Impact from *Pratylenchus thornei, Macalister 2015*

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Key words

Pratylenchus thornei, yield, tolerance, wheat

GRDC code

NGA00004: GRDC Grower Solutions for Northern NSW and Southern Qld

Take home message

1. Multi-crop and variety trials were conducted over strips of 'medium' and 'high' *Pratylenchus thornei* (*Pt*) pressure.
2. Site characterised by generally high crop yields (cereals~4-5.5t/ha, chickpeas ~3.5-4.0t/ha) combined with lower levels of *Pt* yield impact.
3. Negligible decline in *Pt* population during the 21 month fallow leading up to the winter trials being planted.
4. No evidence of yield impact from *Pt* in the brassica, faba bean, chickpea and barley trials.
5. Greater yield loss observed in the wheat trials compared to the barley and broadleaf crops at this site.
6. Addition of crown rot inoculum together with 'high' *Pt* pressure significantly increased mean yield loss (~30%) over a set of six wheat varieties compared to either the effect from crown rot inoculum alone (~13%) or *Pt* alone (~8%).

Background

Previous work has highlighted that the root-lesion nematode, *Pratylenchus thornei (Pt),* is one of the key 'diseases' for winter cereal production in the northern grains region. *Pt* is a major constraint due to: the large impact on yield and economics when intolerant wheat varieties are grown, broad geographic distribution with *Pt* populations frequently at high levels and the susceptibility (*Pt* hosting ability) of key rotation crops such as chickpeas and faba beans.

Successful *Pt* management will involve a range of practices including on-farm hygiene and soil testing to identify problem paddocks. However crop and variety choice are still the major tools used for management. Wheat varieties are well characterised in terms of *tolerance* (yield impact suffered during the year of crop production) and *resistance* (impact from variety on the multiplication or build-up of *Pt*). Both characteristics are important for long term management.

This paper reports on trial work conducted between 2013 and 2015 at a site located near Macalister, approximately 40km north-west of Dalby, Qld. The activity was designed to improve our understanding of the differences in tolerance between a range of winter crops and varieties followed by an assessment of the impact of these options on subsequent *Pt* densities. An approach was used to create alternating strips of differing *Pt* population where the impact of increased *Pt* numbers on each variety could be evaluated. While our intentions from a trial point of view were to create strips of 'low' and 'high' *Pt* populations, in actual fact we ended up with strips of 'medium' and 'high' *Pt* population based on the Predicta B® risk category rating. For this reason, the strips will be referred to as medium (or 'med') and 'high' for the remainder of the paper.

Primary aims

1. Evaluate the impact from *Pratylenchus thornei* (*Pt)* on the **yield and economic returns** from a range of winter crops and varieties
2. Examine the impact from different winter crops and varieties on the **multiplication of *Pt***

Trial activity 2013

Soil testing was conducted in a paddock that had grown chickpeas in 2012. Initial samples were taken at 0-30cm on the 4th April 2013, and analysed by the PreDicta B method revealing an initial population of ~6 *Pt*/g soil. The site also appeared suitable due to a suspected low level of crown rot given only one wheat crop had been grown in the paddock over the past ten years. In addition, negligible levels of other common plant-parasitic nematodes (*Merlinius brevidens)* were found and *Pratylenchus neglectus* were not detected.

The aim in 2013 was to create 'strips' of alternating *Pt* population to allow multi-crop evaluation in 2014. Commercial strips, 18m wide, of Strzelecki wheat or Caparoi durum were planted on the 11th June 2013. Strzelecki was used to maximise the increase in *Pt* population and Caparoi durum was selected as an option that limits multiplication. Strzelecki is rated as S-VS (susceptible to very susceptible) and Caparoi is rated as R-MR (resistant to moderately resistant) for *Pt* resistance - or multiplication.

The first significant rainfall event at the trial site following the 2013 harvest was in March 2014 when approx. 150mm rainfall was received. Unfortunately, this rainfall was not sufficient to enable the trial program to be initiated for winter 2014.

The first soil sampling opportunity for *Pt* following harvest of the wheat strips was conducted on the 13th June 2014 once the topsoil had sufficiently dried following the March rain. This sampling provided a first measure of the population differences between the alternating strips. The extended dry period continued into the spring of 2014, and consequently the summer trials planned for 2014 were also deferred.

