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Row placement strategies in a break crop-wheat sequence

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Key findings

Sowing the following wheat crop *directly* over the row of the previous years break crop provided a 10–16% yield advantage

This system will only work for zero tillage systems where wheat stubble is kept intact

Introduction

Inter-row sowing has been shown to reduce the impact of crown rot and increase yield, by up to 9%, in a wheat-wheat sequence (Verrell *et al* 2009). Crop rotation reduces the incidence and severity of crown rot resulting in yield gains of 17–23% over continuous wheat (Verrell *et al* 2005). There was a need to examine whether row placement strategies coupled with a break crop – wheat rotation, would result in differences in grain yield over a five year crop sequence.

Treatments

A five year crop sequence experiment consisting of three winter sequences;

1. wheat-wheat-wheat-wheat-wheat
2. wheat-chickpea-wheat-chickpea-wheat
3. wheat-mustard-wheat-mustard-wheat

was established in 2008 at the Tamworth Agricultural Institute (TAI). The TAI site consists of a brown vertosol with an average summer and winter rainfall of 400 mm and 280 mm, respectively, and soil plant available water holding capacity of 120mm to a depth of 1.0m. Durum wheat (cv. EGA Bellaroi[Ф]) was sown in 2008 (40cm row spacing) and inoculated with a low level of the crown rot (CR) fungus, *Fusarium pseudograminearum* (*Fp*) at a rate of 0.5 g/m row. This resulted in a low incidence of *Fp* (25%) across the site.

In 2009, wheat, mustard or chickpea was sown either on or between the 2008 wheat rows using GPS guided autosteer. In subsequent seasons crops were sown either on or between the previous year rows resulting in sixteen different row placement combinations by the time the 2012 wheat crop was sown. All crops were sown with Janke coulter-tyne-press wheel parallelograms along with 100 kg N/ha (mustard and wheat) and 10 kg P/ha (all crops).

Results

The results presented here will focus solely on the mustard-wheat and chickpea-wheat systems and the last three years of the sequence trial (2010–2011-2012). Four row placement options are presented for both crop sequences and row placements are relative to the position of the 2010 wheat rows (Table 1).

Table 1: *Row placement options relative to the 2010 wheat rows*

Row Sequence	Row Placement		Abbreviation
	Year 2011	Year 2012	
1	Between 2010 rows	Between 2010 rows	BB
2	On rows 2010 rows	Between 2010 rows	OB
3	On rows 2010 rows	On rows 2010 rows	OO
4	Between 2010 rows	On rows 2010 rows	BO

The 2012 wheat yield, in the mustard-wheat sequence, was significantly higher for the BB row option (4.46 t/ha) compared to other placements (Table 2). Both the OB and OO options had similar yields which were lower than the BB treatment. The lowest yielding row placement option was BO (3.84 t/ha).

Table 2: *Row placement by year with grain yield, grain N removal and whiteheads for the 2012 wheat crop in a wheat-mustard-wheat sequence*

Row Placement Sequence	Row Placement × Crop			2012 Wheat Crop		
	2010 Wheat	2011 Mustard	2012 Wheat	Yield (t/ha)	Grain-N (kgN/ha)	Whiteheads (heads/m^2)
BB				4.46a	87a	0.70a
OB				4.27b	88a	0.64a
OO				4.24b	86a	0.89ab
BO				3.84c	75b	1.53b

NB Values within a column with the same letter are not significantly different ($P<0.05$)

The BO row placement sequence had significantly lower grain nitrogen removal and the highest number of whiteheads compared to the other row placement options in the mustard-wheat sequence (Table 2).

Similar data for the mustard-wheat sequence is presented for the chickpea-wheat sequence (Table 3). In this sequence there was no difference between the BB, OB and OO row placements for the 2012 wheat yield. However, the BO sequence had significantly lower yield (4.03 t/ha) for the 2012 wheat crop compared to other options. The BO sequence also had the lowest grain nitrogen removal rate and the highest number of whiteheads under a chickpea-wheat rotation (Table 3).

