Demonstrating integrated weed management strategies to control barley grass in low rainfall zone farming systems

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Location
Minnipa Agricultural Centre, paddock S3
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2020Total: 367 mm
2020 GSR: 255 mm
Soil type
Red Sandy loam
Paddock history
2019: Compass barley
2018: Scepter wheat
2017: Volga vetch
Plot size
27 m x 620 m x 3 replicates (3 paddock seeder strips (27 m each) wide)

Key messages

- **In 2019 the IMI system had the lowest barley grass plant numbers and the lowest weed seed set.**
- **In 2019 the desiccated Compass barley hay cut at a higher seeding rate reduced the barley grass weed seed set by 75%. Using a hay cut and hay freeze may be an important management option for paddocks with high barley grass populations.**
- **Using only clethodim and a wetter at higher rates is important to maximise the efficacy and coverage and get the best conditions for killing the grass weeds. The broadleaf spray at MAC is now done separately several days after the grass weed control, not in the same tank mix.**
- **The loss of Group A herbicides to control barley grass within local pasture systems has the potential to change rotations and decrease farm profitability.**

Why do the trial?

Barley grass possesses several biological traits that make it difficult for growers to manage it in the low rainfall zone, so it is not surprising that it is becoming more prevalent in field crops in SA and WA. A survey by Llewellyn *et al*. (2015) showed that barley grass has now made its way into the top 10 weeds of Australian cropping in terms of area infested, crop yield loss and revenue loss.

The biological traits that make barley grass difficult for growers to manage in low rainfall zones include:

- early onset of seed production, which reduces effectiveness of crop-topping or spray-topping in pastures,
- shedding seeds well before crop harvest, reducing harvest weed seed control effectiveness compared to weeds such as ryegrass which has a much higher seed retention,
- increased seed dormancy, reducing weed control from knockdown herbicides due to delayed emergence, and
- increasing herbicide resistance, especially to Group A herbicides, used to control grass weeds in pasture phase and legume crops.

Barley grass management is likely to be more challenging in the low rainfall zone because the growing seasons tend to be more variable in terms of rainfall, which can affect the performance of the pre-emergence herbicides. Furthermore, many growers in these areas tend to have lower budgets for management tactics, and break crops are generally perceived as a higher risk rotation strategy than cereals. Therefore, wheat and barley tend to be the dominant crops in the low rainfall zone. This project is undertaking coordinated research with farming systems groups across the Southern and Western cropping regions to demonstrate tactics that can be reliably used to improve the management of barley grass.

How was it done?

At the beginning of the project a meeting was held with growers, MAC staff, consultants and Dr. Gurjeet Gill to discuss the issue of barley grass in upper EP farming systems. A three-year broad acre management plan (2019-21) was developed to be implemented with five different strategies to be tested and compared in a replicated broad acre farm trial on the MAC farm (Table 1).

The management strategies will be tested over the three year rotation with the focus on barley grass weed management and weed seed set. For the 2019 management of the trial refer to 'Demonstrating integrated weed management strategies to control barley grass in low rainfall zone farming systems', EPFS 2019 Summary, p 175.

Table 1. The five different management strategies and crops for each season (2019-2021) at Minnipa Agricultural Centre, paddock S3.

Strategy	2019	2020	2021
District Practice	Compass barley	Self-regenerating medic pasture (Gp A)	Scepter wheat
IMI system	Scope barley (with IMI (Gp B) applied)	Sultan-SU sown medic pasture (IMI tolerant)	Razor CL wheat (IMI tolerant)
Higher cost herbicide	Compass barley (desiccated) for hay cut sown at higher seeding rate	Scepter wheat (Gp K - Sakura) with harvest weed seed control (HWSC) chaff lines and burning	Spartacus barley (with IMI if needed)
Two Year Break	Self-regenerating medic pasture (Gp A)	TT canola (Gp C, Triazines)	Scepter wheat with harvest weed seed control (chaff lines and burning)
Cultural Control	Compass barley at double seeding rate	Self-regenerating medic pasture (Gp A)	Scepter wheat with no row spacing for competition and HWSC

IMI = imidazolinone herbicides (Gp B).

The trial is composed of three replicated broad acre strips of three seeder widths (27 m wide) of each treatment in MAC paddock S3. In 2020 the paddock was sprayed on 25 March with 1.5 L/ha glyphosate, 0.45 L/ha 2,4-D LV Ester 680, 50 ml/ha Hammer and 100 ml/ha LI700 for early weed control.

