ROOT LESION NEMATODE AND CROWN ROT – DOUBLE TROUBLE

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Key words
Wheat, barley, durum, *Pratylenchus thornei*, crown rot

GRDC codes
NGA00001: validation and integration of new technology through grower groups in north-west NSW and south-west Queensland grain growing zones
NGA00002: validation and integration of new technology through grower groups in north-east NSW grain growing zones
DAN00109: Management of Fusarium and other winter cereal diseases in the northern cropping zone

Take home messages

- *Pratylenchus thornei (Pt)* was present in ~40% of randomly selected crown rot (CR) trial sites conducted during 2007-2009.
- Wheat variety selection appears more important for *Pt* management than for CR due to a much narrower range in the reaction of bread wheat varieties to CR.
- Results suggest an additive impact of losses due to both 'diseases'
- The data suggests poor variety choice in *Pt* situations may reduce yields by up to ~1/t/ha.
- Large and consistent differences in *Pt* populations were measured, after the summer fallow, following a range of wheat, durum and barley varieties
- Identifying *Pt* risk paddocks and adjusting hygiene, variety and rotation choices to manage *Pt* are important.

Background

NGA have been involved in 22 field trials since 2007, in collaboration with I&I NSW, evaluating the impact of crown rot (CR) on a range of winter cereal crop types and varieties. This work has greatly improved our understanding of crown rot impact and variety tolerance, but also indicates we may be suffering losses from another 'disease' that often goes unnoticed. Although the trials were not designed to focus on nematodes, a convincing trend was apparent after 2008 that indicated the root lesion nematode *Pratylenchus thornei (Pt)* was having a frequent and large impact on wheat variety yield.

Nematode counts

Routine trial site characterisation included soil tests for background CR level, as well as a range of other pathogens including nematodes. PreDicta B (DNA extraction) was used on all samples with DEEDI also conducting 'manual' nematode counts on soil samples collected in 2008 and 2009. The correlation between the two tests has been good with both tests always indicating *Pt* presence at the same site (Figure 1 shows the 2009 data). One difference is that the DNA assessment is on a 0-15 cm soil fraction whilst the manual count is in layers from 0-90 cm.

Deeper sampling may be useful at sites with prominent nematode ‘bulges’ at depth (eg North Star site seen in Figure 2).

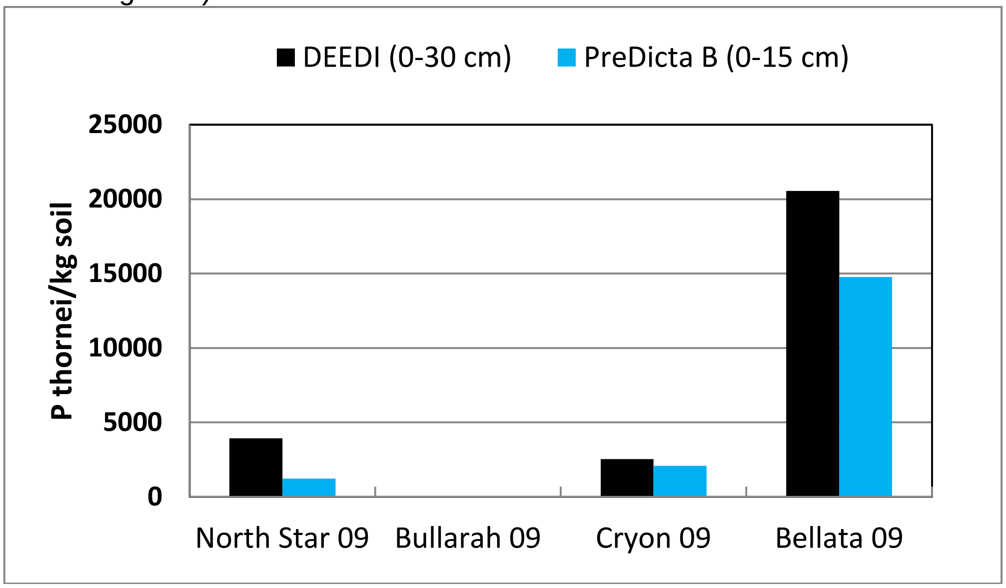

Figure 1. *Pt* assessments 2009: manual count v DNA extraction
NB soil sample depth differs between methods

