Weed management strategies to address herbicide resistance in the Victorian Mallee

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RESEARCH

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Location
Yaapeet, VIC Mallee - Troy Fisher
Rainfall
Av. Annual: 350 mm
Av. GSR: 230 mm
2017 Total: 369 mm
2017 GSR: 203 mm
Yield
Treatment 5
Potential 2017: 4.0 t/ha (W)
Actual: 2017: 2.8 t/ha
Paddock History
2014 - 2016: Various
Soil Type
Neutral to alkaline sandy clay loam
Plot Size
10 m x 3 m x 4 reps

Key message

- **Annual ryegrass populations with identified low to medium herbicide resistance levels to herbicide groups A, B and M were controlled with alternative crops and/or best practice chemical and management strategies.**

Why do the trial?

It is generally recognised that there are progressive increases in weed herbicide resistance associated with current farming systems. With this in mind a four-year research project was established at Yaapeet in 2014 to demonstrate and validate options for depleting weed seed banks over successive seasons.

How was it done?

The four-year study measured annual ryegrass populations through five rotations. Rotation 1 and 2 had a single phase of four years of wheat and rotations 3, 4 and 5 had each phase of each rotation in every year, two wheat, one canola and one field pea treatment. The annual ryegrass densities presented are from the phase of each rotation that finished in wheat in 2017. Grain yields presented are means of each component of each rotation over the four years.

District practice weed control chemistry for each crop was applied. Tri-allate was also applied to wheat treatments in Rotations 2, 3 and 4 (Tables 1 and 2). Hay cutting and brown manure were used as annual grass management strategies. Herbicide resistance levels in the annual ryegrass population measured at the commencement of the study identified a medium resistance level to Group A and low resistance to Groups B and M herbicides.

In all four years Corack and Grenade CL wheat varieties were sown at 50 kg/ha, StingrayTT and 43C80CL canola varieties at 2 kg/ha and Wharton field peas at 100 kg/ha. DAP (18:20:0:0) at 52 kg/ha was applied at seeding coupled with 50 kg/ha of urea on canola. A further 50 kg/ha of urea was applied mid-season to canola and the cereals that did not follow a pulse in the rotation. Sowing was carried out post weed emergence, late May-early June, in all four years following a double knockdown. Pre-emergence herbicides were applied immediately prior to sowing and post-emergent herbicides were applied at 8 and 14 weeks (application 2) post seeding. All crops received best practice broad-leaved weed control along with pesticides and fungicides as required.

Gross margin estimates were based on a single year's representative data derived from the 2015 PIRSA Farm Gross Margin Guide.

What happened?

Growing season rainfall (April–October) in the four years was approximately 150, 100, 250 and 200 mm in 2014, 2015, 2016 and 2017 respectively.

The use of alternative crops with selective grass control (Rotations 3, 4 and 5) and the pre-emergent Group J (Rotation 2) and post-emergent Group B (Rotations 2 and 3) all reduced annual rye grass plant numbers compared to Rotation 1 (Table 3). The continued increase in Rotation 1 annual ryegrass densities resulted in hay becoming the only viable option in 2017.

Rotation 2, with three of the four years in wheat, produced more grain than Rotation 1, also with three years wheat. Total grain production from Rotations 3, 4 and 5 with two years of wheat and one year of field pea and canola was less than Rotation 2 but similar to Rotation 1. Field pea and canola yields were similar irrespective of variety or rotation. Hay production reflected the season, Rotation 1 2017 (200 mm), Rotation 2 2015 (100 mm).

Gross margin calculations indicated that Rotation 1 returned $280/annum, 2 $380, 3 $225, 4 $246 and 5 $300/annum.

Table 1. The five crop rotations and annual grass control pre- and post-emergent herbicide groups and/or management strategies applied over the four year study.

