Barley grass control in a pasture-barley-oat rotation

Author and organisation:
Catherine Borger, Department of Primary Industries and Regional Development (DPIRD)
Ben Whisson, ConsultAg, Lakes Information and Farming Technology (LIFT)

Key messages

- Early application of selective herbicide (Group 1, A) gave excellent control of barley grass. While fewer barley grass plants meant less pasture biomass, it's important to remember that the seeds on the mature barley grass would injure livestock. Further, these barley grass plants could host cereal crop disease.
- Spray topping prevented viable seed set of barley grass while leaving the greatest pasture biomass.
- Good barley grass control in the 2019 pasture was still evident in the 2020 and 2021 crops.
- Late sowing of barley in 2020 (delayed 4 weeks) was relatively ineffective in controlling barley grass and yield was slightly reduced.
- Late sowing of oats in 2021 (delayed 7 weeks) gave excellent weed control, but yield was severely reduced.

Background

The growers in the LIFT group area usually had pasture as the main rotation choice after cereal. In contrast to other areas of the wheatbelt, some growers in this region considered barley grass a valuable (early) feed in pasture as well as a weed in crops. However, growers found that barley grass could have a large impact on crop yield. Growers were interested in both controlling barley grass, and supressing barley grass in crop while allowing it to survive in pasture.

Most group members felt their barley grass was resistant to herbicides (especially low level resistance to Group 1 (A), Targa®). However, growers were unwilling to stop using Targa®, even if efficiency was reduced against barley grass, as it effectively controlled other grass weeds. Growers would like to pair Targa® with other products in pasture to kill barley grass, and then control surviving barley grass in crop with best practice pre-seeding herbicides and delayed sowing.

Aim

The trial aims to investigate pasture barley grass control in 2019, time of seeding in wheat in 2020 and oats in 2021.

Paddock Details

- **Location:** Tarin Rock (-33.0724, 118.2649), Ashton Gray
- **Rainfall**
  2019 Total: 176mm
  2019 GSR (Apr-Oct): 171mm
  2020 Total: 206mm
  2020 GSR (Apr-Oct): 127mm
  2021 Total: 426mm
  2021 GSR (Apr-Oct): 356mm
- **Paddock history**
  2018: pasture
  2017: wheat
- **Soil type** Sandy loam over clay

Trial Details 2019

- Variety: Pasture sown with oats, clover and vetch
- Treatments

1. Untreated

2. Targa® 3-5 leaf
3. Spray top glyphosate
4. Targa® 3-5 leaf and spray top glyphosate
5. Targa® 3-5 leaf and spray top paraquat

- Sowing date: 6 June 2019
- Herbicide
  23 July 2019. Targa® at 300mL/ha sprayed on appropriate treatments
  5 September 2019. Glyphosate® at 400mL/ha sprayed on appropriate treatments
  17 September 2019. Paraquat® at 500 mL/ha on appropriate treatments
- Method and Measurements
  Plot size of 2.5 m by 40 m, 4 replications.
  23 July 2019. Assess barley grass density.
  5 September 2019. Barley grass panicle counts, pasture biomass and barley grass panicles. Seed number per panicle was assessed.

Trial Details 2020

- Variety: Barley cv. Scope.
- Treatments

Each 2019 treatment divided into two plots.

1. Time of sowing 1: Sprayed trifluralin 2.5L/ha, diuron 300g/ha and paraquat 0.6L/ha. Seeding on 28 April 2020.
2. Time of sowing 2: Sprayed 2.5L/ha trifluralin, 2L/ha paraquat. Seeding on 27 May 2020.

- Sowing details: 50 kg/ha, 277mm row spacing.
- Method and Measurements
  10 March 2020. Assess pre-seeding barley grass density.
  27 May 2020 or 23 June 2020. Barley grass and crop density after each time of sowing.
  15 September 2020. Barley grass panicle counts. Collect 20 panicles per plot.
  19 November 2020. Harvest.

Trial Details 2021

- Variety: Oats cv. Wandering.
- Treatments

Each 2019 treatment divided into two plots.

1. Time of sowing 1: Sprayed trifluralin 1.6L/ha, diuron 300g/ha, metolachlor 600mL/ha and paraquat 1L/ha. Seeding on 29 Apr 2021.
2. Time of sowing 2: Sprayed trifluralin 1.6L/ha, diuron 300g/ha, metolachlor 600mL/ha and paraquat 1L/ha. Seeding on 17 Jun 2021.

