Broadacre and optical spot spray treatments for control of milk thistle

Trial co-operator Bolland family, 'Wirra' Bullarah

Weed target: Advanced milk thistle (10/m^2)

100L/ha Rain water (SOA added to all plots) 110015 AIXR @ 2 Bar 6km/hr 3 Reps

	Date	Weed size	Time	Temp	RH%	Delta T
Timing 1	11/2/2025	Elongating	10am	28°C	53%	6.7
Timing 2	11/2/2025	Elongating	2pm	34°C	35%	11.2
Double knock	20/2/2025	Elongating	11pm	23°C	43%	6.0

Objectives of the trial

- Strategies for controlling larger milk thistle?
- Effect of Delta T on performance of glyphosate and glufosinate for control of milk thistle?
- Does Group 14 + oil antagonise or help glyphosate?
- Does Group 14 + oil antagonise or help glufosinate?
- Comparison of different Group 4 herbicides via broadacre or optical spot sprayer rates (where possible applied at equivalent application rates)
- Comparison of different paraquat options applied at optical spot sprayer rates

Two trials were conducted adjacent to each other on a population of elongating milk thistle. The first trial was a comparison of a range of post-emergent fallow options applied at 'broadacre' rates. The second trial applied herbicides at application rates equivalent to optical spot spraying rates (note: these treatments were applied with a standard hand boom to simulate OSST rates and are not a true reflection of OSST application equipment).

All treatments had 1% ammonium sulphate added.

Results for Amicide Advance in trial 1 (Treatment 17) have not been reported, due to an expected application error.

Both trials had a 'double knock' application of the 10 L/100L optical sprayer rate of Biffo (glufosinate) applied to the rear 2m of each plot, nine days after the initial treatments.

A field walk was held 24 days after the initial herbicide treatments (115 days after the double knock application).

Treatment list		Timing 1 Morning – Delta T 6.7	Timing 2 After lunch – Delta T 11.2
Broadacre fallow treatments			
Roundup Ready® Plantshield®	2.1 L/ha (1134 gai)	1 Roundup PL 2.1L	2 Roundup PL 2.1L
Glyphosate 450 CT	2.5 L/ha (1125 gai)	3 Glyphosate CT 2.5L	4 Glyphosate CT 2.5L
Crucial®	5.5 L/ha (3300 gai)	5 Crucial 5.5L	6 Crucial 5.5L
Biffo®	3.75 L/ha	7 Biffo 3.75L	8 Biffo 3.75L
Sharpen® + Hasten	17 g/ha + 1% v/v		9 Sharpen 17g
Voraxor® + Hasten	100 mL/ha + 1% v/v		10 Voraxor 100mL
Sharpen + Roundup Plantshield + Hasten*	17 g/ha + 2.1 L/ha + 1% v/v		11 Sharpen + Rup PL
Voraxor + Roundup Plantshield +Hasten	100 mL/ha + 2.1 L/ha + 1% v/v		12 Voraxor + Rup PL
Sharpen + Biffo + Hasten	17 g/ha + 3.75 L/ha + 1% v/v		13 Sharpen + Biffo
Voraxor + Biffo + Hasten	100 mL/ha + 3.75 L/ha +1% v/v		14 Voraxor + Biffo
Terrad'or® + Crucial + Hasten	40 g/ha + 1.8 L/ha + 1% v/v		15 Terrad'or + Crucial
Amine 625 + Roundup Plantshield	1.7 L/ha (1063 gai) + 2.1 L/ha		16 Amine + Rup PL
Amicide Advance 700	1.5 L/ha (1050 gai)		17 Amicide Ad 1.5L
Dropzone®	2.1 L/ha (1050 gai)		18 Dropzone 2.1L
Colex-D*	2.3 L/ha (1049 gai)		19 Colex-D 2.3L
XtendiMax® 2	1.17 L/ha		20 XtendiMax 1.17L
Flagship® 400 + Hasten	0.5 L/ha + 1% v/v (200 gai)		21 Flagship 0.5L
Monsoon® + Hasten	1.3 L/ha + 1% v/v		22 Monsoon 1.3L

