THE ADDITIVE YIELD IMPACT OF ROOT LESION NEMATODE AND CROWN ROT ?

Richard Daniel, Northern Grower Alliance (NGA)

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)* were 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.
- Identifying *Pt* risk paddocks and adjusting hygiene, variety and rotation choices appears important.

Background

NGA have been involved in 22 field trials since 2007, in collaboration with Steven Simpfendorfer 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)* may be having a wider and larger impact on actual yield than previously expected.

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).

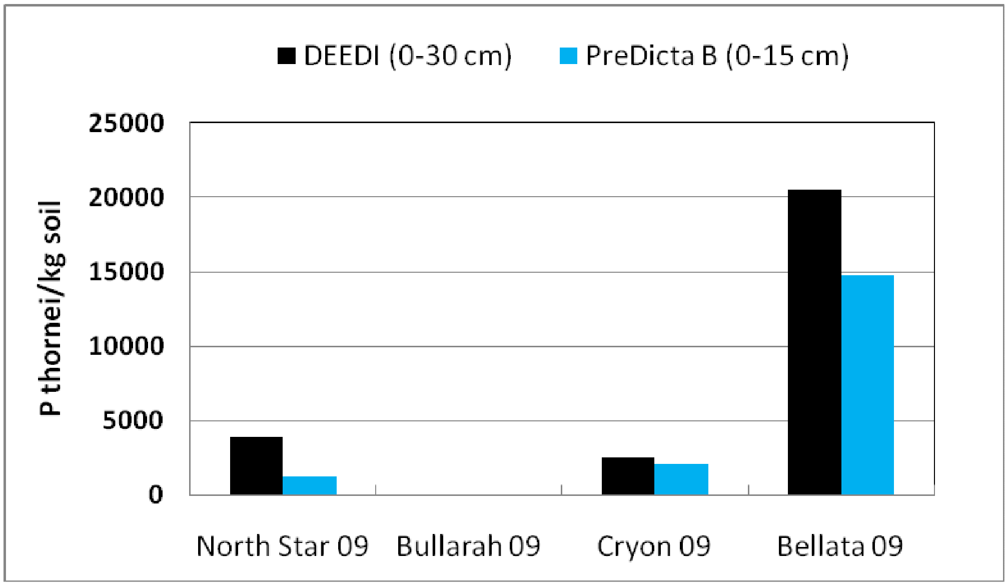

Figure 1. ***Pt*** **assessments 2009: manual count v DNA extraction**
NB soil sample depth differs between methods

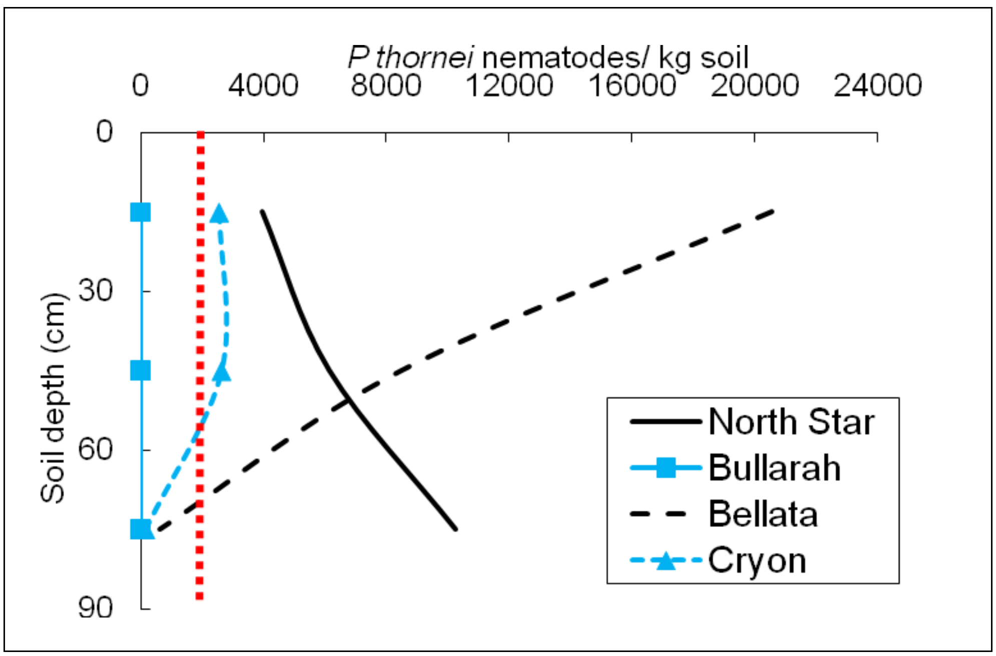

Figure 2. ***Pt*** **assessments 2009: population profiles across sites**
Vertical line = DEEDI threshold (~2000/kg) for yield loss in intolerant varieties

NB although both techniques provided a similar count of nematodes/kg soil, the 'risk ratings' were very different. Even at the Bellata site, PreDicta B 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. Variety yield as a % of a 'standard' was calculated to investigate the performance across sites. EGA Wylie and Skiff were used as standards (EGA Wylie has the highest level of available tolerance to *Pt* in commercial wheat varieties but will still suffer yield loss in the presence of high *Pt* populations. There is little information available for barley varieties).

