Integrated management of crown rot in a chickpea – wheat sequence

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Key findings

Sow chickpea crops between standing wheat rows.

Sow the following wheat crop directly over the row of the chickpea crop from the previous year.

Keep wheat stubble intact and do not spread it across the soil surface.

This will maximise yield of both chickpea and wheat crops and reduce the incidence of crown rot in the wheat phase of the rotation sequence.

Introduction

Crown rot, caused by the stubble-borne fungus *Fusarium pseudograminearum* (*Fp*), remains a major limitation to winter cereal production across the northern grains region of Australia. Crop sequencing with non-host crops has proven to be one of the best means of reducing effects from crown rot (CR) infection (by 3.4–41.3%) and increasing wheat yield (by 0.24–0.89 t/ha) compared with a cereal–wheat sequence (Kirkegaard et al. 2004; Verrell et al. 2005). Inter-row sowing has been shown to reduce CR effects and increase yield, by up to 9%, in a wheat–wheat sequence (Verrell et al. 2009). Verrell et al. (2014) showed that using mustard–wheat and chickpea–wheat crop sequencing resulted in a 40–44% increase in wheat yield over a continuous wheat system under zero-tillage. Adding inter-row sowing increased wheat yield by a further 11–16%, depending on the row placement sequences.

Chickpea is the most prevalent break crop grown in sequence with wheat in the northern NSW region. Chickpea crops rely on using post-sow pre-emergent residual herbicides (groups C and H) for broadleaf weed control. A common commercial practice is to level the seeding furrow after sowing, usually with Kelly chains, to avoid risking herbicide residue concentrating in the furrows and causing damage. The consequence of this levelling is that any standing wheat residue, under a zero-tillage system, is shattered and spread across the entire soil surface. If this wheat residue is infected with *Fp*, then CR inoculum is no longer confined to the standing wheat rows.

There was a need to examine whether integrating row placement, stubble management, chickpea row spacing and a ground engaging tool would affect *Fp* incidence and grain yield in wheat in a chickpea–wheat sequence grown under a zero-tillage system.

Site details

This experiment was conducted at Tamworth over three years.

Parameter	2012	2013	2014
Soil type	Red chromosol	Red chromosol	Red chromosol
Crop	Wheat	Chickpea	Wheat
Sowing dates	31 May	26 June	23 May
Fertiliser rate	100 kg N as urea 50 kg/ha starter Zn	50 kg/ha starter Zn	100 kg N as urea 50 kg/ha starter Zn
Harvest dates	30 November	2 December	10 November
Plant available water at sowing	88 mm	60 mm	52 mm

Treatments

A three-year crop sequence experiment (wheat–chickpea–wheat) was established at Tamworth in 2012 to examine the effect of a ground engaging tool, chickpea row spacing, row placement and wheat residue management on the incidence of *Fp* and grain yield of a wheat crop.

In 2012, durum wheat (EGA Bellaroi⁽ᵇ⁾) was sown into a cultivated paddock using a Trimble® RTK auto-steer system fitted to a New Holland TL80A tractor with narrow row crop tyres. The crop was sown with a disc seeder on 40 cm row spacing and bulk harvested with the residue cut at a uniform height of 24 cm.

In 2013, chickpea (cv. PBA HatTrick⁽ᵇ⁾) was sown at 80 kg/ha and treatments consisted of:

- main plot – row placement (between or on 2012 wheat rows)
- sub plot – stubble management (standing or slashed and spread)

- sub-sub plot – row spacing (narrow 40 cm or wide 80 cm)
- sub-sub-sub plots – ground engaging tools (Barton® single disc opener or Janke® coulter-tyne-press wheel parallelogram).

The stubble management treatment was applied after the plots were sown.

In 2014, wheat (cv. EGA Gregory⁽ᵇ⁾) was sown over the chickpea plots. Treatments consisted of:

- sub-sub plot – row placement (between or on 2012 wheat rows)
- sub-sub-sub plot – ground engaging tools (Barton® single disc opener or Janke® coulter-tyne-press wheel parallelogram).

Results

Chickpea grain yield increased when sown with a disc opener (by 6%), on narrow rows (by 22%) and sown between the 2012 wheat rows (by 7%), but stubble management did not have an effect on chickpea yield at the main treatment level. However, stubble management had a significant interaction with row spacing where chickpeas sown on narrow rows (40 cm) into standing residue out yielded narrow rows where the residue had been slashed (by 6%) (Figure 1). There was no significant effect on chickpea yield when sown on wide rows (80 cm), whether the wheat residue was left standing or slashed.

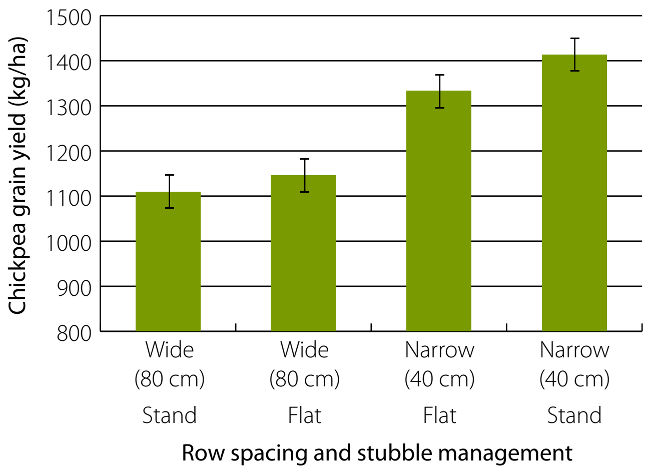

Figure 1. *Effect of row spacing and wheat stubble management on chickpea grain yield (kg/ha)*

In the 2014 wheat crop, sowing with a coulter-tyne-press wheel out yielded the disc opener (by 6.3%). Wheat row placement, relative to the 2012 wheat crop, had a significant interaction with the stubble treatment in the 2013 chickpea crop. Wheat sown into the space between the old wheat rows from 2012 with the stubble left standing in the 2013 chickpea crop resulted in the highest grain yield in 2014 (3718 kg/ha; Figure 2). This was significantly higher than the other row × stubble combinations: on-row × flat; on-row × standing; and between-row × flat, which yielded 3585, 3515 and 3487 kg/ha, respectively, and which were not significantly different from one another.