Further soil sampling was conducted on the 18th February 2015 leading into the 2015 winter season. Soil moisture conditions in autumn 2015 allowed the planting of all the winter season trials. Another round of *Pt* sampling was carried out on the 12th August 2015 to confirm *Pt* population size prior to the summer crop plantings.

Variety and fallow Impact on Pt populations

Figure 1 shows the comparison of *Pt*/g soil (at a depth of 0-30cm) in the strips where Strzelecki and Caparoi durum had been grown in 2013 together with the initial site result. Strips sown to Strzelecki in 2013 had significantly higher *Pt* populations than where Caparoi had been sown at all three sampling times. At both sampling times in 2015, there was still approx. a 7-10 fold difference in *Pt* population between the strips with levels of ~3-4 *Pt*/g soil following Caparoi and ~29 *Pt*/g soil following Strzelecki .

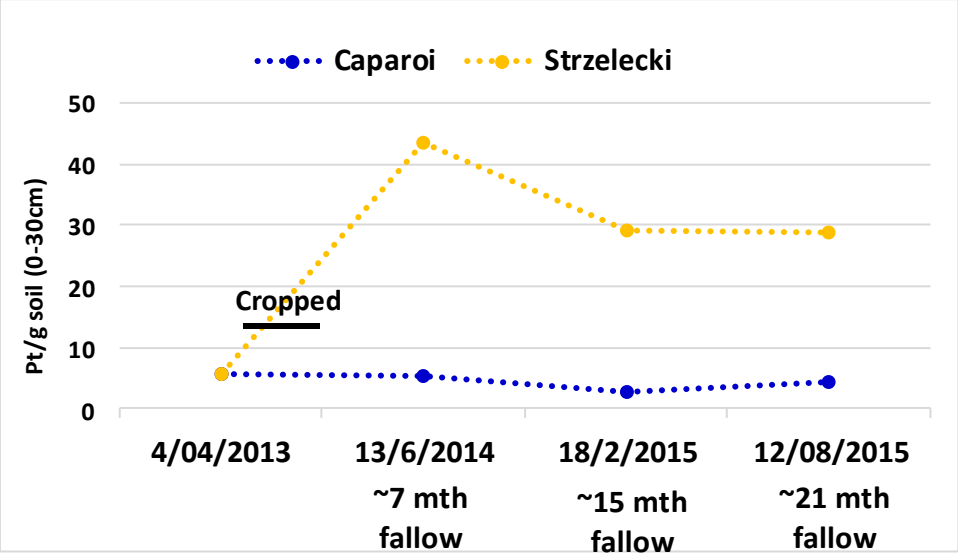

Figure 1. *Pt* population change over time following either Caparoi(þ) or Strzelecki(þ) production in 2013

Trial activity 2015

A total of 14 different trials of the major winter cereal and broadleaf cropping options were evaluated as split plot trials. Seed size and % germination were assessed for all seed lots with sowing rates adjusted to plant equivalent numbers of viable seeds for each crop. All crops received Granulock Z Xtra at 40kg/ha. Commercial crop protection products (and chipping) were used to manage weeds, foliar diseases and insect pressure.

There were four replicates in all trials with the exception of the faba bean and canola trials where eight replicates were included due to the limited number of treatments. Plots were sown at ~9m length x 5 rows on 36cm row spacing. Strips sown to Strzelecki(þ) in 2013 were described as having 'high' *Pt* pressure and the strips sown to Caparoi(þ) were described as having 'med' *Pt* pressure. **NB the population in the 'med' *Pt* pressure strips was still in excess of the widely used commercial 'threshold' of 2 *Pt*/g soil.**

Individual trial details are shown in Table 1. Trials LB1501- LB1503 and NVT trials were conducted as standard split plot trials comparing variety performance in the 'med' and 'high' Pt strips. Trials LB1504-LB1509 had additional factor(s) included.

Table 1. Key details of individual trials conducted in 2015

Trial description	Planting date	Number of varieties	Additional factors	Target plant stand/m^2
Minor crop resistance Screen	28/05/2015	8	-	-
Faba bean evaluation	31/03/2015	6	-	20
Brassica evaluation	15/05/2015	6	-	30
Early wheat NVT		24	-	90
Chickpea NVT	28/05/2015	16		25
Chickpea potential nematicides		2	+/- seed treatment	25
Chickpea Deep P		2	+/- P fertiliser	25
Wheat Deep P		3	+/- P fertiliser	90
Wheat potential nematicides		2	+/- seed treatment	90
Wheat: impact of crown rot (CR)		7	+/- CR inoculum	90
Durum NVT		10	-	90
Main wheat NVT		36	-	90
Barley NVT		30	-	90
Row spacing x Plant Population		2	2 row spacings, 2 plant populations	50 & 100

Trial assessments

Key in-crop assessments were establishment, 'greenness' (measured by NDVI), yield for all crops and grain quality for all cereals and brassicas.

