

BROME GRASS MANAGEMENT IN CLEARFIELD BARLEY

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TAKE HOME MESSAGES

- If there is a full profile of soil moisture and an early break, consider sowing later (after brome germinates) to get a knock down on brome grass for better control.
- Herbicide options are critical to controlling brome, with pre-emergent chemistries not enough to fully control brome, especially when sowing before the break.
- Using Intervix® on Clearfield barley provides a strong control option on brome, however rotation of chemistries is needed to prevent resistance.

BACKGROUND

Brome grass (*Bromus diandrus*) is becoming an increasing problem across the medium to low rainfall regions in the Mallee and Wimmera. As cereal cropping intensity and no-till farming systems have increased, so too has the prevalence of brome. This is due to a lack of control methods in non-Clearfield cereals and the burial brome needs to germinate now occurring when the crop is sown. Brome's extensive root system makes it incredibly competitive and well adapted to low rainfall environments. It also has been shown to significantly affect yields at high densities, with 100 brome plants/m² reducing wheat yields by as much as 30-50 per cent (Kleemann 2011 GRDC Factsheet).

This trial was conducted to better understand which cultural and chemical controls could be used to reduce the impact of increasing brome grass density in cereal crops in the Mallee.

AIM

To determine whether delayed sowing, seeding rates and herbicides can be used to control brome grass.

PADDOCK DETAILS

Location:	Kinnabulla
Crop year rainfall (Nov-Oct):	372mm
GSR (Apr-Oct):	178mm
Soil type:	Clay
Paddock history:	Barley 2017, Grass based pasture 2018

TRIAL DETAILS

Crop type:	Spartacus CL barley
Treatments:	Time of sowing, seeding rate, herbicide strategy
Target plant density:	100 plants/m ² , 150 plants/m ² , 200 plants/m ²
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	TOS1: 29 April 2019; TOS 2: 23 May 2019
Replicates:	Three
Harvest date:	22 November 2019
Trial average yield:	3.6t/ha

TRIAL INPUTS

Fertiliser:	Granulock® Supreme Z + Flutriafol (200mL/100kg) @ 60kg/ha at sowing and 300kg/ha of urea applied as three applications (TOS 1: GS21, GS30, GS33; TOS 2: GS11, GS24, GS30).
Herbicide:	Refer to Table 1 19 July – Velocity® @ 670mL/ha + MCPA LVE @ 400mL/ha
Insecticide:	19 July – Chlorpyrifos @ 400mL/ha
Fungicide:	19 July – Prosaro® @ 300mL/ha, 29 August – Prosaro® @ 300mL/ha
Seed treatment/inoculant:	Vibrance® @180mL/100kg and Gaucho® @240mL/100kg

METHOD

One replicated field trial was sown using a split-plot design, with the main plot being time of sowing and the subplot being randomised for seeding rate and herbicide treatments. Refer to Table 1 for specific treatments. Assessments in-crop included establishment counts for both weeds and crop, panicle counts and panicle collection at seed set. Plots were harvested at maturity, measuring grain yield and subsequent grain quality parameters, including protein, test weight, retention, screenings and thousand grain weight.

Table 1: Treatments applied in this trial.

Treatment 1: Time of Sowing	Treatment 2: Targeted Sowing Rate (plants/m ²)	Treatment 3: Herbicide Strategy
		Nil
		Pre-emergent only:
TOS 1: 29 April	100	TOS 1: 29 April, TOS 2: 23 May – Triflur Xtra @ 1.5L/ha + Avadex® @ 2L/ha + Roundup® PowerMax @ 2L/ha
TOS 2: 23 May	150	
	200	Pre- and post-emergent:
		TOS 1: 29 April, TOS 2: 23 May – Triflur Xtra @ 1.5L/ha + Avadex® @ 2L/ha + Roundup® PowerMax @ 2L/ha 3 July – Intervix® @ 0.6L/ha (TOS1: GS30, TOS2: GS21)

RESULTS AND INTERPRETATION

How did sowing rate affect brome density and overall yield?

The trial did not reach the targeted sowing densities, with all treatments having lower than targeted plant establishment, except for TOS 2 100 plants/m². Time of sowing, seeding rate and herbicide treatment all had significant effects on plant establishment (Table 2). TOS 2 had greater plant establishment than TOS 1, and the use of pre-emergent chemistries Treflan® and Avadex® decreased plant establishment slightly compared to the nil treatment.

Table 2. Average barley establishment (plants/m²) across treatments, displayed with Fisher's Protected LSD (5%). (TOS p<0.001, Seeding rate p<0.001, Herbicide p<0.001, LSD=18.6, CV=8.7%). Letters indicate significant difference.

