Overdependence on Agrichemicals – UNFS 2016 Barley Grass Trial

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Funding: CWF00020

Key messages

- The 2016 trial results looking at cultural control techniques on barley grass largely confirmed the 2015 findings
- Increasing the seeding rate of barley 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 check plots where herbicide was applied.
- During the trials, barley has consistently outperformed wheat in its ability to compete with barley grass, particularly when sown at high seeding rates.

Why do the trial?

Barley grass is becoming an increasingly problematic weed in lower rainfall farming systems across South Australia and specifically in the Upper North. It has a very short growing season which allows it to set seed in even the driest of seasons. Control in the past has been relatively simple in non-cereal years with cheap and effective selective herbicides available. 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 suppress weed seed carry-over.

This trial completed at Appila in the Upper North in 2016 represents a component of a coordinated approach across several 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. The key messages from the 2015 trial results were:

- In the presence of a mixed stand of barley grass and ryegrass, the doubling of seeding rates in a competitive barley variety like Fathom resulted in useful yield benefits, which was likely to be because of the increased crop competition.
- A less competitive barley variety like Hindmarsh and Mace wheat did not achieve significant yield benefits from a doubling of seeding rates.
- Increasing the seeding rate of both barley varieties had a significant impact on reducing weed biomass and potentially reducing weed seed carry-over. This same effect was not evident in wheat.
- At the high seeding rate, weed panicle counts at crop anthesis in barley were reduced significantly (56%) when compared with wheat.

The purpose of the trial in 2016 was to see if these results were repeated. One minor change to the trial protocol was the decision to increase the high seeding rate to double the normal district rate to explore crop competition effects under more extreme circumstances.

As part of a bigger picture, another purpose of the trial was to provide further background information for modelling barley grass carry-over, under differing management regimes.

How was it done?

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 were analysed using Analysis of Variance in GENSTAT version 16.

The site was selected due to the presence of a grass dominated medic pasture in 2015 giving the strong likelihood of good levels of barley grass recruitment for the 2016 season. This worked in practice with an excellent and reasonably even (for barley grass) establishment of grass after the trial was sown.

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 reasonably good but was further consolidated by rainfall occurring 10 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 mean*

Month	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Apr. – Oct.**
2016 rainfall (mm)	9	40	69	34	59	136	28	375
Historical mean	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 modest 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 devastated the wheat plots and grain yields were very poor. Barley was relatively unaffected by the frost with satisfactory yields being recorded.

Seeding rate impact of Scepter wheat

Table 2 compares results from the three sowing treatments for Scepter wheat. Crop establishment of Scepter at the lower seeding rate of 60 kg/ha was reasonably in line with district practice and resulted in plant populations of 161 plants/m^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, but necessary to explore the effect high plant populations have on weed development. 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 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= 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	*n.s.*
Tillering **Crop biomass (g/m^2)**	123	154	149	*n.s.*
Weed biomass (g/m^2)	31.8	25.7	1.1	*11.5*
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	*0.255*

At tillering and at anthesis, there were no significant differences between high and low seeding rates on the density of 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. As would be expected, barley plant numbers in the high seeding rate plots were about 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/m²)**	88	162	161	*17.3*
Barley grass (plants/m²)	149	136	59	*36.6*
Broadleaf (plants/m²)	14	15	11	*n.s.*
Tillering **Crop biomass (g/m²)**	171.5	239.2	244.6	*n.s.*
Weed biomass (g/m²)	31.6	13.1	12.8	*11.1*
Total weed tillers (no/m²)	503	290	197	*132*
Anthesis **Crop biomass (g/m²)**	920	1146	1029	*n.s.*
Grass biomass (g/m²)	198.1	78.2	44.6	*86.7*
Total grass panicles (no/m²)	246	115	68	*85.2*
Harvest **Crop yield (t/ha)**	2.70	3.53	3.64	*0.247*

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. Interestingly, and although a trend was observed, statistically, there was no significant difference in weed measurements between the herbicide applied and non-herbicide applied plots at the high seeding rate. These observations continued to apply at anthesis.