Yield

The following graphs show the pattern of significant yield differences within varieties of the same crop between 'med' and 'high' *Pt* pressure. Significant yield differences within varieties were found in the early wheat, main wheat and durum NVT trials. Significant yield differences were also found in the *P thornei* x crown rot trial.

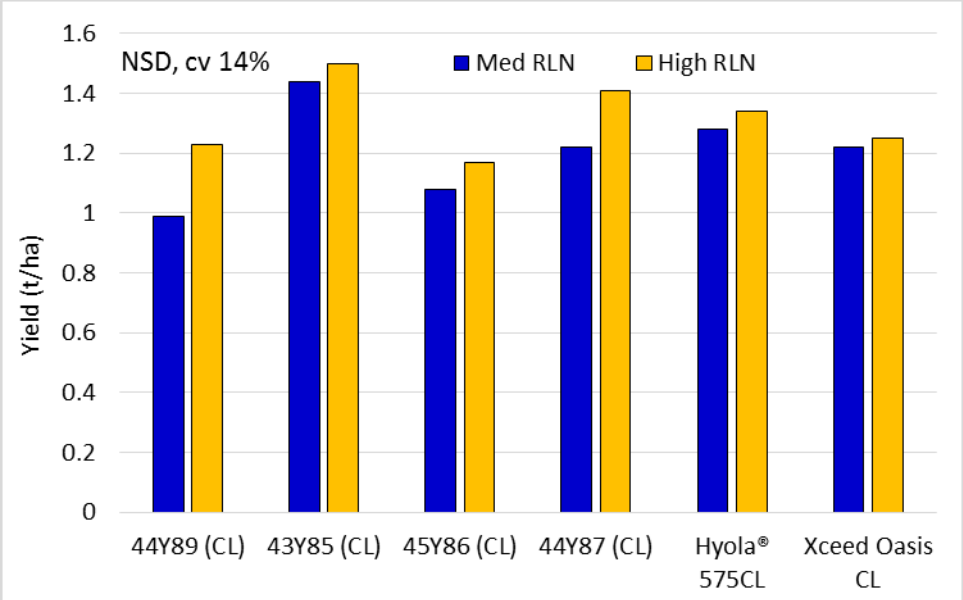

Figure 2. Brassica yields in the 'med' and 'high' *Pt* strips (all canola except the *B juncea* Xceed Oasis CL)

- There was no significant yield loss for any commercial variety between the 'med' and 'high' Pt strips.

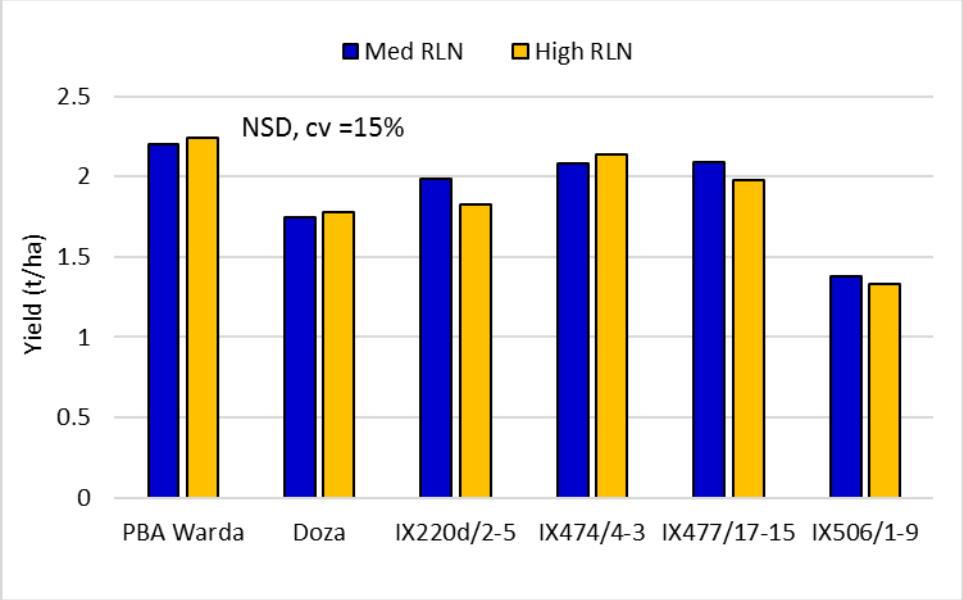

Figure 3. Faba bean variety yields in the 'medium' and 'high' *Pt* strips (Doza® and PBA Warda® are protected under the Plant Breeders Rights Act 1994)

