IMPACT OF SOWING TIME AND VARIETAL TOLERANCE ON YIELD LOSS TO THE ROOT-LESION NEMATODE *PRATYLENCHUS THORNEI*

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Key words

Pratylenchus thornei (*Pt*), crown rot, varietal tolerance, sowing time

GRDC code

DAN00143: Northern NSW integrated disease management
DAN00129: Variety specific management packages

Take home messages

1. Wheat variety choice can have a huge impact on yield loss to *Pt* (up to 43% yield loss in intolerant bread wheat varieties in 2011).
2. Yield losses from *Pt* were exacerbated by delayed sowing and drier conditions.
3. Crown rot remains an important disease of winter cereals causing an average yield loss of 18% in barley, 27% in durum and 22% in bread wheat varieties at Coonamble in 2011.
4. Tolerance of wheat varieties to crown rot **does not** appear related to their level of *Pt* tolerance .
5. However, the difference in tolerance levels between wheat varieties appears larger for *Pt* than for crown rot.

Background

Root-lesion nematodes (RLN) are microscopic worms that feed and reproduce inside plant roots which can lead to yield loss in intolerant cereal and pulse crops. *Pratylenchus thornei* (*Pt*) and *Pratylenchus neglectus* are two important species of RLN in the northern grains region. Survey work indicates that *Pt* is more widespread throughout the region and has a higher frequency of populations >2,000 *Pt*/kg in the 0-30 cm soil layer. These levels present a high risk of yield loss in intolerant varieties. Tolerance is the ability of a variety to maintain yield in the presence of a pathogen e.g. *Pt* or the crown rot fungus. Tolerance in a variety will not reduce the levels of a pathogen that are present and may increase them for subsequent crops. These two trials aimed to examine the interaction of varietal tolerance to *Pt* with both sowing time and crown rot in a range of winter cereal types and varieties.

Trial details

Locations:	'Jabiru', Mungindi	'Woolingar', Coonamble
Agronomist:	Rob Holmes, HMAg	Rohan Brill, NSW DPI
Nematodes:	18,515 *Pt*, 0 *Pn*/kg soil at 0-30cm	5,522 *Pt*, 0 *Pn*/kg soil at 0-30cm
1st Sowing:	10 May 2011	20 May 2011
2nd Sowing:	2 June 2011	22 June 2011

How was it done?

- Five barley varieties (Oxford, Commander, Hindmarsh, Shepherd and Grout).
- Four durum varieties (Caparoi, Hypernoi, EGA Bellaroi and Jandaroi).

- Nine bread wheat varieties (EGA Gregory, SUN627A, Spitfire, EGA Bounty, Livingston, Longreach Crusader, Sunvex, Ellison and Strzelecki).
- All plus and minus crown rot at each sowing time.

