TruFlex/Clearfield (XC) GM dual herbicide stacked canola for integrated management of annual ryegrass

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Key messages

- Stacked tolerance in canola offers multiple options and timings to control annual ryegrass
- Good early weed control is essential to reducing weed numbers in crop
- Resistance to the imidazolinone herbicides is present in most annual ryegrass populations making strategies reliant on these herbicides ineffective.

Aims

This research examines the efficacy of different herbicide strategies in TruFlex/Clearfield canola compared to TruFlex, Clearfield, Clearfield/TT and TT to determine the best management practices for annual ryegrass control.

Introduction

Annual ryegrass (*Lolium rigidum*) is a major weed of crops across southern Australia. Annual ryegrass has evolved resistance to many of the herbicides used for its control. Annual ryegrass has evolved resistance to most post-emergent herbicides, including clethodim across southern Australia. This makes management of herbicide resistant annual ryegrass challenging in canola, as there is now heavy reliance on pre-emergent herbicides. The introduction of Roundup Ready canola provided a new opportunity to control annual ryegrass in canola. The introduction of TruFlex canola increased the window and rate of glyphosate that can be used in canola.

In the past few years, stacked herbicide tolerant canola have been developed. These allow the use of multiple herbicides in canola and provide new opportunities to control annual ryegrass. The increasing complexity of potential use patterns with stacked herbicide tolerant canola varieties can make it difficult to determine the best strategy to use. TruFlex/Clearfield (XC) dual herbicide stacked canola allows several possible use patterns. One is to use the Clearfield trait to manage imidazolinone soil residues. A second opportunity is to use imidazolinone herbicides as an addition or as a replacement of one of the glyphosate applications. This research established three trials to compare a range of herbicide strategies for the control of annual ryegrass.

Method

Trials were established at Frankland WA, Morbinning WA and Teesdale, Vic with canola technologies and herbicide strategies as indicated in Table 1. Five different canola technologies were included: TruFlex (XX), Clearfield (CL), Triazine tolerant (TT) and dual tolerant lines TruFlex/Clearfield XC and Clearfield/Triazine CT. All crop varieties were hybrids, except the open pollinated TT. The varieties used at all sites were: Hyola 410XX, Hyola 540XC, ADV-Equinox CL, Hyola Enforcer CT, and ATR Bonito TT.

The site at Teesdale was sown on 20th April, Morbinning on 28th April and Frankland on 30th April, 2020. A knockdown herbicide application and a pre-emergent herbicide application of 500 g ha^{-1} propyzamide (Edge) were applied at all sites. Annual ryegrass plant counts

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were made 28 days after the 4 to 6-leaf herbicide application. Annual ryegrass seed heads were assessed just prior to harvest. Data were analysed by ANOVA and means separated by Tukey's Honest Significant Difference test. Data were subjected to square root transformation if necessary to ensure variances were equal.

Table 1. Herbicide strategies used in all three trials.

Treatment	Canola type	PSPE	2 to 4-leaf	4 to 6-leaf	First flower	Crop top
1	Hybrid XC			Intervix		
2	Hybrid XX			High RRH	High RRH	
3	Hybrid XC			High RRH	High RRH	
4	Hybrid XX		Low RRH	Low RRH	Low RRH	
5	Hybrid XC		Intervix	High RRH	High RRH	
6	Hybrid XC			High RRH + Intervix	High RRH	
7	Hybrid XC			Intervix		RUM
8	Hybrid XX		Low RRH		Low RRH	RUM
9	Hybrid XC		Low RRH		Low RRH	RUM
10	Hybrid XC		Intervix	Low RRH	Low RRH	RUM
11	Hybrid XC			Low RRH + Intervix	Low RRH	RUM
12	Hybrid XX			Low RRH	Low RRH	RUM
13	Hybrid CL			Intervix + Clethodim		
14	Hybrid CL			Intervix + Clethodim		RUM
15	Hybrid CT	Atrazine		Atrazine + Intervix + Clethodim		
16	Hybrid CT	Atrazine		Atrazine + Intervix + Clethodim		RUM
17	OP TT	Atrazine		Atrazine + Clethodim		
18	OP TT	Atrazine		Atrazine + Clethodim		RUM

Herbicides and rates used: Atrazine 1.1 kg ha^{-1} Kelpie A-zine; Intervix 750 ml ha^{-1}; Clethodim 500 mL ha^{-1}; RRH Roundup Ready Herbicide 0.9 kg ha^{-1} (Low) or 1.3 kg ha^{-1} (High); RUM Roudup Ultra Max 3.4 L ha^{-1}.

