Cook with a height of 3700m, however there are a further 16 peaks over 3000m. When the wind blows from the Northwest these alps create a Fohn Wind which is hot and dry and can raise the temperature by 10 to 15 degrees even in winter (ENZ, 2015).

The South Island of New Zealand straddles the Australian and the Pacific tectonic plates, as the Pacific plate slowly pushes into and under the Australian plate this causes the many earthquakes that Christchurch experiences.

## **2 Aim**

The aim of this project was to identify and critique weed control methods in Christchurch City.

### **2.1 Methodology**

We conducted a literature review by reading journals, reports and articles on current and future methods and established some pros and cons. Following this we carried out interviews of industry representatives and finished with a public survey. This was carried out to establish what the public perception of weed control was in Christchurch and their preferred method of weed control.

## 3 Current Methods of Weed Management

### 3.1 Mulching

Mulch is defined as a protective layer of material that is spread on top of the soil. It is one of the most common practices to manage weeds. If the mulch is applied correctly fewer weed seeds will germinate due to low light and the ones that do are mostly unable to push through. Mulches also have several additional benefits to the soil. They conserve soil moisture by reducing evaporation, reduce erosion and compaction from heavy rain events, and insulate the soil and help maintain a uniform soil temperature. Mulches are often used in flower beds and ornamental gardens as they give a neater, more finished appearance. It should be noted that mulches do not reduce already established weed infestations, and another method of weed control must be used before laying the mulch.

Mulches can be split into two categories; organic and inorganic. Organic mulches break down overtime and include grass clippings, untreated sawdust, straw, and bark chips. Organic mulches have other benefits to plant growth that inorganic mulches do not supply. They can improve the condition of the soil by adding nutrients and organic matter which helps soil structure. Some mulches also have an allelopathic effect: that is they naturally contain a substance that prohibits growth, survival or reproduction of other organisms (Cregg & Schutzki, 2009). However nitrogen can be depleted from the soil as microorganisms use it for decomposing the mulch. Disease causing organisms can also be added to the soil from the mulch. If it is kept too moist, mould may grow on the mulch (Williams, n.d.).

In certain landscapes, inorganic mulches, such as stones and plastic, have their place. Some, like plastic weed mats, are impassable to weeds including perennial broadleaf weeds (e.g. dandelion) that would normally push their way through the mulch.

#### 3.1.1 Weed mats

Weed mats are similar to mulches but form a 'solid blanket' of cover. The size of each weed mat should be at least one square meter around individual plants. Common matting materials that can be used include; woollen weed matting, woven polypropylene (plastic), cardboard, and wet newspaper as shown in Figure 1 and Figure 2. Non-woven plastic sheeting is not recommended

because it is not biodegradable and prevents rain from penetrating the soil. Matting should be held down firmly to stop it moving in flooding or high winds. This can be achieved with mulch, rocks, or wooden, wire or plastic pegs.



**Figure 1 Newspaper ground cover** (Sustainable Landscape Roundtable, 2006)

**Figure 2 Mulch over top of newspaper ground cover** (Sustainable Landscape Roundtable, 2006)



**Figure 3 Cardboard ground cover**(Braden, 2012)

**Advantages:**

- Can provide long-term weed control
- Helps retain moisture depending on material used
- Reduces erosion
- Reduces compaction
- Helps maintain even soil temperature
- Aesthetically pleasing

**Disadvantages:**

- Weeds will penetrate if too thin
- Can be blown away
- Can be disturbed by animals
- Can be washed away by rain or floods
- Time consuming to install
- Delayed increase of soil temperature during spring
- Weeds will come up in any gaps left around plants
- Fate of plastic in the environment is unknown
- Fate and effect of ink from newspaper unknown

### 3.2 Soil Solarisation

Soil solarisation is a non-pesticidal method of controlling weeds and pest plants that is suitable for killing weed seeds and seedlings. By placing UV resistant plastic sheets on top of the soil during summer, it allows the sun's heat to be trapped in the soil raising the soil temperature to a level that will kill most weed seeds and seedlings. Ideally the soil should be covered for 4 to 6 weeks during which time the soil temperature can reach up to 160°C on the surface and up to 100°C at 75mm deep. Solarisation is by far, the most effective way to kill most weed seeds and seedlings.

## **Advantages**

- Good for the environment since there is no pesticides used.
- Can kill seeds like Broom seed which can lie dormant in the soil for decades.
- No expensive equipment needed
- No pretreatment required

## **Disadvantages**

- Requires significant time to work effectively
- Can only be carried out in hot months i.e. summer
- Can look unsightly

### **3.3 Hand weeding or mechanical control**

Hand weeding refers to the extraction of weeds by hand (manual weed control). Mechanical control is the use of weed-eaters that are typically portable and used by a single operator. These methods can be very labour intensive and thus very expensive. They also need to be done repeatedly to remove weeds that have re-grown.

#### **Advantages:**

- Specific removal of plants can be achieved
- Other desirable plants are generally undamaged

#### **Disadvantages:**

- Time consuming and labour intensive
- Need skilled workers with knowledge in weeds and pest plants
- The disturbance of the soil may also encourage weed seeds buried in the soil to germinate
- Need to be repeated due to regrowth

### 3.4 Herbicide spraying

This involves the spraying of herbicide on to the leaves of the weeds. This can be done with a spray gun and hose from a tank on a vehicle, by a technician with a herbicide backpack or by blanket spraying with a tractor. Herbicide spraying is the most common form of weed control and can be applied to large areas quickly with little labour. To avoid contamination, herbicides must be used with great care along waterways (rivers, lakes, etc.) and where groundwater levels are near the surface. Spraying where there are people and animals should be done carefully as they may be subjected to herbicide spray drift. Early in 2015 the World Health Organisation (WHO) labelled glyphosate (the most common herbicide) as “probably carcinogenic to humans”(IARC, 2015) after a report from the International Agency for Research on Cancer (IARC) (Guyton et al., 2015).