Effect of sowing time on yield

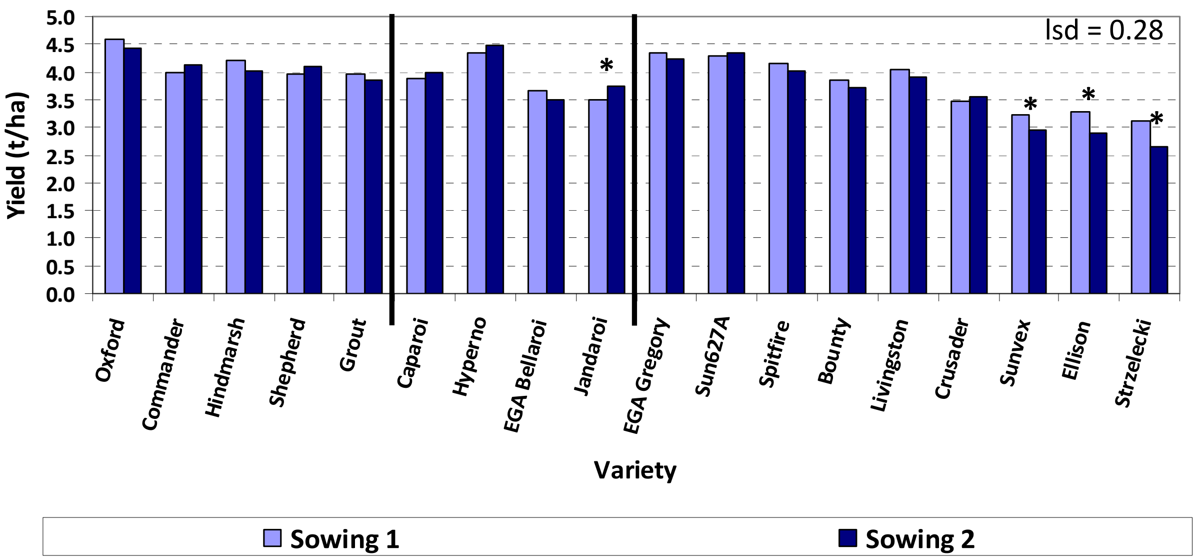

Figure 1: Yield of winter cereals at two sowing times (10th May and 2nd June): Mungindi 2011
*indicates varieties which had a significant (*P*=0.05) difference in yield between sowing times

The trial site near Mungindi (10 km east of town) experienced good rainfall throughout the season, especially during flowering and grain-fill. Plots planted on the 10th May (Sowing 1) experienced 243 mm of in-crop rainfall while those sown on the 2nd June (Sowing 2) experienced 228 mm of in-crop rainfall. This along with generally milder temperatures during grain-fill minimised the impact of sowing time on yield at this site in 2011. Sowing time only had a significant impact on yield in the durum variety Jandaroi, which was higher yielding with the later sowing, and in the three bread wheat varieties Sunvex, Ellison and Strzelecki which were on average 11% lower yielding with delayed sowing (Figure 1). These three bread wheat varieties are all intolerant to very intolerant (I-VI) to *Pt* while the other bread wheat varieties in the trial have varying levels of increased tolerance.

The trial site near Coonamble (~40 km north-west of town) had a large difference in final yields between the two sowing times (Figure 2). Sowing 1 was planted into a dry seedbed on the 20th May in-front of a 12 mm rainfall event on the 23rd which resulted in good establishment. These plots experienced a total of 220 mm of in-crop rainfall. In contrast, plots sown on the 22nd June (Sowing 2) where sown into a moist but drying seedbed and only received 10 mm of rainfall in the month following sowing, which reduced establishment and early root development. Plots in Sowing 2 at Coonamble experienced a total of 180 mm of in-crop rainfall. This resulted in a significant reduction in yield with delayed sowing in all varieties, ranging from a loss of 0.8 t/ha (20%) in the barley variety Shepherd up to 2.1 t/ha (50%) in the bread wheat variety Longreach Crusader (Figure 2).

