Managing root-lesion nematodes: how important are crop and variety choice?

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Key words

Root-lesion nematodes (RLN)*, Pratylenchus thornei (Pt)*, resistance and rotation

GRDC code

NGA00003: GRDC Grower Solutions for Northern NSW and Southern Qld

DAN00143: Northern integrated disease management

DAQ000154: Northern integrated disease management

Take home messages

1. Know your enemy - soil test to determine whether RLN are an issue and which species are present

2. Select wheat varieties with **high tolerance ratings to minimise yield losses** in RLN infected paddocks

3. To manage RLN populations, it is important to **increase the frequency of RLN resistant crops** in the rotation

4. There are **consistent varietal differences in *Pt* resistance** within wheat and chickpea varieties

5. Avoid crops or varieties that allow the build-up of large populations of RLN in infected paddocks

6. Monitor the impact of your rotation

What are nematodes?

Nematodes (or roundworms) are one of the most abundant life-forms on earth. They are adapted to nearly all environments from water to land and from the ocean floors to deserts to alpine regions. In cropping situations they can range from being beneficial to detrimental to plant health.

The root-lesion nematodes (RLN) are a genus of microscopic plant parasitic nematode that are soil-borne, ~0.5 to 0.75 mm in length and will feed and reproduce inside roots of susceptible crops or plants. There are two common species of RLN in the northern grains region; *Pratylenchus thornei* (*Pt*) and *Pratylenchus neglectus (Pn)*. This paper will concentrate on *Pt* – often described as the cereal and legume root-lesion nematode.

Why should you care about *Pt*?

1. ***Pt* are widespread in the northern grains region** with surveys conducted by DAFF QLD and NSW DPI showing *Pt* presence in ~50-70% of paddocks

2. ***Pt* are frequently at concerning levels**, being found at >2,000 *Pt*/kg soil in ~20-30% of paddocks
3. **Yield losses in wheat of up to 50% are not uncommon** when *Pt* intolerant wheat varieties are grown in paddocks infested with *Pt*.
4. Yield losses in chickpeas of up to 20% have also been measured in DAFF QLD trials
5. There is no easy solution to RLN infestation. Variety and crop rotation are currently our major management tools

Figure 1 is a simplified chart that highlights the critical first step in the management of RLN is to **test your soil and determine whether or not you have an issue to manage.**

