Summer spray adjuvants

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Take home messages

- *Based on current prices, adjuvants can account for 5 – 50% of the total cost of application. It is worth getting it right.*
- *Vegetable oils (Infiltrator, Hasten) in general performed better than BS1000, Hot-up and Companion. Wet-as, which contains additional ammonium sulphate to the applied base rate also worked well.*
- *Based on cost, Infiltrator was the best adjuvant to accompany Roundup CT.*

Background

To improve herbicide uptake by the weed, there are a number of adjuvants currently available to accompany herbicides such as glyphosate (Roundup CT). The cost of adjuvants is seen by some as a minor issue, however, the cost of adjuvants ranges from $0.50 – $4.00/ha and based on the current Roundup CT price ($3.50/L), could account for up to 50% of a summer spray application cost.

Spray adjuvants can have different purposes that may be required in certain situations. Below are some categories of adjuvants. Blends of specific categories such as wetters are listed separately.

Water conditioners (Liase/ammonium sulphate): are used to soften hard water (>340mg/kg $CaCO_3$) and may improve performance of Roundup CT in dry, hot environmental conditions.

Buffers/acidifiers/wetters (Companion, LI700): are used to decrease the pH of the water and improve compatibility of herbicides by preventing alkaline hydrolysis.

Wetters/spreaders/surfactants (BS1000): improve herbicide uptake into waxy-leaf targets.

Vegetable oils (Hasten, Infiltrator): are products that are blends of esterified vegetable oils and non-ionic surfactants. The surfactant is designed to improve droplet contact on to the leaf surface, the esterified vegetable oil improves penetrability.

Mineral oils (Uptake, Hot-up): improve the penetration of herbicide into the plant.

Aim

To evaluate a number of commercially available adjuvants to accompany glyphosate for summer weed control.

Method

Location:	Kooloonong
Soil type:	Sandy rise
Replicates:	3

Application date: 3 January 2009

Target weeds: Bindii, afghan melons and pigweed (water weed).

Weather conditions: Temp 24°C, Humidity 21%, Wind 2.7km/hr, Delta T 12

Nozzle type: TT110-02

Droplet size: Coarse

Water hardness: Hard

Water rate: 80L/ha

A base rate of 417g/ha (1L/ha Liase) was applied to correct water hardness. This correction would allow each treatment to be compared without the confounding effect of some of the products containing ammonium sulphate. Table 1 lists the treatments and the rates used in this trial.

A low rate of glyphosate (Roundup CT 450g ai/L) 800mL/ha was used in all treatments other than the control (Table 1) to ensure any treatment effects were due to the addition of the adjuvant and not a robust rate of glyphosate.

Visual weed control ratings (EWRC) of 1 (alive) to 10 (dead) were made 24 days after spraying.

Table 1. Treatments, active ingredients and rates used in the trial.

Product name	Classification	Active ingredient	Rate
Control (no herbicide)	-	No herbicide or adjuvants	-
No adjuvant	Herbicide	glyphosate (450g a.i/L)	800mL/ha
BS1000	Wetter	1000g/L alcohol alkoxylate	0.15% v/v
Hasten	Vegetable oil plus wetter	704g/L ethyl and methyl esters of vegetable oil plus non-ionic surfactant	0.50% v/v
Companion	Surfactant and acidifier	350g/L soyal phospholipids + 350g/L propionic acid	0.50% v/v
Infiltrator	Vegetable oil	700g/L vegetable oil ester	0.50% v/v
Wet-as	Water conditioner & wetter	410g/L ammonium sulphate + 158g/L non-ionic surfactant	0.50% v/v
Uptake	Mineral oil plus wetter	528g/L paraffinic oil + 240g/L non-ionic surfactant	0.50% v/v
Hot-up	Mineral oil plus water conditioner	190g/L mineral oil + 140g/L ammonium sulphate	0.25% v/v
Hot-up	Mineral oil plus water conditioner	As above	0.50% v/v

Results

Despite less than ideal spray conditions (Delta T: 12), Wet-as, Hasten, Infiltrator and Hot-up 0.25% significantly improved weed control compared to the Control and the Roundup CT only treatment (Table 2). BS1000 was equally as effective as Uptake, Companion, Hot-up (both rates) and Wet-as but they did little to improve the effectiveness of weed control compared to the Roundup CT only treatment.

Table 2. Plot EWRC scores taken 24 days after application.