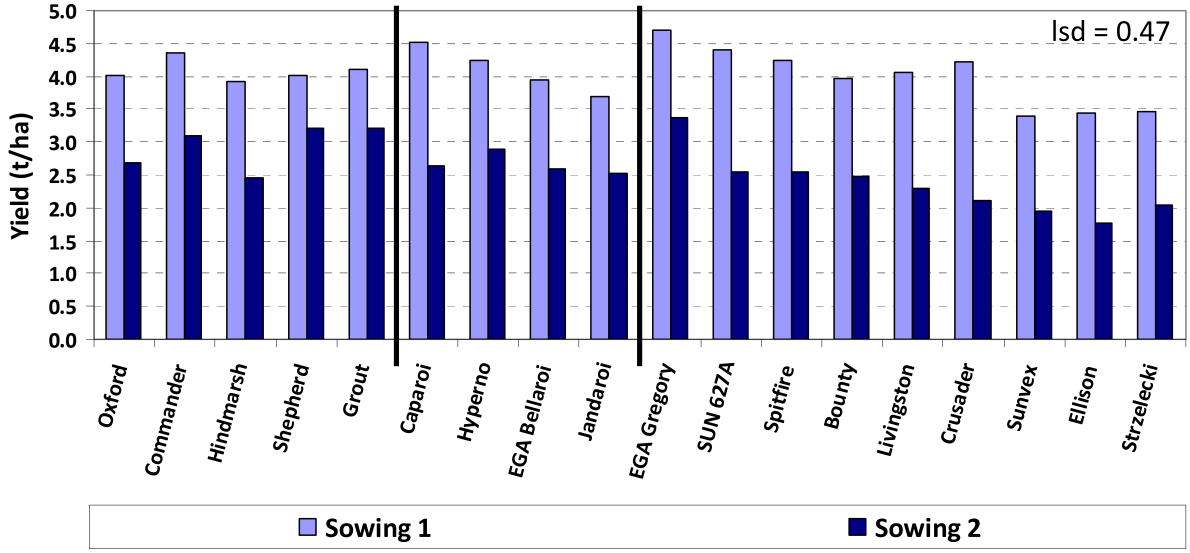

Figure 2: Yield of winter cereals at two sowing times (20th May and 22nd June): Coonamble 2011

Impact of sowing time on yield loss from *Pratylenchus thornei* (*Pt*)

There are currently no commercially available winter cereal varieties that are fully tolerant of *Pt*. Consequently the impact of *Pt* on yield under high soil populations, such as at the Mungindi and Coonamble trials sites in 2011, is determined through comparison with the variety(s) with the highest known levels of tolerance. Tolerance ratings of the nine bread wheat varieties used in this study are outlined in Table 1 below.

Table 1: Tolerance rating of bread wheat varieties to Pratylenchus thornei

MT	MT-MI	MI	I-VI
EGA Gregory	EGA Bounty	Livingston	Ellison
	Spitfire	Longreach Crusader	Strzelecki
	SUN627A (p)		Sunvex

(p) indicates provisional rating

EGA Gregory, with a rating of moderately tolerant (MT) to *Pt*, has the highest level of tolerance of the varieties examined in this study. Hence, the following analysis looks at the average yield effects across varieties with decreasing levels of tolerance to *Pt* compared to this one MT variety. Note: this approach cannot differentiate any inherent yield advantage of an individual variety that is not related to its level of *Pt* tolerance. Hence, this method can be potentially biased as any yield difference is attributed to *Pt* tolerance. Additionally, this method may also underestimate the actual impact of *Pt* as the extent of yield loss in the MT variety cannot be determined.