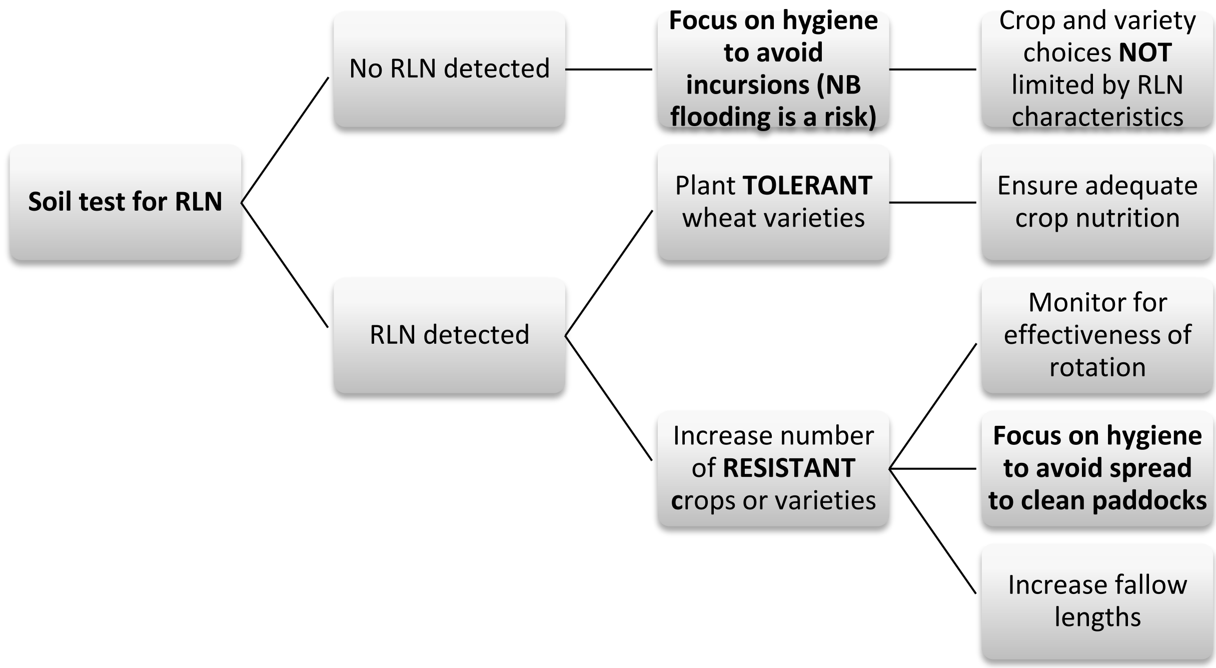

Figure 1: RLN management flow chart

Soil testing

The critical first step in the management of RLN is to test your soil and determine whether or not you even have an issue to manage. Soil testing can be conducted by either manual counting (under microscopes) or by DNA analysis (PreDicta B test from SARDI). Similar results are obtained by both methods with commercial sampling generally at depths of 0-15 or 0-30 cm.

Vertical distribution of *Pt* in soil is variable. Some paddocks have 'relatively' uniform populations down to 30 or even 60 cm, some will have highest *Pt* counts in the 0-15 cm depth whilst other paddocks will have *Pt* populations increasing at deeper depths e.g. 30-60 cm. Although detailed knowledge of the distribution may be helpful, the majority of on-farm management decisions will be based on presence or absence of *Pt* with sampling at 0-15 or 0-30 cm depth providing that information.

What is seen in the paddock?

Although symptoms of RLN damage in wheat can be dramatic, they can be easily confused with nutritional deficiencies and/or moisture stress.

Damage from RLN results in brown root lesions but these can be difficult to see or can also be impacted by other organisms. Root systems are often compromised with reduced branching, reduced quantities of root hairs and an inability to penetrate deeply into the soil profile. **RLN create an inefficient root system that reduces the ability of the plant to access nutrition and also soil water**.

Visual damage above ground from RLN is non-specific. Lower leaf yellowing is often observed together with reduced tillering and a reduction in the amount of crop biomass. Symptoms are more likely to be observed later in the season, particularly when the crop is reliant on sub soil stored moisture.

In the early stages of RLN infection, localised patches of poor performing wheat may be observed. Soil testing of these patches may help to determine or eliminate RLN as a possible issue. In paddocks where previous wheat production has been more uniform, a random soil coring approach may be more suitable. Another useful indicator of RLN presence is low yield performance of RLN intolerant wheat varieties.

Management of RLN

1. **Nematicides** (control in a drum): there are no registered nematicides for RLN in broadacre cropping in Australia. Screening of potential candidates is conducted but RLN are a very difficult target with populations frequently deep in the soil profile.
2. **Nutrition**: damage from RLN reduces the ability of cereal roots to access nutrients and soil moisture and can induce nutrient deficiencies. Under fertilising is likely to exacerbate RLN yield impacts however over fertilising is still unlikely to compensate for a poor variety choice.
3. **Variety choice and crop rotation: *These are currently our most effective management tools for RLN*.** However the focus is on two different characteristics - ***Tolerance*** (ability of the variety to yield under RLN pressure) and ***Resistance*** (impact of the variety on RLN build-up). NB varieties and crops often have varied tolerance and resistance levels to *Pt* and *Pn*.
4. **Fallow:** RLN populations will decrease during a 'clean' fallow but the process is slow and expensive in lost 'potential' income. Additionally long fallows may decrease VAM levels and create more cropping issues than they solve.

Tolerance

The DAFF QLD and NSW DPI wheat variety guides detail the level of variety tolerance to both species of RLN. **Selection of wheat varieties on the basis of these published RLN tolerance rankings is critical to avoid significant yield losses, particularly in paddocks with large populations of *Pt***. Wheat breeding has provided a number of varieties with moderate or higher levels of tolerance to *Pt* eg SunvaleⒹ, BaxterⒹ, EGA WylieⒹ and EGA GregoryⒹ. These varieties will reduce the level of yield loss due to *Pt*.

At a trial site near Yallaroi in 2012, a range of crops and varieties were grown where performance was evaluated under relatively 'low' (~2,000 *Pt*/kg soil) and 'high' (~19,000 *Pt*/kg) starting populations of *Pt*. Figure 2 shows the impact of *Pt* on yield of varieties with a range of tolerance levels.