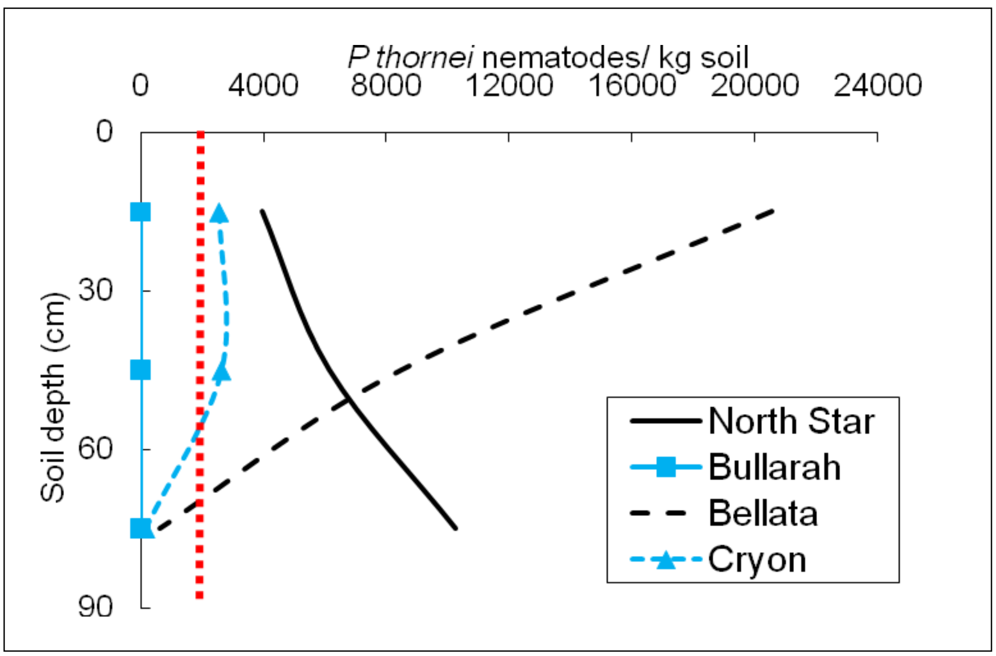

Figure 2. *Pt* assessments 2009: population profiles across sites
Vertical line = DEEDI threshold (~2000 *Pt*/ kg soil) for yield loss in intolerant varieties

NB although both techniques provided a similar count of nematodes/kg soil, the interpretation of ‘risk ratings’ was very different between the two testing agencies. At all three sites, populations were above the 2000 *Pt*/kg soil considered a threshold for yield loss for intolerant wheat varieties in the northern region (Thompson *et al.* 2009) and considerably higher at two of the sites. In contrast, even at the Bellata site, PreDicta B test indicated only a ‘low risk’ of yield loss.

Apparent yield impact of *Pt*

During 2007 & 2008 a common series of 5 bread wheat varieties, 4 barley varieties and 1 durum were evaluated in all 18 trials (NB only 17 yield results are presented as barley varieties were heavily damaged by emus at 1 site in 2008). Variety yield as % of a 'standard' was calculated to investigate the performance across sites. Skiff barley was used as the standard and has the highest *Pt* tolerance rating of VT (very tolerant). EGA Wylie is currently considered the most tolerant commercial bread wheat variety in the northern region (Thompson *et al.* 2009).

Figure 3 shows the wheat variety yield performance compared to Skiff over all 17 trials. Wheat varieties are listed from left to right in decreasing tolerance of *Pt*. Ten trials had no *Pt* detected with 7 sites having *Pt* present (*Pt* were present at 5 of 10 sites in 2007 and 2 of 7 sites in 2008, PreDicta B *Pt* levels ranged from 1000-7000/kg soil in 2007 and 4000-5000/kg soil in 2008). 2007 was a high CR yield loss year with average bread wheat yield loss of ~25% and at the worst site even EGA Wylie lost 50% yield to CR. In contrast 2008 was a very low CR yield loss year with average bread wheat yield loss of only ~1%.