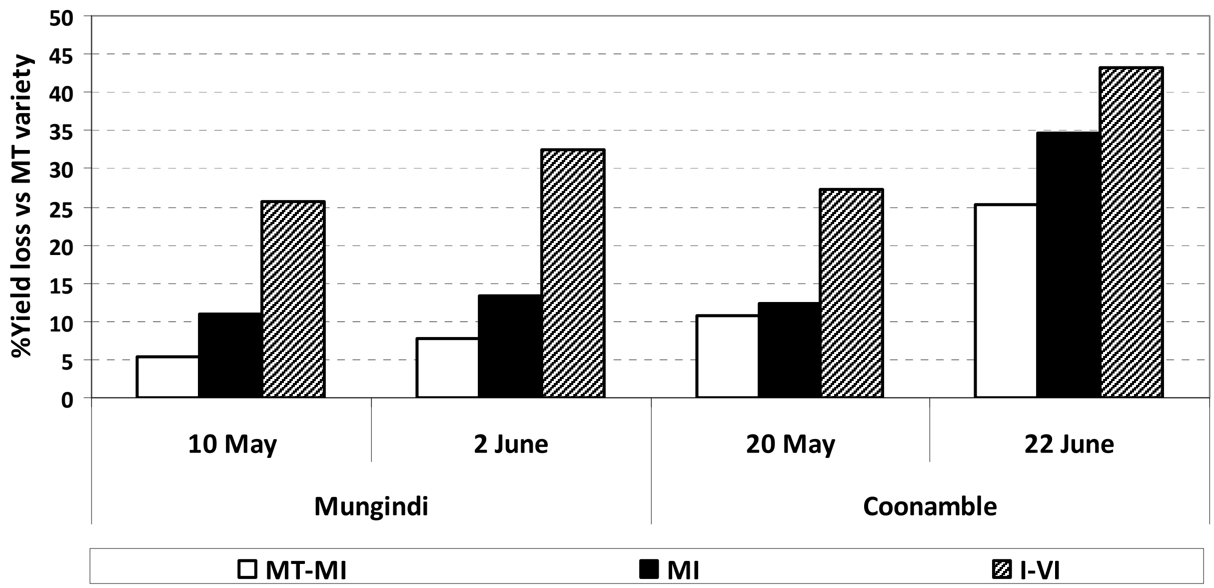

Figure 3: Yield loss from Pratylenchus thornei in wheat varieties with varying levels of tolerance

Decreasing levels of tolerance increased yield loss from *Pt* (relative to the MT variety) at both sites and across both sowing times (Figure 3). There was generally a big jump in the extent of yield loss when moving from a moderately intolerant (MI) to an intolerant-very intolerant (I-VI) variety (additional 9 - 19%), consistent with the disparity in these ratings. Delayed sowing at both sites increased the extent of yield loss across all three tolerance levels. The impact of *Pt* on yield was highest with the second sowing time (22 June) at Coonamble that experienced the driest conditions during establishment and early crop growth. Variety choice can have a large impact on yield and hence profitability when cropping in soils with high populations of *Pt*. Sowing a MT-MI variety rather than a MT variety reduced yield by between 5 to 25%, sowing a MI variety reduced yield by between 11 to 35%, while planting a I-VI variety reduced yield by between 26 to 43% in these trials in 2011 (Figure 3).

Impact of crown rot on yield

Good levels of in-crop rainfall at Mungindi, especially during grain-fill, accompanied by mild temperatures limited the expression of crown rot at this site in 2011. Inoculation of plots at sowing with the crown rot fungus **did not** significantly reduce the yield of any variety at either sowing time.

Conversely, crown rot significantly impacted on the yield of all varieties at both sowing times under tougher growing conditions at Coonamble in 2011. Late rain and milder temperatures again reduced the extent of yield loss that would have occurred if hotter and drier conditions had occurred during grain-fill particularly with the later sowing. The direct impact of crown rot on yield was determined by comparing the yield of each variety in plots without crown rot relative to plots inoculated with the crown rot fungus at sowing. Averaged across the different winter cereal types, crown rot reduced yield by 18% in barley, 27% in durum and 22% in bread wheats. Sowing time did not have a significant impact on the extent of yield loss from crown rot infection at this site in 2011 (Figure 4).