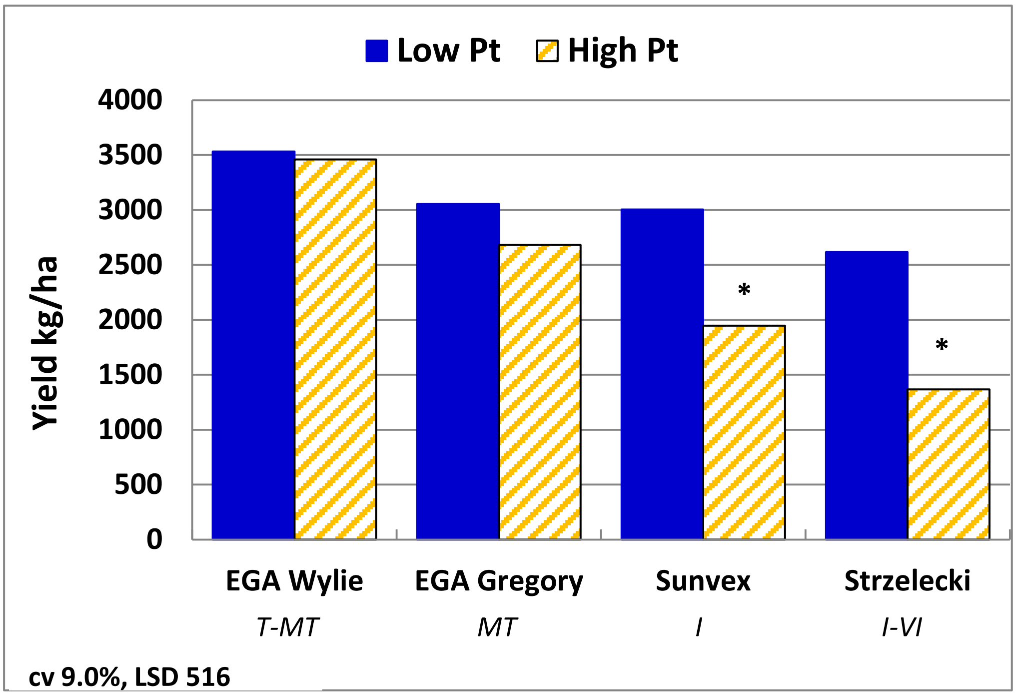

Figure 2: Comparison of wheat variety yield under 'low' and 'high' starting populations of *Pt* near Yallaroi 2012 (Trial RH1213)
* = significant yield difference in same variety between 'low' and 'high' *Pt* strips at p=0.05
Codes below variety names are the DAFF QLD published *Pt* tolerance rating; T=tolerant, MT=moderately tolerant, I=intolerant, VI=very intolerant

NB what was categorised as the 'low' starting Pt population was still equal to the current industry threshold. At this level significant yield losses (up to 20%) may occur in intolerant wheat varieties. Consequently the measured yield impact between 'low' and 'high' Pt in this trial is an underestimate of the full Pt affect.

The varieties rated as *Pt* intolerant (Strzelecki⊕ and Sunvex⊕) suffered significant yield reductions of 35-48% in this trial when grown in the 'high' *Pt* population plots. Yield losses of ~1- 1.25 t/ha were recorded with economic losses >$250/ha. The two more tolerant varieties (EGA Wylie⊕ and EGA Gregory⊕) did not suffer a significant yield reduction.

Choosing tolerant varieties will limit the yield and economic impact from *Pt*, however some of these varieties still allow high levels of nematode build-up. The second issue to be considered is variety resistance/ susceptibility.

Resistance

Resistance is the impact of the variety on RLN multiplication. Eradication of RLN from an individual paddock is highly unlikely so effective long term management is based on choosing options that limit RLN multiplication. This involves using crop or variety choices that have useful levels of *Pt* resistance and avoiding varieties that will cause large 'blow-outs' in *Pt* numbers.

1. **Resistance differences between crops**

The primary method of managing RLN populations is to focus on increasing the number of resistant crops in the rotation. **Knowledge of the species of RLN present is critical as crops that are resistant to *Pt* may be susceptible to *Pn***. Key crops that are generally considered resistant or moderately resistant to *Pt* are sorghum, sunflower, maize, canola, canary seed, cotton, field peas and linseed. Wheat, chickpeas, faba beans, mung beans and soybeans are generally susceptible - although the level of susceptibility may vary between varieties. Figure 3 shows the mean *Pt* population remaining after a range of winter crops were grown in 2011. Although all crops were sown in individual trials - to enable weed and pest control, the data should generally reflect the *Pt* resistance differences between these crops.

