
WEED CONTROL TRIALS COMPARING HYDROTHERMAL AND HERBICIDES IN THE CITY OF JOONDALUP



PREPARED FOR THE CITY OF JOONDALUP
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Consultants' Brief:

Compare a range of herbicide and hydrothermal treatments for weed control effectiveness in the City of Joondalup.

Compare the cost of these treatments described above.

Discuss the weed control options and combinations suitable for use in the City of Joondalup.

Background:

Weed control in an urban setting needs to consider many factors, including public safety, operator safety, effectiveness of control methods, and development of herbicide resistant weeds, cost of control methods and any potential environmental impact on or off site.

To address some of these issues the City of Joondalup has undertaken a review of herbicides used in the City which recommended that certain herbicides were unsuitable for use in an urban setting. In addition to that report, a second report compared the merits of different weed control methods such as hydrothermal and herbicide applications. Those findings suggested that while hydrothermal was more expensive, it is also has lower environmental risks associated with its use.

The purpose of this investigation was to compare hydrothermal and herbicide treatments, through their application, at various locations throughout the City of Joondalup. These trials would allow the level and duration of weed control to be determined as well as the comparative costs of different weed control strategies.

Studies:

Study 1 – Weed control trials

Study 2 – Cost comparisons

Introduction

Weed management in urban settings is often made difficult by the complexity of many plantings which contain more than one species of both annual and perennial forms. The species diversity, soil types and slope differences as well as mulched and un-mulched areas create the need for a range of weed management options. There are also considerations regarding public concern about the use of herbicides to control weeds and their effect on underground water quality if the herbicide moves offsite through deep drainage or runoff. The choice of a specific weed management program depends on the weeds present and the types of non-target plants in the control area. Because of these complexities, combinations of nonchemical and chemical methods are often used to control weeds.

The following considerations apply when considering weed control; identifying the target weed species, identifying the non-target plant species and assessing the target site for potential risks. After control methods have been applied, it is also important to assess efficacy, weed substitution or other issues that may be associated with public or environmental considerations.

This report focuses on a comparison of different control methods and reports on their effectiveness and cost.

Study 1 – Weed Control Trials

Methods and materials

Weed control treatments: The treatments applied and their times of application are presented in table 1.

The hydrothermal treatment (i in Table 1) was applied by itself in the same location at three different timings throughout the growing season (May, August and November). The reason for multiple applications was due to the lack of systemic and residual control that can be expected from hydrothermal treatment methods (see previous report).

The hydrothermal plus glyphosate treatment (ii in Table 1) was undertaken in May and August with the hydrothermal treatment applied in May and glyphosate applied over the same area in August.

This treatment focuses on combining these technologies to reduce overall herbicide use in the City and keep weed control costs as low as possible.

The glyphosate treatment (iii in Table 1) was applied in May and August and hence is directly comparable with treatment ii in table 1.

The final treatment was glyphosate plus pendimethalin (Stomp) which provides residual control of many grass weeds and is considered safe for use in urban settings. It was applied once only in May and was expected to provide control for approximately 4 months.

Table 1. The weed control treatments and their time of application

Treatment	May	August	November
I) Hydrothermal	Hydro	Hydro	Hydro
ii) Hydrothermal + Glyphosate	Hydro	Glee	
iii) Glyphosate	Glee	Glee	
iv) Glyphosate + Pendimethalin (Stomp)	Glee + Stomp		
5) Unsprayed control			

Herbicide rates: The glyphosate used was “Clear up Bio 360”, which is manufactured by Gullf Ag and it was applied at 5 litres per hectare (e.g. 2.5% where 200 L is applied per hectare). The pendimethalin used was “Stomp 330E” which is manufactured by BASF and it was applied at 3 litres per hectare (e.g. 1.5% where 200 L is applied per hectare). The water rate used for herbicide application was equivalent to 200 L/ha.

Hydrothermal: The hydrothermal treatment was applied in excess of 150 degrees celsius and at a water rate of 20 litres per hour.

Trials locations: Six trials were conducted at the following five different locations: Santiago Park Way footpath in Connolly, Shenton Avenue nature strip in Connolly, Chessell Drive road side kerb in South Duncraig, Sheoak footpath in Greenwood, Sheoak kerb in Greenwood and Erindale road kerb in Warwick. These locations are also shown in figures 1 to 6 below.



Figure 1 shows the Santiago Park Way site where all treatments were applied. At this location there is a footpath that starts at the intersection of Santiago Park Way and Prendiville Avenue and extends north on the left hand side of the road. Weed control treatments were applied to a 3 cm strip on either side of the footpath including joins.



Figure 2 shows the Shenton Avenue site in Connolly. At this location there is a traffic island between Marmion Avenue and Christchurch Tce that is sparsely mulched. Weed control treatments were applied to a 2 m strip starting at the kerb top and extending inward (2 m) over the mulched area. The second and third hydrothermal treatment was only applied to a 1 m strip due to its lower suitability for controlling weeds across a large area.



Figure 3 shows the Chessell Drive site in South Duncraig. At this location there is a lawn based traffic island between Beach Road and Warwick Road. Weed control treatments were applied to a 3 cm strip starting at the kerb top and extending inward (3 cm) over the lawned area.