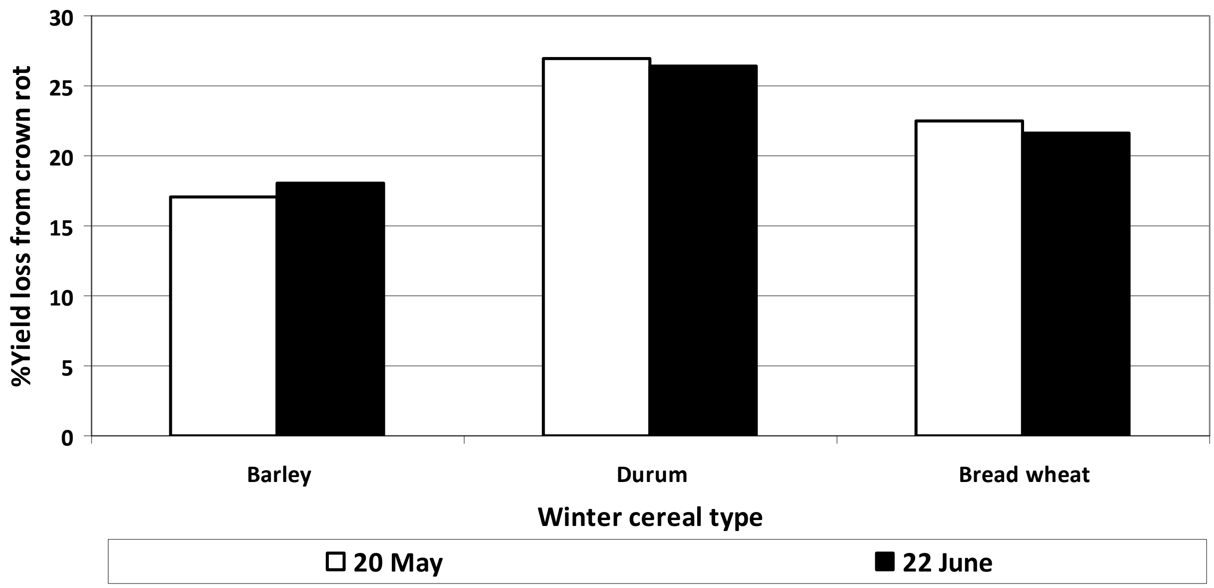

Figure 4: Yield loss from crown rot infection across types of winter cereals – Coonamble 2011

Interaction of *Pt* tolerance with crown rot

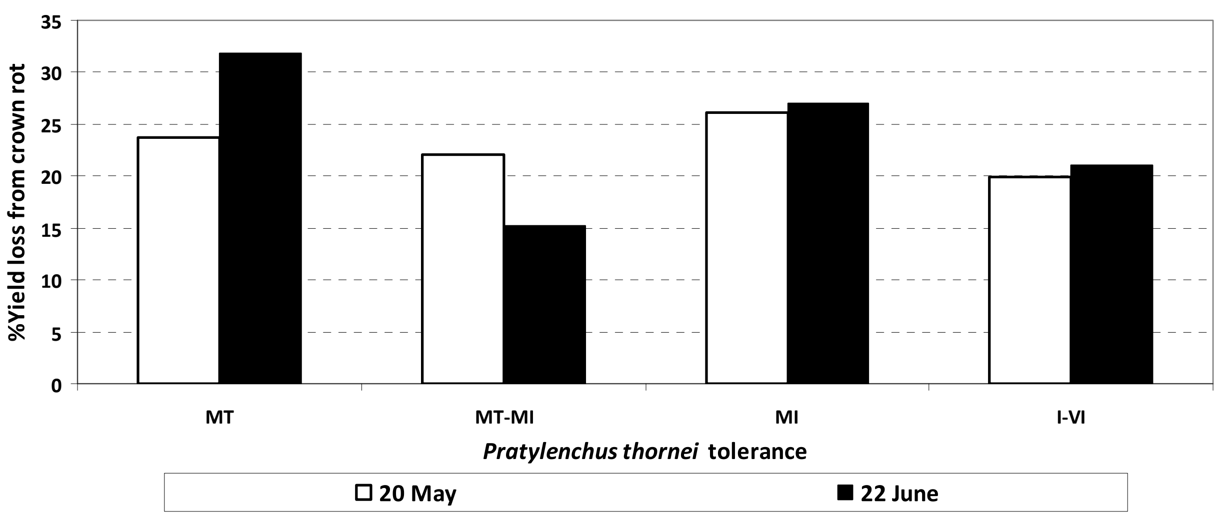

Figure 5: Effect of Pratylenchus thornei tolerance on yield loss from crown rot

Yield loss from crown rot was **not** related to a varieties level of *Pt* tolerance with even the MT variety EGA Gregory⁽ᴰ⁾ suffering 24% yield loss from crown rot at the first sowing and 32% on the second sowing (Figure 5). Varieties rated I-VI to *Pt* suffered around 20% yield loss to crown rot under the same conditions. Varietal tolerance to crown rot appears to be independent of a varieties tolerance to *Pt.*

