Demonstrating the effect of water quality on glyphosate efficacy

The aim of this demonstration was to investigate the effect of water quality on glyphosate efficacy when used in a spring-spraying knockdown scenario. A number of different water ameliorants were compared in four levels of water quality: hard 340ppm ($CaCO_3$), very hard 1000ppm ($CaCO_3$), local dam water (alkaline & turbid) and rainwater. The demonstration was undertaken near Birchip in early spring, as a knockdown in a pasture of wild oat, annual ryegrass and Morava vetch.

Summary

The effect of water quality did have an effect on the efficacy of the chemicals applied. Glyphosate applied with very hard (1000ppm) water did not provide effective knockdown compared with treatments which used hard (340ppm) water or rain water. Interestingly, some of the rainwater + glyphosate treatments resulted in varying degrees of 'brownout' depending on the wetter or ameliorant with which it was mixed.

Background

Following the 2002 drought, water availability has been a problem for spraying, and using rainwater has not been possible in many cases. Spray application failure is common and it is easy to jump to conclusions as to why it occurred. Herbicide resistance, weather conditions, and particularly with glyphosate, dust from tractor tyres are regularly blamed for poor spray results. Glyphosate is very sensitive to hard water, and more particularly, positive calcium and magnesium ions. The glyphosate molecule carries a net negative charge while metal ions carry a net positive charge, so when these two come together in a tank mix they bind to each other. This disengages the glyphosate by the processes of deactivation, breakdown or precipitation, making it unavailable to kill the plant. Very hard (>1000ppm $CaCO_3$) water is also known to affect wetters and oils and will change their wetting or emulsifying properties.

It is important to know the quality of your water before considering its suitability for spraying. There are many products on the market which claim to alleviate the problems associated with poor quality water. This demonstration included most of the commonly used water quality ameliorants.

Methods

This demonstration was sprayed on October 7, 2003. The spray target contained a range of weeds and volunteer vetch which were at the following growth stages:

- wild oat: Z59 (full head emergence)
- vetch: early flowering
- annual ryegrass: Z55 (mid head emergence)

All treatments were compared at the same rate of active ingredient (applied at 600ml/ha Roundup CT® with 100L/ha spray volume, 11001 nozzles at 2 bar using 3m-wide hand boom) (see Table 1 for ameliorants used).

Monitoring was carried out four weeks post spraying. At this stage a phytotoxicity score was assigned to each plot, indicating the level of 'brownout' observed at this stage in each plot.

Table 1. Description of adjuvants and water ameliorators used.

Product	Description
Non-ionic wetter	Bio-degradable, non-ionic wetting and spreading agent
Hotup	Contains wetters, ammonium sulphate and mineral oils. Best used for hard water and hot conditions
Liase	An aqueous solution of ammonium sulphate that is used to reduce antagonism with glyphosate in hard water.
LI-700	Acidifying agent and surfactant, useful when spraying with alkaline water.

Results

Phytotoxicity scores for vetch and annual ryegrass can be seen in Tables 2 and 3 for each treatment. There were varying levels of control depending on quality of water used, additives in spray mix and target species. Results for wild oat control have not been included because of excellent control with all treatments.

Table 2. Vetch: Phytotoxicity scores four weeks post spraying.

Water	No adjuvant	Wetter 0.1%	Hotup #	LI- 700 0.2%	Wetter + Liase 1%	Liase 2%	New VCC* adjuvant 0.5%
Rain	7	5	5	6	6	5	4
Hard	6	3	6	5	5	6	6
Very hard	4	2	5	4	6	5	5
Dam	4	4	4	6	5	5	5

Table 3. Annual ryegrass: Phytotoxicity scores four weeks post spraying.

Water	No adjuvant	Wetter 0.1%	Hotup #	LI- 700 0.2%	Wetter + Liase 1%	Liase 2%	New VCC* adjuvant 0.5%
Rain	7	7	8	6	8	7	6
Hard	8	6	8	7	7	8	8
Very hard	6	6	8	6	7	7	7
Dam	7	8	8	8	8	7	7

*VCC = Victorian Chemical Company

Note: Hotup was used at 0.25% in rain water, 0.35% in hard water, 1% in very hard water and 0.5% in dam water.

Scores for phytotoxicity: European Weed Research Council (EWRC) scoring method: 1 = no symptoms, 3 = slight symptoms, effects reversible, 5 = severe discolouration and stunting, 7 = heavy damage, some plants killed, 9 = complete loss of plants.

Interpretation

Because this experiment was a demonstration rather than a replicated trial, statistical analysis cannot be performed. However, there is some valuable information in Tables 2 and 3. A number of treatments resulted in a very similar control. Glyphosate at 600ml/ha in hard (340ppm) water without additives, resulted in good control of target species, a score of 6 for vetch, 9 for wild oat and 8 for annual ryegrass, giving an average brown out of 76%. This is not recommended practice.

Hotup at 0.35% and the new VCC adjuvant at 0.5% in hard water (340ppm) both resulted in very similar and effective control, with the same scores each for vetch, wild oat and annual ryegrass of 6, 9 and 8 respectively. Average ‘brownout’ score allocated to glyphosate without LI-700 was 66.7%; however LI-700 improved the efficacy of glyphosate with local dam water by 10% (average brownout of 76.7%).

The treatment using very hard water (1000ppm) generally resulted in poor control. The least effective treatment in this demonstration was the mix of glyphosate with

1000ppm hard water and non-ionic wetter; a brownout of only 56.7% was observed. There were two treatments that still performed reasonably well in the presence of very hard water, glyphosate with Hotup and Liase with 1000ppm hard water saw brownout of over 73%, although glyphosate + wetter + Liase had slightly better activity on vetch.

Commercial Practice

There is little doubt that using rainwater on every spray job would be ideal in a perfect world. Unfortunately this is not the case. We need to get spray jobs done on time and with the best possible result. Information from this demonstration indicates ameliorants have an effect on glyphosate efficacy in a range of water quality scenarios. The information above suggests that when using high pH and turbid water LI-700 can be beneficial. It also suggests that Hotup at 0.35% could alleviate the problems associated with hard water (340ppm and 1000ppm).

It is very important to remember that when using products such as Liase and Hotup, they MUST be put in the tank BEFORE the glyphosate. If the glyphosate is put in first, there is no point in adding the ameliorant. The amelioration product must be in contact with the water prior to the glyphosate so it has time to deactivate the positive ions.