Optical spot sprayer rates			
Crucial	2.75 L/100L (1650 gai)		23 Crucial 2.75L
Crucial	5.5 L/100L (3300 gai)		24 Crucial 5.5L
Biffo	6 L/100L		25 Biffo 6L
Biffo	10 L/100L		26 Biffo 10L
Voraxor + Crucial +Hasten	100 mL/100L + 2.75 L/100L + 1% v/v		27 Voraxor + Crucial
Terrad'or + Crucial + Hasten	40 g/100L + 1.8 L/100L + 1% v/v		28 Terrad'or + Crucial
Voraxor + Biffo + Hasten	100 mL/100L + 3.75 L/100L +1% v/v		29 Voraxor + Biffo
Ester 680	4.9 L/100L (3332 gai)		30 Ester 680 4.9L
Amicide Advance 700	4.8 L/100L (3360 gai)		31 Amicide Ad 4.8L
Dropzone	6.7 L/100L (3350 gai)		32 Dropzone 6.7L
Colex-D	6.16 L/100L (2809 gai)		33 Colex-D 6.16L
Trooper® 75D	4 L/100L (1200 gai 2,4-D + picloram)		34 Trooper 75-D 4L
Monsoon	4L (600 gai fluroxypyr + bromoxynil)		35 Monsoon 4L
Flagship 400	1.5 L/100L (600 gai)		36 Flagship 1.5L
Flagship 400	3 L/100L (1200 gai)		37 Flagship 3L
Gramoxone® 360 + Hasten	6.25 L/100L (2250 gai) + 1% v/v		38 Gramoxone 6.25L
Gramoxone 360 + Hasten	4.17 L/100L (1501 gai) + 1% v/v		39 Gramoxone 4.17L
Gramoxone 360 + Voraxor + Hasten	4.17 L/100L + 0.1L/100L + 1% v/v		40 GMX + Voraxor
Gramoxone 360 + Terrad'or + Hasten	4.17 L/100L + 40g/100L + 1% v/v		41 GMX + Terrad'or
Guerrilla®	5.6 L/100L* (1680 gai + amitrole) + 1% v/v		42 Guerrilla 5.6L

* Maximum label rate for milk thistle

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Trial 1 - Treatments applied at broadacre rates to advanced milk thistle.

It must be highlighted that while these treatments were applied at application rates registered for milk thistle, several of these treatments are only registered for control of smaller milk thistle.

At the first brownout assessment (10 days after application) (Figure 1), treatments containing a Group 14 herbicide demonstrated almost complete brownout of milk thistle. Whereas systemic treatments such as glyphosate or Group 4 herbicides had significantly lower brownout scores.

Four treatments were replicated under early morning application conditions (orange bars, Delta T 6.7) to explore if environmental conditions at application have a significant impact of performance of these hydrophilic herbicides.

