Row orientation and weed competition

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RESEARCH

Searching for answers

Location:
Minnipa Agricultural Centre paddock N7/8
Rainfall
Av. Annual: 325 mm
Av. GSR: 241 mm
2015 Total: 333 mm
2015 GSR: 258 mm
Yield
Potential: 3.0 t/ha (W)
Actual: 2.7 t/ha
Paddock History
2015: Mace wheat
2014: Wyalkatchem wheat
2013: Medic pasture
Soil Type
Red loam
Plot Size
20 m x 2 m x 4 reps

Key messages

- **An east-west (E-W) sowing direction increased yield over north-south (N-S) sowing direction in an average season.**
- **The results showed a decline in yield due to weed competition, but no effect on weed competition due to row direction. Sowing in an E-W direction may give a yield benefit with no difference in weed seed set.**
- **The wider row spacing of 30 cm resulted in a yield reduction and greater weed biomass at harvest.**
- **There were no differences in yield with ribbon seeding with either 18 or 30 cm row spacings, but ribbon seeding reduced 'weed' biomass.**

Why do the trial?

Controlling barley grass in upper Eyre Peninsula (EP) farming systems is becoming a major issue for growers, due to the development of herbicide resistance and delayed emergence. Management options other than herbicides need to be considered to address the issue for longer term sustainability. One of the best bets for cultural control of barley grass in-crop is increased crop competition. The Australian Herbicide Resistance Initiative (ARHI) based at the University of Western Australia has shown an increase in grain yield with wheat and barley sown in an east–west (E-W) orientation over crops sown in a north-south (N-S) orientation due to a decrease in ryegrass competition. Lower light interception by the weed due to the crop row orientation resulting in a decrease in weed seed set is the cause behind this effect (Borger, *et. al.*, 2015).

A trial was established at Minnipa Agricultural Centre (MAC) to investigate the impact of row direction and row spacing on grass weed competition and cereal performance over three years.

How was it done?

In 2014 paddock N7/8 on the MAC was sown with Wyalkatchem wheat on 16 May. It was sown on 30 cm row spacing and yielded 2.4 t/ha with 9.6% protein. A paddock demonstration with crop and stubble aligned in the differing directions was located in this paddock.

In 2015 a replicated plot trial was sown with two row orientations; E-W and N-S into the 2014 standing stubble. Treatments within row orientations included two row spacings, 18 cm (7") and 30 cm (12"), sown with two different seeding boots (a Harrington knife point and an Atom-Jet spread row ribbon seeding boot). Plots were direct drilled with press wheels. Oats were spread as a surrogate weed through hoses at the front of the seeder during the seeder pass. Additional "control" plots were sown near each trial block but in the opposite row orientation to that in each block.

The trial was sown on 21-22 May under minimal moisture with Mace wheat and 18:20:0:0 (DAP) fertiliser, both at 60 kg/ha. The oats 'weeds' were spread at a rate estimated to achieve 70 plants/ m^2. The trial was sprayed with a knockdown of 1 L/ha of Roundup Powermax on 21 May and also a post-sowing pre-emergent spray of 1.5 L/ha of Sprayseed to control emerging self-sown cereal on 1 June. The trial was sprayed with 750 ml/ha Tigrex and 100 ml/ha of Lontrel on 27 July.

Trial measurements taken during the season included soil moisture (pre-seeding and harvest), PreDicta B root disease test, soil nutrition, weed establishment, weed seed bank germination, crop establishment, crop and weed biomass (early and late), light interception in crop rows, grain yield and quality.

Soil samples for moisture and nutrient analysis were taken on 21 April. Initial paddock weed counts were done on 20 May. Soil samples containing weed seeds from the trial site were grown out in germination trays, with monthly assessments on weed emergence. The weed seed bank trays were watered as required in 2015. Crop establishment and weed were counts taken on 26 June.

Table 1 Mace wheat growth, light interception (LAI), yield and grain quality with different sowing direction, row spacing and seeding systems at Minnipa 2015.