#### **Advantages:**

- Very effective
- Provides long-term weed control
- Less labour intensive than some weed control methods

#### **Disadvantages:**

- Expensive,
- Repeated applications are necessary to keep weeds under control
- Toxic
- Can cause health damage to humans and animals
- Chemicals can leach into the waterways

### 3.5 Stem injection

This method involves cutting or drilling through the bark into the sapwood tissue of the trunks of woody weeds and trees (e.g Willow, Woolly nightshade). Herbicide is then injected or placed into the hole. Once the herbicide reaches the sapwood layer just under the bark (the cambium

growth layer), it is transported throughout the plant. By using the stem injection method there is less chance of the herbicide spilling out into the soil. This is a very selective way of applying herbicides, and allows more discretion as to which plants are killed.

**Advantages:**

- Avoids over spraying of large plants
- Useful for trees or shrubs where they might cause damage to surrounding vegetation or their removal is difficult

**Disadvantages:**

- It opens up areas to light which can trigger weed germination.
- Falling branches can become a hazard as the parent tree dies and rots

### 3.6 Hot water

Water is essential for plant growth and reproduction, by it can also be used to kill weeds. Hot water when poured directly on weeds produces immediate results. The plant and root tissues are destroyed by the heat, causing instant shock. Within a day or two, the plant withers and dies. Hot water works well for garden paths, walkways and driveways. Any weed seeds the hot water touches will be killed, with boiling water killing the seeds that may lay dormant in the soil. Hot water can be used to kill weeds naturally, safe and cheap. Boiling water can be applied as follows:

**Advantages**

- Is chemical free
- Water is abundant (often where weeds are an issue)

**Disadvantages**

- Requires specialist equipment
- Significant setup costs

### 3.7 Salt

Salt is very effective at killing plants but can also make the ground unsuitable for future plant growth. Salt works by disrupting the internal water balance within the cells of the plant and ultimately dehydrates it (Gardening Know how, 2015). A small pinch of table salt can kill a plant by sprinkling it at the base where it is absorbed by the roots of the plant. Salt can also be mixed with water to kill weeds in a commercial scale in lawns or footpaths. It is preferable to apply salt as a solution mixed 2:1 water to salt and apply it using a funnel on the offensive weeds. The solution penetrates the soil before being picked up by the roots. Once the ground is saturated with the saltwater, the damage to the plant will begin. Constant watering should be done so that the salt leaches into the ground below the root zone. Excessive use can cause salt to accumulate in the ground preventing further plant growth. Care must be taken to avoid contamination of groundwater by over-salting.

#### **Advantages:**

- Salt is inexpensive
- Easy to apply
- Can be long lasting by accumulating in the soil

#### **Disadvantages:**

- Can accumulate in the soil and prevent further planting
- Can contaminate groundwater
- Is not plant specific

### 3.8 Vinegar

Vinegar can be used as an organic weed killer as it contains acetic acid. The acetic acid kills the leaves on the plant but not the roots, therefore it works best on young plants because they do not have enough energy stored in the roots to regrow their leaves (Evans & Bellinder, 2009). Through reapplication the plant will eventually deplete its energy reserves and die.

**Advantages:**

- Does not contain toxic chemicals
- Easily applied
- Inexpensive

**Disadvantages:**

- Is not plant specific

### 3.9 Cut and paint (or stump swab)

These methods involve cutting off the weed at its base (no higher than 15cm from the ground) using a chainsaw or an axe and applying herbicide onto the cut stump to kill the root system and the stump.

**Advantages:**

- It is simple to use and poses minimal risk to desirable plants or water.
- It requires only small amount of herbicide.

**Disadvantages:**

- Need skilled operators for cutting procedure
- Labour intensive as firstly the weed needs to be cut down

## 4 Future Methods

### 4.1 Hot Foam

The British company Weedingtech currently has a product on the market called Foamstream, which is essentially the next step from hot water (Weedingtech). Foamstream uses hot water (60°C) and foam to thermally kill weeds by denaturing (breaking) their proteins (Hanke, n.d.). The foam is advertised as natural and renewable and as having been created from plants free of genetic modification. It is made from; coconut, palm kernel and rapeseed oils, glucose from potato, maize and wheat, and polysaccharides (KemCare, n.d.). The foam acts to keep the water on the plants for longer, as well as being an insulator to keep the heat higher for longer.

In 2005-06 a study was conducted for the “CleanRegion” Project by Dr. Arnd Verschele of the Institute for Weed Research which looked at the control of weeds found on pavements at several sites in the city of Braunschweig, Germany. Like many European Union countries, Germany has strict controls guiding the use of chemical control methods, so alternative solutions are often investigated. One study compared several alternative methods of weed control against herbicide application, these methods were; burn-off, weed brush, steam, and hot foam (Appendix A shows the equipment used for each of these methods). This herbicide was applied with a ‘Rotofix’ machine that discreetly wipes herbicide onto the leaves of weeds.

At the end of the two year study, the hot foam method had the lowest remaining weed coverage rate, of all the alternative methods (Figure 4). While the herbicide had an even lower coverage rate, it was not by much, making the two largely comparable. The foam was also reported to have done better than the herbicide on sites with moss and small weeds, particularly those living in larger cracks or joins of the pavement. There was also some suggestion that the foam was able to kill some of the seeds in the soil, which may be backed up by the decrease in the weed coverage rate between 2005 and 2006. One limitation regarding Foamstream is that because it is relatively new, information on it is only available from its developer; this would need to be peer reviewed. Further research would need to be carried out to ascertain the effect of foam on seeds, soil microbes and its effect on insects. Care would need to be taken with its use to minimize runoff of the hot water as this would be classed as a contaminant under the Resource Management Act in New Zealand.