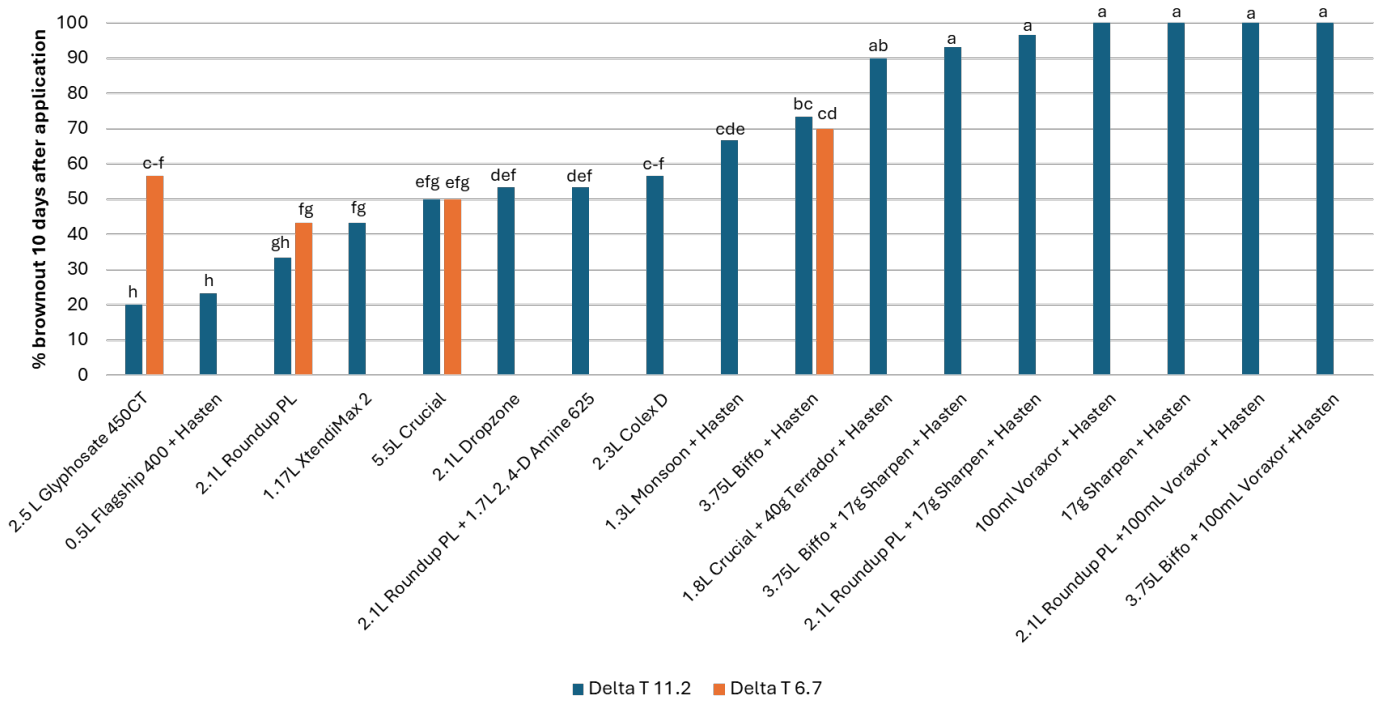

Figure 1. Brownout of large milk thistle at 10 days after application (broadacre application rates).

A second brownout assessment was conducted on 27/3/2025 (16 days after the initial application) (Figure 2). At this assessment timing there was more uniformity in brownout across treatments, with the Group 14 treatments still generally maintaining the highest levels of weed brownout.

The rear 2m of each plot had been treated with 10 L/ha of Biffo (glufosinate) to simulate an optical spot spray double knock application. At this assessment timing (9 days after the double knock application) all plots treated with the double knock application were displaying at least 80% brownout (data not shown).