Even though the herbicide application reduced weed recruitment levels substantially, the increased crop competition from the high seeding rate alone was still sufficient to reduce the impact from weeds down to similar levels achieved by the herbicide. 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 of the high seeding rate plots was significantly higher (by 0.8 t/ha) than the low rate plots. There was no significant difference between the yield of the herbicide treated and non-herbicide treated plots at the high seeding rate indicating the high level of effectiveness of the competition effect of just increased crop plant numbers in the absence of herbicide.

Seeding rate impact of Hindmarsh barley

As noted with earlier treatments, crop establishment in Hindmarsh barley was good and, as would be expected, differences in seeding rates (without herbicide) had no influence on the levels of early grass weed establishment. The herbicide application reduced grass weed levels by about two thirds.

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	*n.s.*
Tillering **Crop biomass (g/m^2)**	146.3	226.0	221.9	*67.4*
Weed biomass (g/m^2)	32.5	24.2	9.0	*18.2*
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)	187.4	104.5	65.0	*79.2*
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 statistical differences showing in weed infestations at 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 reasonable to assume this extra competition eventually affected weed growth. 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 higher 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, 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 although the raw data tended to favour the more competitive variety, Fathom.

Table 5. *Species and variety impact on weed infestation at 60 kg/ha seeding rate*

	60 kg/ha Seeding Rate			
	Sceptre	Fathom	Hindmarsh	LSD (P=.05)
Tillering **Weed Biomass (g/m^2)**	31.8	31.6	32.5	*n.s.*
Total grass weed tillers (no/m^2)	416	434	503	*n.s*
Anthesis **Weed biomass (g/m^2)**	264.3	198.1	187.4	*n.s.*
Total grass weed panicles (no/m^2)	341	246	229	*69*

Table 6. *Species and variety impact on weed infestation at 120 kg/ha seeding rate*

	120 kg/ha Seeding Rate			
	Sceptre	Fathom	Hindmarsh	LSD (P=.05)
Tillering **Weed biomass (g/m²)**	25.7	13.1	24.2	*12.1*
Total grass weed tillers (no/m²)	333	290	408	*n.s.*
Anthesis **Weed biomass (g/m²)**	274.3	78.2	104.5	*104.9*
Total grass weed panicles (no/m²)	326	115	143	*76*

What does this mean?

The aim of this 2016 trial was to build on the information obtained in 2015 on how crop yield and weed seed carry-over is affected by different cereal species and varieties under different sowing rates and under barley grass weed pressure.

The results obtained in 2016 strongly supported the findings from the previous year although with slight variations. 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 grass, wheat again performed poorly against both of the barley varieties. Wheat showed grass carry-over of 2-3 times that of barley. As in 2015, doubling of the wheat seeding rate provided no benefit. Yield data is questionable, given the level of frost impact, but also supports the fact that the Scepter wheat performed quite poorly as a competitor to barley grass, when compared with barley.

The trial has again demonstrated that increasing the seeding rate of barley in situations where barley grass is not controllable by herbicides, can have substantial benefits, both in terms of yield and reducing weed seed carry-over. Wheat would not be a preferred option in such circumstances and increasing seeding rate of wheat is unlikely to provide any benefit.

Acknowledgements

The Ritchie family from Appila for their enthusiasm in providing a suitable site and regular weather updates.
Nigel Wilhelm and Peter Telfer (SARDI) for assisting with trial design and trial seeding and harvest.
Rochelle Wheaton and Sarah Noack (Hart Field Site) for trial assessments
Amanda Cook (SARDI) for statistical analysis.
GRDC for funding the trial under Project No CWF00020 'Overdependence on Agrochemicals'

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Extra Information

Location:
Appila, Upper North
Kevin and Ben Ritchie
Group: Upper North Farming Systems

Rainfall
Av. Annual: 386mm
Av. GSR: 232mm
2016 Total: 605mm
2016 GSR: 375mm

Yield
Potential: 6.2 t/ha according to Yield Prophet
Actual: Note frost affected. Highest barley yield was 3.64 t/ha

Paddock history
2015: Medic Pasture
2014: Barley
2013: Wheat

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

Products used in trial:
Scepter is protected by Plant Breeders Rights. Licencee AGT Seeds.
Fathom is protected by Plant Breeders Rights. Licencee Seednet.
Hindmarsh is protected by Plant Breeders Rights. Licencee Seednet
Sakura is a registered trademark of Kumiai Chemical Industry Co. Ltd
TriflurX is a registered trademark of Nufarm Australia Limited