		Barley establishment (plants/m ²)		
		Herbicide Treatment		
Seeding Rate	Time of Sowing	Nil	Treflan® + Avadex®	Treflan® + Avadex + Intervix®
100	TOS1	86.4 ^{ab}	76.1 ^a	84.4 ^{ab}
	TOS2	110.6 ^c	106.7 ^c	100.3 ^{bc}
150	TOS1	135.8 ^e	115.6 ^{cd}	110 ^c
	TOS2	143.1 ^{ef}	131.7 ^{de}	144.2 ^{ef}
200	TOS1	160 ^{fg}	146.1 ^{ef}	147.8 ^{ef}
	TOS2	182.2 ^h	172.2 ^{gh}	170.3 ^{gh}

Despite differences in plant establishment, targeted seeding rate did not have a significant relationship with either yield (P=0.213), brome panicles/m² at maturity (P=0.889) or brome seed set/m² (P=0.409). It was thought increased crop competition might decrease the number of brome plants and panicles, but this was not observed in the trial in 2019. This could be due to moisture not being a limiting factor or Spartacus CL being a less competitive barley cultivar (Walters 2017). However, 2019 should have been a good season for crop competition, as the barley germinated early, had warm growing conditions and was not stressed.

How did time of sowing affect brome density and overall yield?

Time of sowing was found to have a significant relationship to yield, brome panicles/m² at maturity and brome seed set/m² (Table 3).

TOS 2 had lower panicle densities at maturity than TOS 1 across all herbicide strategies (Table 3). This is due to brome that had germinated on the opening break being present at TOS 1, but at TOS 2 the brome population that had already germinated was killed by glyphosate application before sowing. As there were fewer panicles in TOS 2, the seed set was reduced accordingly (Table 3).

TOS 2 yielded significantly higher than TOS 1 across all treatments, with the greatest difference being 0.46t/ha in the nil herbicide treatments. The yield difference decreased as the herbicides became more effective and weed pressure reduced. There was a 0.08t/ha difference between pre-emergent only TOS and 0.04t/ha difference with Intervix® (Table 3).

This result is unexpected, as earlier sown crops generally yield higher than later sown crops. A possible reason is the significantly greater weed pressure on the barley in TOS 1 from weed competition than in TOS 2, where the early germinating brome was controlled in the glyphosate knock down. TOS 1 also experienced frost during flowering, resulting in patchy frost damage. Furthermore, a 23 May sowing date falls within the optimum sowing window for Spartacus CL, an early maturity variety, while 29 April is earlier than ideal (Agriculture Victoria 2019).

Table 3. Average brome density at maturity (panicles/m²), yield (t/ha) and brome seed set (seeds/m²) for time of sowing and herbicide treatments. ANOVA and coefficients of variation on brome seed and brome density conducted on square-root transformed data. Letters indicate significant difference.

Time of Sowing	Herbicide Strategy	Brome density at maturity (panicles/m ²)	Yield (t/ha)	Brome seed set (seeds/m ²)
TOS1	Nil	181.0 ^d	3.0 ^a	3950 ^d
	Treflan [®] + Avadex [®]	73.2 ^{b^c}	3.7 ^{b^c}	1947 ^{b^c}
	Treflan [®] + Avadex [®] + Intervix [®]	10.8 ^a	3.9 ^{c^d}	142 ^a
TOS2	Nil	102.0 ^c	3.5 ^b	2939 ^{c^d}
	Treflan [®] + Avadex [®]	31.0 ^{a^b}	3.8 ^{c^d}	982 ^{a^b}
	Treflan [®] + Avadex [®] + Intervix [®]	1.4 ^a	4.0 ^{c^d}	41 ^a
	Sig. diff.			
	TOS	0.024	0.024	0.042
	Seeding Rate	0.365	0.213	0.409
	Herbicide	<0.001	<0.001	<0.001
	LSD (P=0.05)			
	TOS	42.08	0.17	985.2
	Seeding Rate	NS	NS	NS
	Herbicide	36.65	0.20	873
	Herbicide*TOS	47.14	0.27	1118.4
	CV%	38.2	8.2	38.6

How did the herbicide strategy affect brome density and overall yield?

Herbicide strategy had a significant relationship with barley grain yield, brome panicle density at maturity and brome seed set (Table 3).

As expected, the strategy containing the combination of Treflan[®] and Avadex[®] pre-emergent and Intervix[®] post-emergent had the lowest weed density, followed by the pre-emergent only strategy. The treatment with no herbicides applied had the highest weed density. This highlights the importance of herbicides as a tool to manage brome grass. The effect of these herbicides on the brome population indicates resistance is not an issue in this paddock.

As the herbicides reduced the impact of the brome on the barley crop, yield increased, with nil yielding an average of 3.2t/ha, pre-emergents only yielding 3.7t/ha and the pre-emergent and post-emergent strategy yielding 4.0t/ha (Table 3).

COMMERCIAL PRACTICE

This trial has shown that better brome grass control can be gained by sowing later to allow for a knock down of emerged weeds without a yield penalty. It is important to keep in mind that a 23 May sowing date for Spartacus CL still falls within the optimum sowing window. A lack of yield penalty was seen in this season due to a full moisture profile from a major rain event in December 2018. In a different season, without subsoil moisture and after a dry spring, TOS 1 would be expected to have yielded higher (unless there was major frost damage). This shows that years starting with good sub-soil moisture should be targeted to get on top of problem weeds, as the early germination allows use of a pre-sowing knockdown strategy with glyphosate.