No	2014	Herbicide groups applied		2015	Herbicide groups applied	
		Pre-emerg	Post-emerg		Pre-emerg	Post-emerg
1	Wheat	D M		Wheat	D M	
2	Wheat CL	D J M	B	Wheat	D J M	Hay
3	Wheat	D J M		Field Pea	D M	M BM**
4	Wheat	D J M		Field Pea	D M	A*A***
5	Field Pea	D M	A*	Wheat	D M	
No	**2016**			**2017**		
1	Wheat	D M		Wheat	D M	Hay
2	Wheat	D J M		Wheat	D J M	
3	Canola TT	D J M	A*	Wheat CL	D J M	B
4	Canola Imi	D J M	A*B	Wheat	D J M	
5	Canola Imi	D J M	A*B	Wheat	D M	

Includes both a fop and dim Group A herbicide, ** BM Brown manure treatment, * Second application a Group A fop only*

Table 2. Herbicide trade names and rates of each chemical group applied.

Group	Chemical (a.i.)	Trade name	Application rate
D	Trifluralin 480 g/L	Trifluralin	1.5 L/ha
J	Tri-allate 500 g/L	Avadex	2 L/ha
M	Glyphosate 450 g/L	Glyphosate	1.5 L/ha
A	Clethodim 360 g/L	Select	500 ml/ha
A	Haloxyfop 520 g/L	Verdict	35 ml/ha
B	Imazamox 33 g/L & Imazapyr 15 g/L	Intervix	600 ml/ha

Table 3. Four year crop rotations and mature annual rye grass densities (plants/m^2).

No	Rotation and annual ryegrass (plants/m^2)							
	2014		2015		2016		2017	
1	Wheat	29	Wheat	9	Wheat	22	Wheat Hay	128
2	Wheat CL	<1	Wheat Hay	0	Wheat	2	Wheat	1
3	Wheat	2	Field Pea BM	0	Canola TT	0	Wheat CL	0
4	Wheat	2	Field Pea	0	Canola Imi	0	Wheat	0
5	Field Pea	<1	Wheat	8	Canola Imi	0	Wheat	0.25

Table 4. Total 2014 to 2017 grain and hay yields (t/ha) from the five crop treatments.

No	Rotation	Wheat	Field pea	Canola	Hay
1	Wheat-Wheat-Wheat-Wheat Hay	5.7			2.9
2	Wheat CL-Wheat Hay-Wheat-Wheat	7.7			2.0
3	Wheat-Field Pea BM-CanolaTT-WheatCL	4.0	0 BM*	0.8	
4	Wheat-Field Pea-Canola Imi-Wheat	4.2	0.8	0.8	
5	Field Pea-Wheat-Canola Imi-Wheat	4.5	0.8	0.8	

**BM Brown manure treatment*

What does this mean?

At the commencement of the study the Plant Science report showed the annual ryegrass population had a 50-60% survival rate to Achieve (dim) and Verdict (fop). However, there was no measured resistance to a high rate of Select (dim). The results confirmed this outcome with no plant survival following Select applied at 500 ml/ha in 2015 and 2016.

The reported low resistance to Groups B and M, suggesting significant stunting but some recovery, was not clearly evident. The laboratory measured 75% survival rate to Group B was significantly lower in the study, Rotation 1 2014, at 50% at most. There was no evidence of 20% Group M resistance with total annual ryegrass control following brown manuring.

There is no evidence that there remains a population of Groups A, B or M herbicide resistance for annual ryegrass following Rotations 3 and 4. Concurrent break crops incorporating Groups A, B and M chemicals have resulted in subsequent annual ryegrass free wheat crops. The late May sowings following a double knock down and the herbicides that were applied at an early timely weed growth stage may have assisted.

Yields (and comparative gross margins) were influenced by the 2015 100 mm growing season rainfall and sowing dates. Field pea and canola completely failed in that season, plus the later than optimum sowing dates reduced the broad-leaved crops' potential yield in all years. Rotation 2 total grain production did not include 2015 when it was cut for hay, whereas Rotation 1 was cut for hay in 2017, a higher grain production season. For these reasons, yields (and the gross margins) give only an indication of the comparative performance of each rotation. However, they do suggest improved reliability from the wheat phase in the system. Rotation 5 with higher grain yields and lower input costs outperformed Rotations 3 and 4.

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