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Section 6

Weeds

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

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Location
Minnipa Agricultural Centre, S3
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2021 Total: 406 mm
2021 GSR: 248 mm
Soil type
Red sandy loam
Paddock history
2021: Implemented broadacre trial and Wheat.
2020: Implemented broadacre trial and Canola.
2019: Implemented broadacre trial and 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

- **The traditional management of pasture systems results in an increase in barley grass weed set.**
- **In 2019 the use of propyzamide in pasture and a desiccated late hay freeze reduced the barley grass weed seed set by 75%.**
- **TT canola systems with simazine reduced barley grass weed seed set.**
- **IMI chemistry worked well in the year of application (2019) but barley grass weed seed set still increased in the sown pasture system in the following season.**
- **There is seasonal variation with the number of seeds set per panicle in a season, with 2020 having a high weed seed set.**
- **Despite getting good control in one season barley grass still has the ability to germinate from the weed seed bank the following season and set high weed seed numbers.**
- **There was no single year elimination strategy identified to control barley grass numbers and weed seed set over the three seasons, which means barley grass management and lowering weed seed set needs to be a focus in all seasons in low rainfall farming systems.**

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

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

Treatment	1	2	3	4	5
Rotation Strategy	**District Practice**	**IMI**	**High cost chemical**	**Two year break**	**Cultural**
YEAR 1- 2019	**Compass Barley** 17 May - 68 kg/ha with GranulockZ 65 kg/ha 17 May -1.2 L/ha Glyphosate, 1.5 L/ha Trifluralin, 400 gm/ha Diuron	**CL Scope Barley** 17 May - 68 kg/ha with GranulockZ 65 kg/ha 17 May - 1.2 L/ha Glyphosate, 1.5 L/ha Trifluralin, 400 gm/ha Diuron 16 July - 700 ml/ha Intervix	**Compass Barley for haycut** 17 May - High seeding rate at 95 kg/ha with GranulockZ 65 kg/ha Hay cut on 26 Sept 17 May - 1.2 L/ha Glyphosate, 1.5 L/ha Trifluralin, 400 gm/ha Diuron 3 Sept - Hay freeze 1.8 L/ha Weedmaster DST (Glyphosate)	**Self-Regenerating Grass Free Pasture** 17 May - Propyzamide 1 L/ha 15 mm rainfall after but grass weeds had germinated 2 July Double hit grasses- 190 ml/ha quizalofop Targa Bolt (GpA), Broadstrike (Gp B -SU) 25 gm/ha and Clethodim (Gp A) 250 ml/ha. 3/9/2019 Paraquat 1.2 L/ha	**Compass Barley** 17 May - Double seeding rate (60 kg/ha spread then 60 kg/ha sown) with GranulockZ 65 kg/ha 17 May - 1.2 L/ha Glyphosate HWS - Chaff lines and burnt
YEAR 2- 2020 All paddock 25 March 1.5 L/ha Glyphosate, 0.45 L/ha 2,4-D LV Ester 680, 50 ml/ha Hammer and 100 ml/ha LI700	**Self-Regenerating Grass Free Medic Pasture** 3 June - 330 ml/ha Clethodim 4 Sept - Karate Zeon 36 ml/ha (insecticide)	**Sultan Sown Medic** 26 April - 7 kg/ha 25 May - 25 gm/ha Broadstrike, 0.75 L/ha Hasten. 3 June 330 ml/ha Clethodim, 0.75 L/ha Hasten 4 Sept- Karate Zeon 36 ml/ha (insecticide)	**Scepter Wheat** 12 May - 70 kg/ha with GranulockZ 70 kg/ha 1.5 L/ha Trifluralin and 50 ml/ha Hammer. 28 August - 1 L/ha 625 Amicide	**Trident TT Canola**, 26 April - 1.8 kg/ha with GranulockZ 80 kg/ha 26 April - 1.5 L/ha Glyphosate, 0.8 L/ha Trifluralin, 800 ml/ha Simazine, 50 ml/ha Hammer. 3 June - 330 ml/ha Clethodim, 0.75 L/ha Hasten 11 June 30 ml/ha Lontrel Advance, 800 gm/ha Atrazine.	**Self-Regenerating Grass Free Medic Pasture** . 3 June - 330 ml/ha Clethodim 4 Sept - Karate Zeon 36 ml/ha (insecticide) 6 Sept - Hay freeze - 1.2 L/ha Paraquat
YEAR 3 - 2021 Scepter wheat seeding rate of 75 kg/ha with GranulockZ 75 kg/ha	**Scepter Wheat** 2 June - 1.2 L/ha Glyphosate, 1.5 L/ha Trifluralin, 400 gm/ha Diuron. 3 August - Saracen 100 ml/ha, and LVE Ester 570 @ 400 ml/ha, Lontrel Advance 40 ml/ha, Topic 85 ml/ha, Zn, Cu, Mn @ 0.5 kg/ha	**Scepter Wheat** 2 June - 1.2 L/ha Glyphosate, 1.5 L/ha Trifluralin, 400 gm/ha Diuron. 3 August - Saracen 100 ml/ha, and LVE Ester 570 @ 400 ml/ha, Lontrel Advance 40 ml/ha, Topic 85 ml/ha, Zn, Cu, Mn @ 0.5 kg/ha	**CL Spartacus Barley** 10 June - 1.2 L/ha Glyphosate, 1.5 L/ha Trifluralin, 400 gm/ha Diuron. 6 August - 700 ml/ha Intervix and LVE Ester 570 @ 400 ml/ha, Zn, Cu, Mn @ 0.5 kg/ha	**Scepter Wheat** 2 June - 1.2 L/ha Glyphosate, 1.5 L/ha Trifluralin, 118 gm/ha Sakura. 3 August - Saracen 100 ml/ha, and LVE Ester 570 @ 400 ml/ha, Lontrel Advance 40 ml/ha, Topic 85 ml/ha, Zn, Cu, Mn @ 0.5 kg/ha	**Scepter Wheat - no row spacing (double sown)** 2 June - 1.2 L/ha Glyphosate, 1.5 L/ha Trifluralin, 400 gm/ha Diuron. 3 August - Saracen 100 ml/ha, and LVE Ester 570 @ 400 ml/ha, Lontrel Advance 40 ml/ha, Topic 85 ml/ha, Zn, Cu, Mn @ 0.5 kg/ha