- There was no significant yield loss for any commercial variety or line between the 'med' and 'high' Pt strips.
- High level of yield variability due to leaf rust and early crop senescence.

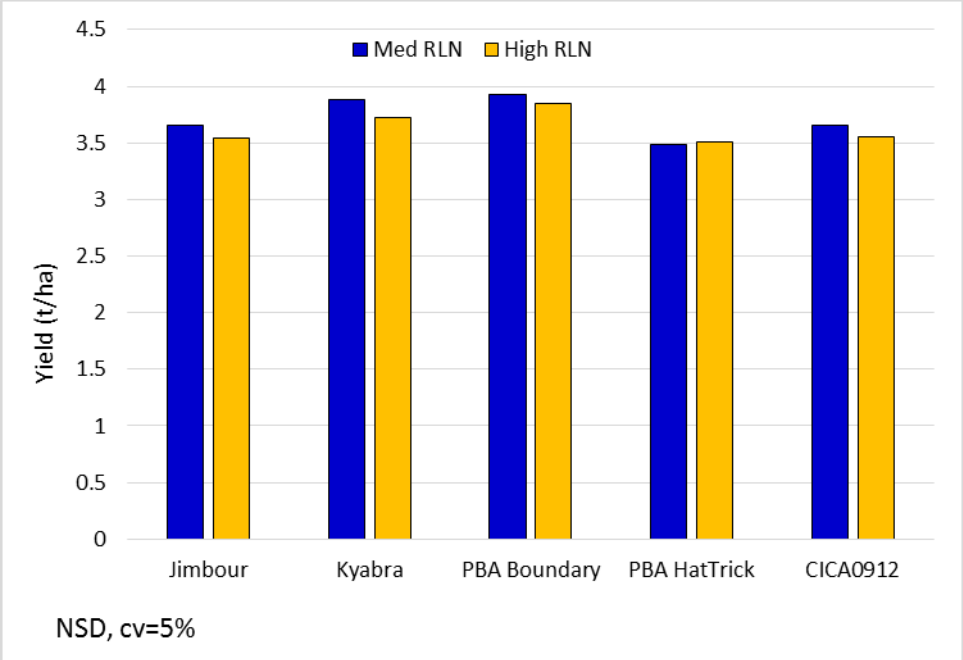

Figure 4. Chickpea yields for key lines in the 'med' and 'high' *Pt* strips (Kyabra, PBA Boundary and PBA HatTrick are protected under the Plant Breeders Rights Act 1994)

- NB only the current commercial lines and next variety planned for release are graphed
- There was no significant yield loss for any commercial variety or line between the 'med' and 'high' Pt strips.