The four lines show the yield performance of each variety as a % of Skiff with:

1. 'No constraint' (no added CR, no *Pt* present at site)
2. 'Added CR' line (**CR inoculum added at planting**, no *Pt* present at site)
3. '*Pt* present' line (no added CR, ***Pt* present at site**)
4. 'Added CR + *Pt* present' line (**CR inoculum added at planting**, ***Pt* present at site**)

NB There was naturally occurring CR present at low levels at all sites

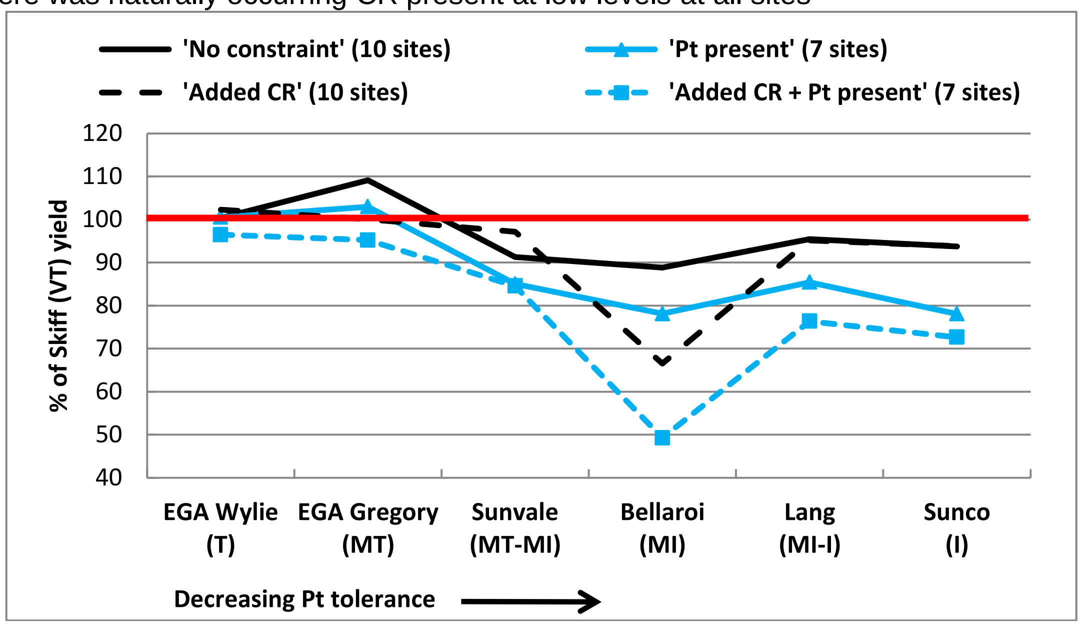

Figure 3. 2007 & 2008 wheat variety yield as a % of Skiff barley
Letters indicate variety *Pt* tolerance rating eg MT moderately tolerant, MI moderately intolerant

Key points:

1. The difference between **'No constraint' and 'Added CR' indicates relative CR tolerance** between varieties eg Bellaroi showed the largest fall, followed by EGA Gregory. **NB this is not a true representation of actual yield loss to CR (Skiff or**

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EGA Wylie can still lose up to 50% yield due to CR) rather it reflects variety performance in the presence of CR relative to Skiff barley or EGA Wylie.**

2. The difference between **'No constraint' and '*Pt* present' indicates relative *Pt* tolerance**. All varieties fell compared to Skiff (and EGA Wylie) with most impact on Bellaroi, Lang and Sunco.
3. The 'Added CR + *Pt* present' line shows the performance when both constraints were present. This data suggests an additive effect of variety CR loss PLUS *Pt* impact
4. **Generally a flat response in yield between bread wheat varieties under CR pressure alone (all were 91-97% of EGA Wylie yield)**
5. **Wider yield range from bread wheat varieties in response to *Pt* tolerance alone (ranged from 78-102% of EGA Wylie yield)**

Barley varieties are generally considered to have increased levels of *Pt* tolerance. Comparison of barley performance over the same trials is seen in Figure 4.