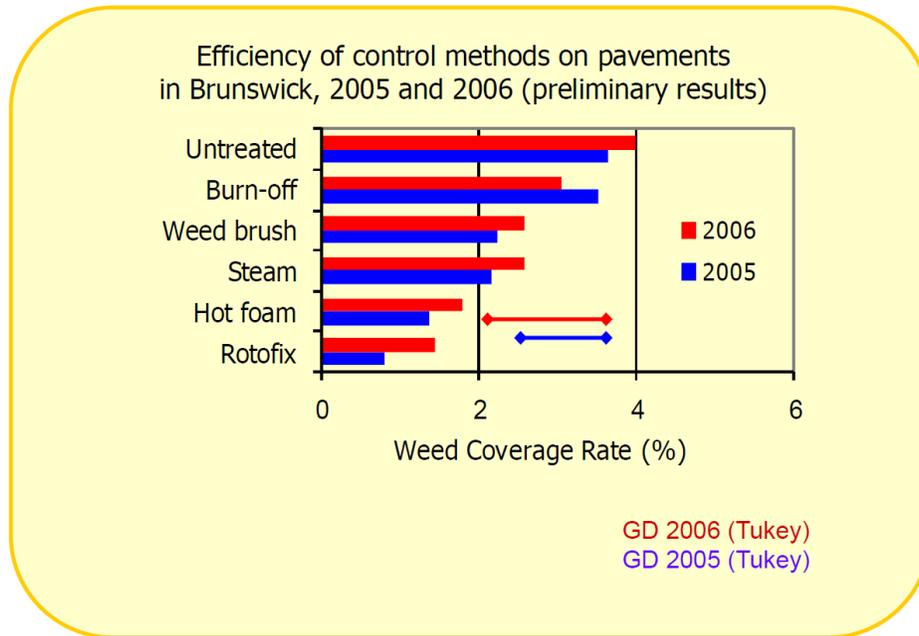


Figure 4 Results of different weed control methods(Verschwele, n.d.)

## 4.2 Ground Covers

Often new technology that can assist a given field already exists. The technology is simply not recognised for its ability to apply. Ground covers are well known and well-studied in the agricultural/horticultural fields. They have almost made it to the public service sector and can often be found home gardens. A few urban areas around the world use ground covers as ornamental plants, often as the only species present. Their potential as a 'living mulch' and as part of an ecosystem has yet to be realised.

Like standard mulching the use of ground covers is a preventative measure. Any existing weeds must first be removed before planting. They also provide many of the same soil benefits as organic mulches. The ground cover plants have to be suitably established before they can provide the dense shading required for weed control. The plants used must be picked based on their suitability to each project; their growth types and tolerances must be considered. This is especially so where droughts and frosts are common, as in Christchurch. How far and fast the plant spreads will affect the level of maintenance required and how many plants are needed for full coverage. It seems that these living mulches have some way to go before landscapers and authorities consider them as an alternative to traditional mulches.

A New Zealand study looked at the effectiveness of ornamental groundcovers in weed control in a plot trial in Palmerston North, with 12 species planted and monitored for two years. Of these species four were New Zealand Natives. Some plants failed to give year round cover due to frost damage, disease and thinning during flowering. Two of the fastest growing species completely covered the 4m<sup>2</sup> plots within twelve months (from an initial planting of 3 seedlings). These two were the most effective at preventing weed establishment over the 5-month assessment period. These species were the New Zealand natives; *Acaena inermis* ('Purpurea') and *Muehlenbeckia axillaris* (Foo, Harrington, & MacKay, 2011).

## 5 Survey on Weed Management in the Transitional City

### 5.1 Aim

For our Project on weed control methods in the Transitional city we felt that it was important to obtain the opinion of the public on weeds and if they thought there was a problem. The aim was to stop people on the street in the city as they will likely have seen some weeds or at least have seen vacant lots and building sites. It can be difficult to get people to stop and talk on the street so it was decided to keep the survey short by limiting it to 5 questions.

### 5.2 Methodology

The three members of our group were equipped with name tags, UC identification, a reference letter from the Department of Geography signed by Professor Simon Kingham stating that we were carrying out a research project and a clip board containing our survey questions. Upon arriving at the city we stationed ourselves separately in well-lit areas of high pedestrian traffic within eyesight of at least one other team member. Each individual also had a mobile phone to call any other member of the team should they need to.

### 5.3 The Questions

#### 5.3.1 Q1: Do you think enough is being done to control weeds in the city?

This question was designed to get people thinking about weeds in general, without supplying them with too much information, the response we were after was a simple yes or no.

#### 5.3.2 Q2: Should more/less/the same resources be expended on this?

Question 2 follows on from Question 1 and asks for more information. Care was given with the order of the options so as not to bias any particular choice.

### 5.3.3 Q3: Should private land owners be required to control weeds on vacant lots?

In talking to Dr Trevor Partridge he pointed out that the Christchurch City Council cannot maintain weeds on private land and the only recourse they have is only if the weeds become a fire hazard, this question was designed to get peoples opinion on that.

### 5.3.4 Q4: In reference to the picture shown, if this was next door to your house would you feel positive /negative or neutral about it?



Figure 5 Picture of weeds used for question 4

The photo in Figure 5 was used to clarify in people's minds the kind of weeds we are talking about and to ensure that they were not thinking of a domestic setting with a few minor weeds. Care was given to the wording of the question to reduce the bias placed on the options.

**5.3.5 Q5: Please number the following methods in order of preference (with 10 being most favoured and 1 being least)**

This question was a two parts as shown in Table 1. Firstly people were asked to rate the methods of weed control from preferred to least preferred. Then after advising people that some methods would involve an increase in resources and therefore an increase in their rates, they were asked what their preferred and least preferred methods are. The list was populated using methods that had been identified as the most familiar and practical.

Methods	Without cost consideration	With cost consideration
Mulch		
Plastic weed mat		
Herbicide spraying		
Vinegar		+
Hot water		+
Organic Herbicide Spraying		+
Natural weed mat		+
Hand weeding		+++
Stem injection of herbicide		+
Steam		++

**Table 1 Methods of weed control**

+ = a slight increase in resources and costs

++ = a medium increase in resources and costs

+++ = a significant increase in resources and costs

## 5.4 Results

In total 78 people were surveyed over two days in the city. On the first day due to drizzling rain and a constant wind we stationed ourselves under cover along Cashel Street, however people were reluctant to stop due to the weather. On the second day the sun was shining and the wind had died down, also we repositioned ourselves near bus stops where people are already stopped and this made them easier to approach.

### 5.4.1 Question 1

A slight majority of people believe that enough is being done to control weeds with 51% of people surveyed saying “Yes” they think enough is being done to control weeds in the city as shown in Figure 6.