Note that 50L/ha UAN fertiliser was added to the early sown plots, but not the late sown plots as the field was too wet to allow traffic.

- Sowing details: 45kg/ha, 277mm row spacing.
- Method and Measurements
  26 May 2021 or 2 June 2021. Barley grass and crop density after each time of sowing.
  23 September 2021 or 8 November 2021. Barley grass panicle counts. Collect 20 panicles per plot.
  15 December 2021. Harvest.

Results 2019

The initial barley grass density (before herbicide treatments) was very high (average of 1966 plants/m^2) and was consistent across the trial (Table 1). Targa® killed almost 100% of plants. Treatments with Targa® alone had 13 seeds/m^2 and Targa® followed by a spray top had 7 or 0 seed/m^2 at the end of the season.

The glyphosate spray top treatment had a similar number of barley grass panicles compared to the control, but less seed production. The seeds that were produced following glyphosate spray top may have lower viability in 2020 than the seeds in the untreated control plot. The control and glyphosate spray topping treatments had greatest pasture biomass, due to the high biomass of barley grass within the sample.

Table 1 Initial barley grass density, panicle production, seed production and dry pasture biomass for each treatment. P and LSD values are included for separation of means.

Treatment	Barley grass density/m^2	Barley grass panicles/m^2	Barley grass seeds/m^2	Pasture biomass (g)/m^2
Untreated	1920	1178	17043	559
Targa®	2063	2	13	352
Spray top glyphosate	2068	1133	10781	514
Targa® + spray top glyphosate	1858	2	7	293
Targa® + spray top paraquat	1924	2	0	243
P	0.874	<0.001	<0.001	<0.001
LSD	476	191	3891	72

Results 2020

At the beginning of 2020, prior to applying herbicide or seeding the crop, there was a significant difference in initial emergence of barley grass (P<0.001, LSD: 2.21). The plots that were untreated in 2019 had an average of 59 plants/m^2, and the plots treated with herbicide had 2-8 plants/m^2. In particular, the treatments spray topped with glyphosate in 2019 had 1.9 and 1.7 plants/m^2 at the start of 2020, which was a similar density to those plots that were sprayed with Targa® in 2019. These spray topped plots had high barley grass seed production in the 2019 pasture (10781 seeds/m^2, Table 1). The low emergence in 2020 indicates that the seeds were inviable after glyphosate spray topping in 2019.

Averaged over all treatments, the impact of time of sowing in 2020 did not affect initial barley grass density (average of 42.5 and 60.2 barley grass plants/m^2, P: 0.272). However, that was because barley grass density was low in the plots treated with herbicide in 2019. The interaction between time of sowing in 2020 and herbicide treatment in 2019 was highly significant (Table 2). In the plots that were untreated in 2019, barley grass density in 2020 was much higher in the early sown crop (587.5 plants/m^2) compared to the late sown crop (399.9 plants/m^2). Barley grass seed production in 2020 was significantly reduced by the 2019 treatments, with 11 776 seeds/m^2 in the untreated control, 1086 seeds/m^2 after Targa®, 1300 seeds/m^2 after spray topping, and 755-908 seeds/m^2 following both Targa® and spray topping (P<0.001, LSD: 561). Sowing date, or the interaction of sowing date and treatment did not significantly affect seed production.

The late sowing date resulted in higher crop density than the early sowing date, with 71 and 96 plants/m^2 (P: 0.004, LSD: 10.2). There was no interaction between time of sowing in 2020 and herbicide treatments in 2019 (data not presented). The late crop may have had increased emergence due to increased soil moisture. April rainfall was 7.5mm and May rainfall was 34mm. Yield was not affected by sowing date, but was reduced where weed density was high due to poor control in 2019. The 2019 herbicide treatments resulted in a 2020 crop yield of 0.93t/ha in the untreated control plots, 1.70t/ha for Targa®, 1.79t/ha for spray top glyphosate, 1.82t/ha for Targa® + spray top glyphosate and 1.65t/ha for Targa® + spray top paraquat. The interaction of 2020 time of sowing and 2019 herbicide treatments was not significant (Table 2). Average protein was 14.8%. Hectolitre weight was higher in the early sown crop (69.8 and 68.2kg/hL, P: 0.012, LSD: 0.926) and screenings were lower, with a significant interaction between 2020 sowing time and 2019 herbicide treatments for screenings (Table 2).

Table 2 Barley grass plant and panicle density, crop yield, and screenings for the interaction between 2019 pasture herbicide treatments and 2020 time of sowing treatments. P and LSD values are included for separation of means. Note that barley grass plant and panicle density is back-transformed from a log_{10} transformation.

