Management of group A herbicide resistant barley grass in pasture phase

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Searching for answers

Location:
Minnipa Agricultural Centre paddock N1

Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2016 Total: 391 mm
2016 GSR: 268 mm

Yield
Actual: 2.9 t/ha, surrounding crop

Paddock History
2015: Pasture legume trial
2014: Mace wheat
2013: Mace wheat

Soil Type
Red loam

Plot Size
27 m x 9 m x 3 split plots (2015)
9 m x 9 m x 4 reps (2016)

Yield Limiting Factors
Barley grass

Livestock
Grazing simulated by mowing in pasture plots

Key messages

- **At present, group A herbicide resistance in barley grass is relatively low at a district level on the EP. However, growers need to act now to integrate multiple control tactics to prolong the effectiveness of these cheap and effective herbicides.**
- **In the absence of group A herbicides, it is still possible to achieve large reductions in barley grass seed bank in a legume pasture phase.**
- **When using moderate efficacy-low cost herbicides (Treflan + Logran) for barley grass control in wheat, effective control of the weed in previous pasture phase was critical.**

Why do the trial?

A field trial has been established at Minnipa Agricultural Centre (MAC) to investigate legume pasture options for controlling group A (ACCase inhibitors) resistant barley grass (GRDC project UA00149).

In 2012 the University of Adelaide (UA) conducted a GRDC-funded random resistance survey on barley grass from across EP and Upper North (UN) cropping districts (Shergill *et al*. 2015). The survey found 3% of the paddocks to be resistant to group A herbicides (≥ 20% survivors) and another 3% were developing resistance (1% ≤ 20% survivors). Resistance was much more prevalent in the UN than on EP (> 5 fold). These survey results are based on sampling barley grass from completely random locations around the survey districts; there could be individual farms in this area where resistance levels could be much higher.

While at a district level group A resistance is currently present at a relatively low level, it is likely to increase in prevalence in the future, which would reduce the effectiveness of the pasture phase in controlling barley grass. This trial was undertaken to investigate barley grass management options when group A herbicide resistance has evolved.

The trial also looked at the impact of these pasture treatments on a subsequent wheat crop and compared one vs. two consecutive years of legume pasture on barley grass management in the absence of group A herbicides.

How was it done?

A trial site was established at MAC in a heavily barley grass-infested paddock (N1) before the 2015 growing season. Soil seedbank sampling was done to establish the initial barley grass seed bank. Soil cores were grown out in trays at Roseworthy Campus to assess the seed bank. Large (9 m x 27 m) replicated plots were set up under eight different pasture management options (Table 1).

Seed bank soil cores were again taken prior to the 2016 growing season. These samples were germinated in trays during 2016 at Roseworthy Campus to assess barley grass seed bank. Comparisons were then made for each plot to calculate the percent reduction in barley grass seed bank by pasture management treatments.

During the 2016 growing season plots were split into 3 sub plots (9 m x 9 m) where one sub plot repeated the pasture treatment of 2015 to provide two consecutive years of pasture treatment. The other two sub plots were sown to Scepter wheat (26 May) with the MAC air seeder. Two pre-emergent herbicide treatments were applied to the wheat sub plots: (a) moderate efficacy and cheaper option of trifluralin 1 L/ha + triasulfuron 30 g/ha (Tref + Log.) and (b) a high efficacy and expensive option of pyroxasulfone 118 g/ha (Sakura).

Table 1 Pasture treatments in 2015

2015 Pasture barley grass management treatments	
1	**Brown manure vetch** – vetch was sown and brown manured with glyphosate (570 g/L) @ 1.5 L/ha (4 September)
2	**Medic (regen.) pasture topped early** – topped with glyphosate (570 g/L) @ 0.5 L/ha when 10% barley grass seed was at soft dough stage (4 September)
3	**Medic (regen.) pasture topped mid** – topped with paraquat @ 1 L/ha when 50% barley grass seed was at soft dough stage (15 September)
4	**Medic (regen.) hay cut** – (29 September)
5	**Medic (regen.) glyphosate + hay cut** – topped with glyphosate (570 g/L) @ 2.4 L/ha (24 September) followed by hay cut (29 September)
6	**Medic (regen.) propyzamide** – applied at 1 L/ha EPE (8 May), note applied when medic had germinated but prior to significant barley grass germination
7	**Medic (regen.) propyzamide + spray topped mid** – propyzamide @ 1 L/ha EPE (8 May), paraquat @ 1 L/ha when 50% barley grass seed at soft dough stage (15 September)
8	**Medic (regen.) grazed (control**) – grazing simulated by mowing (20 August)

During 2016 barley grass panicles were assessed in the wheat sub plots to indicate weed pressure in a subsequent wheat crop under the two pre-emergent herbicide options.

Soil cores will soon be taken to evaluate changes in barley grass seed bank. This approach will allow assessment of the impact of the original pasture treatments on the weed pressure in the subsequent wheat crop (under different herbicide options) and also the difference in barley grass seed bank between one and two consecutive years of legume pasture. These results will be available later in 2017.