Results

There were significant differences in annual ryegrass plants, annual ryegrass spikes and canola yield at all sites (Table 2). Herbicide resistance was present in annual ryegrass at all the sites with high levels of resistance to Intervix present at Frankland and to clethodim at Teesdale. There were low levels of resistance to Intervix and glyphosate at Teesdale.

Herbicide strategies that relied on Intervix or clethodim (Treatments 1, 7 and 13-18) tended to have higher annual ryegrass populations at all three sites compared with the treatments that included

Roundup Ready Herbicide (RRH) treatments (Table 2). In these trials, similar control was achieved from 2 or 3 applications of RRH. Substituting Intervix for one of the low rate RRH applications also provided similar levels of control.

Table 2. Annual ryegrass populations and canola yield in response to the various treatments. Treatments are listed in Table 1. Annual ryegrass plant numbers were assessed 28 days after the 4 to 6-leaf herbicide applications. Annual ryegrass spikes were assessed prior to harvest. Different letters within a column indicate treatments that are significantly different.

Treatment	Annual ryegrass (plants m^{-2})			Annual ryegrass (spikes $plot^{-1}$)			Canola yield (T ha^{-1})		
	F	M	T	F	M	T	F	M	T
1	25.5a-d	2.5ab	7.1a	39bc	39.5ab	240a	2.19ab	1.12c	3.57a
2	8.5ef	0c	0.4c	5.8e	0d	14.8de	2.53ab	1.76ab	3.73a
3	7.5ef	0.1c	0.8bc	6.5e	0d	13.5de	2.44ab	1.46abc	3.71a
4	5f	0.1c	0.2c	9.5e	0d	8.8de	2.50ab	1.85a	3.81a
5	8.8ef	0.1c	0.5bc	7.5e	1d	12de	2.49ab	1.43bc	3.70a
6	6f	0c	0.2c	7.5e	0d	4de	2.47ab	1.42bc	3.74a
7	33.5ab	3.9a	6.9a	36bcd	19.5b	168ab	2.24ab	1.21bc	3.66a
8	15.5def	0.2c	1.9bc	7e	2.5cd	26.5d	2.50ab	1.93a	3.74a
9	18.3cde	0.2c	1.8bc	8e	1d	32.5d	2.43ab	1.55abc	3.79a
10	7.5ef	0.1c	0.1c	4.3e	1d	2.3e	2.59a	1.51abc	3.94a
11	7.5ef	0.2c	0.2c	7.3e	0d	2.3e	2.59a	1.51abc	3.92a
12	8ef	0c	0.5bc	8.5e	0d	8.8de	2.63a	1.86a	3.78a
13	31.5ab	1.7ab	6.3a	26.3cde	46a	188ab	2.14ab	1.50abc	3.92a
14	34a	2ab	5.6a	31.3cde	18b	136bc	2.26ab	1.62abc	4.08a
15	24a-d	2ab	4.9a	21.3de	9.3bc	124bc	2.16ab	1.57abc	3.79a
16	20.5b-e	1.9ab	5.8a	26cde	6.8c	89.3c	2.26ab	1.69ab	3.71a
17	29abc	2.4ab	5a	57.8a	19.8b	177ab	1.69b	1.32bc	2.88b
18	30abc	1.6b	4ab	53ab	18.8b	171ab	1.85ab	1.40bc	2.86b
P	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.018	<0.0001	<0.0001

Annual ryegrass spike numbers tended to follow plant numbers in crop. Crop topping reduced spike numbers in some treatments compared to the same treatment without crop topping, probably by reducing late head production. However, crop topping would be expected to reduce weed seed carryover into the next crop.

The OP TT varieties (Treatments 17 and 18) tended to have lower yield than where hybrid canola was used. There was a tendency for higher yields where early weed control at the 2 to 4-leaf stage was employed.

The extent of resistance to the imidazolinone herbicides and clethodim in annual ryegrass populations in southern Australia mean that annual ryegrass can be difficult to control in TT and CL canola. In such situations, annual ryegrass control is reliant on pre-emergent herbicides, which do not control late emerging annual ryegrass. In these trials, weed populations tended to be higher in CL, CT and TT canola and where Intervix was the only post-emergent herbicide used in XC canola.

There was little difference among the various herbicide strategies used in XX and XC canola, with the exception of Intervix used alone; however, good early control of annual ryegrass tended to increase

yields. Crop topping is important for reducing annual ryegrass seed set and should be factored into the weed management strategy along with harvest weed seed control practices.

Conclusion

XX and XC canola provide opportunities to control annual ryegrass with resistance to imidazolinone and clethodim herbicides. XC canola will also allow management of imidazolinone soil residues right across Australia, even if imidazolinone herbicides are not used in crop.

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