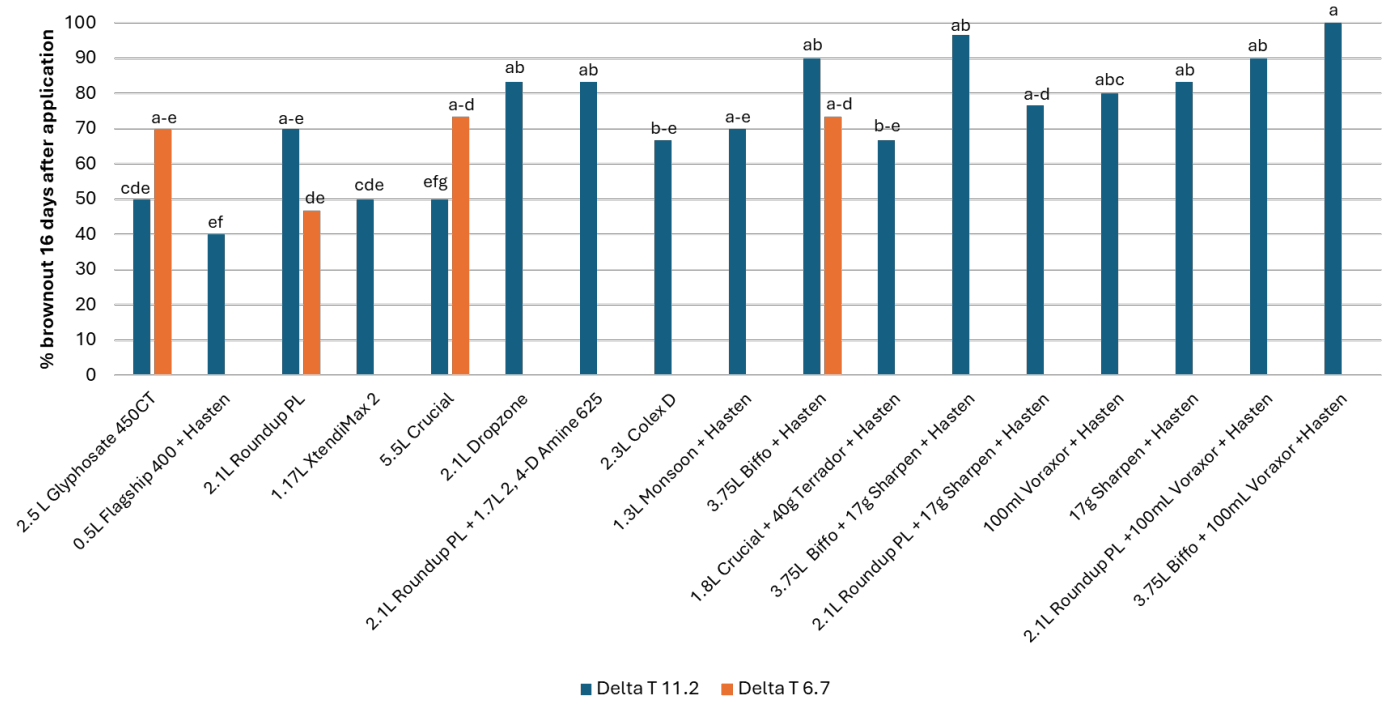

Figure 2. Brownout of large milk thistle at 16 days after application (broadacre application rates).

A final assessment was undertaken on 26/3/2025 (43 days after the initial application) to measure percentage of milk thistle that was regrowing (Figure 3). A higher % regrowth score = more plants regrowing = poorer final control.

