SEEDING RATE BY ROW SPACING FOR BARLEY GRASS MANAGEMENT.

Amanda Cook
Wade Shepperd
Ian Richter
Nigel Wilhelm

SARDI
Minnipa Agricultural Centre

KEY MESSAGES

- 18 cm (7”) systems showed better plant establishment in a drier seeding than the 30 cm (12”) system.
- Higher seeding rates resulted in higher grain yield but also higher screenings and lower protein.
- Grass weeds were lower in the higher seeding rate and in the 18 cm row spacing indicating crop competition is a non-chemical weed reduction method.
- 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 effective but sometimes costly chemical options for grass weed control using pre-emergent and post emergent herbicides. However for longer term sustainability a range of management techniques, not just reliance on chemicals, 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.

HOW WAS IT DONE?

A replicated trial was established at the Minnipa Agricultural Centre

(MAC) (paddock S4) with Mace wheat sown at three seeding rates (targeting 60, 120 or 240 plants/m2) on two different row spacings of 18 cm and 30 cm with two different seeding boots, a single row Harrington point and an Atom-Jet spread row seeding boot with press wheels. The paddock was very grassy in 2013 followed by a pasture with moderate levels of grass weeds present in 2014. In 2014 alternative chemicals for spray topping grass weeds in pastures were used in this paddock as potential small patches of herbicide resistant barley grass had been located in the paddock.

In 2015 the trial was sown on 21 and 22 May with minimal moisture with the 18 cm (or 7") treatments being sown first, then the 30 cm (or 12"). A base fertiliser rate of 60 kg/ha of 18:20:0:0 was applied for all treatments. The trial was sprayed with a knockdown of 1.5 L/ha of TriflurX, 1 L/ha of Roundup Powermax and 80 ml/ha of Nail and broad-leaved weeds were controlled with 750 ml/ha Tigrex and 100 ml/ha Lontrel on 23 July.

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 samples were taken on 21 April. Initial paddock weed counts were done on 20 May and soil taken for weed seed bank germination, with monthly assessments on emergence over the next 12-18 months. Plant establishment and weed counts were taken on 18 June. The Leaf Area Index (LAI) measurements were taken on 18 September using an AccuPAR PAR/LAI Ceptometer (model LP-80), taking the average of 5 readings per plot placed at an angle across the crop rows as per the manufacturer's instruction manual. The measurements were taken at Zadoks growth stage Z49-51, aiming for maximum crop canopy. Late weed counts were taken on 7 October. The trial was harvested on 9 November. Harvest soil moisture measurements of selected treatments were taken on 27 November.

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

WHAT HAPPENED?

The soil analysis showed the trial site is alkaline, with a pH (CaCl) of 7.9. Cowell P measured 46 mg/kg (0-30 cm). Soil mineral N was 76 kg/ha in the top 100 cm. The soil has a moderate phosphorus buffering index of 150 (0-30 cm). At this site, salinity increases down the profile but is still relatively low. The initial soil moisture was 158 mm within the profile to 100 cm depth. The initial PreDicta BTM inoculum level indicated a high risk of Rhizoctonia disease (214 pgDNA/g soil) but low Take-all and Pratylenchus thornei risk.

Sowing occurred on the 21 and 22 May with minimal moisture and the next significant rainfall event was 40 mm on 15 June resulting in uneven crop germination, with some plants at Zadoks growth stage Z12 (2-3 leaf stage) and others plants just germinating.

The trial was direct drilled into a pasture paddock, so the plots were quite cloddy due to the dry moisture conditions and seed placement was not ideal. In the dry seeding conditions all seeding rates resulted in lower plant establishment numbers than expected and the 30 cm system achieved much lower germination and plant establishment than 18 cm. In the 30 cm row spacing some seed on the side of furrows germinated then died due to the dry conditions at seeding and potentially seeds being placed within the chemical zone.

