Stubble management, pre-emergent herbicides and annual ryegrass

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Aim

To determine the effect of stubble management (standing, slashed or burnt) on the crop safety of pre-sowing herbicides, and their efficacy against Group A-resistant annual ryegrass.

Take home messages

- *In 2007, herbicides applied to burnt stubble were more effective than those applied to slashed stubble. In 2008, there was no effect of stubble management on efficacy or crop safety.*
- *All herbicide treatments gave adequate control of ryegrass in both years, but TriflurX® 1.5L/ha + Avadex Xtra® 1.6L/ha gave the best control in both 2007 and 2008.*
- *Improved control of ryegrass did not increase yield, and the most profitable treatments were the lower rates of trifluralin.*
- *Standing stubble substantially increased grain yield relative to slashed stubble (0.41 and 0.47t/ha in 2007 and 2008 respectively).*

Method

Location:	Herbicide resistance site, Jil Jil
Replicates:	Four replicates of herbicide treatments randomised in three contiguous stubble management blocks.
Sowing date:	22 May 2007 and 24 April 2008
Sowing rate:	2007 80 kg/ha, 2008 70 kg/ha
Crop type:	2007 wheat cv. Wyalkatchem, 2008 barley cv. Sloop Vic
Seeding equipment:	Avon-Richardson seeder no-till (knife points, press wheels) 300mm row spacing, inter-row sown with 2cm guidance

This experiment ran over two years at Jil Jil, 25km north of Birchip. In February 2007, three stubble management treatments (standing, slashed and burnt) were applied in blocks to a 2006 wheat cv. Yitpi stubble. Wheat cv. Wyalkatchem was sown into each stubble management treatment block on 22 May 2007. Prior to sowing, four different pre-emergent treatments were applied to each of the stubble management treatment blocks, and incorporated by sowing (Table 2). Ryegrass plant density was estimated on 2 August 2007 from four 0.1m^2 quadrats randomly positioned in each treatment. All treatments were harvested on 19 November 2007, and grain yield recorded.

In February 2008, the three stubble management treatments were again applied to the same blocks from 2007. Barley cv. Sloop Vic was sown dry into each stubble management treatment block on 24 April 2008. Prior to sowing, four different pre-emergent treatments were applied to each of the stubble management treatment blocks, and incorporated by sowing (Table 1). Barley density was estimated on 23 June 2008 from three 0.1m^2 quadrats randomly positioned in each treatment.

Ryegrass plant density was estimated on 23 July 2008 from ten 0.1m^2 quadrats randomly positioned in each treatment. All treatments were harvested on 11 November 2008, and grain yield recorded.

Table 1. Pre-emergent herbicide treatments applied to the stubble management blocks in 2007 and 2008. Active ingredients are given in brackets, and all herbicides were incorporated by sowing.

Treatment	2007 herbicide treatments	2008 herbicide treatments
1	TriflurX® (480g/L trifluralin) 0.8L/ha	BoxerGold® (800g/L prosulfocarb, 120g/L S-metolachlor) 2.5L/ha
2	TriflurX® (480g/L trifluralin) 1.5L/ha	TriflurX® (480g/L trifluralin) 1.5L/ha
3	TriflurX® (480g/L trifluralin) 1.5L/ha + Avadex Xtra® (500g/L tri-allate) 1.6L/ha	TriflurX® (480g/L trifluralin) 1.5L/ha + Avadex Xtra® (500g/L tri-allate) 1.6L/ha
4	TriflurX® (480g/L trifluralin) 3.0 L/ha	TriflurX® (480g/L trifluralin) 3.0L/ha

A two-way factorial analysis of variance (ANOVA) at the 95 percent confidence level was used to test for significant effects of stubble management and herbicide treatment, and interactions between stubble management and herbicide on ryegrass density and grain yield.

Results

In 2007, TriflurX® 1.5L/ha + Avadex Xtra® 1.6L/ha gave better control of ryegrass than TriflurX® 0.8L/ha (Table 2). There were no significant differences (P>0.05) in ryegrass density between any of the other herbicide treatments.

Table 2. Mean ryegrass density at 2 August 2007 for different pre-emergent herbicide treatments. Means with different letter are significantly different (P<0.05).

Herbicide treatment	Ryegrass (plants/m^2)
TriflurX® 0.8L/ha	17^a
TriflurX® 1.5L/ha	11^{ab}
TriflurX® 1.5L/ha + Avadex Xtra® 1.6L/ha	7^b
TriflurX® 3.0L/ha	13^{ab}
LSD (P=0.05) **P-value**	**7** **0.04**

There were an average of 8 plants/m^2 fewer ryegrass plants in the burnt treatments relative to the slashed treatments, but no difference (P>0.05) between burnt and standing or standing and slashed (Table 3).

Table 3. Mean ryegrass density at 2 August 2007 for different stubble management treatments. Means with different letter are significantly different (p<0.05).

Stubble treatment	Ryegrass plants/m^2
Standing	12^{ab}
Slashed	16^a
Burnt	8^{bc}
LSD (P=0.05) 6 **P-value**	 **0.03**

The standing stubble treatments yielded 0.41t/ha and 0.16t/ha more grain than the slashed stubble and burnt stubble treatments respectively (Table 4). There was no significant effect (P>0.05) of herbicide treatment on grain yield across or within stubble treatments.