Figure 4 shows the Sheoak site in Greenwood. At this location there is a footpath on Warwick road and a 3 cm strip to either side of the footpath including joins was treated.

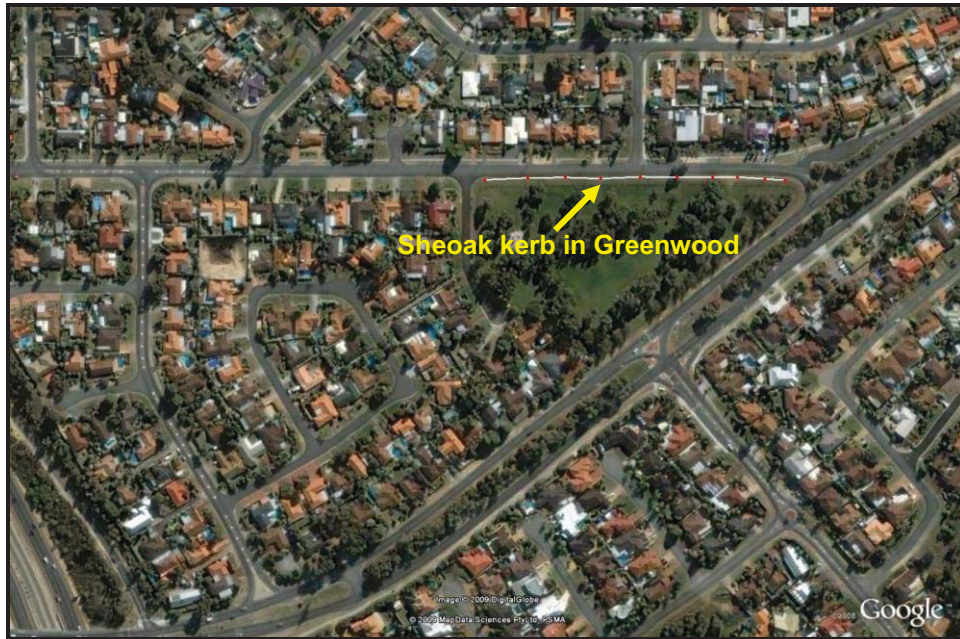


Figure 5 shows the other Sheoak site in Greenwood. At this location there is a kerb on Tuart Road which was treated in a 3 cm strip from the top of the Kerb extending into the grassed area.

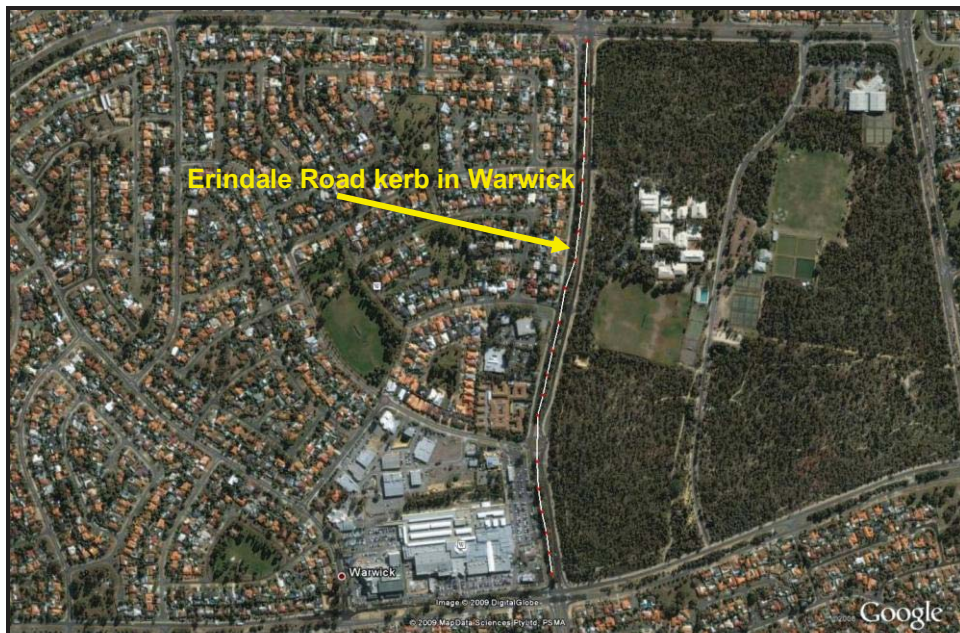


Figure 6 shows the Erindale site in Warwick. At this location there is a lawned traffic island between Beach Road and Warwick Road. Weed control treatments were applied to a 3 cm strip starting at the kerb top and extending inward (3 cm) over the lawned area.

At each trial location each weed control treatment was measured and marked in four different locations using surveyors' paint. So, for example at the Erindale site the hydrothermal only treatment had four locations marked, within which the effectiveness of weed control was recorded in June August, September, November, January and March. The same data collections occur for each weed control treatment applied at each site.

Assessment of weed control: The proportion (percentage) of green weed present at each location was recorded in May prior to all weed control treatments being applied. Assessments of weed control were then made in June, August, September, November, January and March. The data for the levels of weed control achieved are presented in table 5. All results are expressed as a percentage of weed control achieved.

