Overdependence on agrichemicals – UNFS barley grass trial

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Key findings

- The 2016 trial results looking at cultural control techniques for barley grass largely confirmed the 2015 findings.
- Increasing barley seeding rate in the presence of barley grass can provide substantial benefits to both yield and reduced weed seed carry-over. This applies particularly to competitive varieties such as Fathom, but also to less competitive varieties such as Hindmarsh.
- In contrast, doubling the seeding rate of wheat had no beneficial effect on yield or weed carry-over.
- Doubling the district practice seeding rate in barley substantially reduced the competitive effect of barley grass to the stage where crop yields were similar to those plots where herbicide was applied.

Why do the trial?

Barley grass is becoming an increasingly problematic weed in lower rainfall farming systems across South Australia, particularly in the Upper North. It has a very short growing season which allows it to set seed even in the driest of seasons. Control in the past has been relatively simple in non-cereal years with cheap and effective selective herbicides. However, there is now widespread concern about the potential for herbicide resistance; Group A resistance is becoming increasingly common through the region.

There is the need to explore the effectiveness of cultural methods of grass suppression which do not involve the use of herbicides. An important requirement is to find practices which both maximise crop yield in the presence of background grass populations and also suppress weed seed carry-over.

This trial completed at Appila in the Upper North, 2016 represents a component of a coordinated approach across a number of low rainfall farming systems groups as part of a GRDC-funded 'Overdependence on Agrochemicals' project. The same trial was completed at Port Germein in 2015. This trial was reported in EPFS 2016, pp. 166-170.

How was it done?

Location Appila, Upper North Kevin and Ben Ritchie	**Rainfall** Av. Annual: 386mm Av. GSR: 232mm 2016 Total: 605mm 2016 GSR: 375mm
Paddock history 2015: Medic Pasture 2014: Barley 2013: Wheat	**Yield** Potential: 6.2 t/ha according to Yield Prophet Actual: Note frost affected. Highest barley yield was 3.64 t/ha
Soil type Grey soil with surface and sub-surface lime	**Plot size** 20 m x 1.8 m x 4 reps
Yield limiting factors Frost, weeds, possible root disease	

A replicated field trial was established near Appila to study the interaction of cereal type and variety and seeding rate on crop yield and grass suppression on a known weedy site. The trial was direct drilled using knife points and press wheels on 12 May 2016 after receiving 19 mm of rainfall from 8-10 May. The site had a modest level of broadleaf weeds (medic and thistles) from an earlier germination and these were targeted with Sprayseed prior to sowing. There was very little grass evident at sowing. Soil conditions at seeding were damp on the seedbed, but drier at depth. PAW estimates taken on 3 May 2016 showed 21 mm in the soil profile prior to seasonal opening rains.

One wheat variety (Scepter) and two barley varieties (Fathom, a vigorous, more competitive variety and Hindmarsh which is considered less competitive) were sown with three treatments for each variety. This involved two seeding rates (60 and 120 kg/ha) and a further treatment which aimed at best practice weed control (high seeding rate of 120 kg/ha plus appropriate chemical weed control of Sakura @ 118 g/ha on wheat and TriflurX @ 2.5 L/ha on barley). The crop was established using 72 kg/ha 18:20:0:0 fertiliser with 70 kg/ha urea banded below the seed. Yield Prophet was used to monitor the site throughout the year, and this showed no need for further nitrogen applications.

Initial plant establishment counts were taken on 15 June followed by crop and weed early biomass assessments at crop tillering stage on 8 August. Anthesis crop and weed biomass and weed panicle assessments were completed on 13 October. For the purpose of the trial, it was assumed that panicle counts would provide a good indication of weed seed carry-over. Plot grain harvest was completed on 12 December with grain samples retained for subsequent quality analysis (this analysis was still to be completed at the time of writing this report).

Data was analysed using Analysis of Variance in GENSTAT version 16.

The Predicta B root disease test results completed prior to seeding showed cereal cyst nematode was below detection levels, haydie/take-all and crown rot was at low risk level, and rhizoctonia at moderate risk level.

What happened?

Crop establishment from seedbed moisture was good but was further consolidated by rainfall occurring ten days after seeding. The remainder of the season saw above average rainfall culminating in a very wet September.

Table 1. Monthly and growing season rain at Appila in 2016 compared with historical average.

Month	April	May	June	July	August	Sept	October	April-Oct
2016 rainfall (mm)	9	40	69	34	59	136	28	375
Historical average	28	37	42	41	43	43	37	232

Good levels of barley grass recruitment were observed during the early crop establishment phase. The control treatments which involved herbicide applications on the wheat plots (Sakura @ 118 g/ha) achieved good grass control, but the trifluralin treated barley plots only saw minor levels of grass control. There was moderate late-season development of broadleaf weeds (mainly saffron thistle and volunteer vetch).