Adjuvant	EWRC
Control (no herbicide)	3*
No adjuvant	5
BS1000	6
Hasten	9
Companion	7
Infiltrator	9
Wet-as	8
Uptake	7
Hot-up 0.25%	8
Hot-up 0.50%	6
Sig. diff	**P<0.001**
LSD (P<0.05)	**3**
CV (%)	**25.0**

** Natural senescence*

Differences in terms of control on various weed species were evident between treatments (Table 3). Control of bindii and afghan melons was significantly improved by Hasten. Infiltrator, Wet-as and Hot-up 0.5% was significantly better than the straight Roundup CT treatment.

Pigweed (waterweed) was barely affected by the herbicide with no difference in control between any of the adjuvant treatments.

Table 3. Effect of treatments on individual weed species.

Treatment	EWRC		
	Melons	Bindii	Pigweed
Control (no herbicide)	3	4	2
No adjuvant	6	7	4
BS1000	6	6	3
Hasten	9	9	5
Companion	8	7	2
Infiltrator	7	9	4
Wet-as	8	9	2
Uptake	3	7	5
Hot-up 0.25%	7	7	4
Hot-up 0.50%	7	10	3
Sig. diff	**P= 0.05**	**P= 0.031**	**NS**
LSD (P<0.05)	**3**	**3**	
CV (%)	**24.7**	**24.6**	**46.5**

An observation was made that the rate of Roundup CT in most cases was not adequate to completely kill the melons.

Interpretation

The results of this trial have shown that differences do exist between adjuvants. Vegetable oils (Hasten and Infiltrator) as an adjuvant category were the most effective on the majority of weed species present. In this trial BS1000 and mineral oils (Hot-up & Uptake) did little to improve the activity from the straight application of Roundup on a whole plot basis (Table 2).

On a weed specific basis Hot-up 0.50% was equally effective as Infiltrator and Hasten on bindii and melons. The results published in Table 2 are subjective to weed populations. For example, if there was only 2 bindii plants in the whole plot and >30 pigweed, given one weed (bindii) was easily killed compared to the other (pigweed), the plot score would have been lower than if populations were reversed. This is why the subsequent individual weed species assessment was made. In the case of melons, all the adjuvants were arguably the same.

Adjuvant costs vary widely depending on the type and concentration of active ingredient in the product. In general non-ionic surfactants and crop-oil concentrates are the least expensive followed by esterified seed oils and water acidifiers. Table 4 below shows the current cost of these adjuvants plus Roundup CT. The rate of Roundup CT is assumed to be 1L/ha at $3.50/L. The cost of ammonium sulphate depends on the source you use: for example, crystallised ammonium sulphate costs $0.50/ha compared to Liase $1.90/ha. For the simplicity of this table, the cost of ammonium sulphate was not included in the below costings.

Table 4. Current costing of the products used in this trial.

Adjuvant	Prices as of January 2010		
	Cost ($/L)	Cost ($/ha)	Total cost ($/ha)
BS1000	5.50	0.65	4.15
Hasten	6.00	2.40	5.90
Companion	9.55	3.80	7.30
Infiltrator	4.90	1.95	5.45
Wet-as	3.80	1.50	5.00
Uptake	6.00	2.40	5.90
Hot-up 0.25%	8.25	1.65	5.15
Hot-up 0.50%	8.25	3.30	6.80

Note: *Hot-up and Wet-as contain ammonium sulphate.*

Given the effectiveness of vegetable oils, both Infiltrator and Hasten have given the best return. Infiltrator has the advantage of being cheaper. Wet-as contains ammonium sulphate (water conditioner) and wetting agent and performed very well in this trial. The addition of ammonium sulphate makes it quite cheap and subsequently it removes the need for an additional product.

The trial tested most products at the same rate (0.5% v/v); but it should be recognised that some of the adjuvants used in the trial offer a label rate range; thereby potentially changing the performance or cost.

Optimum results with summer weed control are achieved when weeds are sprayed early, when they are young and actively growing. Spray when conditions are ideal with winds 3 – 15km/hr and Delta T between 2 and 8, which is often in the early parts of the morning. The quality of water still needs to be known so the correct adjuvant can be chosen to compensate. Ammonium sulphate is cheap and is now commonly recommended in mixtures. Under these circumstances, you will find the activity of the herbicide will be maximised.

Given current low prices of glyphosate; a robust rate of herbicide is one of the best ways to ensure reliable results.

Some adjuvants have other advantages ie: LI700 acts as a wetter and penetrant but also reduces the number of fine droplets which is important for spray drift management.