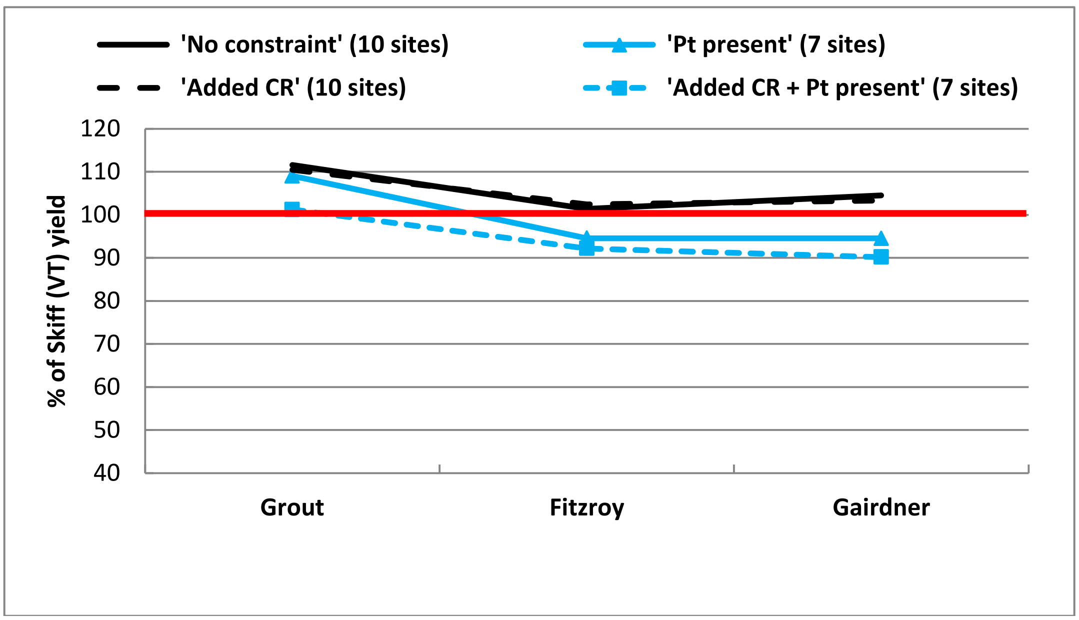

Figure 4. 2007 & 2008 barley variety yield as a % of Skiff

Key points:

1. Negligible apparent difference in barley variety CR tolerance
2. Less apparent range in variety *Pt* tolerance than seen for bread wheat

Figure 5 shows the variety yield performance compared to EGA Wylie for all wheat varieties evaluated in both 2008 and 2009. There was no *Pt* detection at 6 sites, with 5 sites having *Pt* present (NB site selection biased to *Pt* presence in 2009). 2008 was a very low CR yield loss year with average bread wheat yield loss of ~1% with low to moderate CR losses in 2009 with an average bread wheat yield loss of ~8%.