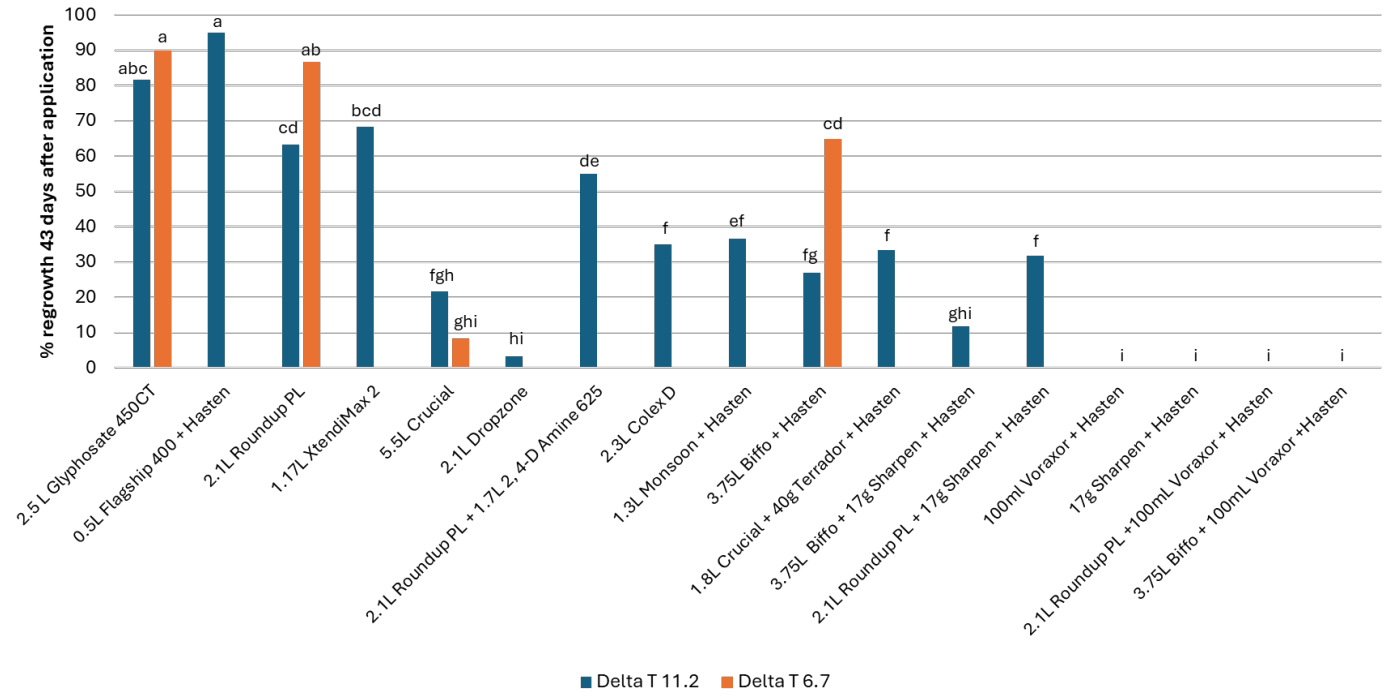

Figure 3. Regrowth of large milk thistle at 43 days after application (broadacre application rates).

There is strong evidence of glyphosate resistance in this population, with typical rates of glyphosate performing poorly, however the very high rate of Crucial did control the majority of plants.

Treatments containing Voraxor, or Sharpen when applied alone, were able to provide 100% control. However when this rate of Sharpen was taken mixed with either glyphosate of glufosinate control was reduced.

Of the Group 4 herbicides tested, XtendiMax 2 (dicamba) and Flagship 400 (fluroxypyr) failed to provide adequate control on this population. However the addition of bromoxynil to fluroxypyr (as Monsoon) provided better control than the equivalent rate of fluroxypyr alone. Within the 2,4-D treatments, only Dropzone was able to deliver a high level of regrowth suppression.

Glufosinate alone (as Biffo) at this application rate generally had unacceptable level of regrowth, unless it was mixed with a Group 14 herbicide. Interestingly, there was more regrowth occurring at the final rating from the treatment applied under the more humid (53% RH) conditions at application, compared to the later application applied on the same day (35% RH).

All treatments were double knocked with 10L of Biffo which provided 100% control and no regrowth at this final assessment timing (data not shown).

Trial 2 - Treatments applied at optical spot spray rates to advanced milk thistle.

A second trial was established adjacent to the first trial to investigate optical spot spraying technology (OSST) application rates against advanced milk thistle. While these treatments were applied at labelled OSST rates, they were applied via a hand boom with standard research nozzle configuration, so does not truly reflect commercial OSST applications.