Figure 1: *Left, 30 cm (12") ribbon @ 60 plants/m^2 and right, 18 cm (7") ribbon at 240 plants/m^2.*

The initial barley grass weed pressure within the trial area was much lower than expected with all plots having less than 10 plants/m2. This weed density is considered to be below what is required for adequate grass weed pressure (for reliable measurement) within a grass weed trial (B Fleet, pers. comm.). No barley grass weeds germinated in the weed seed bank trays despite this site being selected due to high barley grass weed numbers in 2014, while ryegrass and broadleaved weeds both had 31 plants/m2. Wild oats became a more prevalent weed in the 2015 season due to later rainfall events and later germination after the soil applied chemicals at seeding became inactive.

Table 1: *Grass weed density and canopy measurements taken in seeding rate and row spacing trial sown with Mace wheat at Minnipa, 2015.*

SEEDING RATE TARGET PLANTS/M2	ROW SPACING (CM)	EARLY BARLEY GRASS (PLANTS/ M2)	EARLY RYE GRASS (PLANTS/ M2)	LAI (UMOLS)	LATE GRASS WEEDS DM (T/HA)	LATE BARLEY GRASS (PLANTS/ M2)	LATE RYEGRASS (PLANTS/ M2)	LATE WILD OATS (PLANTS/ M2)
60	18	0.7	0.6	60	0.48	15.5	3.4	34.4
	18 ribbon	0.7	0.6	59	0.19	2.3	3.7	13.8
	30	2.9	0.4	51	0.67	15	6.3	45.1
	30 ribbon	1.2	1.6	53	0.86	12.9	7.4	62.5
120	18	2.1	0.7	66	0.19	8.0	1.0	14.8
	18 ribbon	0.7	1.0	67	0.16	6.6	0.9	11.9
	30	5.3	4.0	54	0.58	20.0	6.7	33.9
	30 ribbon	4.1	1.9	59	0.91	9.6	4.3	77.3
240	18	6.3	2.5	67	0.13	0	0.4	12.2
	18 ribbon	2.8	0.7	67	0.22	1.4	0.9	20.7
	30	5.3	1.2	61	0.18	12.0	2.6	5.2
	30 ribbon	5.3	1.2	59	0.21	25.2	0.5	7.9
LSD (P=0.05) row spacing x seeding rate		*ns*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
	18	3.1	1.3	64	0.27	7.8	1.6	20.5
	18 ribbon	1.4	0.8	64	0.19	3.4	1.8	15.5
	30	4.5	1.9	56	0.48	15.7	5.2	28.1
	30 ribbon	3.6	1.6	57	0.66	15.9	4.1	49.2
LSD (P=0.05) row spacing		*ns*	*ns*	*2.5*	*0.25*	*ns*	*2.8*	*21.7*
60		1.4	0.8	56	0.55	11.4	5.2	38.9
120		3.1	1.9	62	0.46	11.0	3.2	34.5
240		5.0	1.4	64	0.19	9.7	1.1	11.5
LSD (P=0.05) seeding rate		*ns*	*ns*	*2.2*	*2.1*	*ns*	*2.4*	*18.8*

Table 2: Wheat growth, yield and grain quality measurements taken in seeding rate and row spacing trial sown with Mace wheat at Minnipa, 2015.

