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Section 5

Weeds

Seeding rate by row spacing for barley grass management

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RESEARCH

Searching for answers

Location:
Minnipa Agricultural Centre paddock S3N
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2016 Total: 391 mm
2016 GSR: 268 mm
Yield
Potential: 3.6 t/ha (W)
Actual: 2.6 t/ha
Paddock History
2016: Mace wheat
2015: Grenade wheat
2014:Spray topped medic pasture
Soil Type
Red loam
Plot Size
20 m x 2 x m x 4 reps

Key messages

- **Reducing row spacing to 18 cm from 30 cm increased grain yield of wheat by more than 0.5 t/ha in 2015 and 2016.**
- **Increasing seeding rate also increased grain yield in 2015 and 2016.**
- **Late grassy weed dry matter was 65% lower, and barley grass weed seed set was 57% lower, with a higher seeding rate.**
- **18 cm row spacing had 42% lower grass weed dry matter than 30 cm row spacing.**
- **Single row or spread row seeding boots showed little differences in plant establishment, grain yield and quality or grass weed competition.**

Why do the trial?

Controlling barley grass in upper EP low rainfall farming systems is becoming a major issue for growers, due to the development of herbicide resistance and changing ecology of the weeds, such as delayed emergence of barley grass populations.

There are reasonably effective but costly chemical options for grass weed control using pre-emergent and post emergent herbicides. However for long-term sustainability, a range of management techniques, not just reliance on herbicides, is required to address the issue. One of the potential non-chemical options for managing barley grass in a crop is increasing crop competition by reducing row spacing and increasing sowing rate. This research is funded as part of the GRDC ‘Overdependence on Agrochemicals’ project, which aims to find ways to reduce dependence on agrochemicals in our current farming systems.

How was it done?

A replicated trial was established at Minnipa Agricultural Centre (MAC) (paddock S3N) with Mace wheat sown at three seeding rates (targeting 60, 120 or 240 plants/m^2) on two different row spacings of 18 cm (7”) and 30 cm (12”) with two different seeding boots, a narrow row Harrington point and an Atom-Jet spread row seeding boot with press wheels.

The trial was sown on 18 May 2016 into good moisture. A base fertiliser rate of 60 kg/ha of 18:20:0:0 was applied to all treatments. The trial was sprayed on 16 May with a knockdown of 1.5 L/ha of glyphosate, 1.5 L/ha of trifluralin and 80 ml/ha of carfentrazone-ethyl. An insecticide was sprayed on 22 June and broad-leaved weeds were controlled on 24 August after sampling.

Trial measurements taken during the season included soil moisture, PreDicta B root disease test, soil nutrition, weed establishment, weed seedbank germination, crop and weed establishment, crop and weed biomass (early and late), light interception in crop rows (using AccuPAR PAR/LAI ceptometer), grain yield and quality.

Soil moisture and soil nutrition were sampled on 18 April. Plant establishment and weed counts were taken on 20 June. The Leaf Area Index (LAI) measurements were taken on 17 August at Zadoks growth stage Z49-51, aiming for maximum crop canopy. Late weed counts were taken on 12 October. The trial was harvested on 4 November. Post-harvest soil moisture in selected treatments was sampled on 29 November.

Grass weed seed set was calculated using the total panicle length and number of panicles/m^2 of individual plots. Weed seeds per panicle were counted from selected treatments and a regression was used to calculate weed seed set per plot.

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

What happened?

The soil is an alkaline red sandy loam, with a pH ($CaCl_2$) of 7.8. Colwell P was 33 mg/kg (0-30 cm). Soil mineral N was 151 kg/ha in the top 90 cm in March. The soil has a moderate phosphorus buffering index of 143 (0-30 cm). Initial soil moisture was 107 mm to a depth of 90 cm.

There was a high risk of Rhizoctonia disease (332 pgDNA/g soil) but *Pratylenchus thornei* was a low risk. All other disease risks were low.

There were no significant statistical interactions for row spacing and seeding rate so the results are presented for the individual factors only.

This trial targeted barley grass weeds but there was also some ryegrass present. Seeding rate increased the number of wheat plants/m^2 however no rate achieved the targeted plant densities despite good seeding conditions. The 18 cm row spacing resulted in higher plant densities than the 30 cm row spacing (Table 1), but the seeding system boots had no impact on plant numbers (data not presented). There were no differences in early weed numbers for row spacing or seeding rates (Table 2).

Table 1 Wheat growth, yield and grain quality measurements taken in seeding rate and row spacing trial sown with Mace wheat at Minnipa, 2016

Seeding rate target (plants/m^2)	Row spacing (cm)	Plant establishment (plants/m^2)	Early DM (t/ha)	Late DM (t/ha)	Yield (t/ha)	Protein (%)	Screenings (%)
	18	108.4	0.21	3.87	2.87	10.3	1.8
	30	95.3	0.29	5.12	2.39	10.2	1.8
LSD (P=0.05) row spacing		*7.4*	*0.06*	*0.71*	*0.16*	*ns*	*ns*
60		51.8	0.16	4.23	2.28	10.2	2.1
120 (district practice)		87.0	0.25	4.52	2.76	10.2	1.8
240		166.6	0.34	4.74	2.85	10.3	1.4
LSD (P=0.05) seeding rate		*6.4*	*0.05*	*ns*	*0.14*	*ns*	*0.2*

Early crop dry matter was greater in the 30 cm row spacing than in the 18 cm, and this trend carried through to late DM. Seeding rate progressively increased dry matter early in the season but the effect had largely disappeared by late season dry matter cuts (Table 1).