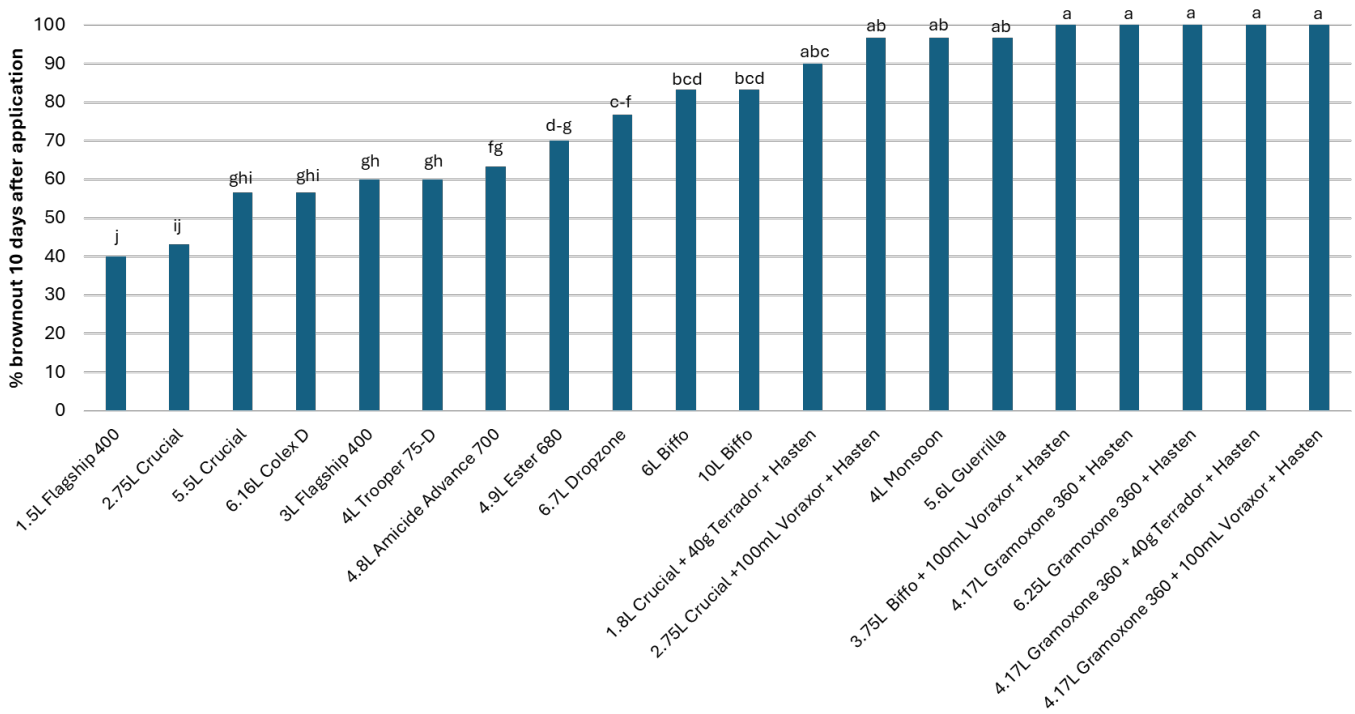

Figure 4. Brownout of large milk thistle at 10 days after application (optical sprayer rates).

At the first assessment timing (Figure4), the paraquat treatments provided complete or almost complete brownout. Monsoon (fluroxypyr + bromoxynil) and treatments containing a Group 14 herbicide were statistically similar. These results are to be expected from these fast-acting 'contact' herbicides. The 'systemic' herbicides (glyphosate and Group 4 herbicides) were showing significantly less brownout at this timing.

A second brownout rating was conducted on 27/3/2025 (16 days after the initial application) (Figure 5). As per the 'broadacre' trial, there was increased evenness in brownout scores across treatments at this more advanced timing, as the 'systemic' herbicides were starting to achieve higher levels of brownout.