The incidence of *Fp* at harvest, as main effects, was lower where chickpeas had been sown between wheat rows (6.6%) compared with on the row (10.0%), and lower when stubble was left standing (6.4%) compared with spreading (9.9%). The type of ground engaging tool, row spacing in the previous chickpea crop or row placement of the 2014 wheat crop, had no significant main effect on the incidence of *Fp* at harvest. For the narrow row (40 cm) chickpea system, sowing on the old wheat row led to a significant increase in the incidence of *Fp* at harvest in the following wheat crop (11.8%) compared with sowing between the old wheat rows (5.8%).

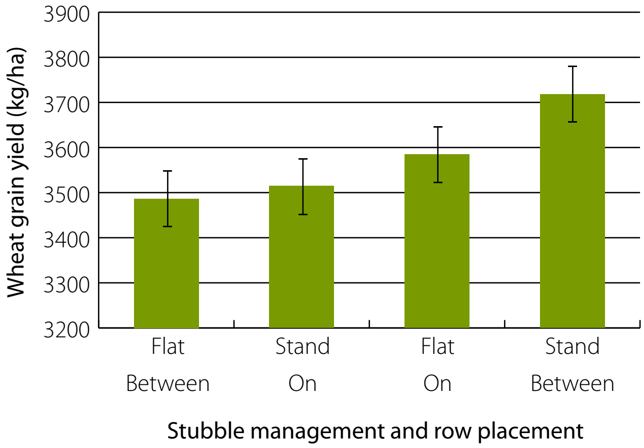

***Figure 2.** Effect of row placement (relative to the 2012 wheat crop) and stubble management in the 2013 chickpea crop on grain yield (kg/ha) in the 2014 wheat crop*

Under the wide row (80 cm) chickpea system, row placement had no effect on *Fp* incidence (mean 7.5%). Sowing the 2013 chickpea crop between standing wheat rows, and the following wheat crop directly over the previous chickpea row and between the old wheat rows, resulted in the lowest incidence of *Fp* (4.6%) (Figure 3).

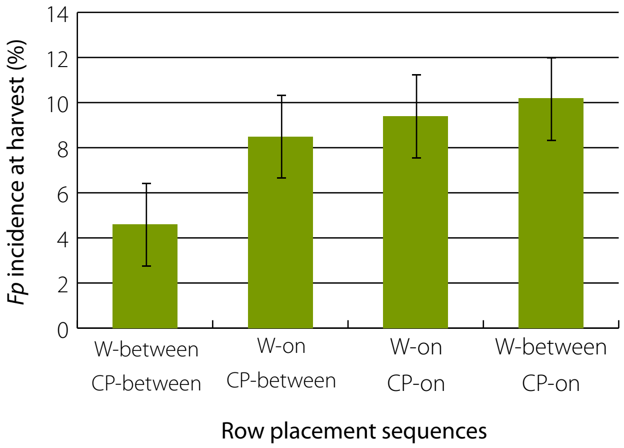

***Figure 3.** The interaction of chickpea row placement (2013) and wheat row placement (2014) on the incidence of Fusarium pseudograminearum in wheat*

Other row placement combinations: chickpea between wheat rows × wheat on-rows, chickpea on wheat rows × wheat on-rows, and chickpea on-rows × wheat between wheat rows resulted in *Fp* levels of 8.5, 9.4 and 10.2%, respectively (Figure 3).

Summary

At Tamworth in 2013, sowing chickpea on narrow rows (40 cm) realised a 22% yield advantage over wide rows (80 cm). Also, sowing chickpeas between standing wheat rows resulted in a higher yield (by 6%) compared with sowing the crop then slashing the wheat stubble and spreading it across the surface. Growing chickpeas between standing wheat stubble has been shown to provide a yield advantage in previous studies, largely by reducing the incidence of aphid-transmitted viruses (Verrell & Moore, 2015).

The highest wheat yield (3718 kg/ha) came from sowing the wheat into the inter-row space of the old wheat crop (two years old) and keeping the stubble standing. Using a tyne also resulted in a yield advantage over a disc opener. When stubble was left standing, the *Fp* incidence was lower (6.4%) compared with spreading stubble across the surface (9.9%). Sowing the 2013 chickpea crop between standing wheat rows, and the following wheat crop directly over the previous chickpea row and between the old wheat rows, resulted in the lowest incidence of *Fp* (4.6%). Any stubble management practice that spreads residues into the inter-row space is likely to undo row placement benefits associated with

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reducing the incidence of crown rot infection as *Fp* inoculum is no longer confined to the standing wheat rows. The perceived crop safety benefits of levelling the seeding furrow after applying post-sow pre-emergent residual herbicides (groups C and H) in chickpeas needs to be balanced against potential impacts on chickpea yield and increased incidence of crown rot infection in the following winter cereal crop.

References

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