- increasing herbicide resistance, especially to Group 1/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-emergent 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?

In early 2019 a meeting was held with growers, MAC staff 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 were tested over the three year of rotation with the focus on barley grass weed management and weed seed set. For the previous seasons' trial details refer to 'Demonstrating integrated weed management strategies to control barley grass in low rainfall zone farming systems', EPFSS 2019 Summary p. 175, and EPFSS 2020 Summary p. 171.

The trial was composed of three replicated broad acre strips of three seeder widths (27 m wide) of each treatment in MAC paddock S3. The 2019 - 2021 paddock management is listed in Table 1.

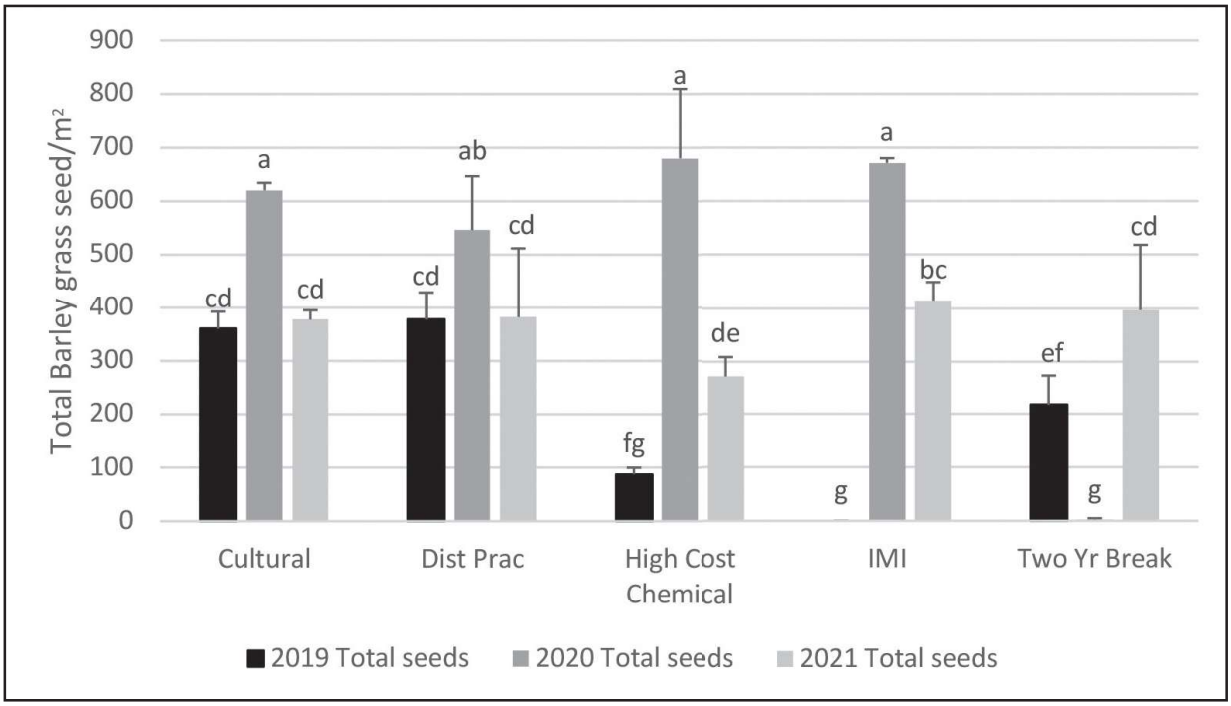

Figure 1. The five different management strategies and total barley grass weed seed set for each season (2019-2021) at Minnipa Agricultural Centre S3, different letters are significantly different LSD=138. Error bars represent standard deviation of the population.

Strategy	2019	2020	2021
Cultural	Double rate Barley (HWSC)	Pasture	Wheat (no row)
District Practice	Barley	Pasture	Wheat
High Cost Chemical	Barley Hay cut	Wheat	Barley
IMI	Barley IMI	Sown Pasture	Wheat
Two Year Break	Pasture (prop)	Canola	Wheat

During 2021 the sampling and timings assessed during the growing season were, pre-sowing barley grass numbers (14 May), crop establishment and early barley grass numbers (6 July), late barley grass number and crop dry matter (26 August), barley grass seed set (12 October), and grain yield (6 December) and quality. 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 (4 times) per treatment on 6 December for wheat and barley, and the grain quality was assessed.

What happened?

In 2019 the IMI system had no barley grass weed seed set at harvest (Figure 1). The Compass barley in 2019 in the District Practice and Cultural Control systems produced similar barley grass weed seed set. The desiccated Compass barley hay cut sown at a higher seeding rate of 95 kg/ha reduced the overall barley grass weed seed set to 88 seeds/m^2 (Figure 1). 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 (Figure 1).