Statistical analysis: Trial results were analyzed using Genstat 11th addition and levels of control compared to unsprayed areas were assessed at the $P=0.001$ level while treatment comparisons (control methods) were made at the $P=0.05$ level.

Results

Weed control effectiveness compared with untreated areas: All weed control treatments significantly reduced the proportion of weeds present when measured in June and August at the $P=0.001$ level (Table 2).

By September, all treatments had still significantly reduced the presents of weeds except for the hydrothermal treatments at the Shenton Avenue and the Sheoak kerb side sites. Similar results were obtained from the November measurements as there was no significant level of weed control for the hydrothermal treatment at the Shenton Avenue, Sheoak kerb side and Sheoak footpath sites (Table 2).

The January and March measurements produced the same results and are as follows. No weed control treatments were significantly different to untreated areas at the Shenton Avenue and Sheoak kerb side sites. At the Santiago Park Way and Erindale road sites, hydrothermal treatment was ineffective when measured at these times (January and March). At the Sheoak footpath site, both hydrothermal and the hydrothermal plus glyphosate treatments were ineffective and, at the Chessell drive site all treatments were effective (Table 2).

The best treatments were hydrothermal plus glyphosate, glyphosate only and glyphosate plus stomp. These performed the same when comparing significant levels to the unsprayed control zones. The only exception to this was at the Sheoak footpath site in January where glyphosate only and glyphosate plus stomp outperformed hydrothermal plus glyphosate (Table 2).

Table 2 shows when and where the level of weed control achieved was statistically greater than the untreated area. Ticks indicate effective control and crosses indicate ineffective control.

Location	Treatment	Jun	Aug	Sep	Nov	Jan	Mar
Santiago Pkwy, Connolly	Hydrothermal	✓	✓	✓	✓	✗	✗
Santiago Pkwy, Connolly	Hydrothermal + Glyphosate	✓	✓	✓	✓	✓	✓
Santiago Pkwy, Connolly	Glyphosate	✓	✓	✓	✓	✓	✓
Santiago Pkwy, Connolly	Glyphosate + Stomp	✓	✓	✓	✓	✓	✓
Shenton Ave, Connolly	Hydrothermal	✓	✓	✗	✗	✗	✗
Shenton Ave, Connolly	Hydrothermal + Glyphosate	✓	✓	✓	✓	✗	✗
Shenton Ave, Connolly	Glyphosate	✓	✓	✓	✓	✗	✗
Shenton Ave, Connolly	Glyphosate + Stomp	✓	✓	✓	✓	✗	✗
Chessell Dr South Duncraig	Hydrothermal	✓	✓	✓	✓	✓	✓
Chessell Dr South Duncraig	Hydrothermal + Glyphosate	✓	✓	✓	✓	✓	✓
Chessell Dr South Duncraig	Glyphosate	✓	✓	✓	✓	✓	✓
Chessell Dr South Duncraig	Glyphosate + Stomp	✓	✓	✓	✓	✓	✓
Sheoak FP, Greenwood	Hydrothermal	✓	✓	✓	✗	✗	✗
Sheoak FP, Greenwood	Hydrothermal + Glyphosate	✓	✓	✓	✓	✗	✗
Sheoak FP, Greenwood	Glyphosate	✓	✓	✓	✓	✓	✓
Sheoak FP, Greenwood	Glyphosate + Stomp	✓	✓	✓	✓	✓	✓
Sheoak Kerb, Greenwood	Hydrothermal	✓	✓	✗	✗	✗	✗
Sheoak Kerb, Greenwood	Hydrothermal + Glyphosate	✓	✓	✓	✓	✗	✗
Sheoak Kerb, Greenwood	Glyphosate	✓	✓	✓	✓	✗	✗
Sheoak Kerb, Greenwood	Glyphosate + Stomp	✓	✓	✓	✓	✗	✗
Erindale Rd, Warwick	Hydrothermal	✓	✓	✓	✓	✗	✗
Erindale Rd, Warwick	Hydrothermal + Glyphosate	✓	✓	✓	✓	✓	✓
Erindale Rd, Warwick	Glyphosate	✓	✓	✓	✓	✓	✓
Erindale Rd, Warwick	Glyphosate + Stomp	✓	✓	✓	✓	✓	✓

Treatment performance compared with the glyphosate plus stomp application:

The performance of weed control treatments compare with glyphosate plus stomp varied across sites and is shown in the following graphs (figures 7 to 12). There were significant site interactions, for example the glyphosate plus stomp treatment outperformed the glyphosate treatment at the Santiago Park Way site during January and March (Figure 7). However, the same comparisons at the Chessell Drive site showed no significant differences between these treatments (compare figure 7 and 8 for January and March glyphosate plus stomp and glyphosate treatments).

Santiago Park Way site: At the Santiago Park Way site the glyphosate plus stomp treatment provided the highest level of control for the longest period, however for the June and August treatments there were no significant differences between treatments. In September the only treatment that was significantly lower than glyphosate plus stomp was the hydrothermal treatment. In November both the hydrothermal and hydrothermal plus glyphosate treatments were significantly lower than the glyphosate plus stomp treatment. In January and March all treatments had lower levels of control compared with the glyphosate plus stomp treatment. The most effective weed control choice at this site was glyphosate plus stomp.