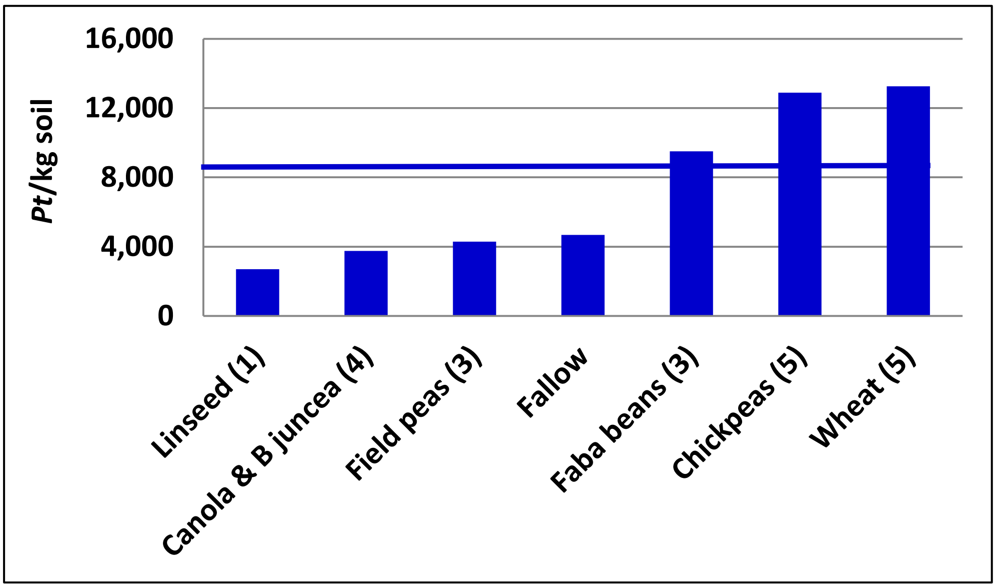

Figure 3: Comparison of *Pt* population remaining in March /April 2012 following different winter crop species near Weemelah 2011 (Trials RH1101-1109)
(Number) indicates the number of varieties of each crop
The solid blue horizontal line indicates the **mean *Pt* level in March 2011**

Sorghum is generally characterised as resistant to *Pt*. NGA conducted sampling of 8 sorghum variety trials in summer 2012/13. Across all sites there was mean 45% reduction in *Pt* population following a single sorghum crop. **Sorghum is a very useful option to assist in *Pt* management**.

2. **Resistance differences between commercial wheat varieties**

RLN resistance ratings for wheat varieties have been available for many years, however the development of high throughput DNA analysis has enabled an increased amount of testing to compare RLN build-up between varieties under field conditions. This data appears to be a very useful addition to our current knowledge on varietal resistance with relative variety performance fairly consistent across sites. Figure 4 shows the relative performance of a range of varieties as a % of EGA Gregory⦵ in a wide range of trials during 2009-2012.

