# Row orientation, seeding system and weed competition

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RESEARCH

**Searching for answers**

**Location:**
Minnipa Agricultural Centre
Paddock S5
**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: 3.3 t/ha
**Paddock History**
2016: Mace wheat
2015: Medic pasture
2014: Wyalkatchem wheat
**Soil Type**
Red loam
**Plot Size**
20 m x 2 m x 4 reps

## Key messages

- **There was no detectable direct effect of sowing direction this season at Minnipa with a mild spring.**
- **Using a narrow row spacing of 18 cm instead of 30 cm resulted in wheat yield increasing from 3 t/ha to 3.6 t/ha (19% increase).**
- **Light interception was very sensitive to sowing direction, and not having 'weeds' resulted in higher light within the canopy in the north-south direction compared to east-west.**
- **Knife point and ribbon seeding systems achieved similar crop establishment and crop performance.**

## Why do the trial?

Controlling barley grass in upper EP farming systems is becoming a major issue for growers, due to the development of herbicide resistance and delayed weed emergence. Management options other than herbicides need to be considered to address the issue for long-term sustainability. One of the best bets for cultural control of barley grass in-crop may be increased crop competition. The Australian Herbicide Resistance Initiative (ARHI) based at 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. This effect is due to lower light interception by the weed due to the crop row orientation resulting in a decrease in weed seed (Borger, 2015).

A trial was established at Minnipa Agricultural Centre to investigate the impact of row direction and row spacing on weed competition and cereal performance over two years. The previous season's research is reported in EPFS Summary 2015, Row orientation and weed competition, p163.

## How was it done?

In 2016 a replicated plot trial was sown in blocks with two row orientations; E-W and N-S into a pasture paddock. The ten treatments within the row orientation blocks 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, both with and without 'oat weeds'. An 'oat' weed only treatment was also sown at both row spacings with the Harrington knife points. Plots were direct drilled with press wheels. Oats were spread at 70 plants/$m^2$ as a surrogate weed through the seeder on the 'weed' plots before the seeder pass.

The trial was sown 17-18 May. A base fertiliser rate of 60 kg/ha of 18:20:0:0 was applied for all treatments. The trial was sprayed on 16 May with a knockdown of 1.5 L/ha of glyphosate, and Broadside (MCPA; bromoxynil; dicamba) at 800 ml/ha on 22 June.

Trial measurements taken during the season included soil moisture, PreDictaB root disease test, soil nutrition, weed establishment, 'weed' 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 for soil moisture and soil nutrition were taken on 18 April. Plant establishment and weed counts were taken on 22 June. The Leaf Area Index (LAI) measurements were taken on 17 August 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 dry matter, weed counts and cuts were taken on 12 October. The trial was harvested on 4 November. Harvest soil moisture measurements of selected treatments were taken on 29 November.

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

## What happened?

The 2016 row direction trial was sown into a medic pasture stubble so did not have previous crop stubble rows in the given orientations of 2015. Using oats as a surrogate grass weed resulted in an even weed pressure across the large area of the trial which was unlikely to be achieved by only relying on the background grass weed levels. Using oat 'weeds' gives a relative indication of the outcome that would be achieved with other grass weeds such as ryegrass and barley grass at high populations in the system.

In 2016 there were no interactions between row spacing, seed rate or seeding system in terms of the effect on weeds. There was no difference in crop establishment due to row direction with the average being 112 plants/m$^2$. There was a difference in plant numbers between the row spacing treatments, with 120 wheat plants/m$^2$ established in the 18 cm row spacing treatment and 105 plants/m$^2$ in the 30 cm row spacing (Table 1). The type of seeding point or the addition of weeds had no impact on wheat establishment. The oat-only treatment (no wheat sown) resulted in 72 plants/m$^2$, achieving the targeted plant density for weed pressure, unlike 2015 when the weed pressure was only 26 plants/m$^2$.

There were no differences in late crop dry matter due to sowing direction or seeding systems in the absence of weeds (Table 1). The late dry matter was greater in the narrow row spacing than in the wider row spacing (Table 1).

In 2016 there was no detectable difference in wheat yield due to sowing direction in the absence of weeds (Table 1). The narrow row spacing resulted in higher yields compared to wider (Table 1).There was no significant difference in grain quality, likely due to the mild finish (Table 1).

There was a significant difference in grain yield due to 'weeds' in the system with an average wheat grain yield decrease of 0.7 t/ha (Table 2). The 'oat' weed seed set averaged 0.23 t/ha and there was no effect on weed seed set due to sowing direction or row spacing in 2016 (data not presented).

***Table 1 Mace wheat growth, yield and grain quality with different sowing direction, row spacing and seeding systems at Minnipa 2016***

| | | Crop establishment (plants/m$^2$) | Late DM (t/ha) | Yield (t/ha) | Protein (%) | Screenings (%) |
|---|---|---|---|---|---|---|
| **Sowing direction** | East-West | 116 | 6.33 | 3.36 | 10.2 | 0.9 |
| | North-South | 108 | 6.40 | 3.30 | 10.3 | 0.9 |
| | | * | * | * | * | * |
| **Row spacing (cm)**** | 18 | 120 | 7.05 | 3.64 | 10.3 | 1.0 |
| | 30 | 105 | 5.68 | 3.02 | 10.3 | 0.9 |
| *LSD (P=0.05)* | | *10.4* | *0.53* | *0.2* | *ns* | *ns* |
| **Seeding system** | Knife points | 114 | 6.13 | 4.03 | 10.3 | 0.9 |
| | Knife points plus weed | 115 | - | 2.58 | - | - |
| | Ribbon | 111 | 6.61 | 4.16 | 10.3 | 1.0 |
| | Ribbon plus weed | 110 | - | 2.52 | - | - |
| *LSD (P=0.05)* | | *ns* | *ns* | *0.20* | *ns* | *0.7* |