Total late grass weed dry matter was lower in the higher seeding rate treatment. The 18 cm row spacing also had lower late grass weed dry matter compared to the 30 cm row spacing (Table 2).

The late barely grass and ryegrass weed seed set followed similar trends to the grassy weed dry matter. Barley grass seed production was lower with narrower 18 cm row spacing compared to 30 cm (Table 2). There was no difference in the ryegrass numbers or weed seed set with the narrow row spacing as ryegrass density was similar. The increase in seeding rate and plant density also decreased barley and ryegrass weed seed set (Table 2).

Grain yield increased with seeding rate (Table 1). The 18 cm row spacing also out-yielded the 30 cm row spacing for the second season, by 0.48 t/ha in 2016, but again there were no differences between the two seeding boots (data not presented).

There were no significant differences in grain protein in 2016 due to the unusually cool finish to the growing seasons, which reduces the protein level in the grain due to extra carbohydrates being formed. Screenings were very low in 2016 due to the cool finish to the season resulting in good grain filling conditions.

What does this mean?

The 18 cm row spacing achieved higher plant numbers than the 30 cm row spacing with the same seeding rate, but the seeding system (ribbon or narrow boots) had no significant impact on crop numbers. Row spacing did not significantly affect ryegrass seed set in this trial.

There were no differences in early weed numbers due to row spacing or seeding rates. The total late grass dry matter declined with the higher seeding rate, and also declined with narrower row spacing. The late barley grass showed similar trends decreasing weed seed set in the narrow row spacing, and also the higher seeding rate.

Table 2 Grass weed density and canopy measurements taken in seeding rate and row spacing trial sown with Mace wheat at Minnipa, 2016

Seeding rate target (plants/m^2)	Row spacing (cm)	Early (plants/m^2)		LAI (μmols)	Late				
		Barley grass	Rye grass		Grass weeds DM (t/ha)	Barley grass (plants/ m^2)	Barley grass seed/m^2	Ryegrass (plants/m^2)	Ryegrass seed /m^2
	18	29	12	381	0.24 (42% reduction)	12.3	582 (44% reduction)	6.0	193 (8% reduction)
	30	35	17	458	0.41	18.4	1037	5.4	209
LSD (P=0.05) row spacing		*ns*	*ns*	*73*	*0.14*	*5.6*	*322*	*ns*	*ns*
60		33	18	517	0.50 (47% increase)	16.3	1245 (50% increase)	7.3	328 (95% increase)
120 (district practice)		37	13	408	0.34	18.0	828	5.2	168
240		25	13	334	0.12 (65% reduction)	11.8	356 (57% reduction)	4.7	107 (36% reduction)
LSD (P=0.05) seeding rate		*ns*	*ns*	*63*	*0.12*	*4.8*	*279*	*3.7*	*58*

In the 2016 season the 18 cm again yielded higher (+0.48 t/ha) than the 30 cm system with no differences in grain quality this season due to the mild finish. In 2015 the higher seeding rates also resulted in higher grain yield, but grain quality differences were present due to the drier spring. Previous research from WA showed there is no difference in yield due to row spacing in crops less than 0.5 t/ha, but in crops greater than 3.0 t/ha there is a yield penalty with wider row spacing. The decrease in wheat crops (between 2.7 – 3.4 t/ha) was an 8% decrease in yield for every 9 cm increase in row spacing (GRDC, 2011).

A more recent review of row spacing of winter crops in broad scale agriculture in southern Australia, by Scott *et al*. in 2013, suggests the direct effect on yield of adopting wider rows (reduced yield at greater than 18 cm) has often been overlooked, due to the relative ease of stubble management in wider rows. At yields of 2.0 t/ha widening row spacing from 18 cm to 36 cm reduced yield by 1860 kg/ha (Scott, 2013). This review also noted crops sown on wider rows are less competitive with weeds, mainly ryegrass.

Research into using crop competition for weed control in barley and wheat in 2015 at Hart showed varying the seeding rates (increasing from 100 to 300 plants/ m^2) reduced the yield loss due to weed competition (Goss, 2015). This research also showed there were differences in wheat and barley varieties' ability to compete with grass weeds, and it also found no difference between normal or spreader seeding boots (Goss, 2015). Spreader boots were used to try reduce the row spacing (by spreading the seed) and increase grass weed competition, however this effect has not occurred at Minnipa in the last two seasons.

Research in the Upper North of SA showed barley sown at higher seeding rates is more effective than wheat at reducing barley grass seed set, particularly with more vigorous varieties such as Fathom, compared to less vigorous varieties such as Hindmarsh (Mudge, EPFS Summary 2016).

At Minnipa the seeding system boots showed little difference in either weed competition or crop yield.

Achieving 166 plants/m^2 instead of 87 plants /m^2 (targeted rate was district practice rate of 120 plants/ m^2) has reduced barley grass seed set by 57% and ryegrass by 36%. Sowing to achieve a district practice seeding rate of 60 kg/ ha (actually108 plants/m^2) at 18 cm spacing instead of 30 cm has led to a 44% decrease in barley grass seed production. Overall the reduction in barley grass numbers demonstrates using crop competition (either by using a narrow 18 cm row spacing, or by increasing plant density) are potentially effective non-chemical methods to reduce barley grass and ryegrass numbers in current farming systems. Using narrow row spacings of 18 cm in greater than 2 t/ha wheat crops have also shown a yield advantage in this environment.

References

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