Table 3: *Row placement by year with grain yield and grain N removal for the 2012 wheat crop in a wheat-chickpea-wheat sequence*

Row Placement Sequence	Row Placement × Crop			2012 Wheat Crop		
	2010 Wheat	2011 Chickpea	2012 Wheat	Yield (t/ha)	Grain-N (kg N/ha)	Whiteheads (heads/m²)
BB				4.46a	91a	0.92a
OB				4.45a	92a	0.92a
OO				4.36a	90a	0.83a
BO				4.03b	82b	1.63b

NB Values within a column with the same letter are not significantly different (P<0.05)

Whiteheads for the wheat-wheat sequence were 2.2, 0.8, 3.5 and 1.2 (heads/m^2) for the BB, OB, OO and BO row placement options, respectively (rest of data not shown).

Summary

After five years, both break crop systems showed grain yield advantages in 2012, over continuous wheat, of 40% and 44%, for the mustard-wheat and chickpea-wheat systems, respectively. The chickpea-wheat system tended to have slightly higher wheat grain yields in 2012 for each of the four row placement strategies compared to the mustard-wheat sequence (Table 2 and Table 3).

The number of whiteheads/m^2 does not reflect the total level of incidence of *Fp* in a crop. Whitehead production is heavily influenced by the amount of water (rainfall + soil stored) available to the crop. Under high water levels, whitehead numbers can be very low or even non-existent even if the crop has a high incidence of *Fp*. The whitehead counts provide a trend and should not be considered as absolute values. In this experiment whitehead numbers are low due to high levels of crop available water, from zero-till fallowing and in-crop rainfall.

What this experiment has shown is that simply alternating row placement in consecutive years will not result in yield gains but a yield loss and increased CR (BO system). In the BO sequence the break crop was sown between standing cereal stubble which was kept intact. The following wheat crop was then sown between the previous years (break crop) rows but this put it directly over the old 2010 wheat row. The consequence of this sequence was that the wheat crop was sown into old infected wheat stubble hence the higher level of CR infection resulting in higher whitehead counts. The benefit of the break crop in breaking any disease cycle was reduced. This is supported by the wheat-wheat whitehead data which showed higher incidence of whiteheads/m^2 for row placements where wheat was sown directly over the previous row (BB=2.5, OO=3.5) compared to between row sequences (OB=0.8, BO=1.2).

Even the traditional on row system (OO) had a better yield and CR outcome than the BO system because the break crop was sown directly over the old wheat stubble row excavating the residue out of the row (tyne with spear points) and providing a direct break to the CR fungus (Table 2 and 3). This may not be the case however if a low disturbance disc system is used.

Based on these results the best option for row placement sequences in a break crop system is shown in Table 4.

Table 4: *Proposed row placement strategy to optimise crop yield in a wheat-break crop-wheat sequence.*

Year 1 Wheat	Year 2 Chickpea	Year 3 Wheat	Year 4 Canola	Year 5 Wheat

Following a wheat crop, the break crop (pulse or oilseed) should be sown between the standing stubble rows. In the next year, the wheat crop should be sown directly over the previous seasons break crop row. Then in the next year of the rotation the break crop should shift back and be sown between the standing wheat rows. Finally, in the fifth year, the wheat crop again should be sown directly over the previous years break crop row.

There are two simple rules that need to be followed;

- Sow break crops between standing wheat rows which need to be kept intact
- Sow the following wheat crop *directly* over the row of the previous years break crop

By following these two rules it ensures the following;

- Ensures four years occur between wheat crops being sown in the same row space (Table 4)
- Improved germination of break crops, especially canola, not hindered by stubble
- Chickpeas will benefit from standing stubble reducing the impact of virus
- Standing wheat stubble gives better protection to break crop seedlings

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References

Verrell, A.G., Simpfendorfer S., Nash P. and Moore K. (2009) Can inter-row sowing be used in continuous wheat systems to control crown rot and increase yield? 13th Annual Symposium on Precision Agriculture in Australasia (2009), UNE, Armidale.

Verrell, A.G., Simpfendorfer S., Nash P. and Moore K. (2005) Crop rotation and its effect on crown rot, common root rot, soil water extraction and water use efficiency in wheat. Proceedings 2005 GRDC Grains Research Update, Goondiwindi.