Figure 3 shows the variety yield performance compared to EGA Wylie over all 18 trials. 11 trials had no *Pt* detected with 7 sites having *Pt* present (*Pt* were present at 5 of 11 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 EGA Wylie with:

1. 'no constraint' (no added CR, no *Pt* present)
2. 'CR alone' line (**added CR**, no *Pt* present)
3. '*Pt* alone' line (no added CR, ***Pt* present**)
4. 'CR + *Pt*' line (**added CR**, ***Pt* present**)

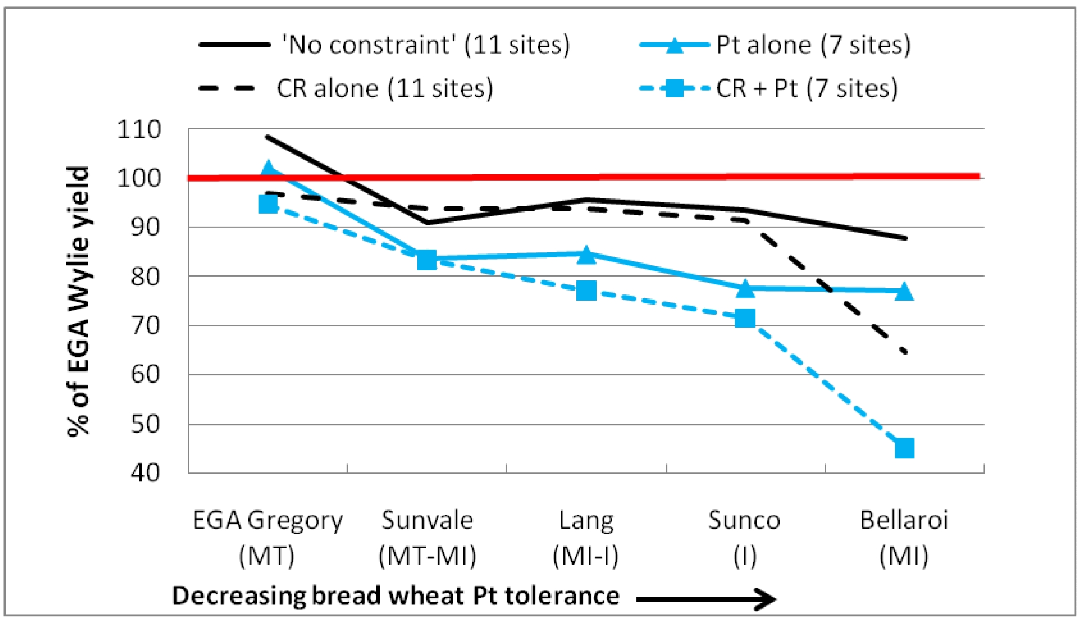

Figure 3. 2007 & 2008 wheat variety yield as a % of EGA Wylie

Letters indicate variety *Pt* tolerance rating eg MT moderately tolerant, MI moderately intolerant

Key points:

1. The difference between **'no constraint' and 'CR alone' 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 (EGA Wylie can still lose up to 50% yield to CR) rather it reflects variety performance in the presence of CR relative to EGA Wylie.**
2. The difference between **'no constraint' and '*Pt* alone' indicates relative *Pt* tolerance**. All varieties fell compared to EGA Wylie with most impact on Lang, Sunco and Bellaroi.
3. The 'CR + *Pt*' 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)**

Over these two years, varieties such as Lang and Sunco performed well when CR was added in the absence of *Pt* (~90-95% of EGA Wylie yield). However when CR was added and *Pt* were present they only recorded~70-80% 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.