The Two Year Break system had Trident TT canola sown on 26 April at 1.8 kg/ha, with Granulock Z fertiliser at 80kg/ha, and 1.5 L/ha glyphosate, 0.8 L/ha trifluralin, 800 gm/ha Simazine and 50 ml/ha Hammer and an insecticide on the 4 May and 4 September. On the 3 June the canola was sprayed with 330 ml/ha clethodim and 0.75 L/ha Hasten for grass weeds. On the 11 June it was sprayed with 30 ml/ha of Lontrel advance and 800 gm/ha of Atrazine.

The IMI system, following Scope barley in 2019, was sown with Sultan-SU (IMI tolerant) medic pasture at 7 kg/ha with 50 kg/ha of GranulockZ fertiliser on the 26 April, with 1.5 L/ha glyphosate and 50 ml/ha Hammer pre-sowing. On the 25 May all pasture treatments were sprayed with 25 gm/ha Broadstrike and 0.75 L/ha Hasten for broadleaf weed control, and on the 3 June 330 ml/ha clethodim and 0.75 L/ha Hasten for grass weed control. Karate Zeon insecticide was sprayed on the 4 September.

Scepter wheat was sown on the 12 May at a seeding rate of 70 kg/ha, with GranulockZ fertiliser at 70kg/ha, and 1.6 L/ha glyphosate, 1.5 L/ha trifluralin and 50 ml/ha Hammer. It was sprayed with 1 L/ha Amicide 625 for broadleaf weeds on 28 August. Unfortunately, the Gp K herbicide Sakura was not applied pre-sowing.

Crop establishment, barley grass numbers, barley grass seed set, grain yield and quality were assessed during the growing season. Late barley grass samples were taken and panicles sent to Roseworthy for the assessment of barley grass seed set. The 27 m strips were harvested with the plot header (3 times) per treatment on 19 October for canola and 3 November for wheat, and the grain quality was assessed.

What happened?

In 2019 the IMI system had no barley grass weed seed set at harvest (Table 2). The Compass barley in 2019 in the District Practice and Cultural Control systems produced similar barley grass weed seed set with 377 seeds/m^2 and 360 seeds/m^2 respectively. The desiccated compass barley hay cut at a higher seeding rate of 95 kg/ha reduced the overall barley grass weed seed set to 88 seeds/m^2 (Table 2). The Two Year Break self-regenerating pasture system had the higher barley grass numbers during the 2019 season, but the late paraquat application in early September in the pasture phase lowered weed seed set to 216 seeds/m^2 (Table 2).

In 2020 the majority of the barley grass again germinated later in the season during mid July and August avoiding the early weed control with pre-sowing herbicide applications. The residual carryover in the IMI system resulted in the lowest pre-seeding germination and low barley grass numbers/m^2 (Table 2). The different crops all established well but a lower than average rainfall in May, June and July resulted in very slow crop growth until August and September.

The chemical applications applied in the break crop systems of the canola and medic crops reduced the late barley grass plant numbers (Table 2), with the TT Canola system giving the best later barley grass weed management. Despite the lower numbers of barley grass there were differences in the number of barley grass seed heads per plant (Table 2) with the Higher Cost Chemical system sown with Scepter wheat having more seed heads per plant late in the season. The 2020 late barley grass weed seed set at harvest is still being assessed at Roseworthy.

Table 1. The five different management strategies and crops for each season (2019-2021) at Minnipa Agricultural Centre, paddock S3.

2020 Barley grass weed control strategy and crop variety	2019 Pre-harvest barley grass weed seed set (seeds/m²)	Pre seeding barley grass numbers (plants/m²) 27 April	Crop establishment (plants/m²) 16 June	Early barley grass numbers (plants/m²) 16 June	Late barley grass (plants /m²) 1 Sept	Late barley grass (heads /m²) 1 Sept
District Practice Self-regenerating medic pasture	377	9.3	45.5	34.8	1.6	3.3
IMI system Sultan (SU tolerant) sown medic pasture	0	3.7	88.3	26	1.3	4.7
Cultural Control Self-regenerating medic pasture	360	42.4	46.3	39.3	2.8	5.7
Higher cost herbicide Scepter wheat	88	20	124.7	0.1	1.3	11.3
Two Year Break Trident TT canola	216	45.9	38.5	18	0.1	0.1
LSD (P=0.05)	*84.3*	*ns*	*9.2*	*22.6*	*1.2*	*4.8*