A late frost at early grain fill reduced the grain yields of wheat plots. Barley was relatively unaffected by the frost with satisfactory yields being recorded.

Seeding rate impact of Scepter wheat

Crop establishment of Scepter at the lower seeding rate of 60 kg/ha was in line with district practice and resulted in plant populations of 161 plants/m^2 (Table 2). The high sowing rate of 120 kg/ha resulted in plant populations of around 280 plants/m^2, which would be regarded as very high. Different seeding rates (with no herbicide treatments) had no influence on initial weed establishment levels. The herbicide treatment (Sakura @ 118 g/ha) resulted in a significant reduction in barley grass establishment.

Table 2. Impact of different seeding treatments of Scepter wheat on crop growth and weed infestation through the season.

	Treatment and sowing rate			
	60 kg/ha (no herbicide)	120 kg/ha (no herbicide)	120 kg/ha (plus herbicide)	LSD ($P \leq 0.05$)
Early Crop Establishment Crop (plants/m^2)	161	275	288	*41*
Barley grass (plants/m^2)	118	142	21	*45*
Broadleaf (plants/m^2)	14	10	10	*ns*
Tillering Crop biomass (g/m^2)	123	154	149	*ns*
Weed biomass (g/m^2)	32	26	1	*12*
Total weed tillers (no/m^2)	415	333	24	*130*
Anthesis Crop biomass (g/m^2)	695	701	919	*115*
Grass biomass (g/m^2)	264	274	6	*129*
Total grass panicles (no/m^2)	341	326	16	*124*
Harvest Crop yield (t/ha)	1.21	1.24	1.50	*0.26*

At tillering and at anthesis, there were no significant differences between high and low seeding rates on the density of barley grass and other weeds where herbicides were not applied. There was also no observed influence of seeding rate on total weed panicles measured at crop anthesis. High seeding rate in Scepter wheat did not result in increased competition and did not influence weed density. At anthesis, there was no observed difference between the crop biomass in the high and low seeding rate plots, indicating that the wheat sown at low seeding rates had effectively compensated.

Although frost-affected, there was no difference in the final yield of the Scepter wheat sown at the two different seeding rates with no herbicide treatments. This means there was no benefit to yield from any crop competition effects from higher seeding rates.

The herbicide treatment resulted in significant reductions in grass levels at all crop stages. Crop biomass was also significantly greater at anthesis than the non-herbicide treated plots. As would be expected, the final crop yield of the herbicide treated plots was significantly higher although still substantially affected by the frost.

Seeding rate impact of Fathom barley

As with Scepter wheat, crop establishment of Fathom barley was good. Barley plant numbers in the high seeding rate plots were double that of the lower seeding rate ones. There was no influence of seeding rate on early grass establishment. The pre-sowing herbicide treatment of 2.5 L/ha of TriflurX (incorporated by sowing) was moderately effective at controlling grass with grass establishment levels at about one quarter of levels in non-herbicide applied plots.

Table 3. Impact of different seeding treatments of Fathom barley on crop growth and weed infestation through the season.

	Treatment and sowing rate			
	60 kg/ha (no herbicide)	120 kg/ha (no herbicide)	120 kg/ha (plus herbicide)	LSD (P= 0.05)
Early Crop Establishment Crop (plants/m^2)	88	162	161	*17*
Barley grass (plants/m^2)	149	136	59	*37*
Broadleaf (plants/m^2)	14	15	11	*ns*
Tillering Crop biomass (g/m^2)	172	239	245	*ns*
Weed biomass (g/m^2)	32	13	13	*11*
Total weed tillers (no/m^2)	503	290	197	*132*
Anthesis Crop biomass (g/m^2)	920	1146	1029	*ns*
Grass biomass (g/m^2)	198	78	45	*87*
Total grass panicles (no/m^2)	246	115	68	*85*
Harvest Crop yield (t/ha)	2.70	3.53	3.64	*0.25*

By tillering, crop competition effects from the high seeding rate were evident. Both weed biomass and weed tillers under the high seeding rate (with no herbicide applied) were significantly lower than at the low rate. Statistically there was no significant difference in weed measurements between the herbicide applied and non-herbicide applied plots at the high seeding rate. However, there was a trend of lower numbers in the plus herbicide treatment and these observations continued to apply at anthesis.

