Controlling ryegrass with different crop rotations

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Aim

To assess the ryegrass control ability of crop rotation, in combination with pre- and post- emergent herbicides.

Take home messages

- *Trifluralin was more effective at reducing ryegrass numbers in the cereal phase than in break crops*
- *There are more benefits from good rotation than improved weed control alone, but benefits (in this case additional nitrogen) may not be apparent until several years after the non-cereal break crop or pasture phase.*

Method

A crop rotation trial was established in 2006 at a site with confirmed Group A (fop) resistance at Jil Jil, 25km north of Birchip. Three crop rotations were established to assess their impact on ryegrass density.

In 2006, the trial was split into three different blocks each containing a different crop type: lentils, medic and oats for hay production. These blocks were managed with the intention of reducing ryegrass numbers (Table 1). Pre-emergent herbicides along with Select® in-crop were applied to the lentils, while hay cutting and spray-topping were used to control ryegrass in the oats and medic pasture respectively.

The oats were cut for hay on 22 September 2006 and the medic was spray-topped on 26 September 2006. Ryegrass regrowth after hay cutting was controlled with Gramxone® to prevent late seed set.

Table 1. Rotation and herbicides applied in 2006 (Year 1). Active ingredients are given in brackets.

Application timing	Rotation		
	Lentils	**Medic**	**Oaten hay**
Post-sowing, pre-emergence	Simazine900® (simazine 900g/kg) 400g/ha + Lexone DF® (metribuzin 750g/kg) 130g/ha **(Group C+C)**	n/a	Diuron900® (diuron 900g/kg) 560g/ha + Dual Gold® (S-metolachlor 960g/L) 500ml/ha **(Group C+K)**
Post- emergence	Select® (clethodim 240g /L) 500ml/ha **(Group A)**	Roundup CT® (glyphosate 450g/L) 1.5L/ha + wetter 0.2% **(Group M)**	Gramoxone® (paraquat 250g/L) 1.0L/ha **(Group L)** *after hay had been baled*

All plots were sown to wheat cv. Yitpi on 12 May 2007, and barley cv. Sloop Vic on 24 April 2008.

During the 2007 and 2008 seasons, five treatments were imposed across the three rotations. These treatments included stand-alone pre-emergent herbicide applications (all based on TriflurX®, active ingredient 480g/L trifluralin) incorporated by sowing, herbicide applications in conjunction with a chaff cart and a chaff cart only (Table 2). To simulate a chaff cart, a wool bale was attached to the rear of the plot harvester to catch all chaff during harvest operation.

Table 2. Ryegrass control treatments applied to wheat in 2007 and barley in 2008.

Treatment no.	Treatment
1	Control
2	TriflurX® 1.5L/ha
3	TriflurX® 3.0L/ha
4	TriflurX® 1.5L/ha + chaff cart
5	Chaff cart

Note: A chaff cart is designed to catch all the chaff from the header during harvest, including any weed seeds that were harvested from the plot.

Ryegrass density was determined at emergence and again at maturity for each year of the project using ten $0.1m^2$ quadrats randomly positioned within each plot.

In 2008, the barley crop showed visible signs of nitrogen deficiency, and 11kg N/ha was applied as urea to all plots on 5 July 2008 and again on 7 August 2008 giving a total of 22kg N/ha applied to the trial.

In 2007 and 2008 plots were harvested and grain yields were recorded.

Location:	Herbicide resistance site, Jil Jil
Replicates:	Four replicates of herbicide treatments randomised in three contiguous rotation blocks.
Treatments:	5
Sowing date:	12 May 2007, 24 April 2008
Sowing Rate:	2007 80kg/ha, 2008 70kg/ha
Crop type:	2007 wheat cv. Yitpi, 2008 barley cv. Sloop Vic
Seeding equipment:	Avon-Richardson seeder, no-till (knife points, press wheels) 300mm row spacing

Results

2006 – Lentils, medic and oaten hay

In 2006, pre-emergent application of Simazine + Lexone to lentils did not significantly reduce ryegrass density in comparison to the medic rotation where no herbicide was applied at sowing (Table 3). However, the application of Select in-crop for the lentil rotation reduced ryegrass from 90 plants/m^2 to 5 plants/m^2, which was significantly less ($P<0.05$) than the ryegrass densities recorded in oats and medic when counts were taken on 22 October 2006 (Table 3).

The medic block, solely reliant on spray-topping at the end of the season, carried high ryegrass numbers throughout the year. On 22 October 2006, ryegrass density was 129 plants/m^2. Although spray-topped plants were counted, it is likely that seed production from these plants was substantially reduced.

Pre-emergent application of Diuron + Dual Gold to oats for hay did not significantly reduce ryegrass density compared to the medic rotation where no herbicide was applied pre-sowing. The oats were cut for hay before ryegrass set seed on 22 September 2006, but some shorter ryegrass seed heads escaped the baling operation. After baling, ryegrass numbers were estimated at 72 plants/m² (Table 3). Gramoxone was applied to the oat rotation on 30 October 2006 to control regrowth and escapees from baling.

Table 3. Mean ryegrass plant density at different times of the year in 2006.