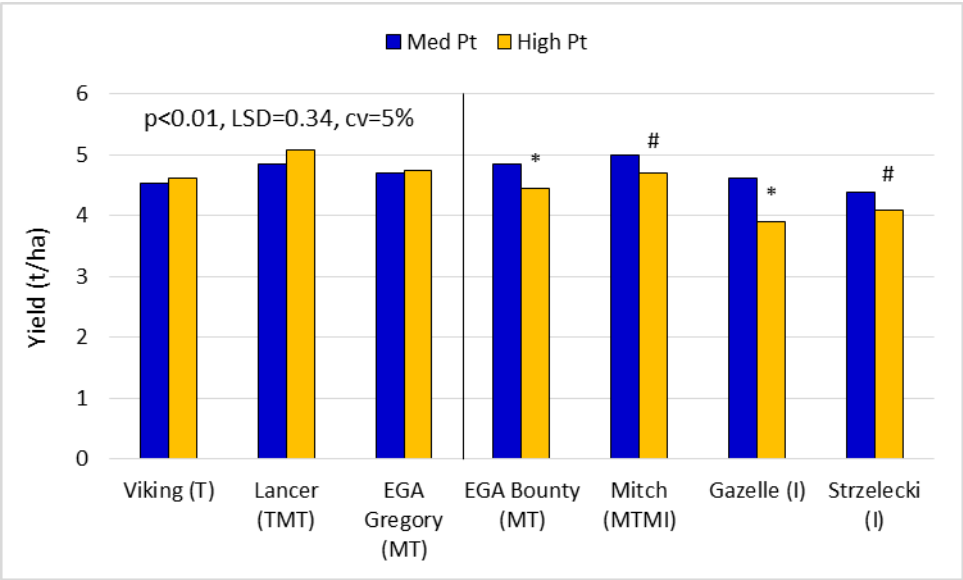

Figure 5. Early sown wheat yields for key lines in the 'med' and 'high' Pt strips. (Lancer, EGA Gregory, EGA Bounty, Mitch, Gazelle and Strzelecki are protected under the Plant Breeders Rights Act 1994)

*indicates the variety had a significant yield reduction in the 'high' *Pt* strips at p=0.05
# indicates the variety had a significant yield reduction in the 'high' *Pt* strips but only at p=0.10

NB the letter following the variety name indicates the *Pt* tolerance rating with the poorer rated varieties to the right of the solid vertical line. Varieties to the left of the vertical line are included for benchmarking purposes only.

- Mitch(b), Gazelle(b) and Strzelecki(b) all recorded significantly lower NDVI readings in the 'high' *Pt* strips when assessed in September. EGA Bounty(b) was significant at the 10% level
- All these varieties also recorded significant yield losses in the 'high' *Pt* strips at either the 5 or 10% level

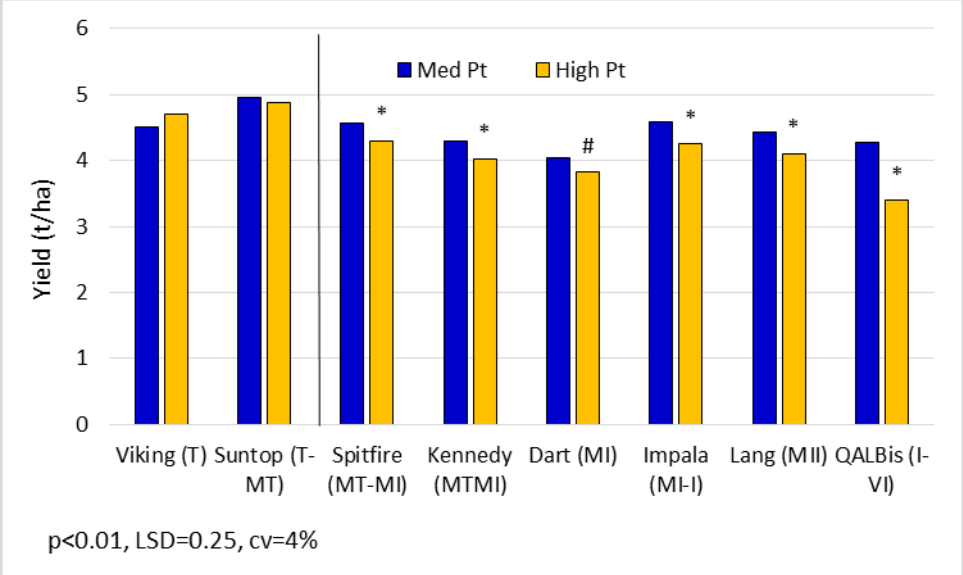

Figure 6. Main sown wheat yields for key lines in the 'med' and 'high' *Pt* strips. (Suntop(b), Spitfire(b), Kennedy(b), Dart(b), Impala(b) and Lang(b) are protected under the Plant Breeders Rights Act 1994)

*indicates the variety had a significant yield reduction in the 'high' *Pt* strips at p=0.05
# indicates the variety had a significant yield reduction in the 'high' *Pt* strips but only at p=0.10

NB the letter following the variety name indicates the *Pt* tolerance rating with the poorer rated varieties to the right of the solid vertical line. Varieties to the left of the vertical line are included for benchmarking purposes only.