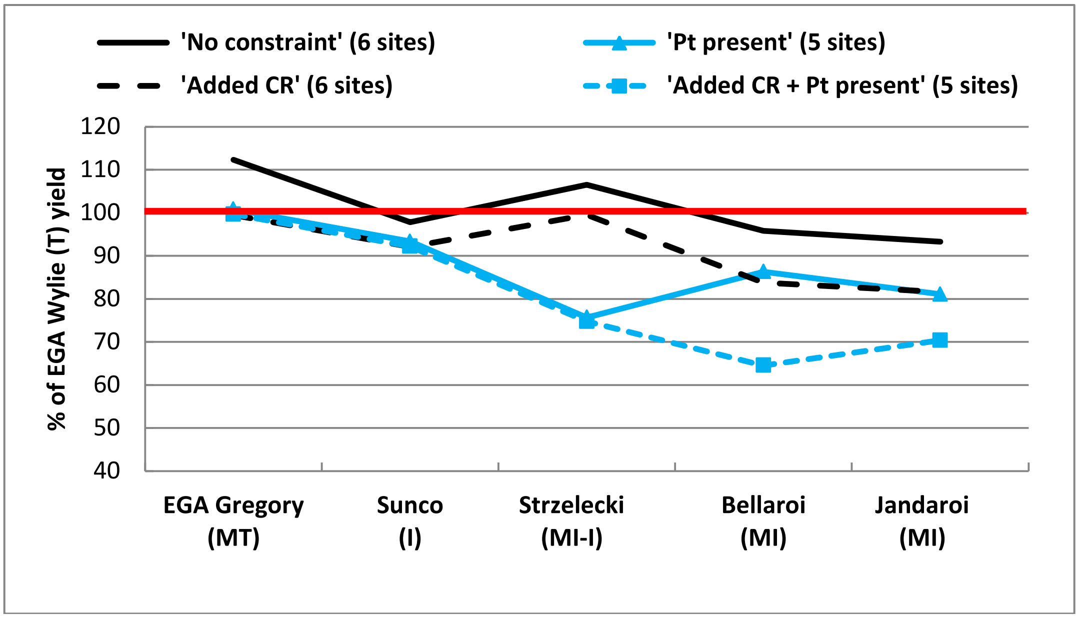

Figure 5. 2008 & 2009 wheat variety yield as a % of EGA Wylie (NB lower CR yield loss seasons)

Key points:

1. Less varietal CR tolerance difference evident, as expected, in lower CR yield loss years
2. Poor relative yield performance from Strzelecki, Bellaroi and Jandaroi at sites with both *Pt* presence and CR added

The impact of variety choice on *Pt* population

The data above has indicated the level of yield impact of *Pt* on less tolerant varieties. However there is a second varietal characteristic which appears equally important in overall nematode management. This is the level of resistance of the individual crop or variety as shown by the degree of build-up (or retardation) of the nematode population. Ratings have been published by DEEDI for a number of years showing both the tolerance (yield impact under nematode pressure) and resistance (impact on nematode build-up) of a wide range of wheat varieties.

In May and June 2010, soil samples were taken for nematode assay from three of the crown rot trial sites conducted in 2009 and tested using the PreDicta B DNA extraction method. These sites were sampled ~ six months after harvest and indicated the population of nematodes that had built up on each wheat variety during the growing season and had survived through to the next potential planting opportunity. The data presented in this paper is for the eight varieties that were sampled at all three sites.

Figures 6-8 shows the *Pt* detections across these trial sites. Both Bellata (Figure 6) and Coonamble (Figure 7) had very high *Pt* pressure with in excess of 30,000 *Pt*/kg soil detected following a very susceptible variety, even after ~six months fallow. Although consistent differences in remaining *Pt* population were measured, even the more resistant varieties still recorded populations greater than the 2,000 *Pt/*kg threshold level at both of these sites. Two key points: 1) the two durum varieties, Bellaroi and Jandaroi, trended to the lowest surviving *Pt* populations at both high pressure sites 2) the greatly increased level of *Pt* following the more susceptible varieties is likely to significantly increase yield loss in following crop sequences.

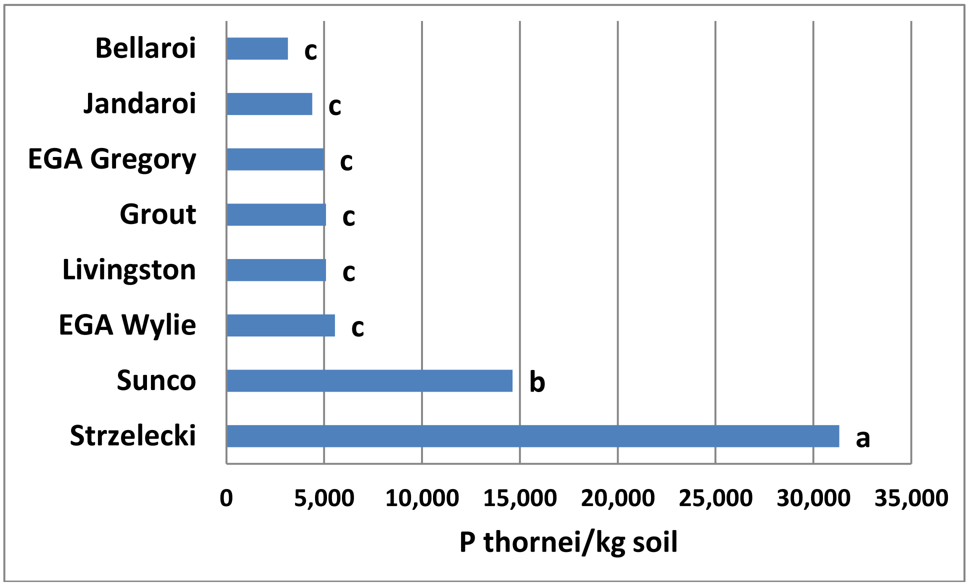

Figure 6. Impact on *P thornei* population from 2009 cereal variety at Bellata (sampled 19/5/10)