		Crop establishment (plants/m²)	LAI (umols)	Late DM (t/ha)	Yield (t/ha)	Protein (%)	Screenings (%)
Row spacing (cm)	18	104	51.6	5.71	2.99	9.8	6.9
	30	156	45.9	4.64	2.33	9.9	6.3
LSD (P=0.05)		*9*	*2.8*	*0.30*	*0.10*	*0.15*	*0.5*
Seeding system	Knife points	124	48.7	5.81	2.82	9.9	6.4
	Knife points plus weed	131	50.4	5.74	2.53	9.8	7.0
	Ribbon	132	48.9	6.06	2.77	9.9	6.0
	Ribbon plus weed	133	51.3	5.73	2.52	9.8	6.9
LSD (P=0.05)		*ns*	*ns*	*0.45*	*0.14*	*ns*	*0.7*

Leaf Area Index (LAI) was measured on 18 September using an AccuPAR/LAI Ceptometer (model LP-80), taking the average of 5 readings per plot placed at an angle across the crop rows as per the operator's instruction manual. The measurements were taken at Zadoks growth stage (GS) 49-51, aiming for maximum crop canopy. The trial was harvested on 12 November. Harvest soil moisture samples of selected treatments were taken on 27 November.

Design and analysis of this trial was undertaken by SARDI statistician Chris Dyson using GENSTAT 16.

What happened?

In the 2014 season in the broad acre strips the yields were 2.64 t/ha and 2.95 t/ha for the N-S and E-W orientations respectively.

In 2015, crop establishment was similar in both sowing orientations, averaging 130 plants/m². There were more wheat plants in the 30 cm row spacing treatment than in the 18 cm (Table 1). Seeding point design had no impact on wheat establishment. An oat-only treatment (no wheat sown) resulted in only 26 plants/m² which was well below the targeted density of 70 plants/m², but still provided some weed pressure.

Late crop dry matter was greater in the narrow row spacing than in the wider row spacing. The ribbon seeding boot had the highest dry matter compared to knife point and the added weed treatments (Table 1).

Wheat yield was greater in the E-W direction than the N-S this season with no difference between seeding boots (Table 1 and 3). The wider row spacing resulted in lower yields compared to narrow (Table 1). The protein level was lower with the higher yield in 18 cm compared to the 30 cm row spacing. There were no differences in protein with the different seeding boots (Table 1).

Oats as a surrogate grass weed decreased wheat yields by 12% regardless of row orientation. The weed levels were very low (Table 2). Dry matter taken at harvest shows greater weed mass in the wider row spacing of 30 cm. The knife point system also had a greater weed biomass compared to the ribbon seeding boot. Other weeds within the trial area, such as ryegrass and wild oats were very low in numbers and did not affect the trial results (data not presented).

Table 2 Average weed dry matter at harvest with different sowing direction, row spacing and seeding systems at Minnipa 2015.

		Oat 'weed' dry matter (t/ha)	Barley grass dry matter (t/ha)
Row spacing (cm)	18	0.06	0.02
	30	0.12	0.01
Seeding system	Knife points	0.14	0
	Knife points plus weed	0.10	0.01
	Ribbon	0.04	0.01
	Ribbon plus weed	0.08	0.04

Table 3 Mace wheat yield (t/ha) sown on 30 cm row spacing with different sowing orientation and seeding boots at Minnipa 2015. *Because the orientation blocks were not replicated formal yield comparison is not possible, but values are believed to be indicative. Note the Extra control directional plots were placed alongside the other orientation block.*

Row Direction	Row spacing (cm)	Knife points	Knife points plus weed	Ribbon spread	Ribbon plus weed	Extra control directional plots
North South	30	2.32	1.95	2.29	1.87	2.23
East West	30	2.69	2.38	2.66	2.45	2.38 *CV 8.4%*

What does this mean?

These results support previous trial work at Minnipa Agricultural Centre (Cook, *et. al.*, 2009) which showed that sowing in an E-W direction increased yield over N-S sowing direction in an average season. Research from Western Australia also showed an increase in grain yield with wheat and barley sown in an E-W orientation due to a decrease in grass weed competition with high ryegrass populations. The extra directional control plots have not fully supported the sowing direction yield increase as the E-W control in the N-S block were no better than the 30 cm N-S treatments (Table 3) which may be due to light interception by the crop.

The trial reported here showed a decline in wheat yield from oats as a surrogate grassy weed, but this competition was similar in both row orientations. The wider row spacing resulted in an increase in 'weed' biomass as did the knife point system compared to the ribbon seeding boots.

The wider row spacing of 30 cm resulted in a large yield reduction regardless of the seeding boots used.

While this trial was sown into stubble with the same orientation as the cropping direction in the previous year, factors such as distribution of nutrients/weeds/diseases or soil constraints prior to the previous crop may also have affected our row orientation blocks differently. This trial will continue for another two seasons.

References

Borger C, Hashem A, Powles S (2015) *Manipulating crop row orientation and crop density to suppress* Lolium rigidum. Weed Research 56, 22-30.

Cook, A., Shepperd, W., and Hancock, J., *Row Direction and Stubble Cover*. EPFS Summary 2009, p114-115.

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