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. 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 2020 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. Despite the lower numbers of barley grass there were differences in the number of barley grass seed/m^2 (Figure 1) with the Higher Cost Chemical system sown with Scepter wheat having more seed heads per plant late in the season, but it must be noted this system did not receive the Sakura herbicide as initially planned (Figure 2).

In 2021 there was some germination of barley grass plants by early July but again most barley grass germinated in mid July-August which is reflected in the higher late barley grass numbers counted on September 1 (Table 2). The Higher cost herbicide treatment sown with CL Spartacus Barley had high early barley grass numbers but the Intervix applied in early August reduced the late barley grass population and lowered the overall weed seed set (Figure 1 and Table 2). All other management strategies which were sown to Scepter wheat had a similar barley grass weed seed set of greater than 370 barley grass weed seeds/m^2 (Table 2). There were no differences in yield of the management treatments sown to cereals in 2021.

Table 2. Plant and barley grass weed numbers, dry matter, yield and grain quality in GRDC Low Rainfall Barley Grass Management farm trial, 2021.

2021 Barley grass weed control strategy and crop variety	2020 Pre-harvest barley grass weed seed set/m^2	Pre seeding barley grass numbers (plants/m^2) 14 May	Crop establ-ishment (plants/m^2) 6 July	Early barley grass numbers (plants/m^2) 6 July	Late barley grass (plants /m^2) 1 Sept	Late barley grass (heads /m^2) 1 Sept	Yield (t/ha)	2021 Harvest barley grass weed seed set/m^2
District Practice Scepter Wheat	620	0	142	4.8	6.7	16.4	2.85	382
IMI system Scepter wheat	546	0	136	1.2	2.4	5.1	2.38	413
Cultural Control Scepter wheat	680	0	157	6.3	20.3	55.2	2.09	377
Higher cost herbicide CL Spartacus Barley	671	0.5	112	23.5	1.9	2.7	2.31	272
Two Year Break Scepter Wheat	2	0	133	0.5	1.3	2.7	2.32	397
LSD (P=0.05)	*159*	*ns*	*ns*	*13.7*	*8.9*	*23.5*	*ns*	*ns*