What happened?

Initial barley grass seed bank at the experimental site at the start of 2015 season was 1432 seeds/m^2. There was no statistical difference (P>0.05) between the replicates indicating the presence of a uniform weed population across the site.

Results from barley grass seed bank assessments at the start of 2016 were used to evaluate the reduction in barley grass by the pasture treatments applied in 2015 (Table 2).

Weeds

Table 2 Summary of results 2015 pasture and 2016 wheat, letters within each column indicate statistical differences between the treatments; grain yield as percentage of the control treatment is shown in brackets

2015 pasture treatments	**2016 wheat yield**	**2015 reduction in barley grass**	**2016 barley grass in wheat (panicles/m^2)**	
	t/ha	**% reduction**	**Tref + Log**	**Sakura**
1. Vetch brown manure	2.10 ***bc*** *(101.8%)*	69 ***a***	16.5 ***cd***	11.2 ***cd***
2. Medic early spray-top	2.13 ***bc*** *(103.3%)*	66 ***a***	18.3 ***c***	8.7 ***cd***
3. Medic mid spray-top	2.29 ***ab*** *(110.9%)*	60 ***a***	13.0 ***cd***	7.8 ***d***
4. Medic hay cut	2.19 ***b*** *(106.3%)*	62 ***a***	29.3 ***b***	17.5 ***cd***
5. Medic glypho. + hay	2.20 ***ab*** *(106.8%)*	49 ***ab***	25.8 ***bc***	9.2 ***cd***
6. Medic propyz.	2.13 ***bc*** *(103.0%)*	27 ***b***	50.0 ***a***	7.0 ***d***
7. Medic propyz. + spray-top	2.32 ***a*** *(112.4%)*	79 ***b***	16.7 ***cd***	8.0 ***cd***
8. Medic grazed (control)	2.06 ***c*** *(100%)*	23 ***b***	47.5 ***a***	12.0 ***cd***
	P<0.001, LSD=0.12	*P<0.013 LSD=31.9 cv rep = 8.4%*	*Interaction P<0.001 LSD=10.48 cv rep = 10.8%*	

All 2015 pasture treatments reduced barley grass density, ranging between 23% and 79% (Table 2). These results show that the barley grass population can be reduced significantly in pasture even in the absence of group A herbicides. However, when starting with such a high seedbank, it is likely there will still be significant weed pressure for subsequent crop or pasture after a single year pasture treatment. In this trial, the best pasture treatment reduced barley grass from approximately 1400 seeds/m^2 to about 300 seeds/m^2. This means that even the most effective pasture treatment would require an effective herbicide treatment to achieve high yield potential of subsequent wheat crops.

For the two hay based treatments (49% and 62% control), it is likely that that weed control could have been improved if hay was cut at an earlier growth stage of barley grass.

Pasture topping treatments reduced weed seedbank by 60 and 66% for early and mid-timings. Reducing the variability in maturity in barley grass population is critical for improving the effectiveness of pasture topping or hay cut operation. In a weed species with such variable maturity, synchronising plant development can be difficult. Historically group A herbicides have been used to synchronise plant development in barley grass populations to improve the performance of pasture topping. After group A resistance develops in barley grass, other tools such as crash grazing and soil applied herbicides will be needed to reduce variability of barley grass maturity.

Propyzamide was relatively ineffective in 2015, which may have been due to reduced herbicide uptake caused by the dry conditions early in the growing season. Visual observations (seed bank data still to be assessed) from 2016 indicate propyzamide was very successful in reducing barley grass under more favourable moisture conditions. Therefore, the use of propyzamide to control barley grass in legume pastures can be highly effective but highly dependent on the weather. It also has a significant grazing withholding period that needs to be carefully considered.