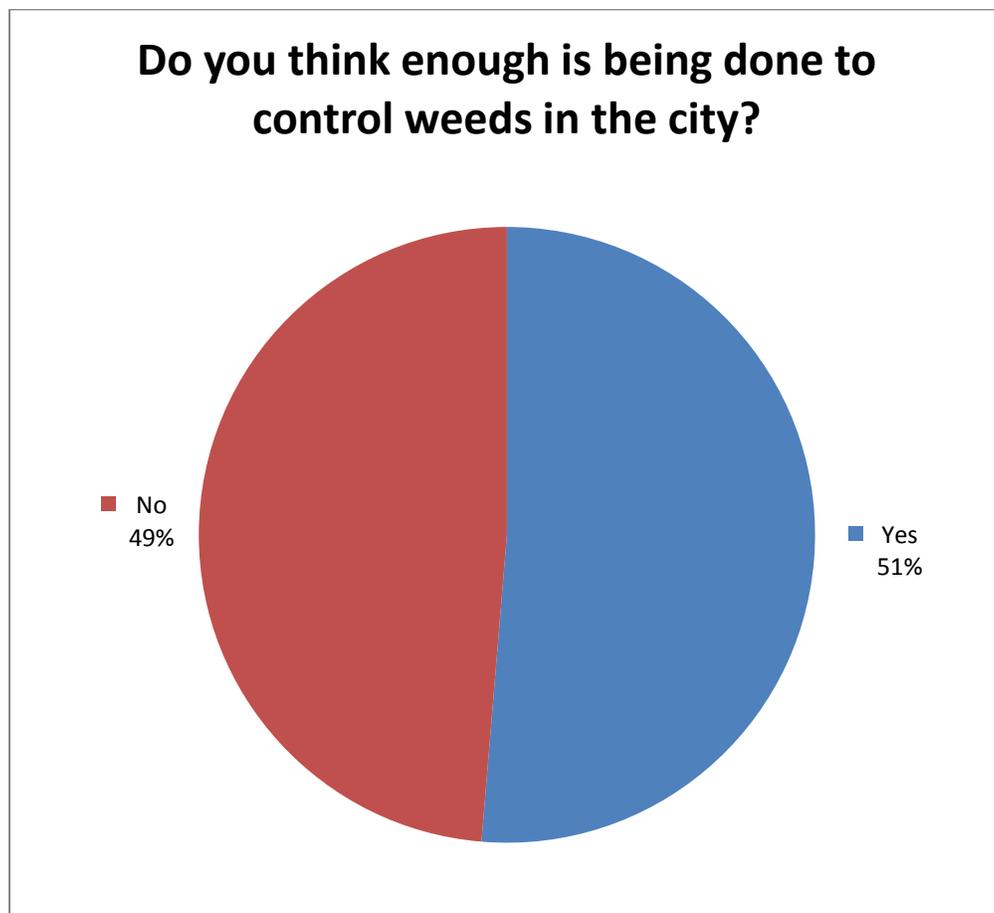


Figure 6 Results graph for Question 1

**5.4.2 Question 2: Should more/less/the same resources be expended on this?**

A narrow majority of people with 48% believe that status quo should be maintained and that the same amount of resources should be expended on weed control. This was closely followed by 45% of the responses being for “More” to be spent as seen on Figure 7.

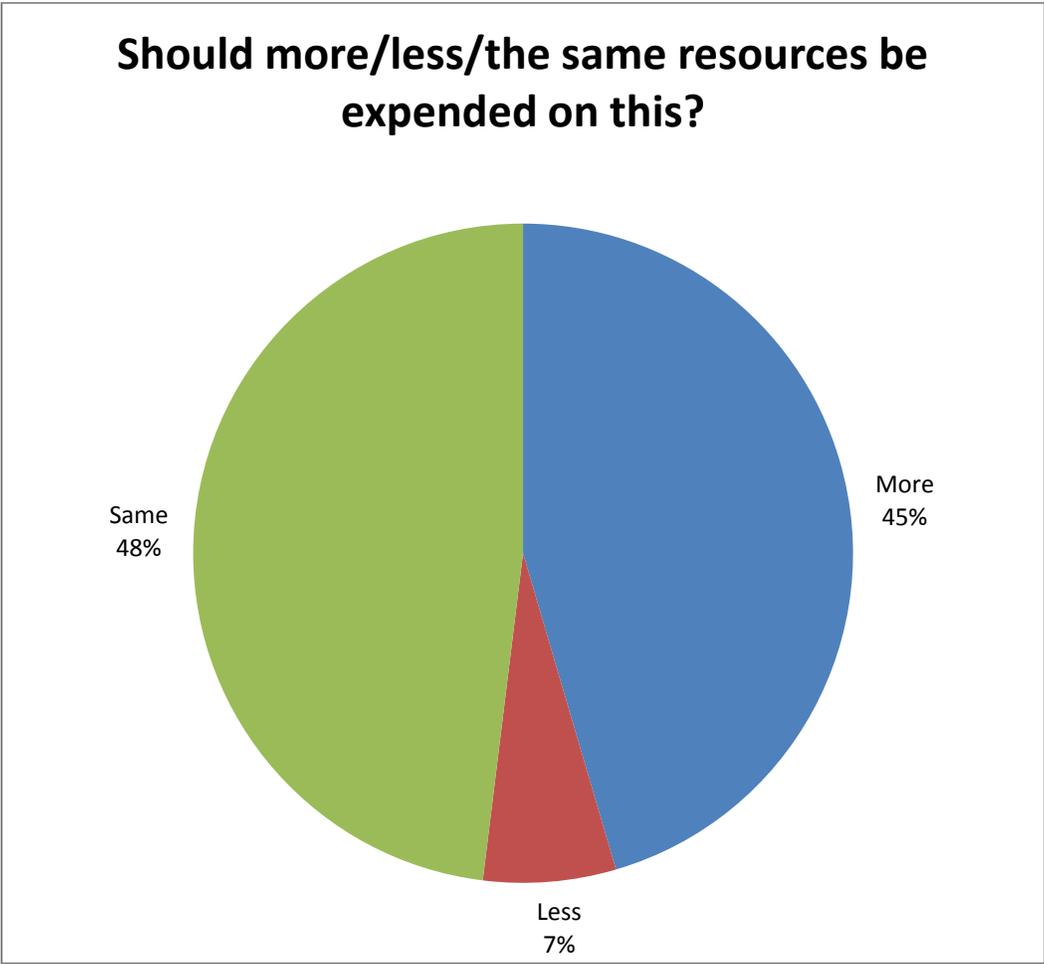


Figure 7 Results graph for Question 2

**5.4.3 Question 3: Should private land owners be required to control weeds on vacant lots?**

This question had a very definite majority with nearly 9 out of 10 people answering that Yes; private property owners should be required to control weeds on vacant lots as shown in Figure 8.