The Trident TT canola was harvested on the 19 October and yielded 0.59 t/ha with 30% oil, 26.8% protein and 6.2% moisture. The Scepter wheat was harvested on the 3 November and yielded 1.39 t/ha. The grain quality achieved the required delivery standards with 11.9% protein, 4.2% screenings, 10% moisture, test weight 82.9 gm and 38.2 gm/1000 grain weight.

What does this mean?

The barley grass seed germination occurred between late June and August indicating a late germinating population that avoids early weed control with pre-sowing herbicide applications. The germination patterns of this barley grass population was assessed at Roseworthy and showed it was a late germinating population with a requirement for cold (vernalisation), and Group A resistance to quizalofop.

In 2019 the desiccated Compass barley hay cut at a higher seeding rate of 95 kg/ha reduced the overall barley grass weed seed set to 88 seeds/m² compared to the other Compass barley systems, reducing the weed seed set by 75%. Despite the 2019 Two Year Break self-regenerating pasture system having higher barley grass numbers during the season the late hay freeze with paraquat sprayed at 1.2 L/ha, 500 mls LI700/100L at water rate 100L/ha in early September sprayed in the morning in cooler overcast conditions (approximately 19 degrees with a Delta T around 3.5) in the pasture phase prevented weed seed set. Using a hay cut and following up with a hay freeze may be an important management option to manage barley grass populations.

With confirmed Group A resistance levels at Minnipa Agricultural Centre in barley grass populations to FOPS, moving to clethodim could be effective for the short term. Generally higher rate of clethodim (500 mL/ha) appears to be effective on most populations where 250 mL/ha rate does not work effectively at present. However, resistance to the higher rate is likely to evolve over the next few years. The broadleaf spray at MAC is done separately several days after the grass weed control, not in the same tank mix. The environmental conditions can also affect the spray efficacy, especially cold weather/frost either 2-3 days before or after spraying, so avoid these events if possible. Dry conditions, plant stress and soil constraints may also affect spray efficacy, but more research is needed in this area.

While the IMI herbicide system is working well at MAC it tends to be quite prone to evolution of resistance in weeds. The strategic use of the IMI herbicide system must be used to maximise the effectiveness and long term use of this system. Growers also need to be aware of herbicide breakdown and plant back periods, especially in low rainfall seasons to avoid bare paddocks.

The chemical applications applied in the break crop systems of the canola and medic crops reduced the late barley grass plant numbers, with the TT Canola system giving the best later barley grass weed management. All systems had some level of barley grass escapes and weed seed carry over, and the number and size of barley grass seed heads will impact on the size of the seed bank in the following season.

The Group A herbicide resistance is becoming a major issue on MAC and in this region. The loss of Group A chemicals within our pasture break system has the potential to totally change farming systems. Currently farmers on upper EP rely on self-regenerating medic-based systems with a profitable livestock enterprise, with grass control applied to prevent weed seed set in spring. The loss of the ability to control barley grass weeds using Group A herbicides will result in medic pasture having to be sprayed out using glyphosate in spring. This will reduce the feed base and carrying capacity, incur later sowing times in the cropping phase to gain weed control or more cropping dominate systems with other break crops (canola, vetch, lentils) and alternative herbicide groups which will increase risk and impact on profitability.

To ensure Group A resistance is kept in check, farmers may want to ensure that any suspected resistant plants are dealt with in pasture systems by following up with a knockdown herbicide as early as possible to prevent seed set. Always have follow up options to control any survivors and to preserve Group A herbicides. Using alternative chemical groups by including canola or introducing Clearfield systems as a different rotational break may also be an option. The loss of Group A herbicides within current farming systems may result in high barley grass seed bank carry over. Reducing the weed seed bank is pivotal to managing all grass weeds.

If barley grass herbicide resistance is suspected, the first step is to test the population to know exactly what you are dealing with and ensure the best use of chemicals to maximise the herbicide efficacy. This paddock scale MAC research is ongoing for the 2021 season to assess the barley grass weed management strategies.

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Harvest at Minnipa Agricultural Centre, 2020.

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