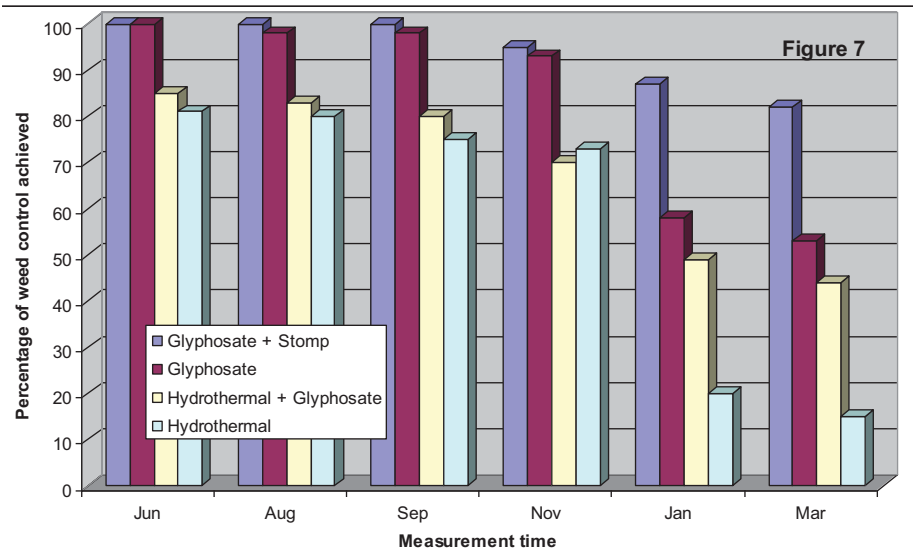
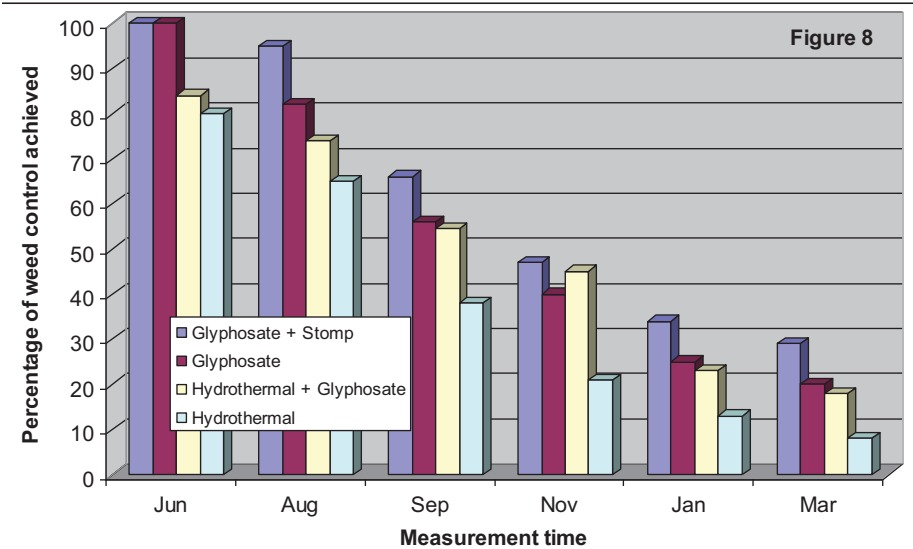


Figure 7 shows the percentage of weed control achieved at the Santiago Park Way site for six different measurement times and

four different weed control treatments.

Shenton Avenue site: At the Shenton Avenue site no significant differences occurred at the June measurement time between any treatments. The hydrothermal treatment however was less effective than the glyphosate plus stomp treatment for the period August to March. For all other measurement times and treatment combinations there were no significant differences except in August when the hydrothermal plus



glyphosate treatment was less effective than the glyphosate plus stomp treatment. The most effective weed control

treatments at this site were glyphosate plus stomp, glyphosate and hydrothermal plus glyphosate. Figure 8 above shows the percentage of weed control achieved at the Shenton Avenue site for six different measurement times and four different weed control treatments.

Chessell Drive site: The hydrothermal treatment at the Chessell Drive site produced the same results as those recorded at the Shenton Avenue site, in that, during the August to March period the hydrothermal treatment was less effective than the glyphosate plus stomp treatment. All treatments were the same when weeds were measure in June. The only other significant difference between treatments was recorded in September for the hydrothermal plus glyphosate treatment which was not as effective as the glyphosate plus stomp treatment. As with the Shenton Avenue site the most effective weed control treatments at this site were glyphosate plus stomp, glyphosate and hydrothermal plus glyphosate.