SEEDING RATE TARGET PLANTS/M2	ROW SPACING (CM)	PLANT ESTAB-LISHMENT (PLANTS/M2)	EARLY DM (T/HA)	LATE DM (T/HA)	YIELD (T/HA)	PROTEIN (%)	SCREEN-INGS (%)	TEST WEIGHT (KG/HL)
60	18	64	0.32	8.1	2.88	11.6	10.7	80.0
	18 ribbon	57	0.26	8.7	2.79	11.8	10.0	79.5
	30	31	0.16	5.8	2.03	12.1	11.5	79.5
	30 ribbon	27	0.15	7.0	2.03	12.3	11.7	79.0
120	18	109	0.47	8.8	3.34	11.5	7.6	80.0
	18 ribbon	114	0.53	8.9	3.36	11.4	8.5	79.7
	30	59	0.27	6.5	2.29	12.2	10.5	78.9
	30 ribbon	67	0.26	6.9	2.40	12.2	10.9	79.2
240	18	194	0.65	9.1	3.56	11.4	8.4	79.5
	18 ribbon	186	0.71	8.1	3.54	11.3	7.1	80.2
	30	106	0.42	8.0	2.78	11.6	8.2	79.7
	30 ribbon	103	0.41	7.6	2.64	12.2	9.9	79.6
LSD (P=0.05) row spacing x seeding rate		*19*	*ns*	*ns*	*ns*	*0.3*	*ns*	*ns*
	18	122	0.48	8.7	3.26	11.5	8.9	79.8
	18 ribbon	119	0.50	8.5	3.23	11.5	8.5	79.8
	30	66	0.28	6.7	2.37	12.0	10.1	79.3
	30	66	0.27	7.2	2.36	12.2	10.9	79.2
LSD (P=0.05) row spacing		*10.7*	*0.25*	*0.7*	*0.09*	*0.16*	*1.8*	*ns*
60		45	0.22	7.4	2.43	11.9	11.0	79.5
120		87	0.38	7.7	2.85	11.8	9.4	79.4
240		147	0.55	8.2	3.13	11.6	8.4	79.8
LSD (P=0.05) seeding rate		*9.3*	*0.22*	*ns*	*0.08*	*0.14*	*1.6*	*ns*

Seeding rate increased the number of plants/m2 however no rate achieved the targeted plant densities due to the dry seeding conditions. The 18 cm row spacing achieved higher plant density than the 30 cm row spacing, but the seeding system boots had no impact on plant numbers (Table 2). There were no differences in early weed numbers for row spacing or seeding rates (Table 1).

Early crop dry matter was greater in the 18 cm row spacing than in the 30 cm, likely due to higher plant numbers. By 7 October the dry matter differences were not present in seeding rate, however the row spacing effect was still present with the 30 cm and 30 cm ribbon system having lower dry matter than the 18 cm treatments (Table 2).

LAI (the area of leaves per unit area of soil surface) increased with seeding rate. The 18 cm row spacing had a higher LAI than the 30 cm row spacing (Table 2). Head emergence was faster with higher seeding rate and 18 cm row spacing (data not presented).

The total dry matter and numbers of the late grass weeds for ryegrass and wild oats was lower in the higher seeding rate. The 18 cm row spacing showed the same trend with late grass weed dry matter and ryegrass and wild oat plant numbers compared to the 30 cm row spacing. Late barley grass numbers did not change with treatments (Table 1).

Grain yield increased with seeding rate (Figure 2). The 18 cm row spacing also out-yielded the 30 cm row spacing but there were no differences between the two seeding boots. This yield difference between the 18 cm and 30 cm system may be due to the difference in initial plant establishment.

Grain protein showed the opposite trend to grain yield with protein increasing with the lower seeding rate and increasing with the 30 cm system compared to the 18 cm, and again the different seeding boots showed no differences. Higher screenings occurred in the lower plant density treatments, 11% to 8.4% from low to high seeding rates. The 18 cm system had an average of 8.9%, with 8.5% on 18 cm ribbon, 30 cm 10.0% and 30 cm ribbon 10.9%. There were no differences in test weight.