Conclusions

Both *Pt* and crown rot are significant diseases of winter cereal crops in the northern cropping region. In these two trials conducted in 2011, *Pt* could be demonstrated to reduce yield by up to 43% under high starting populations with delayed sowing and drier growing conditions. Delayed sowing into late autumn/winter is likely to see crops initially develop under cooler soil temperatures which are likely to reduce the rate of root development. Conversely, earlier sown crops would establish under warmer soil conditions and have more rapid early root growth if adequate moisture is available. Drier soil conditions during crop establishment and early growth, e.g. with the second sowing time (22 June) at Coonamble in 2011, is also likely to restrict early root development. In theory, any restriction to root development is likely to negatively impact on a crops ability to compensate for feeding upon these root systems by *Pt.* Variety choice can have a large impact on yield and hence profitability when cropping in soils with high populations of *Pt*. Currently these trials have only examined the relative tolerance of varieties to *Pt*. It should be stressed that a varieties resistance to *Pt* (build-up of nematode populations within the soil) should also be an important consideration in variety choice.

Crown rot remains a significant disease in the region with losses dependent on soil moisture and temperature stress experienced during flowering and grain-fill. Crown rot caused up to 37% yield loss in durum varieties at the Coonamble site in 2011 but cooler, wetter conditions limited the expression (yield loss) of this disease at Mungindi in 2011. Averaged across the different winter cereal types, crown rot reduced yield by 18% in barley, 27% in durum and 22% in bread wheats at Coonamble in 2011. Previous research conducted by NSWDPI and NGA across 11 sites in northern NSW in 2007, has demonstrated that crown rot caused average yield losses of 20% in barley (up to 69% under drier conditions and hotter temperatures during grain-fill), 25% in bread wheat (up to 65%) and 58% in durum (up to 90%).

The Coonamble site demonstrates that the tolerance of wheat varieties to crown rot **does not** appear to be related to their level of *Pt* tolerance. Yield losses to both diseases in intolerant varieties can be significant (up to 43% for *Pt* and up to 37% for crown rot at Coonamble in 2011) under high inoculum levels. However, the benefit obtained from sowing a more tolerant bread wheat variety appears to be greater for *Pt* (up to 43%) than for crown rot (up to 21%). Another way of expressing this is that the difference in tolerance levels between wheat varieties appears larger for *Pt* than for crown rot. Selecting tolerant wheat varieties is one of the main options for maintaining profit in the presence of high populations of *Pt*. In contrast, even the most crown rot resistant/tolerant commercial wheat variety can still suffer up to 50% yield loss under high inoculum levels when hot/dry conditions occur during grain-fill. Variety selection is not a primary strategy for managing crown rot. Hence, under high soil populations of *Pt* more emphasis should be placed on a wheat varieties tolerance to *Pt* than to crown rot. Rotation to non-host crops remains the primary management tool for crown rot and can also be a valuable strategy to reduce or maintain *Pt* populations below the threshold (<2,000 *Pt*/kg soil) for yield loss in intolerant wheat varieties.

Acknowledgments
Firstly we thank the collaborators at each trial site who allowed access to their farms and provided valuable assistance throughout the season. At 'Jabiru' we thank the owner Bruce Longworth, manager Joe Robertson and agronomist Rob Holmes (HMAg). At 'Woolingar' we thank the owner Lindsay Meers, manager Jason Peters and district agronomist Rohan Brill (NSW DPI). Technical assistance provided by Rod Bambach, Zeb Taylor, Stephen Morphett, Jim Perfrement, Ben Bowman, Alan Bowring, Robyn Shapland, Kay Warren, Amy Alston and Patrick Mortell is gratefully acknowledged.

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