A three year strategy to manage clethodim resistant ryegrass without oaten hay

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Key Findings

- Effective management of clethodim-resistant ryegrass can be achieved by using combinations of control tactics, effective herbicide strategies, and more competitive crops.
- Oaten hay remains one of the most effective phases for ryegrass management but effective control of ryegrass regrowth and seed set are of critical importance.

Why do the trial?

Clethodim (i.e. Select®) has been an important herbicide for controlling annual ryegrass in break crops in South Australia, allowing weed populations to be reduced prior to sowing wheat. However, clethodim resistance in annual ryegrass is increasing across the Mid-North of South Australia and this could threaten the value of break crops in cropping rotations.

Crop rotation is important to the overall success of long-term ryegrass management. Oaten hay is a popular and profitable option for growers to reduce ryegrass numbers. However, not all growers want to include oaten hay in their rotations. Therefore, other suitable strategies for managing clethodim resistant annual ryegrass need to be identified.

A three year rotation trial was established at the Hart Field-Site on a population with resistance to clethodim and butroxydim to examine the impact and profitability of different strategies for managing clethodim-resistant annual ryegrass.

How was it done?

In year 1 of the study (2013), ryegrass seed from Roseworthy with low-medium level resistance to clethodim and butroxydim was hand broadcast and lightly incorporated across the site to establish a seedbank.

The trial comprised two three year rotations of pea/wheat/barley and canola/wheat/barley. In 2014 field peas and canola were sown, followed by wheat in 2015, and barley last season (2016). A standard knife-point press wheel system was used to sow the trials on 22.5 cm (9") row spacings. Sowing and fertiliser rates were undertaken as per district practice.

Herbicide strategies reflected low (HS1), medium (HS2) and high (HS3) intensity of ryegrass management:

Herbicides for Kaspa field peas:

HS1. Trifluralin (1.6 L/ha) + clethodim (0.7 L/ha)
HS2. Triallate (2.0 L/ha) + propyzamide (1.0 L/ha) + trifluralin (1.6 L/ha) + clethodim (0.7 L/ha) + CT (paraquat)
HS3. Triallate + propyzamide + trifluralin + clethodim (2×) + Factor (180 g/ha) + CT (paraquat)

Herbicides for ATR-Stingray canola:

HS1. Trifluralin (1.6 L/ha) + clethodim (0.5 L/ha)
HS2. Triallate (2.0 L/ha) + propyzamide (1.0 L/ha)
HS3. Propyzamide + clethodim + CT (glyphosate)

Herbicides for Mace wheat:

HS1. Trifluralin (1.6 L/ha) + triallate (2.0 L/ha) IBS
HS2. Sakura (118 g/ha) + triallate (2.0 L/ha) IBS
HS3. Sakura (118 g/ha) + triallate (2.0 L/ha) IBS + Boxer Gold (2.5 L/ha) POST (crop 2-3 leaf)

Herbicides for Compass barley:

HS1. Trifluralin (1.4 L/ha) + triallate (2.0 L/ha) IBS
HS2. Triallate (2.0 L/ha) + Boxer Gold (2.0 L/ha) IBS
HS3. Triallate (2.0 L/ha) + Boxer Gold (2.0 L/ha) IBS + Boxer Gold (2.0 L/ha) POST (crop 2-3 leaf)

The trial was established in a split-plot design; with crop rotation assigned to main-plots and herbicide strategies to sub-plots with 3 replicates. Assessments included ryegrass control (reduction in plant and seed set), crop establishment, grain yield and quality.

Results and discussion

The ryegrass population established at the site was resistant to clethodim with more than ten-fold greater clethodim dose required to control the population than the standard susceptible population. The population was only weakly resistant to butroxydim.

In 2014, excellent ryegrass control was initially obtained in field peas and canola with pre-sowing herbicides under herbicide strategies two and three (Table 1). By contrast herbicide strategy one was the weakest treatment where control was poor with trifluralin exposing more annual ryegrass to clethodim, to which the population is moderately resistant.

Table 1. Changes in annual ryegrass weed and head density (no./m^2) in response to the herbicide strategy (1-3) employed in field peas and canola in 2014, in wheat in 2015, and in barley in 2016 at Hart.

Crop sequence	Herbicide strategy (HS)	2014		2015		2016	
		Plants	Heads	Plants	Heads	Plants	Heads
				(*no./m^2*)			
Field peas/ wheat/barley	1	48a	17a	5	8	15a	18a
	2	3b	0b	5	3	9b	8b
	3	1b	0b	4	2	3b	8b
Canola/ wheat/barley	1	55a	34	30a	42	17	21a
	2	24b	23	4b	19	9	9b
	3	12b	23	10b	10	14	4b

Letters within columns for each crop sequence indicate significantly different data. Where no letters are present, the data are not significantly different.

In 2015, a significant amount of ryegrass was controlled by knockdown herbicides before the crop was sown, exposing less ryegrass to pre-emergent treatments in wheat. However, annual ryegrass numbers were generally higher following canola than following field peas. This is most likely due to greater efficacy of crop-topping peas with paraquat compared to crop-topping canola with glyphosate.

Despite the low weed infestation in 2016 (<20 plants/m2), ryegrass control in barley was more effective under herbicide strategy two and three compared to strategy one. These strategies (HS2 & HS3) combined with the competitive barley crop were able to suppress ryegrass seed set (<9 heads/m^2) even though conditions were favourable for seed production. Competition is often an underutilised tool, however when combined with effective pre-emergent herbicides it can greatly reduce the seed set of ryegrass.