- There were a larger number of varieties in the main sown wheat NVT that recorded significantly lower yield in the 'high' *Pt* strips
- In addition to the commercial lines in figure 6, four experimental lines also recorded significant yield losses

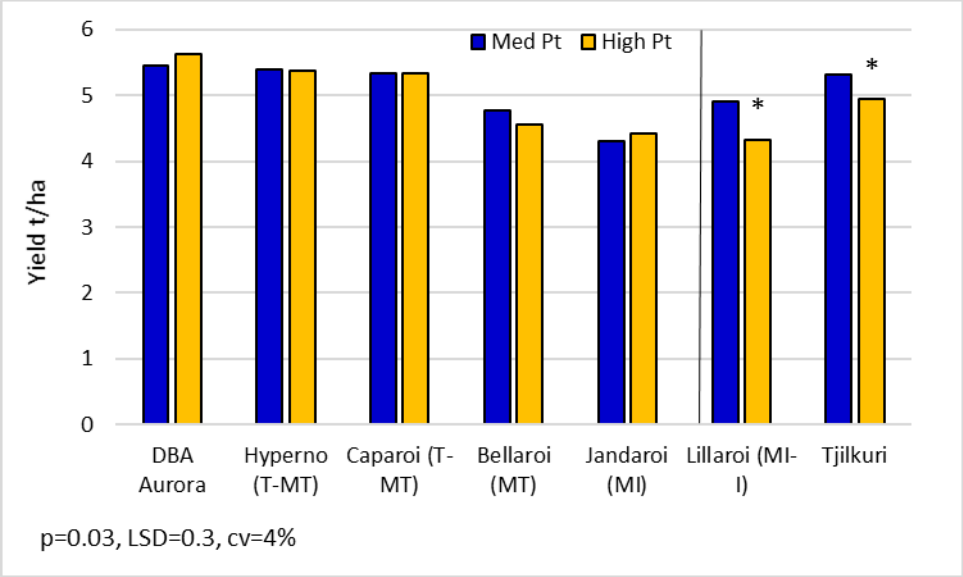

Figure 7. Durum yields for key lines in the 'med' and 'high' *Pt* strips.
(DBA Aurora(Þ), Hyperno(Þ), Caparoi(Þ), Bellaroi(Þ), Jandaroi(Þ), Lillaroi(Þ) and Tjilkuri(Þ) are protected under the Plant Breeders Rights Act 1994)

*indicates the variety had a significant yield reduction in the 'high' *Pt* strips at p=0.05

NB. Varieties to the left of the vertical line are included for benchmarking purposes only with the poorer rated varieties for *Pt* effects to the right of the solid vertical line. The letter following the variety name indicates the *Pt* tolerance rating.

- Only two varieties within the durum NVT trial at this site recorded significant yield reductions when moving from 'med' to 'high' *Pt*.

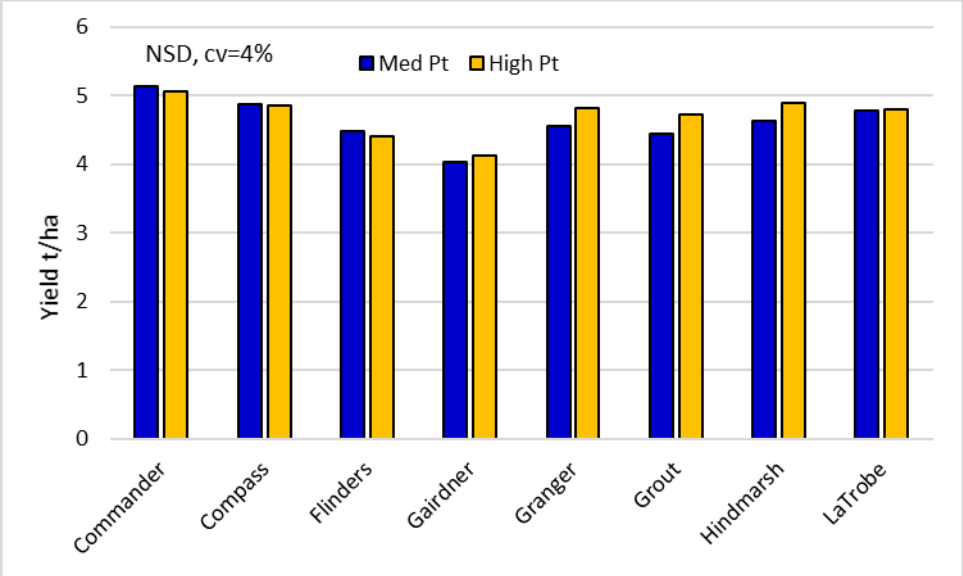

Figure 8. Barley yields for key lines in the 'med' and 'high' *Pt* strips.
(Commander(Þ), Compass(Þ), Flinders(Þ), Granger(Þ), Grout(Þ), Hindmarsh(Þ) and La Trobe(Þ) are protected under the Plant Breeders Rights Act 1994)