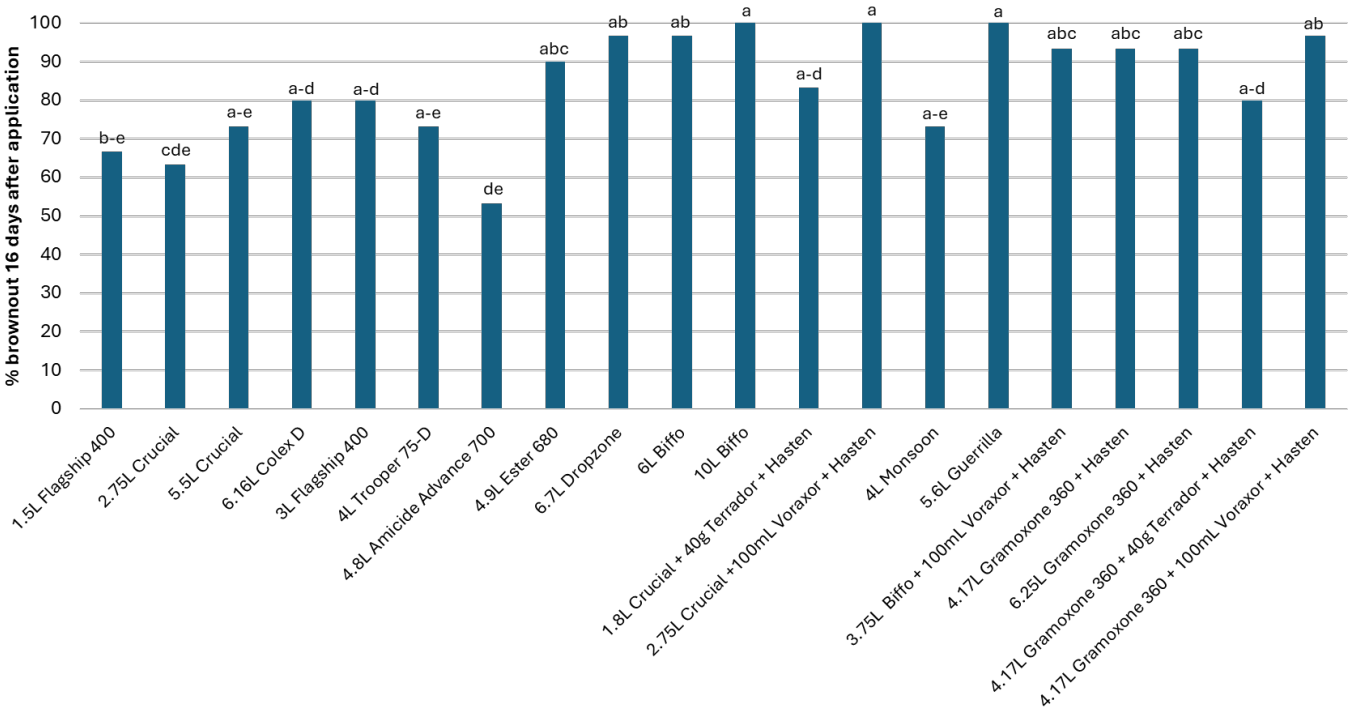

Figure 5. Brownout of large milk thistle at 16 days after application (optical sprayer rates).

The final assessment measuring 'regrowth' from these treatments was completed on 26/3/2025 (43 days after the initial application) (Figure6). As can be seen, several treatments were able to achieve 100% control of these large milk thistle plants, with no regrowth occurring.

Of particular interest

- Almost all plants treated with the lower rate of glyphosate were regrowing by 43 days after application, where these plants were not double knocked. Significantly better control was achieved at the 5.5L rate of Crucial. These trends were mirrored in the 'broadcast' trial.
- Across both trials, a dose response of glufosinate (applied as Biffo) was evident, with increasing control being achieve as rates increased from 3.75L (approximately 27% regrowth), to 6L (10% regrowth present), and finally to 10L (no regrowth present).
- Fluroxypyr (as Flagship 400) was included at an equivalent rate of fluroxypyr to what was in the Monsoon treatment, so that we could observe the additional benefit of the inclusion of the bromoxynil.

This lower rate of fluroxypyr alone left significant plants regrowing, however the addition of the bromoxynil (in Monsoon) or utilizing the maximum OSST rate for fluroxypyr (solo) both achieved full control with no regrowth.

Across both trials, a dose response to fluroxypyr (applied as Flagship 400) was evident, with the 0.5L rate having 95% regrowth, the 1.5L rate having 28% regrowth and the 3L rate having no regrowth.

- 2,4-D based treatments
    - The application rates of Amicide Advance 700, Dropzone and Ester 680 were selected to contain equivalent rates of 2,4-D (approximately 3350 gai/ha).
    - The rate of Colex-D used in this trial was 2809 gai/ha (approximately 20% lower than the other solo 2,4-D formulations).
    - Trooper 75-D (picloram + 2,4-D) at the OSST rate provides only 1200 gai/ha of 2,4-D (approximately 36% of the highest rate solo 2,4-D products), however was still statistically similar to the other 2,4-D based treatments.