The application of herbicide reduced weed recruitment, however a high seeding rate reduced the impact of weeds to a similar level. In terms of weed seed carry-over, the high seeding rate reduced total grass panicles by about half that of the low seeding rate.

The final Fathom barley yield from the high seeding rate was significantly higher (by 0.8 t/ha) than the low rate. There was no significant difference between the yield of the herbicide treated and non-herbicide treated plots at the high seeding rate. This indicates the effectiveness of crop competition in the absence of herbicide.

Seeding rate impact of Hindmarsh barley

Seeding rate (without herbicide) had no influence on the levels of early grass weed establishment. The herbicide application reduced grass weed levels on average by 60% (Table 4).

Table 4. Impact of different seeding treatments of Hindmarsh barley on crop growth and weed infestation through the season.

	Treatment and sowing rate			
	60 kg/ha (no herbicide)	120 kg/ha (no herbicide)	120 kg/ha (plus herbicide)	LSD (P= 0.05)
Early Crop Establishment Crop (plants/m^{2})	106	204	199	*24.1*
Barley grass (plants/m^2)	150	140	53	*56*
Broadleaf (plants/m^2)	14	13	8	*ns*
Tillering Crop biomass (g/m^2)	146	226	222	*67*
Weed biomass (g/m^2)	33	24	9	*18*
Total weed tillers (no/m^2)	434	408	152	*169*
Anthesis Crop biomass (g/m^2)	780	1062	1079	*167*
Grass biomass (g/m^2)	187	105	65	*79*
Total grass panicles (no/m^2)	229	143	83	*58*
Harvest Crop yield (t/ha)	2.75	3.28	3.38	*0.41*

At crop tillering, there were no difference in barley grass numbers at the different seeding rates. However, by anthesis, weed biomass and total grass panicles were almost halved under the high seeding rates. Crop biomass at both tillering and anthesis was significantly higher under the high seeding rates. It is likely this extra competition affected weed growth later in the season. Hindmarsh crop biomass at the high seeding rate with no herbicide applied was not significantly different to the treatment with herbicide.

In contrast to the results seen in 2015, the final crop yield of Hindmarsh barley at the high seeding rate was about 0.5 t/ha higher than the low seeding rate treatment. Similar to the Fathom results, the application of herbicide at the high seeding rate did not achieve a further significant increase in yield.

Comparison of species and variety impact on weed infestation and seed set at different seeding rates

At the high seeding rate of 120 kg/ha (refer Table 6), weed measurements taken at anthesis showed that both barley varieties had reduced grass weed panicles to well under half that observed in the wheat plots. At the low seeding rate (Table 5), this reduction in grass seed carry-over was still evident, but not to the same extent. The analysis did not reveal any significant differences between the two barley varieties in terms of their impact on weed levels.

Table 5. Crop and variety impact on barley grass at 60 kg/ha seeding rate.

	60 kg/ha Seeding Rate			
	Scepter	Fathom	Hindmarsh	LSD ($P \le 0.05$)
Tillering Weed biomass (g/m^2)	32	32	33	*ns*
Total grass weed tillers (no/m^2)	416	434	503	*ns*
Anthesis Weed biomass (g/m^2)	264	198	187	*ns*
Total grass weed panicles (no/m^2)	341	246	229	*69*

Table 6. Crop and variety impact on barley grass at 120 kg/ha seeding rate.

	120 kg/ha Seeding Rate			
	Scepter	Fathom	Hindmarsh	LSD ($P \le 0.05$)
Tillering Weed biomass (g/m^2)	26	13	24	*12*
Total grass weed tillers (no/m^2)	333	290	408	*ns*
Anthesis Weed biomass (g/m^2)	274	78	105	*105*
Total grass weed panicles (no/m^2)	326	115	143	*76*

What does this mean?

The results obtained in 2016 strongly supported the findings from the previous year. Doubling the standard district seeding rate in both varieties of barley in the presence of barley grass had a significant benefit in terms of improved yield. In 2015, only the more competitive variety, Fathom, showed improved yield from higher seeding rates. The yield benefit (0.5 t/ha in Hindmarsh and 0.8 t/ha in Fathom) represented $75-$120/ha at a barley price of $150/tonne. This was a very good return on the extra seed cost (60kg/ha at a clean seed cost of $200/tonne) of $12/ha.

Similar to 2015, there was the additional benefit from high seeding rates in both varieties of reducing grass weed carry-over by about half as measured by panicles at anthesis.

In the presence of barley grass, wheat performed poorly against both of the barley varieties. Wheat showed barley grass carry-over of two to three times that of barley. As in 2015, doubling the wheat seeding rate provided no benefit. Yield data is confounded due to the level of frost impact.

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