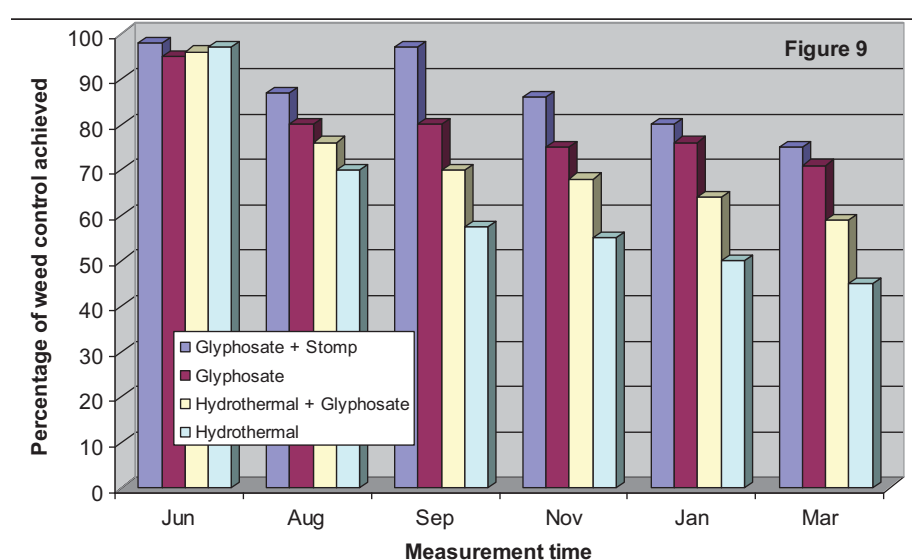


Figure 9 shows the percentage of weed control achieved at the Chessell Drive site for six different measurement times and four

different weed control treatments.

Sheoak footpath site: The hydrothermal treatment at the Sheoak footpath site showed similar results to those obtained at the Santiago Park Way site in that during the September to March period the hydrothermal treatment was not as effective as the glyphosate plus stomp treatment. The hydrothermal plus glyphosate treatment was also less effective than the glyphosate plus stomp treatment for the January and March periods. The most effective weed control at this site was glyphosate plus stomp and glyphosate.

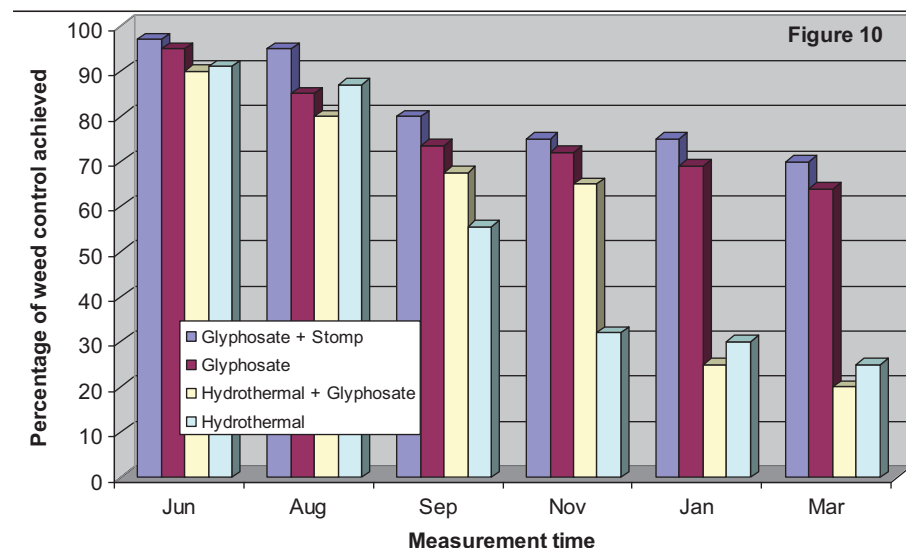


Figure 10 shows the percentage of weed control achieved at the Sheoak footpath site for six different measurement times and

four different weed control treatments.

Sheoak kerb site: At this site, the hydrothermal and hydrothermal plus glyphosate treatments were less effective than the glyphosate plus stomp treatment for the June to November period. The glyphosate treatments were also less effective than the glyphosate plus stomp treatment for the August to November period. The most effective weed control at this site was achieved by the glyphosate plus stomp treatment for the June to November period. No significant differences were recorded for January and March.

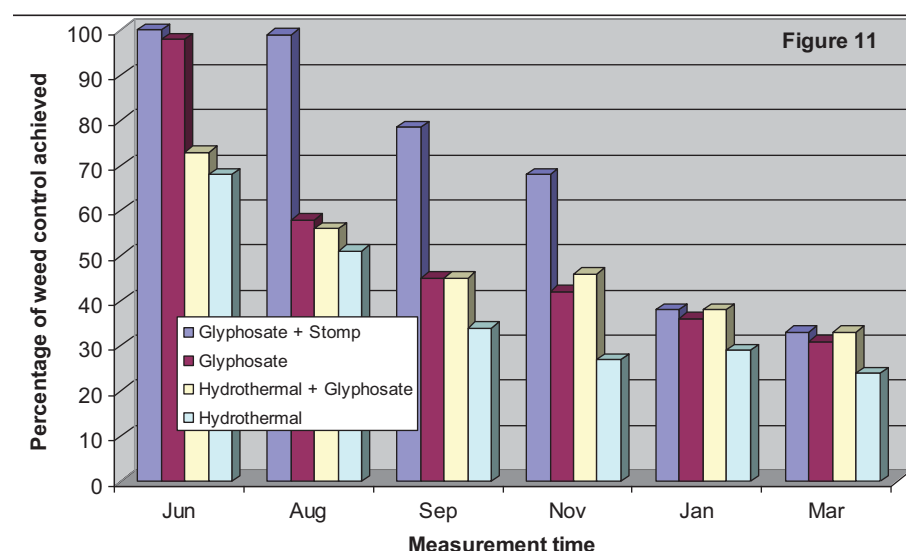


Figure 11 shows the percentage of weed control achieved at the Sheoak kerb side site for six different measurement times and

four different weed control treatments.