**LSD not available due to lack of replication (>8 required for statistical comparison)*
*** in absence of weeds*
*- Analysed data not provided*

***Table 2 Oat 'weed' growth, yield and grain quality with different sowing direction, row spacing and seeding systems trial at Minnipa 2016***

| | Crop establishment (plants/m$^2$) | Late DM (t/ha) | Yield (t/ha) | Protein (%) |
|---|---|---|---|---|
| **'Oats' weeds in wheat crop** | 60 | 2.41 | 2.56 | 10.4 |
| **'Oats' weeds only** | 72 | 7.43 | 4.10 | 10.2 |
| *LSD (P=0.05)* | | *0.59* | *0.14* | *0.15* |

Weeds

***Table 3 Light interception measured as leaf area index (LAI) of Mace wheat with different sowing direction, row spacing and seeding systems at Minnipa 2016***

| | | Seeding system | | | | |
|---|---|---|---|---|---|---|
| **Sowing direction** | **Row spacing (cm)** | **Knife points** | **Knife points plus weed** | **Ribbon** | **Ribbon plus weed** | **Weed only** |
| East-West | 18 | 196.4 | 108.2 | 117.7 | 118.4 | 106.5 |
| | 30 | 160.2 | 120.5 | 176.4 | 127.3 | 174.8 |
| *LSD (P=0.05)* | *62.3* | | | | | |
| North-South | 18 | 237.0 | 118.5 | 215.1 | 133.0 | 147.3 |
| | 30 | 377.5 | 130.6 | 380.3 | 129.6 | 240.5 |
| *LSD (P=0.05)* | *62.3* | | | | | |
| *LSD (P=0.05)* | *147.7 (between different orientations)* | | | | | |

***Table 4 Average weed dry matter at harvest with different sowing direction, row spacing and seeding systems at Minnipa 2016***

| | | Weed establishment | Oat 'weed' dry matter (t/ha) | Volunteer grass weed dry matter (t/ha) |
|---|---|---|---|---|
| **Sowing direction** | East-West | 73 | 3.94 | 0.12 |
| | North-South | 71 | 4.23 | 0.09 |
| | | * | * | * |
| **Row spacing (cm)** | 18 | 77 | 4.37 | 0.14 |
| | 30 | 67 | 3.79 | 0.19 |
| | | - | *ns* | - |
| **Seeding system** | Knife points | ^ | ^ | 0.17 |
| | Knife points plus weed | 60 | 2.31 | 0.05 |
| | Ribbon | ^ | ^ | 0.14 |
| | Ribbon plus weed | 53 | 2.51 | 0.05 |
| | Weed only | 72 | 7.43 | 0.12 |

**LSD not available due to lack of replication (>8 required for statistical comparison)*
*- Analysed data not provided*
*^ not applicable (no weeds)*

The light interception measured as leaf area index (LAI) showed greater shading in the E-W sowing direction compared to N-S, taken in August on a clear sunny day. Not having weeds in the system resulted in higher light within the canopy in the north-south direction compared to east-west. The narrow 18 cm row spacing also showed greater shading due to canopy cover compared to the 30 cm row spacing (Table 3). There was greater shading in the ribbon seeding system compared to the knife points and having weeds increased the shading in both systems (Table 3).

The volunteer weed numbers were low and the dry matter cuts taken at harvest showed no difference between seeding systems, but there was a decrease due to having oat weeds in the system (Table 4).

## What does this mean?

Research from Western Australia showed an increase in grain yield with wheat and barley sown in an east-west orientation compared to north-south, due to a decrease in grass weed competition with high ryegrass populations (Borger 2015). The 2016 results showed no differences in grain yield, late dry matter or grain quality due to sowing direction at Minnipa Agricultural Centre in an above average season with a very mild spring with an average 69 plants/ m$^2$ 'oat' weed population.

The light interception showed greater shading in the E-W sowing direction compared to N-S and also the narrow 18 cm row spacing also showed greater shading; however there were no differences in weed dry matter measurement in 2016 due to light interception. The light interception differences show the potential benefits of E-W orientation, although it didn't affect weed dry matter this season. The higher than average rainfall season and very mild spring grain filling conditions may have allowed the crop and weeds to both achieve their potential this season rather than being competitive and resulting in yield differences between the treatments.

There was a difference in Mace wheat late dry matter and grain yield increase of 0.6 t/ha due to the 18 cm row spacing compared to the 30 cm in the absence of 'oat' weeds. 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 in 2013 of row spacing of winter crops in broad scale agriculture in southern Australia, by Scott *et al*, shows at yields of 2.0 t/ha widening row spacing from 18 cm to 36 cm reduced yield by 1.86 t/ 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). There was no difference at Minnipa due to seeding systems in these trials in 2015 or 2016.

Overall the 'Overdependence on Agrochemicals' research has shown the greatest benefit in low rainfall farming systems can be achieved by sowing on as narrow row spacing as possible, without compromising stubble handling, which will gain benefits in grain yield as well as weed competition.

## References


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