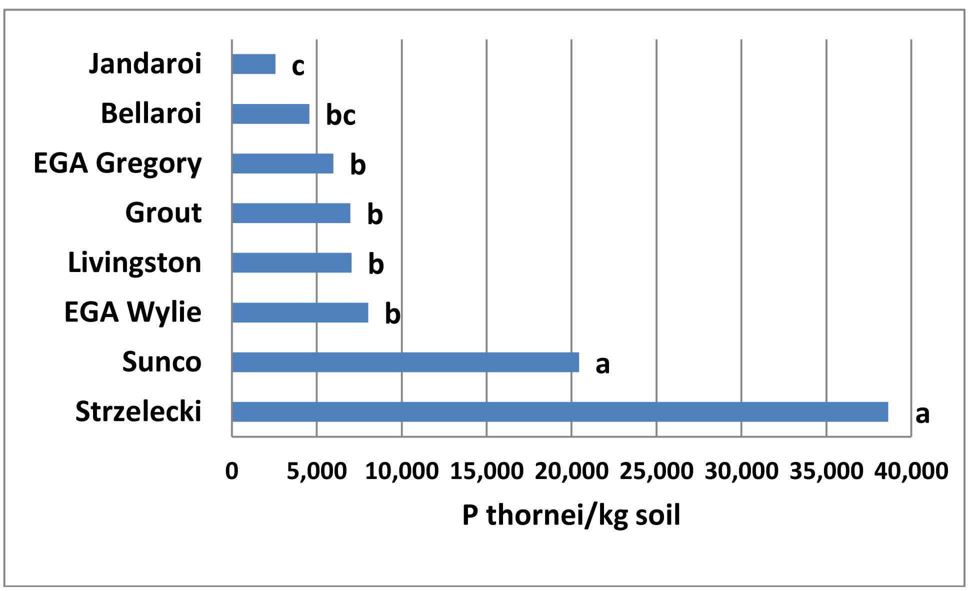

Figure 7. Impact on *P thornei* population from 2009 cereal variety at Coonamble (NSW I&I, sampled 8/6/10)

At North Star (figure 8) much lower *Pt* populations were measured but with similar overall varietal performance.

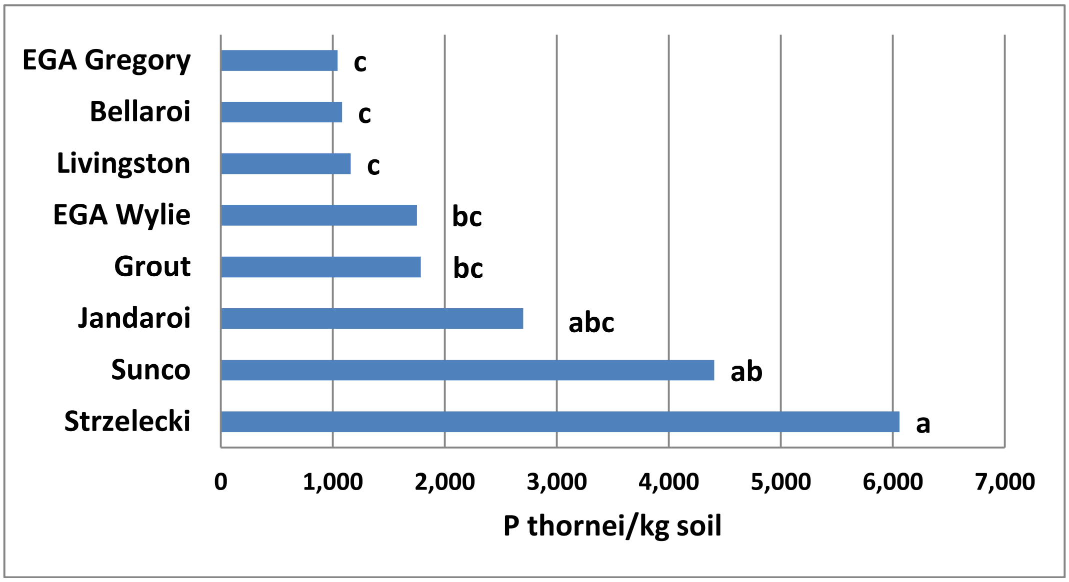

Figure 7. Impact on *P thornei* population from 2009 cereal variety at North Star (sampled 10/6/10)

Summary

CR impact and variety choice

There are clear differences in levels of CR tolerance between bread wheat varieties. However the relationship between CR tolerance rating and actual final yield has been poor ie inherent variety yield potential and local adaptation has generally been more important than CR rating.