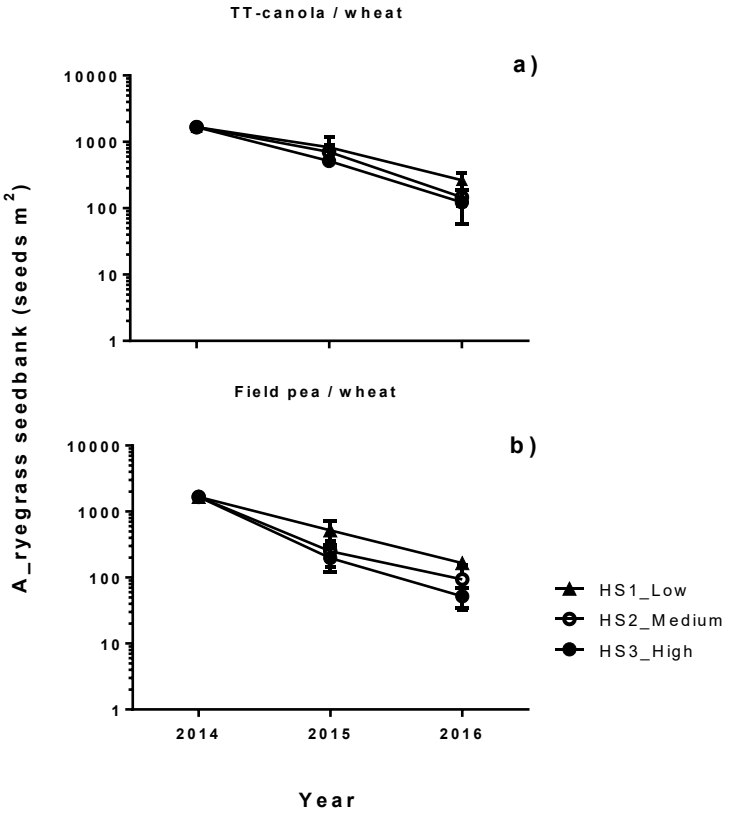

Figure 1. Change in ryegrass seedbank in response to herbicide strategy (HS1-3) in TT-canola/wheat (a), and field pea/wheat crop sequences at Hart. Vertical bars represent SE.

Although the ryegrass seedbank declined more rapidly following field peas than following canola in year one (Figure 1), by year three the Autumn seedbank had been significantly reduced (84-97%) under both crop sequences (Table 2). The seedbank declined further under wheat, due in part to the effectiveness of the pre-emergent herbicide treatments, but also because of the extremely dry Spring conditions which would have reduced the ability of ryegrass to set seed in 2015. Herbicide strategy three treatment under both field pea/wheat and canola/wheat crop sequences provided the greatest reduction in ryegrass seedbank (97 & 93%) from 2014 to 2016.

Combination of effective pre-emergent herbicides under HS2 and HS3 with a more competitive barley crop may have helped reduce the seedbank further. However, the benefits of the practice won't be known until seedbank sampling is again undertaken in April 2017.

Although there were significant differences in ryegrass control between HS treatments (Table 1), this had little effect on the grain yield of barley (P=0.88). This is not surprising given ryegrass on per plant basis is a relatively weak competitor, with much higher weed infestations (>100 plants/m^2) required to produce measurable yield losses. Given the effectiveness of the HS to maintain ryegrass density at low levels, the competitive influence of ryegrass would have been negligible.

When data were combined over HS and presented as the average of cropping sequence (Table 3), differences in barley yield between the two crop sequences were significant (P<0.01). Barley yield was higher in field pea/wheat/barley rotation (5.09 t/ha) than in canola/wheat/barley rotation (4.74 t/ha).

Table 2. Impact of crop sequence and herbicide strategy (HS1-3) on % reduction in ryegrass seedbank from 2014 to 2016 at Hart. Detailed description of herbicide strategies are provided in the materials & methods section. Canola and field peas were sown in 2014, and wheat in 2015.

Crop sequence	Herbicide strategy (HS)	% reduction in ryegrass seedbank from 2014 to 2016
Field peas/wheat/barley	1	90
	2	94
	3	97
Canola/wheat/barley	1	84
	2	91
	3	93

Table 3. Impact of crop sequence and herbicide strategy (HS1-3) on the grain yield of barley at Hart in 2016.

Herbicide strategy (HS)	HS1	HS2	HS3	Average
Crop sequence	Barley grain yield (t/ha)			
Field peas/wheat/barley	5.20	5.11	4.97	5.09
Canola/wheat/barley	4.57	4.76	4.88	4.74
Average	4.87	4.94	4.92	
Interaction	NS			
Crop sequence	P<0.01			
Herbicide strategy	NS			

Conclusion

The results of this study have shown that long-term management of clethodim resistant ryegrass is achievable without oaten hay when appropriate herbicide strategies and cropping sequences are deployed. Where clethodim is no longer effective, it is essential that seed control tactics are used to stop resistant ryegrass seed from returning to the seedbank. In field peas, crop-topping with paraquat can be effective, in canola crop-topping with Weedmaster DST or windrow burning can be used to reduce ryegrass seedbank. In wheat and barley robust pre-emergent herbicides should be used in order to maintain or decline the ryegrass seedbank further. Crop competition is also an easy and simple to use tool, and selection of more competitive crops (e.g. barley) and their cultivars can be an effective means of weed management.

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Right: Kathy Fisher, SARDI, harvesting the trial at Hart, 2016.