Erindale road site: At the Erindale site the hydrothermal treatment achieved a consistently lower level of weed control compared to the glyphosate plus stomp treatment. The only other treatment that had lower levels of weed control than the glyphosate plus stomp treatment was hydrothermal plus glyphosate at the August measurement time. This site was also the only site that had an improved weed control response in September for the hydrothermal plus glyphosate treatment compared with the previous August measurement (Figure 12). This was most probably due to the timing of the glyphosate as the second part of the hydrothermal plus glyphosate treatment. The most effective treatments at this site in their order of effectiveness were glyphosate plus stomp, glyphosate and glyphosate plus hydrothermal.

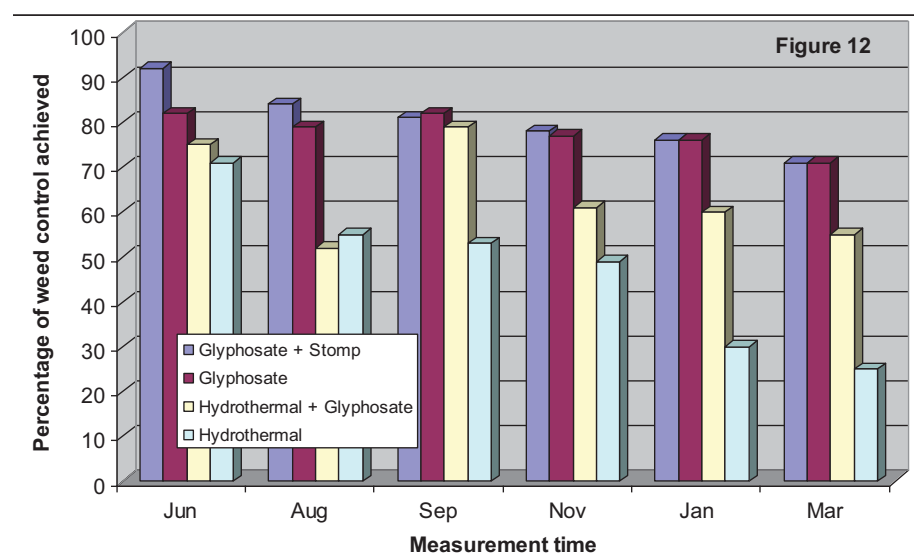


Figure 12 shows the percentage of weed control achieved at the Erindale road side site for six different measurement times and

four different weed control treatments.

Overview: All control methods were effective for the June and August measurement times when meaned over all sites. The most effective treatments for the June to November period were glyphosate plus stomp, glyphosate and hydrothermal plus glyphosate. Weed control results beyond November were more variable however the most effective treatment in general terms over this period (January to March) was glyphosate plus stomp.

Discussion:

Hydrothermal: Hydrothermal weed control was effective in the short term but less effective in the longer term. This may be as a result of some perennials (such as couch which was present at most sites) having rhizomes which survive in the soil to a depth of at least 12 cm. These deeper rhizomes are protected from the heat applied in the hydrothermal treatment and are able to reproduce new green shoots when moisture conditions are suitable. As a result of this phenomenon, the hydrothermal treatment was less effective for longer term control (see table 5).

This treatment would best be restricted to smaller areas where multiple applications can be applied or alternatively it could be used in rotation with chemical control methods.

Hydrothermal plus glyphosate: The hydrothermal plus glyphosate treatment is attractive as it reduces the overall use of chemicals in the City and provides a method of control that ensures herbicide resistant weeds are less likely to occur. It should perhaps be used in reverse order; so instead of hydrothermal treatment being used first, it would be better to use glyphosate first and hydrothermal second. The reason for this relates back to couch rhizomes or roots of other perennials. For example, if the hydrothermal treatment burns off all the above ground photosynthetic material then it is possible that the follow-up roundup treatment (some months later) may not translocate to all rhizomes as some may not have produced new shoots at the time of glyphosate application. As a result some rhizomes would escape the glyphosate treatment where it followed hydrothermal treatment. Therefore the effectiveness of weed control is likely to be improved where glyphosate is applied first and hydrothermal second.

This combination (glyphosate then hydrothermal 2 or 3 months later) would be most suitable for use along footpaths and kerbs in water catchment areas.

Glyphosate and Stomp: The glyphosate plus stomp treatment provided the best overall control (see Table 4). Stomp is a soil residual herbicide and was chosen because it has a very low solubility in water and the lowest rating for potential ground water flow and ground water toxicity (see report on herbicides and their use in the City of Joondalup October 2007) and is effective against a range of grass and broadleaf weeds. The combination of these herbicides also reduces the likelihood of glyphosate resistance occurring over sprayed areas.

This combination is suitable for use in the City where the area being sprayed is not part of a water catchment (see Department of Health circular PSC88 “Use of Herbicides in Water Catchment Areas”).

