

Integrated weed management: a demonstration of cultural and chemical methods for controlling herbicide resistant annual ryegrass

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Take home messages:

- Integrated weed management is the best approach for long-term control of herbicide resistant annual ryegrass
- The most effective cultural control method trialled was mouldboard ploughing which was significantly better than stubble burning or direct sowing into retained stubble in terms of in crop weed numbers
- Sakura + Avadex Xtra IBS herbicide regime achieved the best control of annual ryegrass later into the season
- Crop establishment, wheat yield and grain quality were not affected by the choice of weed control method in this trial

Introduction

Grass weeds such as annual ryegrass have become critically important in winter grain crops in terms of their potential to limit productivity and therefore profitability. When untreated, yield losses can be up to 50-60% of a crop. In the HRZ of Victoria annual ryegrass has become an issue of concern due to the increase in cereal cropping, short rotations, the move towards reduced or no tillage systems and the increased use of herbicides as the main weed control method. This has put pressure on the use of selective herbicides

Surveys of annual ryegrass populations across Australia's grain growing regions have revealed varying levels of resistance to Group A, B, C, D, Q and M herbicides. The use of Integrated Weed Management (IWM) tools is the best approach for managing herbicide resistance and for ensuring that the herbicide options we have left will be more useful for longer. This involves moving away from an exclusive reliance on herbicides and instead pursuing an integrated approach involving a mix of currently available effective herbicides and a range of non-herbicide practices.

Method

SFS are conducting a 3-year trial at the Lake Bolac research site investigating different ways of controlling resistant ryegrass in the crop rotation. Through funding from the GRDC we are running a project that is looking at a strategic approach to this problem that combines 4 different seed bed preparation options with 3 different pre-emergent herbicide treatments:

Cultural control treatments:

- Mouldboard ploughing
- Stubble burning
- Stubble incorporation with light cultivation
- Retained stubble with direct sowing

Chemical control treatments:

- Trifluralin 2L/ha + Dual Gold 250mls/ha
- Boxer Gold 2.5L/ha
- Sakura 118g/ha + Avadex Xtra 1L/ha

The site was split into blocks of a minimum of 0.3ha in size in order to layout the four cultural treatments. This was then replicated 4 times, meaning the total trial area is almost 5ha.

Soil samples were taken in February and stimulated to germinate the weed seed present in the soil to measure the starting weed seed bank population. This will, over the course of the project, enable conclusions to be drawn over the effectiveness of the treatments trialled in terms of relative depletion of initial ryegrass population.

Ploughing and light cultivation occurred on the 20th March and the trial was sown to Beaufort wheat on the 8th June. All chemical control treatments were incorporated by sowing (IBS) on that day. Crop establishment and the number of annual ryegrass seedlings per square metre were assessed 70 days after sowing (DAS) and at weed maturity, 180 DAS, an assessment of ryegrass heads per square metre was made.

Results and Discussion

The photos below illustrate weed populations in the four different seedbeds on the 1st of June, 7 days prior to sowing. Visually, burnt plots were by far the worst for ryegrass control and ploughed the best, although ploughing seemed to stimulate the germination of more broadleaf weed seeds. Retained stubble plots were generally weedier than those where the stubble had been incorporated.



Stubble incorporation with light cultivation



Retained stubble



Stubble burning



Mouldboard ploughing

Figure 1. Examples of weed control on the four different seedbeds prior to the application of pre-emergent herbicide

There were no significant differences in crop establishment, wheat yield or grain quality between the 12 different treatments. When the effect of seedbed preparation was considered in isolation to choice of herbicide it was observed that burning resulted in significantly ($P < 0.05$) higher crop establishment than ploughing or stubble incorporation but this did not translate into higher yields.