- There was no significant yield loss for any commercial variety between the 'med' and 'high' *Pt* strips.
- The barley varieties tested appeared more tolerant than the range of wheat varieties sown at the same time

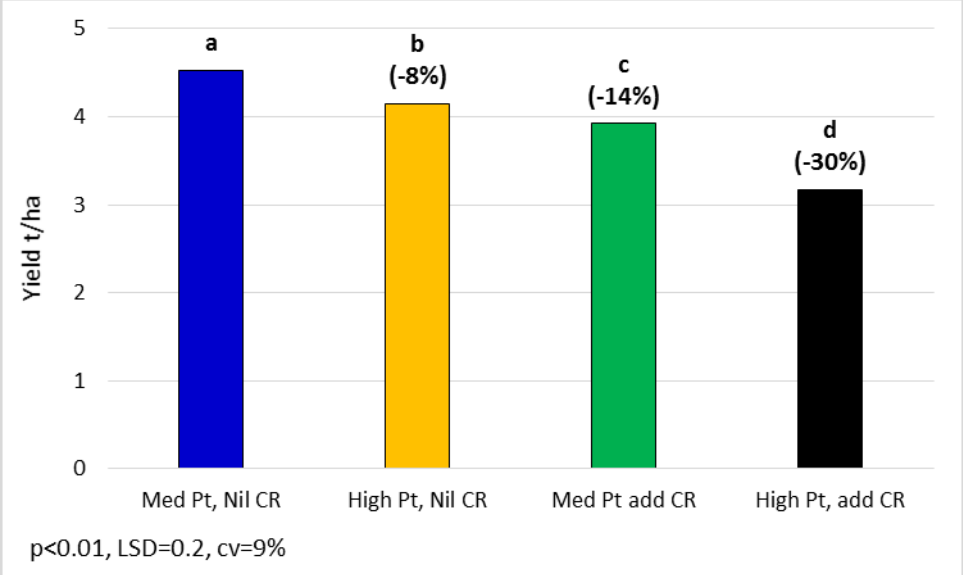

Figure 9. Wheat mean yields for six varieties with or without added crown rot (CR) inoculum. The six varieties include Spitfire(b), Sungard(b), EGA Gregory(b), Sunmate(b), Mitch(b) and Elmore CL(b).

Treatments that do not share the same letter are significantly different at p=.05

- When moving from 'med' *Pt* strips to 'high' *Pt* strips without adding CR, the mean yield reduction was 0.4t/ha over all six varieties.
- The addition of crown rot inoculum resulted in a mean yield loss of 0.6t/ha, while remaining under the 'med' *Pt* strips.
- When moving from 'med' *Pt* strips to 'high' *Pt* strips, in addition to adding crown rot inoculum, the mean yield reduction was 1.4t/ha over all six varieties.

Conclusions

This trial was conducted to allow a sound scientific evaluation of the impact of *Pt* on the yield of a broad range of winter crops and varieties and subsequently to measure the crop impact on *Pt* population (i.e. rotational impact and fit). Trial results indicate that there was no significant difference in yield within varieties of canola, faba bean, chickpea and barley between low versus high nematode populations. However, significant yield reductions were recorded for varieties in the early wheat, main wheat and durum NVT's. In addition, significant yield losses were also recorded in the CR x RLN interaction trial.

Data still to come

Soil coring to determine the impact of the crops and varieties on *Pt* multiplication (the second key trial aim) will be conducted in early 2016. Grain quality analysis is also planned to take place in early 2016. Dual EM readings have been taken from all treatment plots to estimate the remaining soil water after harvest.

Acknowledgements

This was an exceptional trial in both size and complexity but also in the way it was managed. Sincere thanks to Rob Taylor and DAF Qld for field trial activity and their ability to successfully manage the multi-crops grown. Thanks also to AGT, BASF, Austgrains, Pacific Seeds, Pioneer, University of Sydney PBI, Seedmark, and Seednet for providing seed or inoculants.

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the author would like to thank them for their continued support.

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