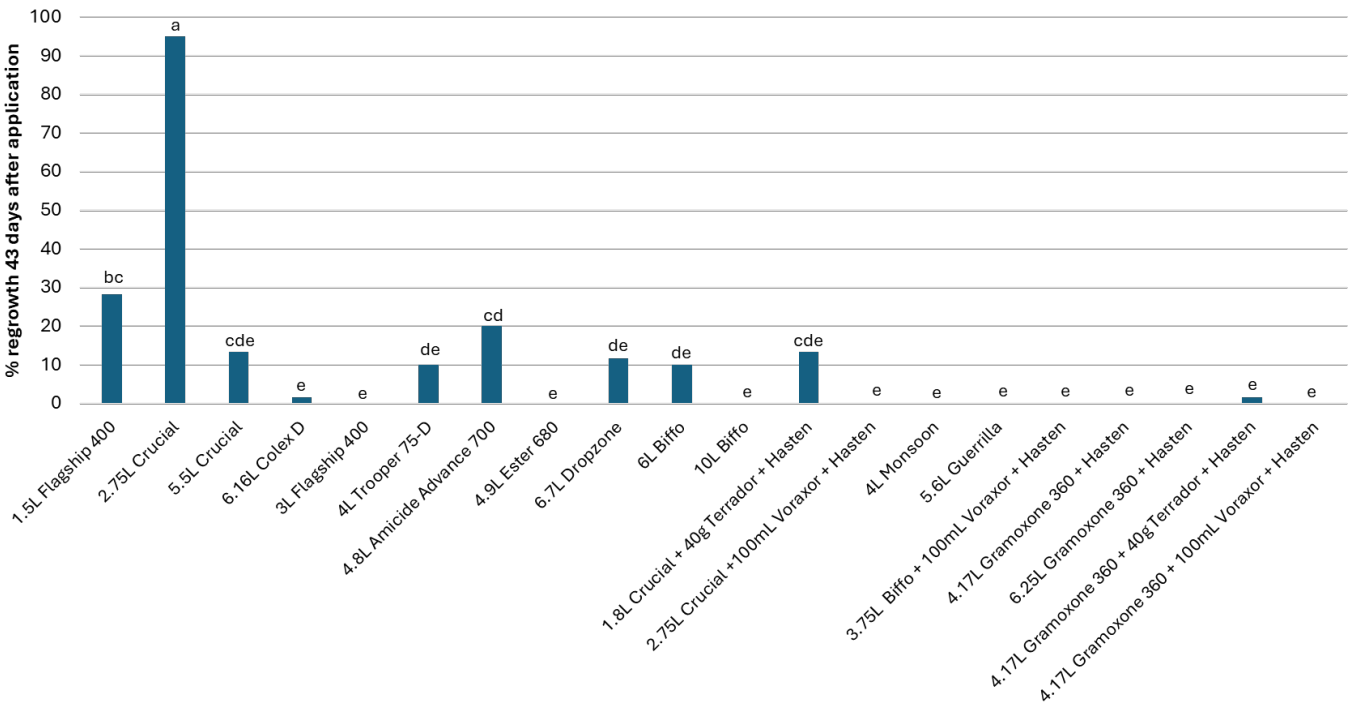

Figure 6 Regrowth of large milk thistle at 43 days after application (optical sprayer rates).

As per the previous trial, the rear 2m of all plots were also double knocked with the 10L rate of Biffo (glufosinate) which provided 100% control and no regrowth across all treatments (data not shown).

Appendix - Active ingredients of treatments

Name	Active ingredient	Concentration
Roundup Plantshield	Glyphosate as potassium salt	540 g/L
Glyphosate 450 CT	Glyphosate as isopropylamine salt	450 g/L
Crucial	Glyphosate as potassium, monomethylamine & ammonium salt	600 g/L
Biffo	Glufosinate-ammonium	200 g/L
Sharpen	Saflufenacil	700 g/kg
Hasten	Ethyl and methyl esters of fatty acids with non-ionic surfactants	704 g/L + 196 g/L
Voraxor	Saflufenacil + trifludimoxazin	250 g/L + 125 g/L
Terrad'or	Tiafenacil	700 g/kg
Amine 625	2,4-D present as the dimethylamine and diethanolamine salts	625 g/L
Amicide Advance 700	2,4-D present as the dimethylamine and monomethylamine salts	700 g/L
Dropzone	2,4-D present as the dimethylamine and monomethylamine salts	500 g/L
Colex-D	2,4-D present as the choline salt	456 g/L
XtendiMax 2	Dicamba present as the monoethanolamine salt	480 g/L
Flagship 400	Fluroxypyr present as the methylheptyl ester	400 g/L
Monsoon	Bromoxynil present as the octanoyl ester + fluroxypyr present as the methylheptyl ester	300 g/L + 150 g/L
Ester 680	2,4-D present as the 2-ethylhexyl ester	680 g/L
Trooper 75D	2,4-D as the triisopropanolamine salt + picloram as the triisopropanolamine salt	300 g/L + 75 g/L
Gramoxone 360	Paraquat present as paraquat dichloride	360 g/L
Guerrilla	Paraquat present as paraquat dichloride + amitrole	300 g/L +12 g/L

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