Table 4. Mean grain yield for different stubble management treatments in 2007.

Stubble treatment	Grain yield t/ha
Standing	2.11
Slashed	1.70
Burnt	1.95
LSD (P=0.05)	**0.10**
P-value	**<0.01**

In 2008, TriflurX® 3.0L/ha gave better control of ryegrass relative to BoxerGold® 2.5L/ha and TriflurX® 1.5L/ha. TriflurX® 1.5L/ha + Avadex Xtra® 1.6L/ha gave better control than BoxerGold® 2.5L/ha (Table 5). There was no significant effect of stubble management on ryegrass density within or across the herbicide treatments.

Table 5. Mean ryegrass density at 23 July 2008 for different pre-emergent herbicide treatments. Means with different letter are significantly different (P<0.05).

Herbicide treatment	Ryegrass plants/m^2
BoxerGold® 2.5L/ha	12.8^{a}
TriflurX® 1.5L/ha	12.0^{ab}
TriflurX® 1.5L/ha + Avadex Xtra® 1.6 L/ha	6.2^{bc}
TriflurX® 3.0L/ha	5.7^{c}
LSD (P=0.05)	**6.2**
P-value	**0.04**

There was no significant (P>0.05) effect of either herbicide or stubble treatment on barley plant density (data not shown).

The standing stubble treatments yielded 0.47t/ha and 0.34t/ha more grain than the slashed stubble and burnt stubble treatments respectively (Table 6). There was no significant effect (P>0.05) of herbicide treatment on grain yield across or within stubble treatments.

Table 6. Mean grain yield for different stubble management treatments in 2008.

Stubble treatment	Grain yield t/ha
Standing	1.69
Slashed	1.22
Burnt	1.35
LSD (P=0.05)	**0.10**
P-value	**<0.01**

Interpretation

This site had a relatively low population of ryegrass with no evidence of resistance to Group D herbicides. Consequently, it was difficult to detect differences in ryegrass density between herbicide and stubble management treatments. However, TriflurX® 1.5L/ha + Avadex Xtra® 1.6L/ha did give consistently better control in 2007 and 2008 compared to TriflurX® 0.8L/ha and BoxerGold® 2.5L/ha respectively. BoxerGold® 2.5L/ha, which represents a new pre-emergent herbicide mode-of-action (Group E + K), would be expected to perform better relative to the trifluralin treatments had the ryegrass population been Group D-resistant. The higher rate of trifluralin (TriflurX® 3.0L/ha) gave better control than the lower rate (TriflurX® 1.5L/ha) in 2008, but this was not the case in 2007.

Stubble management had little effect on herbicide efficacy in this trial, although greater control of ryegrass was achieved in the burnt stubble than in the slashed stubble in 2007. Trifluralin and Boxer Gold can be inactivated by organic matter so the slashed stubble treatments were expected to provide lower levels of control. This effect may have been masked by the generally low ryegrass numbers at the site and the low stubble burden (especially in 2007 season), which reduced the likelihood of inactivation by organic matter.

There was no effect of stubble management on crop safety in 2008. Standing stubble reduces the throw of chemically treated soil into the neighbouring crop row, and in theory should provide a higher level of crop safety. There was also no difference found in crop establishment between 1.5L/ha and 3.0L/ha of TriflurX®, despite the higher rate posing a potential risk to crop safety.

The standing stubble treatment yielded more than the two other stubble management techniques across all herbicide treatments. Ryegrass and crop density data presented here indicate that this result is unlikely to be due to the herbicide efficacy or crop safety effects of stubble management. It is possible that standing stubble reduced evaporation more effectively than burnt or slashed stubble, thus improving water-use efficiency. However, the stubble management treatments were contiguously blocked, making it impossible to tell if the observed yield increase from standing stubble is due to the effect of the treatment, or due to chance resulting from paddock variability, eg. the standing stubble block was located on a better soil type, received more rain etc. A yield increase of this magnitude in response to stubble management certainly warrants further research into the role that stubble might play in reducing evaporation and improving water-use efficiency. As part of its GRDC-funded water use efficiency project, BCG has initiated a fully replicated experiment which will quantify the effect of different stubble management treatments on water use and grain yield.

Application

With the low ryegrass pressure at this site, only very small decreases in ryegrass density were achieved by either higher rates of trifluralin, or the addition of Avadex Xtra®. There was certainly no yield benefit from the higher rate of trifluralin or addition of Avadex Xtra, making TriflurX 1.5L/ha the most profitable treatment. However, this may not be the case in situations with a higher ryegrass population or the presence of other grass weeds (eg. wild oats). The use of higher rates of trifluralin or the addition of Avadex Xtra can help slow the build-up of Group D resistance in the ryegrass population, as would use of BoxerGold®.

The different stubble management treatments did not greatly influence herbicide efficacy or safety. Stubble loads in both 2007 and 2008 were relatively light.

The higher yields recorded in the standing stubble treatments in 2007 and 2008 are of significant interest. However, we cannot confidently attribute the observed yield increase to the effect of standing stubble due to the flawed design of this experiment, and further work is required to investigate this response.

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