The performance of EGA Gregory is a good example. Under CR pressure, EGA Gregory will certainly show more disease symptoms than Sunco but has still significantly outyielded Sunco in 10 of 22 trials. There was no situation when Sunco significantly outyielded EGA Gregory. EGA Gregory is NOT better than Sunco for CR tolerance but is a higher yielding, widely adapted variety. This demonstrates the relatively small progress and the difficulty of breeding for CR tolerance. Furthermore, pre-breeding programs have traditionally focused more on CR resistance rather than CR tolerance under field conditions. **Bread wheat variety choice cannot be your major CR management tool. However, changing from a durum variety, which are highly susceptible to CR, to a bread wheat or barley variety will assist in limiting losses.**

***Pt* impact and variety choice**

The pattern of yield results obtained at sites with *Pt* presence, generally supports the DEEDI (2010) published variety *Pt* ratings. There appears to be a much stronger relationship between variety *Pt* rating and final yield under *Pt* pressure than exists for CR. **Bread wheat variety choice on the basis of *Pt* tolerance rating appears a useful tool in *Pt* management and is likely to impact actual yield and economic results.**

The performance of Strzelecki appears a good example. Over the last 2 years at sites without *Pt*, it averaged 6% higher yield than EGA Wylie. However at sites with *Pt* present, it has averaged 24% lower yield. The apparent loss in yield 'potential' has equaled ~1 t/ha. A poor variety choice, in the presence of *Pt* may be costing a grower more than $180/ha.

Recent soil sampling has also supported the existing DEEDI varietal resistance rankings but has indicated that even more difference in nematode field survival may be occurring in our very susceptible varieties eg Strzelecki and Sunco. These intolerant and very susceptible varieties pose an extreme risk in three areas:

1) Yield performance under *Pt* attack in the year of production
2) The build-up of *Pt* populations during the growing season
3) Decreased yields of following crops due to high populations of *Pt* remaining in the soil.

***Pt* intolerant/susceptible varieties should only be grown in paddocks where growers are confident there is no *Pt* risk.**

Conclusions

These trials were designed to evaluate the impact of CR on variety yield and quality. However they strongly suggest that *Pt* is also having a significant impact on yield performance. **The results do not compare the actual levels of yield loss due to the two diseases** but indicate there is a greater range in variety *Pt* tolerance than currently exists for CR tolerance. **Put simply, variety choice appears a more valuable tool when under *Pt* pressure than as a tool for CR management.** It may be a co-incidence but four of the most widely adopted and successful varieties in the north (EGA Wylie, EGA Gregory, Baxter and Sunvale) are the varieties with the highest currently available level of *Pt* tolerance.

Root lesion nematodes are a 'disease' that have no obvious visual symptoms in the paddock. To improve our management of this 'disease' we must take more advantage of nematode testing. An increase in level of awareness of *Pt* status in individual paddocks and across properties will assist to:

1) Develop sound hygiene practices to help limit further spread and reduce the risk of new infestations.
2) Provide a measure of the impact of varying management approaches designed to limit or reduce nematode build-up.

This knowledge is also likely to provide direct economic gains from sound varietal and crop rotation choices. Soil testing for nematodes may also provide benefits in the identification of other plant parasitic species not covered in this paper eg *Pratylenchus neglectus* and *Merlinius brevidens*.

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For more information on root lesion nematodes in the northern grain region:

DEEDI (2010) Queensland wheat varieties. GRDC and Qld Government.
Thompson J, Owen K, Clewett T, Sheedy J, and Reen R (2009) Management of root-lesion nematodes in

the northern grain region. Queensland Primary Industries and Fisheries, DEEDI, Brisbane.
and also www.nvtonline.com.au

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