Canola tolerance to clethodim

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Key findings

- Grain yield losses of up to 40% can be caused by clethodim at particular rates and timings.
- Early application timings were the best to avoid crop damage.
- Variation does exist between herbicide tolerant crop types (Conventional, Clearfield and TT) and their level of sensitivity to clethodim.

Why do the trial?

Given the widespread importance of clethodim use in crop rotations and increased application rates to combat herbicide resistant annual ryegrass, a field trial at Hart was established to identify the level of crop tolerance to clethodim rates in canola. The level of yield losses that may occur from the use of high clethodim rates is relatively unknown. Observed crop damage symptoms include, delayed flowering, distorted flower buds and possible grain yield suppression. Symptoms appear to be more severe from later application timings. Other factors that may influence crop effects include herbicide rate, crop stress at herbicide application and possible varietal differences in tolerance. The purpose of this trial was to investigate the level of damage that may occur from clethodim applications and what factors might influence the degree of damage, over two seasons.

How was it done?

Plot size	1.75 m x 10 m	**Fertiliser**	DAP (18:20) 2% Zn @ 100 kg/ha
Seeding date	4th May 2014		UAN (42:0) @ 110 L/ha on 13th June
			UAN (42:0) @ 95 L/ha on 7th July

Table 1. Clethodim treatments applied at Hart during 2014.

CLETHODIM TREATMENTS
1. Untreated control
2. 0.5 L/ha applied at 4-leaf growth stage
3. 1 L/ha applied at 4-leaf growth stage
4. 0.5 L/ha applied at 8-leaf growth stage
5. 1 L/ha applied at 8-leaf growth stage
6. 0.25 L/ha applied at 4-leaf and 8-leaf growth stages (0.5 L/ha in total)
7. 0.5 L/ha applied at 4-leaf and 8-leaf growth stages (1 L/ha in total)
8. 0.5 L/ha applied at bud initiation (ie. first visible green buds)
9. 1 L/ha applied at bud initiation

Application of clethodim at 1 L/ha is not a registered rate and was undertaken for experimental purposes.

The trial was established as a split-plot design with three replicates. Three canola varieties were used; AV Garnet (conventional), ATR Gem (triazine tolerant) and Hyola 474 CL (Clearfield) to investigate the influence of clethodim rate and timing. Nine clethodim treatments were applied to each variety (Table 1). This trial was aimed at investigating the impact of clethodim on crop safety rather than weed control.

Spray treatments for each growth stage were applied on the same day for each variety. As a result the exact growth stage at the time of application for each variety may have differed slightly, despite all varieties used in this trial being of very similar maturity. Following each spray application NDVI readings using a Greenseeker and visual damage scores were recorded.

Results and discussion

This was the second year this trial has been run at Hart. The 2014 trial showed similar results across clethodim treatments that were observed in 2013 however, crop damage was less severe during 2014.

A range of damage symptoms were observed and consistent across both seasons. The first of which was a slight change in the colour of the crop canopy. The more damaged or sensitive plots become paler green in colour as compared to the untreated control plots. There were no visual changes in overall crop biomass or any significant change in NDVI between treatments in this particular trial. As the crop further developed to reach flowering the damage symptoms become more pronounced. The flower buds become distorted and failed to open up fully leading to poor pod development (Figure 1), which resulted in reduced grain yields. The grain yield losses were strongly correlated to the severity of the observed visual symptoms.

Figure 1. Canola displaying damage symptoms caused by clethodim (left) compared to healthy unaffected canola (right).

Of the varieties tested the conventional type variety AV Garnet appeared to show a greater level of tolerance to clethodim compared to the other varieties across both seasons. Both ATR Gem (TT) and Hyola 474CL were very similar in their response to clethodim, both incurring almost 40% yield losses in the most damaging clethodim treatment in both years (Table 2). In the same treatment AV Garnet only suffered an 8-10% yield reduction.

The latest application time caused the most visual crop damage resulting in the largest grain yield losses (Table 2). Applications of 0.5 L/ha within current label recommendations of up until flower buds become visible appear relatively safe in this trial across both seasons. All treatments sprayed with a single label rate application of 0.5 L/ha up to the 8-leaf growth stage were not significantly different from the unsprayed control for any variety. Early sprays (4-leaf growth stage) at 1.0 L/ha had no significant implications on grain yield for any variety over the two years of this trial (Table 2). Yield reductions were also not observed at the 1 L/ha rate when applied at 8-leaf growth stage during 2014. However, past results would suggest the risk of yield reductions is high with significant yield losses of up to 13% in ATR Gem and Hyola 474CL during 2013. The split application appeared to improve the safety of the 1.0 L/ha treatment when it was applied over two applications rather than in one application at the later 8-leaf timing during 2013. This wasn't observed in the 2014 trial as the single 8-leaf application did not cause any significant yield reduction.

Table 2. Effect of clethodim applied at different timings and rates on the grain yield of canola at Hart during 2013 and 2014. Highlighted values indicate significantly less than untreated (p≤0.05).

Application timing	Clethodim rate	ATR Gem		AV Garnet		Hyola 474CL	
		2013	*2014*	*2013*	*2014*	*2013*	*2014*
Untreated		1.11 t/ha	1.65 t/ha	1.37 t/ha	2.11 t/ha	1.69 t/ha	2.06 t/ha
		----------grain yield % of control----------					
4 leaf	0.5L/ha	98	95	99	101	100	101
	1L/ha	94	99	106	100	96	98
8 leaf	0.5L/ha	99	102	104	95	96	97
	1L/ha	87	101	106	97	87	99
4 leaf and	0.25L/ha + 0.25L/ha	91	103	102	98	92	104
8 leaf split	0.5L/ha + 0.5L/ha	95	103	103	98	91	102
Bud initiation	0.5L/ha	80	95	97	96	87	93
	1L/ha	61	66	90	92	61	60

The latest timing treatment used in this study at bud initiation which is outside current label recommendations was found to be highly damaging causing significant yield reductions in all varieties across both seasons (Table 2). Depending on the variety, grain yields could be reduced by as much as 20% at 0.5 L/ha and up to 40% at 1 L/ha.

Implications

Increased application rates of clethodim have created concern due to crop damage in canola, which is the most sensitive crop of those registered for clethodim use. Two seasons of trials at Hart has shown late timings (bud initiation) of clethodim can result in severe yield losses. Care should be taken to apply clethodim at correct growth stages and application rates. Applications exceeding 0.5 L/ha are at high risk of causing yield reductions in most canola varieties. From the trial results it is evident that the early application at 4-leaf growth stage of canola was the safest on the crop but this may not be always the best time of application for targeting weed control. For example, a large proportion of the weed population may germinate later, requiring additional follow up sprays or delaying initial spray applications. Or higher rates might be required to achieve acceptable control of weed populations developing resistance. This may require a compromise in rates and timings for best control weeds while minimising the risk of crop damage.

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