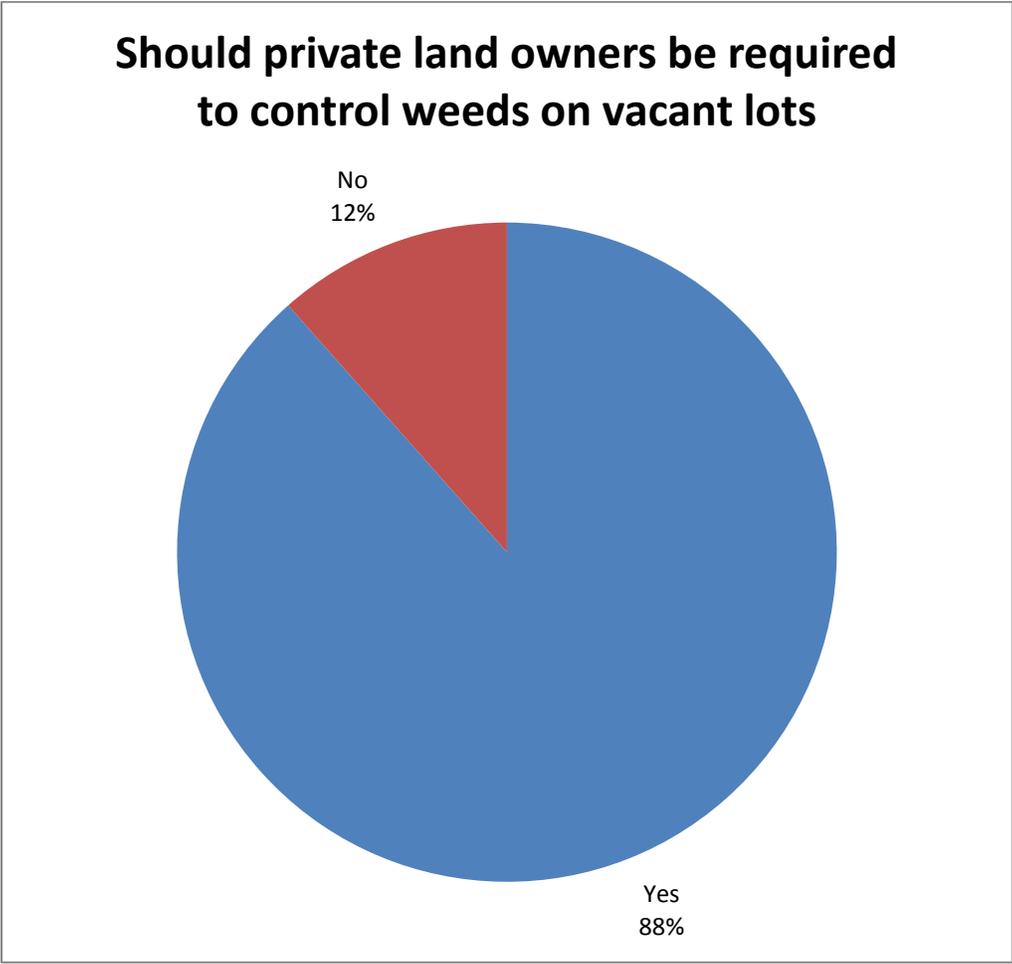


Figure 8 Results graph for Question 3

#### 5.4.4 Question 4: If this was next door to your house would you feel positive /negative or neutral about it?

The results for this question closely followed question 3 with 82% of responses saying that they felt negative towards the picture that was shown to them as shown in Figure 9. The 4% positive equates to 3 people.