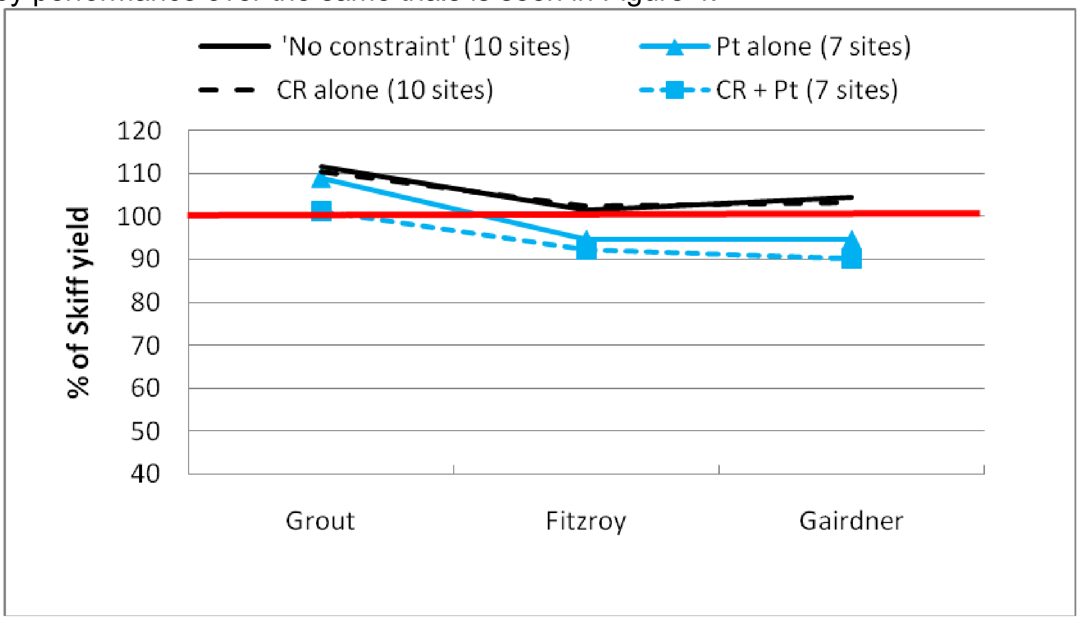

Figure 4. 2007 & 2008 barley variety yield as a % of Skiff

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 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%.

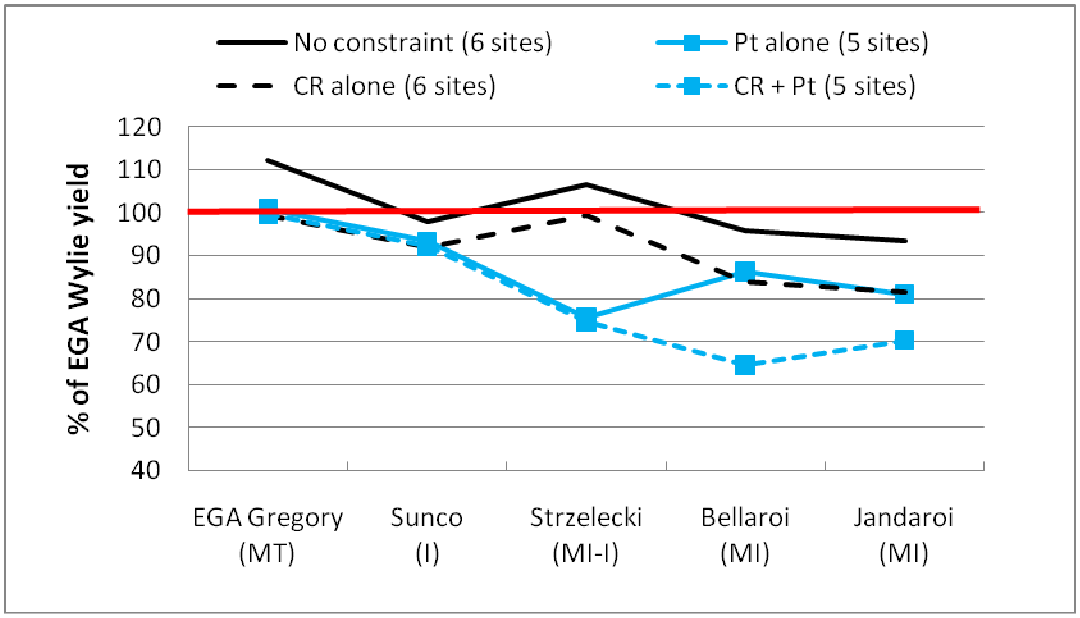

Figure 5. 2008 & 2009 wheat variety yield as a % of EGA Wylie (NB lower CR yield loss seasons)

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

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 yield loss has been poor ie inherent yield potential and local adaptation has 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 option. This demonstrates the relatively small progress and the difficulty of breeding for CR tolerance. **Bread wheat variety choice cannot be your major CR management tool. However, changing from durum, 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 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* 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 (NB there may be other factors than just *Pt* responsible for this difference). The apparent loss in yield 'potential' has equaled ~1 t/ha. A poor variety choice, in the presence of *Pt,*could be costing a grower more than $180/ha.

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.

Improved understanding of *Pt* status in individual paddocks should assist in developing sound hygiene practices to help limit further spread. This knowledge is also likely to provide economic gains from both sound varietal and 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*.

Acknowledgements

Thanks to the many growers and consultants involved in this trial work, the support and advice of Steven Simpfendorfer and his pathology team, the support and advice of John Thompson and his pathology team together with Clare Felton-Taylor and Anthony Mitchell for field co-ordination.

Contact details

Richard Daniel
Northern Grower Alliance
07 4639 5344
richard.daniel@nga.org.au