This trial was also fortunate to receive an earlier than average break on 2 May – the median break for Birchip is the second week in May (Grey 2019). This allowed for an early germination of weeds, which occurred while the TOS 1 pre-emergent herbicides still had residual activity and allowed for a knock down in TOS 2. In other seasons where the break may not occur until the second, third or fourth week of May, the pre-emergent herbicides may not have enough residual to control grass weeds, and a post-emergent herbicide (such as Intervix®) may be required.

While this trial showed Intervix® applied post-emergent is the strongest treatment for controlling brome grass, it also reduces variety and rotation options for farmers. The year after applying Intervix® will commonly need to be a Clearfield, which may not be the preferred variety and can rule out some rotations all together, such as lupins and vetch. As such, using Intervix® to control brome needs to be part of a well-thought out rotation over two to three years. Controlling brome during a broadleaf crop using non-Clearfield chemistry may be a better option.

While Intervix® is a strong control option for brome in cereal crops, the constant use of Intervix® and other Clearfield chemistries is increasing the risk of resistance. This mode of action will eventually become less effective than seen in this trial. To slow the development of resistance to Clearfield chemistries, it is important to rotate chemicals with different modes of action, and to consider other methods of controlling brome, such as time of sowing, harvest weed seed control and crop competition.

It is also worth mentioning that while not seen across all plots, some of the Intervix® treated plots had a very late germination of brome grass from rain in October. This late germination was included in the panicle counts. If a late germination occurs, it is important to also prevent it from setting seed to ensure the seed bank is reduced. A late application of glyphosate during grain fill (crop-topping) would be a valuable tool.

A further consideration when choosing brome grass control methods is access to markets, whether that be to a local grain receival site or more broadly. Late-season use of glyphosate and use of imidazolinone products (such as Intervix®) in barley might prevent grain from meeting market specifications – the grain may not be able to be sold or may receive a lower price. For example, if an imidazolinone tolerant variety such as Spartacus CL does not need to be grown or treated with Intervix® or crop-topped with glyphosate to control brome, other herbicide options or a similar non-imidazolinone variety such as La Trobe may be a better option for providing diversity in market options.

Finally, controlling brome needs to be considered as a part of a rotation, rather than just one season. Previous research has shown brome seed can persist in the soil for up to three years, and that controlling brome over at least three successive years is required to deplete the seedbank (SAGIT 2015).

ON-FARM PROFITABILITY

Overall, the highest yielding treatments were the most profitable (Table 4). The differences in income were driven more by yield than by protein, due to the small difference between SP1 and FEED 1 barley this year (\$5 per tonne).

Income remaining after spray costs was calculated for each treatment to allow the grower to deduct their input costs on a per hectare basis. Using both post-emergent and pre-emergent herbicides provided a financial return for the grower in the 2019 season. It was found that the pre- and post-emergent herbicide strategy provided the highest incomes after spray costs. This was followed by pre-emergent only, then the nil herbicides applied treatment. As such, there was a definite financial benefit for the farmer in applying Intervix®, Treflan®, Avadex® and Roundup® to barley crops in the 2019 season.

Table 4. Average income remaining after herbicide and application costs (\$/ha), calculated using average yield, protein and income for each herbicide strategy. Income estimated using SP1=\$248/t delivered to Birchip GrainFlow (GrainFlow website 20/11/19); Treflan® \$5.24/L (SARDI Gross Margins Guide); Avadex® \$8.86/L; Roundup® PowerMax \$6.30/L; Intervix® \$30/L; Contract Spraying costs=\$10/ha, with the pre-emergent only strategy requiring one pass, and the pre-emergent followed by post-emergent strategy requiring two passes.

Herbicide Strategy	Yield (t/ha)	Protein (%)	Grade	Income (\$/ha)	Herbicide costs (\$/ha)	Income after herbicide costs (\$/ha)
Nil	3.2	9.5	SP1	798	0	798
Treflan® + Avadex®	3.7	9.4	SP1	919	48	871
Treflan® + Avadex® + Intervix®	4.0	9.3	SP1	976	76	900

REFERENCES

Brown S., and Harris K., Agriculture Victoria, 2019, 2020 Victorian Crop Sowing Guide <https://grdc.com.au/2020-victorian-crop-sowing-guide>

Grey D., 2019, *BCG Technical Bulletin* 'No. 15, 3 May 2019' <https://www.bcg.org.au/technical-bulletin-3-may-2019/>

Kleemann S., 2011, *Brome Grass Fact Sheet*, 'Brome grass, a persistent but manageable weed' https://grdc.com.au/__data/assets/pdf_file/0027/199260/brome-grass.pdf.pdf

South Australian Grain Industry Trust (SAGIT), 2015, 'The Brome Grass Bulletin' http://www.sagit.com.au/wp-content/uploads/2015/09/Bromegrass-Bulletin_FA_LR.pdf

Walters L., 2017, 2017 BCG Season Research Results, 'Using barley cultivars for non-herbicide control of grass weeds' pp 128-134. <https://www.bcg.org.au/using-barley-cultivars-for-non-herbicide-control-of-grass-weeds/>

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