Glyphosate only: Two applications of glyphosate were similar to one application of glyphosate plus stomp in most but not all situations. Although this treatment is safe and effective, its prolonged and continuous use will lead to the development of herbicide resistant weeds. It is therefore recommended that this treatment not be used for more than two successive years over the same area. The isopropylamine formulation of glyphosate is also preferred as it is less harmful to aquatic life should off-site surface flow occur.

This treatment is most suitable either for use by itself or in combination with hydrothermal especially in that part of the City that is designated as a water catchment.

Other observations: Observations were made of some weed substitution that occurred. For example, before weed control options were applied at the Shenton Avenue site, grass weeds were predominant and, towards the end of the experiment, these same areas were mostly occupied by broadleaf weeds and some of these were more difficult to control than many of the earlier grass weeds (e.g. Common name: fleabane, Scientific name: *Conyza bonariensis*). Weed substitution is a serious consideration, and in some situations, weeds should be left in place and simply managed by mowing or cutting rather than choosing an outright control approach.

Study 2 – Cost Comparisons

Treatment costs for the trial: Cost comparisons are made for the same distance of footpath and kerb for the Santiago, Chessell, Sheoak and Erindale sites (excludes the Shenton site).

- (i) Glyphosate plus Stomp applied once in May cost approximately \$266 for the trial or \$88 per km.
- (ii) Glyphosate in May then again in August cost approximately \$508 for the trial or \$84 per km for each application (i.e. \$168 per km in total for both applications – May plus August).

- (iii) Hydrothermal undertaken in May plus glyphosate in August cost \$650 and \$254 respectively. Note that the hydrothermal cost would have been lower if this treatment followed the glyphosate treatment (e.g. glyphosate applied in May – see below for further explanation). Total cost was \$904 or an average of \$150 per km for each application (i.e. \$300 per km in total for both applications).

It is estimated that if glyphosate was applied in May and hydrothermal in August the approximate costs would have been \$254 for glyphosate and \$475 for hydrothermal. The total estimated cost would therefore have been \$729 (\$121 per km for each application or \$242 per km in total for both applications) which is less expensive than undertaking hydrothermal treatment first.

- (iv) The hydrothermal treatment in May cost approximately \$650, in August cost \$475 and in November \$475 providing an approximate total of \$1500 or an average cost of \$177 per km per application or \$532 per km in total for all three applications.

Costs comparisons for the trial: The total cost of herbicide treatments for sites (excluding the Shenton Avenue site because it was not a 3 cm strip but, rather, a 2 m strip) was \$990 and this same comparison for hydrothermal application was \$2,250. These comparisons are based on the same distance (e.g. same km of kerb and footpath). The price difference (approximately 2.3 time greater for hydrothermal) is explained by labour inputs because the total hours required for hydrothermal treatment was 15 hours whereas herbicide treatments were able to be applied over the same area in 3 hours (times are inclusive of travel between sites).

It is anticipated that if hydrothermal treatment is applied post glyphosate (e.g. glyphosate was applied in May and hydrothermal in August) then time savings would apply and cost savings could be made for the hydrothermal treatment. This view is supported by these trials because the re-application of hydrothermal treatments (e.g. August application) took less time than the initial treatments (e.g. May application). Hence the second application of the hydrothermal treatment was less expensive.

It is estimated that a hydrothermal treatment after glyphosate would also take less time as it was observed during these trials that after the May glyphosate treatment the weed densities were lower which facilitates faster hydrothermal treatment.

Hydrothermal treatment, therefore, may be best applied as a follow-up treatment after an initial glyphosate treatment or glyphosate plus stomp.

To understand the impact of speed of operation for hydrothermal treatments, the May applications took 10 hours (\$1,500) and the August treatments took 5 hours (\$750) which amounts to a total of \$2,250 (15 hours) to treat the Santiago, Chessell, Sheoak and Erindale sites. If glyphosate replaced the first hydrothermal treatment the cost would have been \$216 for glyphosate and \$475 for the hydrothermal treatment (applied 2 or 3 months after glyphosate) amounting to a total of \$691. The same area and number of applications would have cost \$508 for glyphosate. This highlights how herbicide treatments can be used in combination with hydrothermal treatments to reduce the cost of hydrothermal applications and at the same time reduce the overall use and reliance on herbicides.

The lowest cost treatment was a single application of glyphosate plus Stomp which was \$266 for the trial.

At the Shenton Avenue site the herbicide treatments covered a 2 m strip on the first (May) and second (August) treatment times and the total cost for this was \$495. In contrast the hydrothermal treatment covered a 2 m strip on the first treatment time and a 1 m strip on the second and third treatment times. The total cost for hydrothermal treatment was \$3,855 which highlights the fact that hydrothermal should be restricted to kerb and footpath edges and not used for weed control in open areas (note these comparisons are made on the same distance basis however the hydrothermal area was less for the second and third treatments).

Commercial cost comparisons: The trial costs may not accurately reflect the likely commercial costs which are often lower than trial costs due primarily to the larger scale of commercial operations. Presented below are the ranges expect for commercial quotes for weed control.