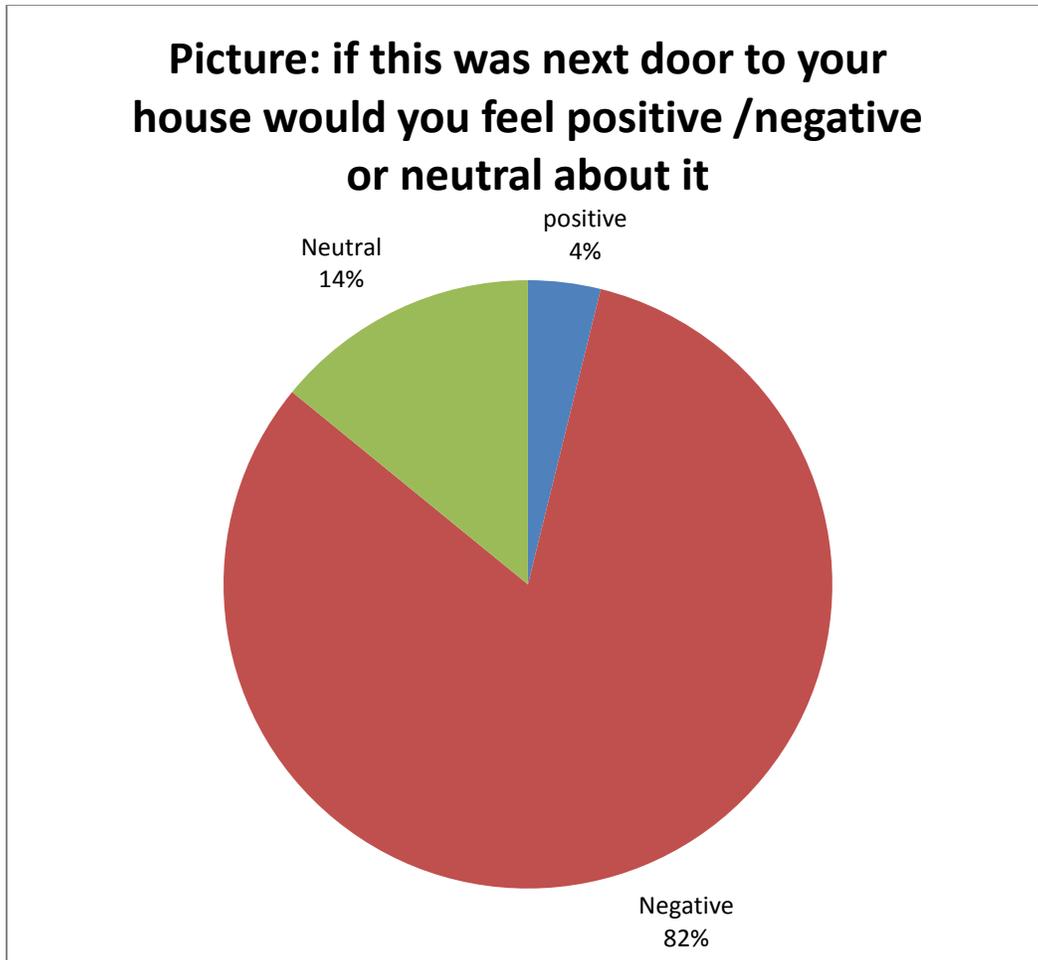


Figure 9 Results graph for Question 4

### 5.4.5 Question 5

The original methodology was that each method would get a number out of 10, with 10 being there most preferred and 1 being least preferred. In practice this was difficult for people to understand and time consuming so it was simplified to identifying only the most preferred and least preferred methods.

#### The most preferred method of weed control

As shown in Figure 10, Hand weeding with 24% just beat Mulch at 22% to be the most preferred with no cost influence. Hand weeding dropped to 3<sup>rd</sup> place after cost information was included with 19%, and Organic Herbicide Spraying and Mulch moving up to tie for first place on 27%.

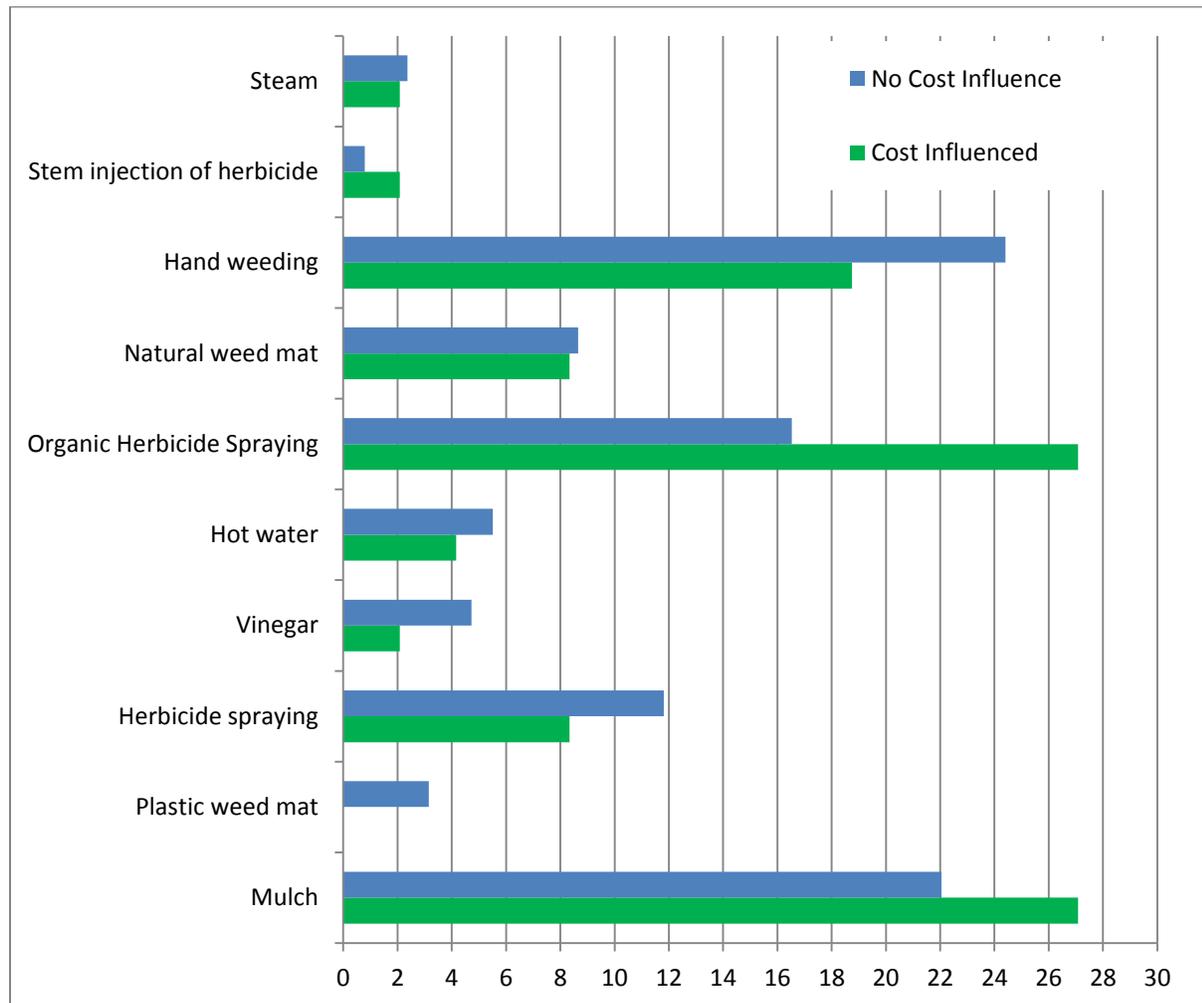


Figure 10 Graph of preferred methods of weed control

### The least preferred method of weed control

Herbicide spraying was the least preferred with and without cost influence with 38% as shown in Figure 11. Plastic weed mat was the second without cost influence with considerably less votes on just 15%, this marginally increased to 16% with cost influence. The main mover was Hand Weeding, which went from 4th= on 8% to second outright with 18%.