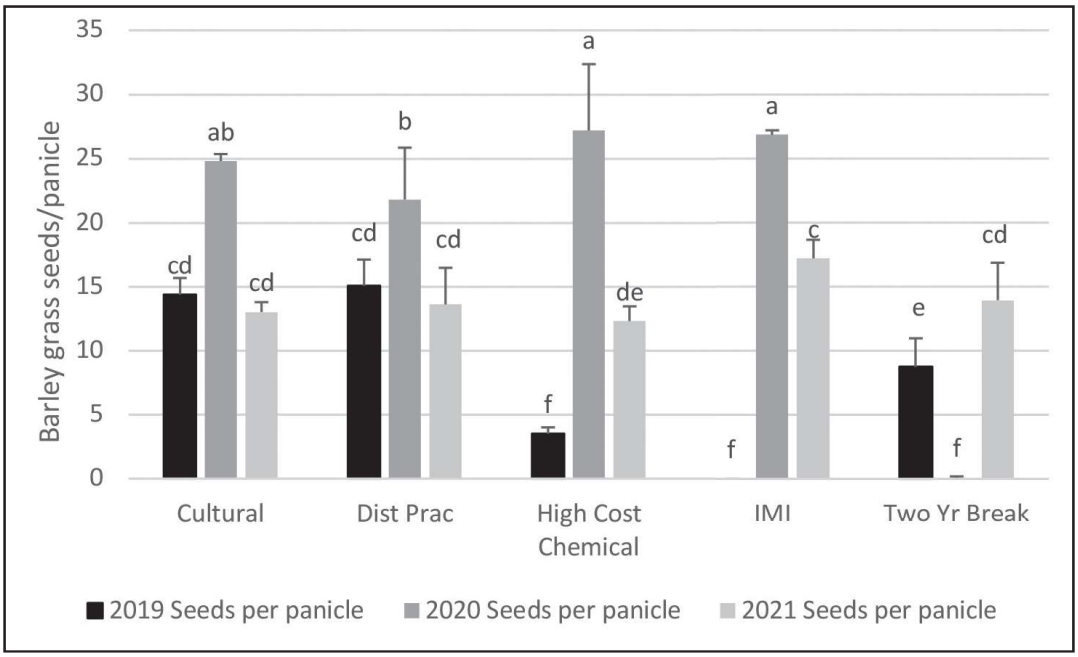

Figure 2. The five different management strategies and the number of barley grass weed seeds per panicle for each season (2019-2021) at Minnipa Agricultural Centre, paddock S3 different letters are significantly different LSD = 4.6. Error bars represent standard deviation of the population.

What does this mean?

The MAC S3 barley grass is a later germinating population with a requirement for cold (vernalisation), therefore avoids early weed control with pre-sowing herbicide applications, and it also has confirmed Group 1/A resistance to quizalofop.

The three years of the broadacre barley grass management strategies have shown:

- The traditional management of pasture systems results in an increase in barley grass weed set.
- In 2019 the use of propyzamide in pasture and a desiccated late hay freeze reduced the barley grass weed seed set by 75%.
- The use of TT canola systems with simazine reduced barley grass weed seed set.
- The IMI chemistry worked well in the year of application (2019) but barley grass weed seed set still increased in the sown pasture system in the following season.
- There is seasonal variation with the number of seeds set per panicle in a season, with 2020 having a high weed seed set.
- Despite getting good control in one season barley grass has the ability to germinate from the weed seed bank the following season and still set high weed seed numbers.
- There was no overall management strategy identified to control barley grass numbers and weed seed set over the three seasons which means barley grass management and lowering weed seed set needs to be a focus in all seasons in low rainfall farming systems.

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.

With confirmed Group 1/A resistance levels at Minnipa Agricultural Centre in barley grass populations to FOPS, moving to clethodim could be effective for the short term. Generally a higher rate of clethodim (500 mL/ha) appears to be effective on most populations where the 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 spraying 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.

The Group 1/A herbicide resistance is becoming a major issue on MAC and in this region. The loss of Group 1/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 1/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, reduce the medic seed bank, incur later sowing times in the cropping phase to gain weed control or more cropping dominant systems with other break crops (canola, vetch, lentils) and alternative herbicide groups which will increase risk and impact on profitability.

To ensure Group 1/A resistance is kept in check, farmers may want to make sure 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 1/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 1/A herbicides within current farming systems may result in high barley grass seed set and 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 is the final season of this GRDC southern cropping region research.

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Farmers listening to Amanda Cook at the MAC South 3 broadacre low rainfall barley grass demonstration, 2021.