Table 1. Effect of treatments on yield, crop establishment and annual ryegrass (ARG)

Treatment	Yield		Crop Establishment (pl/m ²)		ARG 70DAS (pl/m ²)		ARG heads 180DAS (heads/m ²)	
Plough + Sakura+Avadex	8.18	a	121	a	7.75	a	9.00	d
Retain + Sakura+Avadex	8.15	a	133	a	49.25	a	14.00	cd
Incorporate + Trifluralin+Dual Gold	8.13	a	118	a	13.50	a	31.13	a-d
Incorporate + Sakura+Avadex	8.11	a	127	a	20.38	a	27.88	bcd
Plough + Trifluralin+Dual Gold	8.10	a	115	a	3.50	a	26.63	bcd
Incorporate + Boxer Gold	8.09	a	129	a	19.13	a	28.25	bcd
Burn + Boxer Gold	8.08	a	138	a	53.58	a	40.84	abc
Plough + Boxer Gold	7.98	a	122	a	3.50	a	16.13	cd
Burn + Sakura+Avadex	7.94	a	139	a	45.00	a	25.25	bcd
Retain + Boxer Gold	7.62	a	130	a	26.38	a	41.38	abc
Retain + Trifluralin+Dual Gold	7.61	a	127	a	13.50	a	53.75	ab
Burn + Trifluralin+Dual Gold	7.37	a	134	a	42.63	a	57.75	a
LSD (P=0.05)	n.s.		n.s.		n.s.		28.99	
P-value	0.735		0.169		0.448		0.036	

Annual ryegrass (ARG) numbers 70 DAS were not significantly affected by the cultural or chemical method of weed control used (see Table 1 above). Paddock observations from this time rated ploughing the best for early weed control and burning the worst, with little visual difference discernible between retained and incorporated stubble. The three pre-emergent herbicide options could not be separated at this stage.

Mature ARG heads assessed 180 DAS were significantly influenced by both chemical ($P=0.02$) and cultural ($P=0.05$) methods of weed control. A pre-emergent spray of Sakura + Avadex Xtra was significantly better at reducing ARG populations than using a combination of Trifluralin + Dual Gold. Ploughing had the lowest ryegrass populations and had significantly better ARG control than stubble retention and burning. The differences in ARG numbers at 70 and 180 DAS under the different cultural and chemical treatments are shown in Figure 2 below.

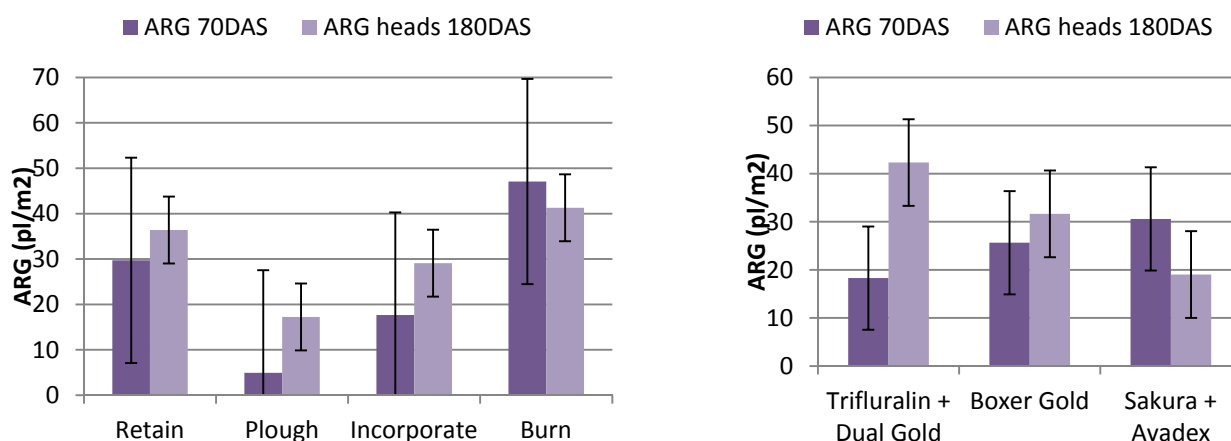


Figure 2. Effect of cultural (left) and chemical (right) treatments on ARG numbers 70 and 180 days after sowing

Economics

Table 2 below enables us to consider the economics of the various treatments on trial. Cost versus benefit must always be a key consideration for growers when deciding whether or not to change management practices. In relation to the results in this trial, the most expensive chemical treatment of Sakura + Avadex proved significantly better at reducing ryegrass populations than the least expensive, Trifluralin + Dual Gold. Ploughing is vastly more expensive than the widely practised direct sowing into retained stubble, yet results indicate better control of ryegrass. However is the enhanced control offered by the more expensive options actually worth it in terms of increased output at the end of the season? Will the increased costs be covered?