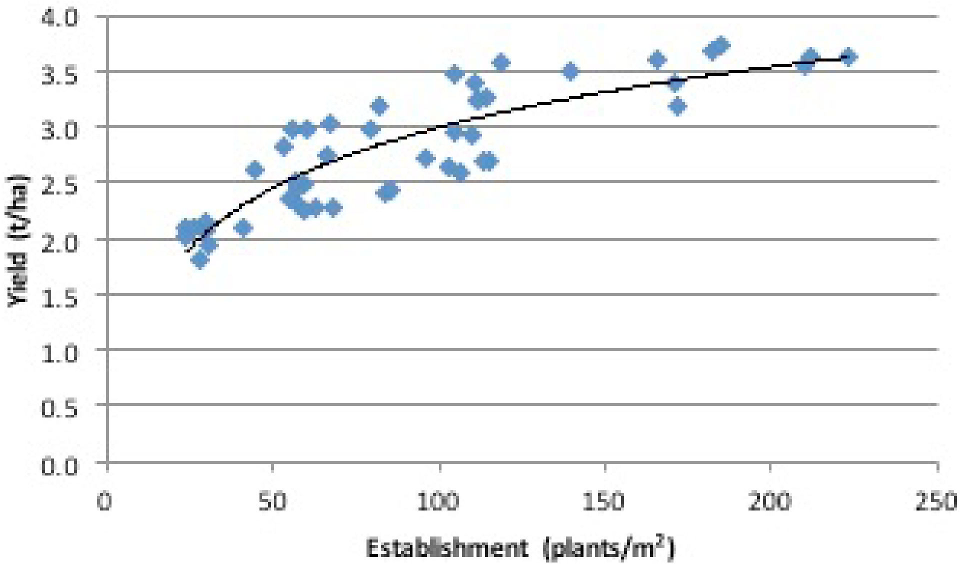

Figure 2: *Plant establishment and grain yield at Minnipa in 2015.*

There were no differences in harvest soil moisture between the highest and lowest seeding rates (60 and 240 plants/m2) at the different row spacing after harvest (data not presented).

WHAT DOES THIS MEAN?

This trial aimed to target barley grass weeds but numbers were much lower than expected due to dry early seasonal conditions, however wild oat numbers were higher than expected and some ryegrass was present. There were no differences in early weed numbers in the row spacing of 18 cm (7”) or 30 cm (12”) or the 60, 120 or 240 kg/ha seeding rates this season in moisture limited conditions.

The seeding rate increased the number of plants/m2 but no rate achieved the targeted plant densities due to the dry seeding conditions affecting seed placement and possibly chemical damage. The 18 cm row spacing achieved higher plant numbers than the 30 cm row spacing but the ribbon seeding system boots showed little impact on plant numbers.

Overall this season the 18 cm (7”) systems showed better plant establishment in a drier seeding which resulted in plant numbers closer to the targeted seeding rates than the 30 cm (12”) system. The higher seeding rates resulted in higher grain yield but also higher screenings and lower protein due to stressful conditions at the end of the season resulting in poor grain filling.

The total dry matter of the late grass weeds significantly declined with the higher seeding rate in the narrower 18 cm row spacing compared to 30 cm, indicating higher seeding rates and narrower row spacing increased crop competition and lowered grass weed numbers. The late barley grass numbers did not show differences (possibly due to the low starting numbers, as discussed previously) however ryegrass and wild oat did, both showing the same trend as the late weed dry matter with lower weed numbers in the higher seeding rate and in narrower row spacing compared to wider. The reduction in ryegrass and wild oat grass weed numbers demonstrates the potential for barley grass reduction.

The 2015 results show crop competition by using narrow row spacing and increasing plant density is a non-chemical method to reduce grass weed numbers in current farming systems, however the seeding system boots showed little differences. The trial will be repeated for another two seasons hopefully with better initial crop establishment and greater barley grass weed numbers so more information on crop competitiveness and barley grass seed set can be collected.

ACKNOWLEDGEMENTS

Thank you to Sue Budarick for doing the weed counts and managing the weed germination trays. Funded by the GRDC Overdependence on Agrochemicals project (CWF00020).

Registered products: see chemical trademark list.

Agrochemicals project (CWF00020), which is led by CWFS

LOCATION: MINNIPA AGRICULTURAL CENTRE PADDOCK S4

Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2015 Total: 333 mm
2015 GSR: 258 mm

Yield
Potential: (W) 3.0 t/ha
Actual: 2.8 t/ha

Paddock history
2015: Mace wheat
2014: Spray topped medic pasture
2013: Wheat

Soil type
Red loam

Plot size
20 m x 2 m x 4 reps