- (1) Herbicide applications usually range between \$40 and \$130 per km. The variation is due to such considerations as the concentration of the herbicide used, weather one or more herbicides are used and whether the herbicide is applied to a footpath or kerb.
- (2) A comparison made 12 months ago between companies offering hydrothermal control realised quotations ranging from \$150 to \$300 per km.

The differences are due to weed density and whether treatments were to be undertaken on kerbs or footpaths.

- (3) Recent quotes for commercial hydrothermal weed control of kerbs and footpaths range from \$60 to \$160 per km. Differences again are a result of weed density and kerb versus footpath situations.

It is also important to note that advances in hydrothermal equipment are continuing to reduce prices for this control method. In addition larger scale operations are likely to be possible as new equipment becomes more available.

Recent quotations for weed control in the City of Nedlands have shown that the herbicide approach would cost \$17,325 and the hydrothermal approach would cost \$27,522. This covered an approximate target area including roads, traffic islands and footpaths of 184 km. The approach that should be considered is using herbicides for the initial application and hydrothermal for follow up control. For large cities such as Joondalup where cost is a much greater consideration, the combination approach (of chemical and non chemical treatments) is worthy of consideration and could be contemplated as a “herbicide reduction scheme”.

Summary

Weed control: Glyphosate plus stomp provided the highest level of control, although it was not statistically different than the other treatments for the June and August measurement times. The only treatment that was statistically and consistently lower than glyphosate plus stomp was the hydrothermal treatment for the period September to March.

These results also show that the glyphosate and glyphosate plus hydrothermal treatments are as effective as glyphosate plus stomp in most situations. Hence from a weed control perspective all three of these strategies can be considered effective.

Cost: The cost per treatment on a kilometre basis is shown in table 4 below. It indicates that glyphosate plus stomp was the most cost effective means of weed control. This treatment however can not be applied in water catchments and is safest when applied in small strips. This minimizes the application area of the residual component of this mixture (e.g. Stomp).

The next most cost effective treatment was two applications of glyphosate, followed by the glyphosate plus hydrothermal combination which was not a part of the trial but is most likely the best order of applying these control methods. These treatments can be safely used in water catchment areas of the city.

Table 4. The costs per km for weed control in the City of Joondalup trail.

Treatment	May	August	November	Total
Trials cost				
Hydrothermal	\$216/km	\$158/km	\$158/km	\$532/km
Hydrothermal + Glyphosate	\$216/km	\$84/km		\$300/km
Glyphosate + Hydrothermal**	\$84/km	\$158/km		\$242/km
Glyphosate	\$84/km	\$84/km		\$168/km
Glyphosate + Pendimethalin (Stomp)	\$88/km			\$88/km

**This treatment was not a part of the experimental research undertaken and hence is an estimate based on the hydrothermal costs being lower when applied as follow-up weed control (e.g. see August hydrothermal cost compared with May hydrothermal costs).

Table 5. The mean percentage of weed control achieved for each weed control treatment at each site. For statistical differences to apply, the difference between treatments needs to be greater than 20.

Santiago Pkwy, Connolly	Jun	Aug	Sep	Nov	Jan	Mar
Glyphosate + Stomp	100	100	100	95	87	82
Glyphosate	100	98	98	93	58	53
Hydrothermal + Glyphosate	85	83	80	70	49	44
Hydrothermal	81	80	75	73	20	15
Shenton Ave, Connolly	Jun	Aug	Sep	Nov	Jan	Mar
Glyphosate + Stomp	100	95	66	47	34	29
Glyphosate	100	82	56	40	25	20
Hydrothermal + Glyphosate	84	74	55	45	23	18
Hydrothermal	80	65	38	21	13	8
Chessell Dr South Duncraig	Jun	Aug	Sep	Nov	Jan	Mar
Glyphosate + Stomp	98	87	97	86	80	75
Glyphosate	95	80	80	75	76	71
Hydrothermal + Glyphosate	96	76	70	68	64	59
Hydrothermal	97	70	58	55	50	45
Sheoak FP, Greenwood	Jun	Aug	Sep	Nov	Jan	Mar
Glyphosate + Stomp	97	95	80	75	75	70
Glyphosate	95	85	74	72	69	64
Hydrothermal + Glyphosate	90	80	68	65	25	20
Hydrothermal	91	87	56	32	30	25
Sheoak Kerb, Greenwood	Jun	Aug	Sep	Nov	Jan	Mar
Glyphosate + Stomp	100	99	79	68	38	33
Glyphosate	98	58	45	42	36	31
Hydrothermal + Glyphosate	73	56	45	46	38	33
Hydrothermal	68	51	34	27	29	24
Erindale Rd, Warwick	Jun	Aug	Sep	Nov	Jan	Mar
Glyphosate + Stomp	92	84	81	78	76	71
Glyphosate	82	79	82	77	76	71
Hydrothermal + Glyphosate	75	52	79	61	60	55
Hydrothermal	71	55	53	49	30	25
Means	Jun	Aug	Sep	Nov	Jan	Mar
Glyphosate + Stomp	98	93	84	75	65	60
Glyphosate	95	80	72	67	57	52
Hydrothermal + Glyphosate	84	70	66	59	43	38
Hydrothermal	81	68	52	43	29	24