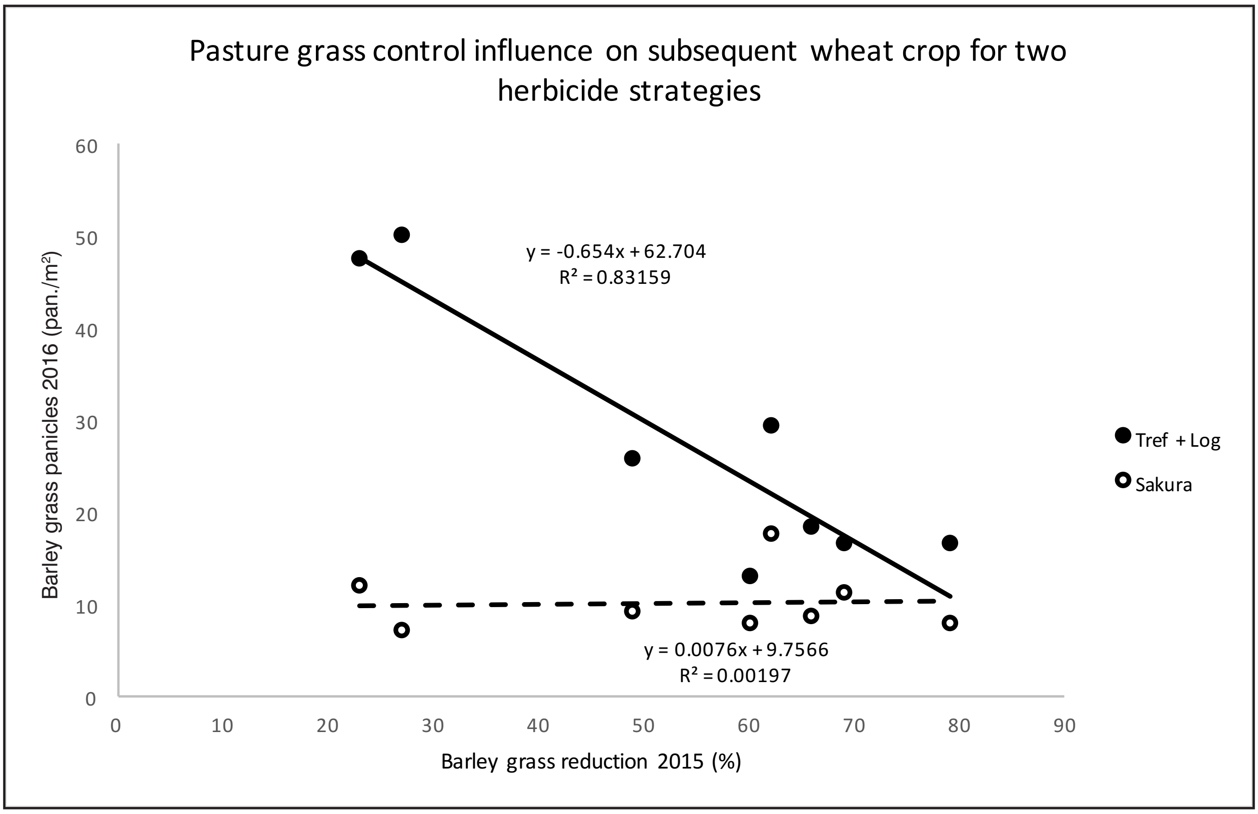

Figure 1 Relationship between barley grass control in pasture (2015) and the amount of barley grass present in subsequent wheat crop (2016) for the two herbicide options investigated

Barley grass infestation in wheat under the moderate efficacy-low cost (Treflan + Logran) treatment strongly reflected the level of barley grass control achieved in the previous year's pasture (R^2=0.83). However, barley grass numbers in wheat under the highly effective-high cost regime (Sakura) was unaffected by the previous year's pasture treatment (R^2=0.002), (Figure 1). Sakura in wheat was able to control barley grass effectively even in pasture treatments that provided poor barley grass control in 2015. Even though Sakura had high efficacy even in high weed density situations, using this herbicide repeatedly in such situations could accelerate resistance development. These results also show that the moderate efficacy-low cost (Treflan+ Logran) herbicide regime was adequate only under low weed pressure, but inadequate in situations of high barley grass pressure. These results are consistent with previous UA work on barley grass management in wheat on the EP.

Wheat yields in 2016 ranged from 2.06 to 2.32 t/ha; on initial investigation wheat yield was not closely related to previous pasture barley grass control (R^2=0.35, data not shown), but when treatment 1 (vetch brown manure) and treatment 2 (medic early pasture topped) were excluded the yields were strongly correlated to previous pasture weed control (R^2=0.86, data not shown).

The final barley grass seed bank assessment will be done in 2017 and is expected to show the differences between a single and consecutive years of each pasture treatment. It should also show seed bank changes for these pasture treatments following a wheat crop under both high and low efficacy weed control options.

What does this mean?

- At present, group A herbicide resistance is low at a district level on the EP, but expected to increase resulting in the eventual loss of these highly effective and affordable herbicides.
- We need to be integrating multiple control tactics when controlling barley grass in a legume pasture phase to prolong the useful life of these affordable and effective group A herbicides.
- It is possible to greatly reduce barley grass seed bank in a legume pasture phase, but in the absence of group A herbicides, it is more difficult to synchronise plant development and results of seed set control tactics tend to be more variable.
- Despite being able to achieve large reductions in barley grass seedbank in a single year, sufficient weed infestations can occur to rapidly increase weed infestation unless they are managed effectively.
- When using moderate efficacy-low cost herbicides (Treflan + Logran) for barley grass control in wheat, effective control of the weed in previous pasture phase in critical.
- The high efficacy-high cost herbicide (Sakura) provided effective control of barley grass in wheat irrespective of the level of weed control achieved in previous pasture. However, repeated use of Sakura in a high weed pressure situation would speed up resistance development to this valuable herbicide.

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