Rotation	Ryegrass density plants/m^2 5 July 2006	Ryegrass density plants/m^2 22 October 2006
Lentils	90	5
Oats	108	72
Medic	110	129
LSD (P=0.05)	**NS**	**29**

2007 - Wheat

In 2007, 34mm of rain fell at the end of April. Herbicide treatments were applied and the crop sown with adequate moisture for emergence. Ryegrass density was reduced in both the TriflurX® 1.5L/ha and TriflurX® 3.0L/ha treatments relative to the control (Table 4). Ryegrass density was 20 plants/m2 less in the TriflurX® 3.0L/ha treatment relative to the TriflurX® 1.5L/ha treatment. However, there was no significant effect of rotation on ryegrass density, of herbicide within rotation treatments or rotation within herbicide treatments. Despite the large difference in ryegrass density between the herbicide treatments and the control, there was no significant effect on yields of the rotation or herbicide treatments, and mean site yield was 2.1t/ha.

Table 4. Mean ryegrass density for the different herbicide treatments as of 2 August 2007. Results from the chaff cart treatments were included in the calculation of the TriflurX® 1.5L/ha and control means, as the chaff cart had not yet been applied as a treatment in the trial.

Herbicide	Ryegrass density plants/m^2 2 August 2007
Control	107
TriflurX® 1.5L/ha	40
TriflurX® 3.0L/ha	20
LSD (P=0.05)	**14**

2008 - Barley

In 2008, trifluralin was applied to dry soil and incorporated by sowing one hour after application. The crop was nitrogen-deficient during the early growth stages and rhizoctonia was present. The effects of the disease and N deficiency appeared to be exacerbated by application of trifluralin, which affected root growth causing yellowing and stunting.

Ryegrass density was reduced in all of the herbicide treatments relative to the control and stand-alone chaff cart treatment, but there was no difference in density between any of the herbicide treatments (Table 5). The chaff cart treatment did not reduce ryegrass density relative to the control.

There was no significant effect of rotation on ryegrass density.

Table 5. Mean ryegrass density for the different herbicide and chaff cart treatments as of 25 July 2008. Means with different letters are significantly different (P<0.05).

Herbicide	Ryegrass density plants/m^2 25 July 2008
Control	170a
TriflurX® 1.5L/ha	35b
TriflurX® 3.0L/ha	19b
TriflurX® 1.5L/ha + chaff cart @ harvest 2007	31b
Chaff cart @ harvest 2007	171a
LSD (P=0.05)	**26**

In 2008, the TriflurX® 1.5L/ha + chaff cart treatment yielded more than the control and other herbicide treatments, but here was no difference between stand-alone herbicide treatments and the control (Table 6). The medic treatments yielded more then both the lentil and oaten hay treatments (Table 7).

Table 6. Mean grain yield for the different ryegrass control treatments in 2008. Means with different letter are significantly different (P<0.05).

Herbicide	Yield t/ha
Control	1.29a
TriflurX 1.5L/ha	1.38a
TriflurX 3.0L/ha	1.42a
TriflurX 1.5L/ha + chaff cart @ harvest 2007	1.61b
Chaff cart @ harvest 2007	1.43a
LSD (P=0.05)	**0.17**

Table 7. Mean grain yield for the different rotation treatments in 2008. Means with different letter are significantly different (P<0.05).

Rotation	Yield t/ha
Lentils	1.29a
Medic	1.66b
Oats	1.32a
LSD (P=0.05)	**0.16**

Interpretation

There was no effect of rotation on ryegrass density in the cereal crops of either 2007 or 2008. However, if the ryegrass population had have been resistant to Group D herbicides, then an effect may have been observed. By allowing ryegrass to be controlled with herbicides with different modes of action to Group D, crop rotations do slow the build-up of resistance within a population.

The application of Select® to the 2006 lentil crop was more successful at reducing ryegrass than cutting oats for hay or spray-topping medic, which avoided the use of selective herbicides. However, the use of Group A herbicides on this site is not a long-term control option as resistance to this mode of action already exists in this ryegrass population.

Rotation proved to be less important than herbicide selection in subsequent years. Trifluralin reduced ryegrass density in cereal crops in 2007 and 2008 relative to the control, but rotation did not. In 2007, greater ryegrass control was achieved when trifluralin rates were increased from 1.5L/ha to 3.0L/ha, but there was no difference between rates in 2008. Trifluralin applied under ideal soil conditions in 2007 and dry soil conditions in 2008 provided successful control on both occasions.

The use of a chaff cart by itself was unable to reduce ryegrass density relative to the control in 2008. This was possibly caused by ryegrass seeds being shed prior to harvest and/or seed heads below the cutting height of the harvester. The higher yield observed in the TriflurX 1.5L/ha + chaff cart is likely to have been caused by less nitrogen immobilisation in that treatment due to the removal of chaff. Nitrogen stress was observed in the crop, and more available nitrogen caused by less immobilisation would have translated into yield. Greater nitrogen availability also explains the higher yield achieved in the medic rotation, as medic is known to fix significantly more nitrogen than lentils, particularly if it is not grazed.

Application

While trifluralin was highly successful at reducing ryegrass density in this trial, rotations should allow control with different herbicide groups, or by non-chemical means. Resistance to trifluralin is common in South Australia, with 49 percent of populations surveyed in 2003 showing resistance. A survey of Victoria in 2005 found only 4.5 percent of populations resistant to trifluralin, although there was widespread resistance to Group A and B herbicides (Preston *et al.* 2008). In the Mallee, a regional shift towards continuous cereal cropping and no-till farming systems has increased reliance on trifluralin whilst speeding the development of resistance.

The results of this trial indicate that chaff carts are unlikely to be a worthwhile investment in the Mallee, although further research is required to investigate the causes of its inefficacy in this trial eg. seed retention and height relative to harvest height.

The yield increase in the medic treatment in 2008 shows that there are more benefits to a good rotation than improved weed control alone, and that the benefits may not be apparent until several years after the non-cereal break crop or pasture.

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