Table 2. Costs of cultural and chemical control options for ARG control

Cultural control treatments:	Cost	Chemical control treatments:	Cost
Mouldboard ploughing (to include following discing & rolling to prepare seed bed)	\$190/ha	Trifluralin 2L/ha + Dual Gold 250mls/ha	\$16.73/ha
Stubble burning	\$12/ha	Boxer Gold 2.5L/ha	\$34.48/ha
Stubble incorporation with light cultivation	\$60/ha	Sakura 118gms/ha + Avadex Xtra 1L/ha	\$48.26/ha
Retained stubble	\$0/ha		

If we consider just one replicate of the trial; the previous crop was winter sown barley and ryegrass weed control was poor. This was backed up with high numbers of ryegrass in seed bank samples collected pre-sowing. The results from just the chemical treatments alone highlighted the yield advantage of the Sakura + Avadex over Trifluralin that equates to \$102.5/ha (Using harvest feed wheat price of \$250/t and yield increase of 0.41t/ha). This more than covers the extra cost of \$31.53/ha of using the more expensive treatment, still leaving over \$70/ha of profit.

When observing just the yield effects of the cultural treatments over the whole trial, the mouldboard plough outperformed the retained stubble treatment by 0.61 t/ha. Given this seasons feed wheat price of \$250/t that equates to an extra \$152.5/ha. This covers 80% of the cost of the alternative management technique, thus still meaning a loss in one season. However, ploughing is just a one off cost and if such yield improvements can be sustained in the following crops then this will have been a much more profitable change in management practice than not changing at all. As this project continues into year 2 and 3 the impact of such changes in management will become clearer.

Commercial application – what does this mean to the grower?

Sowing directly into retained stubble is the most common approach to crop establishment in the Western Districts of Victoria but as shown in this trial it can be difficult to control weeds when this technique is used. Pre-emergent herbicides that require contact with the soil or emerging weeds in order to work are less effective because crop stubbles prevent even and thorough chemical application.

Stubble burning is commonly used to get rid of particularly high loads of straw residues and trash in order to make sowing easier and improve the incorporation of pre-emergent herbicides. Burning can kill weed seedlings and viable seed in the soil but it will typically only achieve 50% control of ryegrass. Although we thought we achieved a good, hot burn in this trial there were actually more weeds in burnt plots than in any other treatment.

Mouldboard ploughing is able to considerably reduce grass weed populations when chemical control is no longer cost effective and there is a need to start anew. When done correctly, ploughing buries weed seed deep, making it unviable and preventing germination. Mouldboard ploughing is expensive at approximately \$170/ha but can achieve up to 95% weed control.

Lightly cultivating seed beds allows germination of seed which can subsequently be burned off with a non-selective herbicide prior to sowing. However it is only effective on the previous year's seed set with an average of 15% ryegrass control. It can also potentially lead to delays in sowing date, especially on heavier soils. This can be risky as delayed sown crops tend to be less competitive and can be at further risk from slugs and waterlogging going into winter if behind in establishment, not to mention pushing back optimal flowering date into a time where heat in the spring can decrease yield potential.

In terms of the best chemical choice for pre-emergent control of ryegrass, in this trial a tank mix of Sakura (118gms/ha) + Avadex Xtra (1L/ha) provided the best and longest-lasting control of ARG in the crop. Out of the three chemical regimes used, this was the only one to result in a reduction of ARG numbers later in the season (see Figure 2 above). When Trifluralin+Dual Gold or Boxer Gold was applied, weed numbers actually increased later in the season. Boxer Gold and Trifluralin will work well initially but will not last into the season, unlike Sakura, which is residual for 12 weeks and beyond.

Summary

Resistance to Group A, B and D herbicides has been confirmed in the grain growing areas of Victoria, with group D increasing in recent years. With this in mind, it is important growers understand what resistance status they have and how this varies between paddocks. Resistance testing is crucial to be able to successfully integrate management tactics to combat multiple-resistant ryegrass.

Managing herbicide resistant ryegrass may involve changing planned pre sowing seedbed preparation options to tackle resistant populations. This, in conjunction with the use of newer group J and K chemistry options, should become a crucial part of a growers integrated weed management tactics.

Acknowledgements

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Further reading

For further information on IWM refer to:

Integrated weed management in Australian cropping systems – A training resource for farm advisors available as a free download from the GRDC Weedlinks web page: <http://www.grdc.com.au/Resources/Links-Pages/Weedlinks>

WeedSmart, the new herbicide resistance management program for the grains industry: www.weedsmart.org.au



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