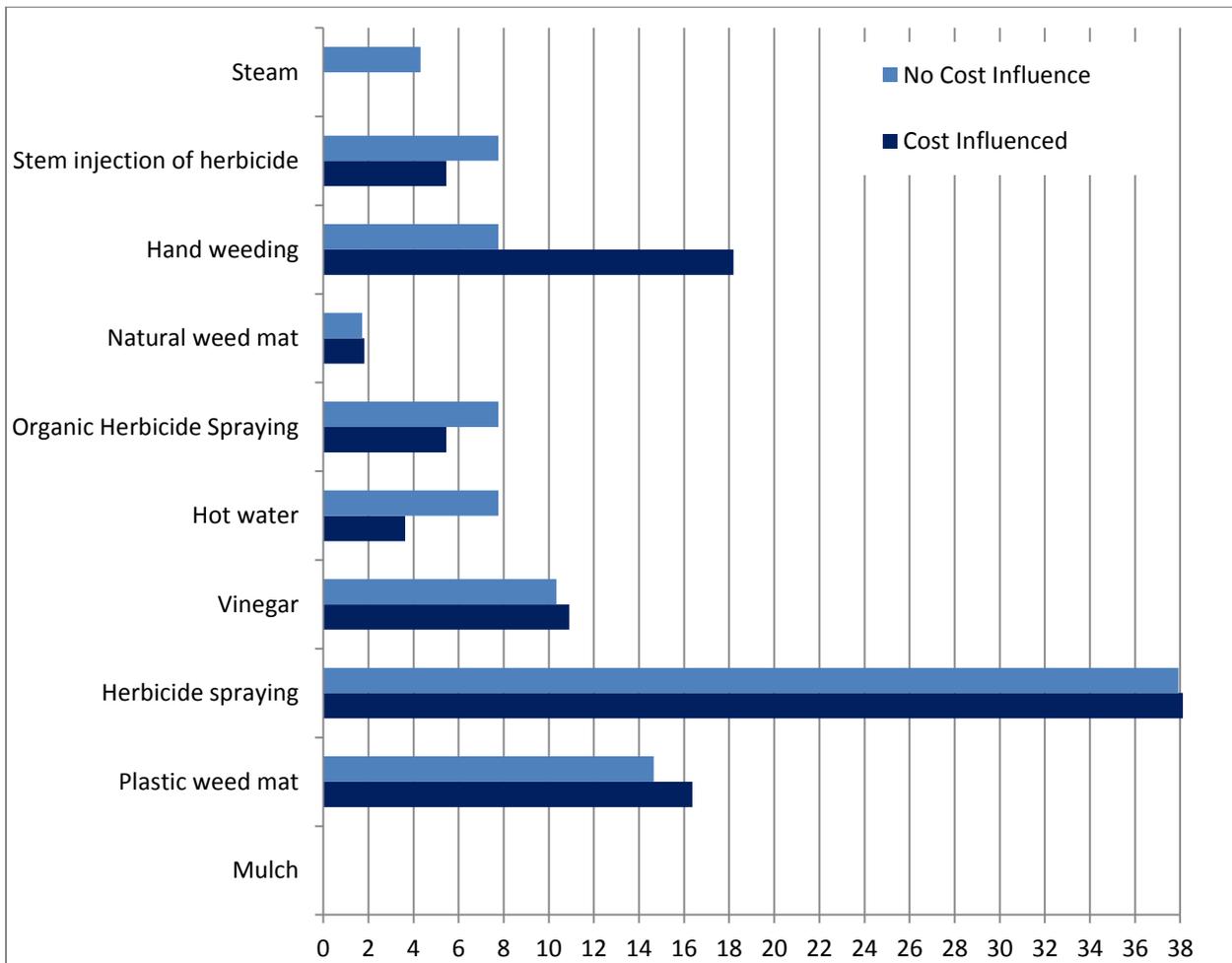


Figure 11 Graph of least preferred methods of weed control

## 5.5 Discussion

### 5.5.1 Question 1: Do you think enough is being done to control weeds in the city?

This question stumped a lot of people, many replied that they had not given it much thought, and began scanning around them to see if they could see any weeds. We had positioned ourselves with the intent to be near a lot of foot traffic and thus it was generally a well looked after area. Had we been standing next to an untended vacant lot this could have skewed the results.

### 5.5.2 Question 2: Should more/less/the same resources be expended on this?

It was interesting to note that although this question was related to question 1, the percentages did not align. The percentage dropped from 49% of people answering that “not enough is being done” to 45% of people saying that “more resources should be expended”. The difference could be put down to some people commenting that not enough is being done, but that there are more important issues than weeds facing the city which the resources would be better spent on, thus they chose to keep resources at “same” amount.

### 5.5.3 Question 3: Should private land owners be required to control weeds on vacant lots?

One common take on this question from those surveyed was that someone was going to come round to their house and inspect their garden to which they were indignant. Once it was further clarified that the question was directed at empty sites where earthquake damaged buildings had been removed nearly 9 out of 10 people readily answered “yes”.

This question was included as the council had said that they have no mechanism for which to control weeds on private land unless it is a fire risk. From the result it is clear that people believe weeds should be maintained so maybe there is room for new legislation to require it. The question was directed at private owners as it was believed that public owners like Christchurch City Council already actively control weeds.

#### **5.5.4 Question 4: If this was next door to your house would you feel positive /negative or neutral about it?**

This question was a deliberate follow on from question 3 but used an actual picture to show the extent of the weeds. The surprise here was the number of people who felt that the weeds represented a positive thing. Two people justified their answers with comments of “It shows that no sprays have been used” and “it’s an open space”. In developing this question further perhaps a photo showing the rats and litter that had accumulated due to these weeds might change the opinion of this minority.

#### **5.5.5 Question 5: What is your preferred and least preferred method of weed control?**

Question 5 was delivered in two parts so that the cost of each option could be taken into account. Some of the methods involve significantly more resources than others; either in time or equipment, so these increases would need to be passed on to the rate payer. To ensure this realisation was understood by those being interviewed, the surveyors deliberately screened those people who appeared too young to be bill payers.