Treatments 2019	Treatments 2020	Pre-seeding barley grass density/m^2	In-crop barley grass plants/m^2	Barley grass panicles/m^2	Yield t/ha	Screenings (%)
Untreated		59.3	587.5	962	1.09	0.15
Targa®		2.3	28.1	48	2.04	0.16

Spray top glyphosate	Early sowing in April	1.9	63.0	97	1.99	0.15
Targa® + spray top glyphosate		8.1	12.6	54	2.07	0.17
Targa® + spray top paraquat		2.3	10.5	61	1.87	0.16
Untreated	Late sowing in May	58.7	399.9	676	0.77	0.30
Targa®		1.6	40.6	106	1.37	0.32
Spray top glyphosate		1.7	33.8	72	1.58	0.23
Targa® + spray top glyphosate		3.9	28.1	48	1.57	0.31
Targa® + spray top paraquat		1.6	51.8	51	1.44	0.32
P		0.893	<0.001	0.138	0.270	0.050
LSD		NS	2.30	2.00	0.65	0.061

Results 2021

Late sown plots gave excellent weed control (Table 3). Initial plant density was close to zero, except for the 1 plant/m^2 in the late sown plots that were untreated in the 2019 pasture. There were no panicles or seeds produced. In the early sown plots, the effect of the 2019 pasture treatments were still evident in the barley grass plant, panicle and seed numbers.

Late sowing significantly reduced oat density (Table 3). The very cold, wet conditions caused very poor emergence at the later sowing date. Yield was much lower in the late sown plots compared to early sowing (Table 3). Within early sown plots, yield was reduced in the untreated plots, presumably due to high barley grass density. Hectolitre weight was not affected by treatment (average 53 kg/hL) and protein was higher in the late sown, lower yielding crop (7.2 to 7.4% in early sown crop and 8.7 to 8.9% in the late sown crop, P<0.001, LSD: 0.54). As for 2020, screenings were much higher in the late sown crop.

Table 3 Barley grass plant and panicle density, crop yield, and screenings for the interaction between 2019 pasture herbicide treatments and 2020/2021 time of sowing treatments. P and LSD values are included for separation of means.

Treatments 2019	Treatments 2020/2021	Barley grass plants /m^2	Oat plants /m^2	Barley grass panicles /m^2	Barley grass seeds/ m^2	Yield t/ha	Screenings (%)
Untreated	Early sowing in April	598	114	291	6514	2.7	1.0
Targa®		88	105	106	1256	3.6	1.6
Spray top glyphosate		138	125	137	2628	3.3	1.2
Targa® + spray top glyphosate		116	118	85	1016	3.5	1.1
Targa® + spray top paraquat		136	114	99	1109	3.6	1.5
Untreated	Late sowing in May	1	48	0	0	1.6	8.6
Targa®		0	51	0	0	1.9	7.4
Spray top glyphosate		0	54	0	0	1.8	8.0
Targa® + spray top glyphosate		0	48	0	0	1.9	8.3

Targa® + spray top paraquat		0	51	0	0	1.8	7.7
P		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
LSD		98.8	11.5	55.4	1328.7	0.39	0.83

Conclusions

In 2019, Targa® provided excellent barley grass control. The plots spray topped with glyphosate in 2019 had high barley grass seed production, but the spray topping treatment prevented the production of viable barley grass seed in 2019. The spray topping treatment also had high pasture biomass in 2019 due to delayed weed control. However, even though the barley grass seed were not viable, they were still formed in the panicles. These un-viable seeds would still have been able to injure livestock or contaminate wool in the pasture phase.

Late sowing in 2020 (delayed 4 weeks) provided some control of barley grass and late sowing in 2021 (delayed 7 weeks) provided exceptional control of barley grass. In 2020 the late sown crop had better emergence, possibly due to improved soil moisture. In 2021 there was too much moisture, and the very cold, wet conditions caused low emergence. Crop yield was slightly (not significantly) reduced by late sowing in 2020, but yield was severely reduced in 2021.

The GRDC project UA00156 (Seed bank ecology) highlighted that barley grass cohorts had staggered emergence during winter, depending on the population. By comparison, brome grass or annual ryegrass have earlier emergence. Due to the delated barley grass emergence, a large delay to sowing was necessary to remove all barley grass, which significantly reduced yield. Late sowing may be necessary where resistance is widespread and there are few other options. However, it may be more cost effective to return to the pasture 'break crop', with more options for selective and late season control.

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