An example of this cost influence was shown by the 5% drop in people that initial preferred hand weeding but then changed upon realising there would be an increase to their rates. The cost also affected the results for least preferred with a dramatic increase in the number of people who disliked hand weeding when they were informed of a possible rate increase. The most common comment for the change being “rates are already enough”.

Herbicide is clearly least favoured but it is also 4<sup>th</sup> on the most preferred, with nearly 10%.

## 5.6 Limitations and Further Research

The following areas have been identified as possibly having an effect on the data gathered and therefore the overall results.

- Results for cost influence could be skewed as not all interviewers followed the same method, the follow up question was not always asked, possibly due to time constraints
- Another variation was some interviewers asked for two preferred methods and two least preferred methods.
- The survey population of 78 is very small in terms of the population of Christchurch and may not accurately represent the residents.
- By using the same locations to survey on both days might mean that we do not have a true representation of the public's point of view.
- By surveying only over the weekend our survey population may not include Christchurch residents who work in the city as they may prefer not to enter the city on the weekend.
- The weather on the first day was unpleasant so only people that had business to carry out in the city would have ventured out. This might skew the results by only have affluent people being surveyed.
- Some of our survey sites were near bus stops so this could skew the results to the lower income brackets.
- By surveying on consecutive days it is a small time window.
- The surveyors screened people that appeared too young; this may have resulted in valid opinions from one demographic of society being missed.
- Some people were renters so did not associate an increase in rates to an increase in their weekly rent.

## 6 Conclusion

It is important for Christchurch to feel welcoming to people coming back into the city after the earthquakes. But the presence of weeds, and what may come with them, detracts from this.

There are many methods currently available for the control of weeds, each has their own situations that they are not suited for, as well as advantages and disadvantages of their use. A city wide weed control strategy should therefore utilise several different methods.

The future of weed control may come from technology that is already employed in other fields. Ground cover plants have the potential to provide an effective means of controlling weeds, while possessing several benefits to the soil and to aesthetics. Or it might be evolved technology that provides the best solutions. Foamstream is an exciting advance in thermal weed control that has few drawbacks. Or maybe what is required for weed control is an entirely new technology.

The results from the public survey gave a clear indication of the public opinion on weed control in Christchurch City. Although it was close, the slim majority of people surveyed believe that enough is being done to address weeds in the city and that the same amount of resources should be continued. Residents strongly agree that private landowners should control weeds on vacant sites and that living next door to a site that is overgrown with weeds would be a negative thing.

The preferred weed control methods we identified as organic herbicide spraying and mulch when costs were taken into account, with hand weeding being the choice without cost implications. These choices are likely out of concern for the environment, but this would require further research to ascertain. The least preferred weed control method was herbicide spraying both with and without cost constraints. When considering associated costs hand weeding was second on the least preferred list.

In summary, based on these results Christchurch residents do not dislike spraying in fact they prefer it, as long as it is organic herbicide that is being sprayed.

## 7 Acknowledgements

In completing this report we would like to acknowledge the following people:

- Professor Simon Kingham – University of Canterbury
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- Di Lucas – Lucas Associates
- Paul Michael – Fern Factor
- Di Carter – Christchurch City Council
- Trevor Partridge – Christchurch City Council
- Christchurch City Park Rangers
- Trees for Canterbury

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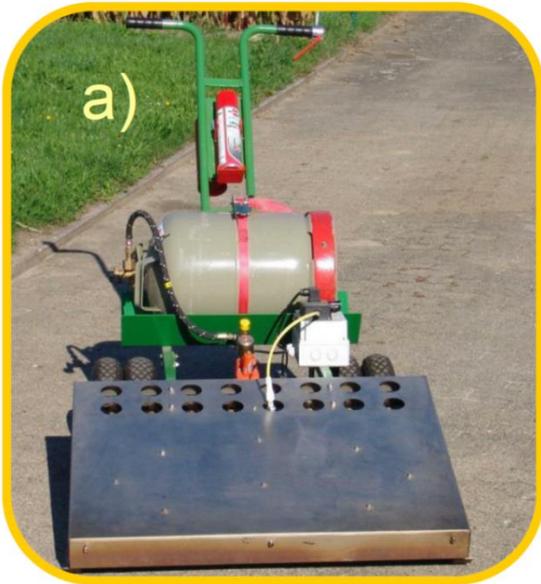
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## 9 Appendix

### 9.1 Appendix A

All pictures in Appendix A were sourced from (Verschwele, n.d.)

Burn-off



Weedbrush



Steam



Hot Foam



Rotofix



## 9.2 Appendix B

Results from Public survey on weed management conducted in Christchurch on Saturday May 16 and Sunday May 17

For Questions 1-4, “1” represents the answer given

For Question 5, a scale is used with 10 = most preferred down to 1 = least preferred

	Do you think enough is being done to control weeds in the city?		Should more/less/the same resources be expended on this?			Should private land owners be required to control weeds on vacant lots			Picture: if this was next door to your house would you feel positive /negative or neutral about it			Mulch	Mulch	Plastic weed mat	Plastic weed mat	Herbicide spraying	Herbicide spraying	Vinegar	Vinegar	Hot water	Hot water	Organic Herbicide Spraying	Organic Herbicide Spraying	Natural weed mat	Natural weed mat	Hand weeding	Hand weeding	Stem injection of herbicide	Stem injection of herbicide	Steam	Steam
	Yes	No	More	Less	Same	Yes	No	positive	Negative	Neutral																					
1	1				1	1			1		10																				
2		1				1	1			1										1				10							
3	1					1	1		1								1	1					10	10							
4	1					1	1		1								1	1								10	10				
5		1	1			1			1							1											10				
6		1				1	1		1		10		10																1		
7	1					1	1		1		9		3			1		5									10	2		2	
8	1					1	1		1		10		10			1															
9		1	1			1			1							1							10								
10	1		1			1			1							1										10					
11		1	1			1			1											1									10		
12		1	1			1			1		10				1											10					