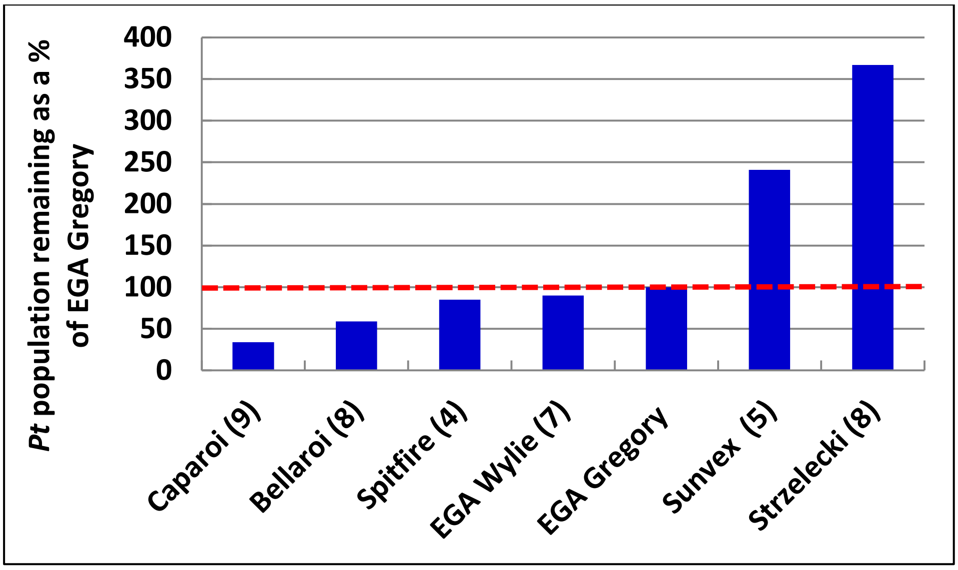

Figure 4: Comparison of *Pt* population remaining as a % of EGA Gregory, 2009-2012
(Number) indicates the number of trials compared to EGA Gregory
The red broken line indicates the ***Pt* level remaining after EGA Gregory**

Key point: Bread wheats are generally *Pt* susceptible but there are large differences between varieties in the level of susceptibility. Growers with *Pt* infestations must avoid 'sucker' varieties that result in very high levels of *Pt* multiplication. NB although durums generally restrict *Pt* multiplication compared to bread wheats they are very susceptible to crown rot.

3. Resistance differences between desi chickpea varieties

Recent field data is also showing consistent differences in *Pt* resistance between commercial chickpea varieties. Figure 5 shows a summary of key chickpea variety performance in 8 trials sampled by DAFF QLD, NSW DPI or NGA.

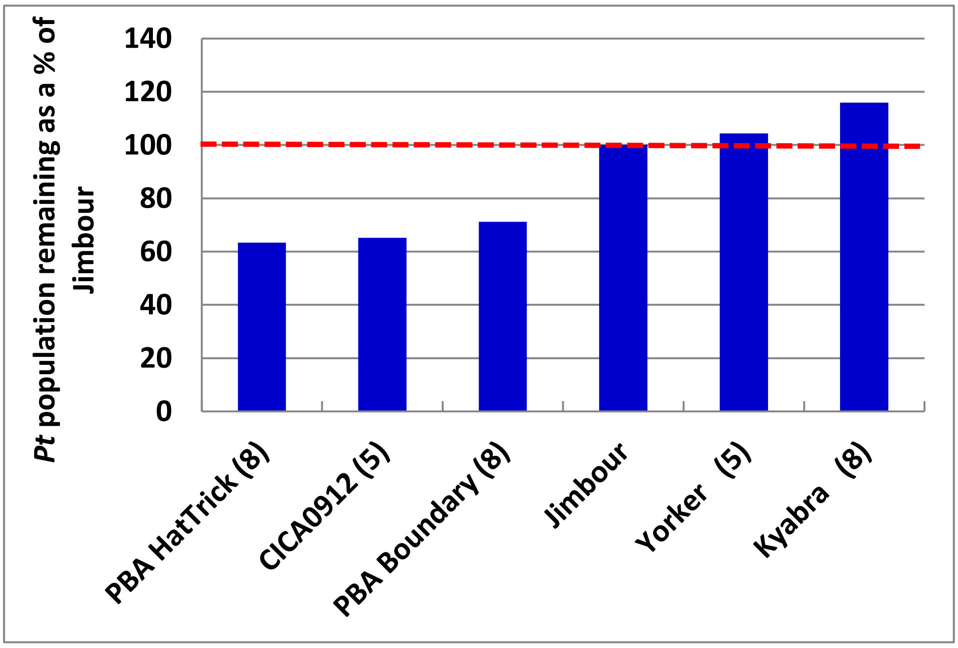

Figure 5: Comparison of *Pt* population remaining as a % of Jimbour, 2010-2012
(Number) indicates the number of trials compared to Jimbour
The red broken line indicates the ***Pt* level remaining after Jimbour**

Key point: Chickpeas are *Pt* susceptible but there are differences in the level of susceptibility. Larger *Pt* populations are consistently found after Jimbour and Kyabra than after PBA HatTrick or PBA Boundary. Growers with *Pt* infestations should certainly avoid varieties that produce higher levels of *Pt* multiplication.

4. Variety resistance differences less evident in other crops

Smaller data sets have been generated for commercial varieties of faba beans, field peas, canola, kabuli chickpeas, cotton and sorghum. Differences in level of resistance in these crops have been small or not significant to date. Figure 6 shows the mean results of 6 sorghum hybrids that were evaluated in a series of 8 individual trials. There was no indication of any consistent difference in *Pt* resistance between these, or any other, sorghum hybrids evaluated.

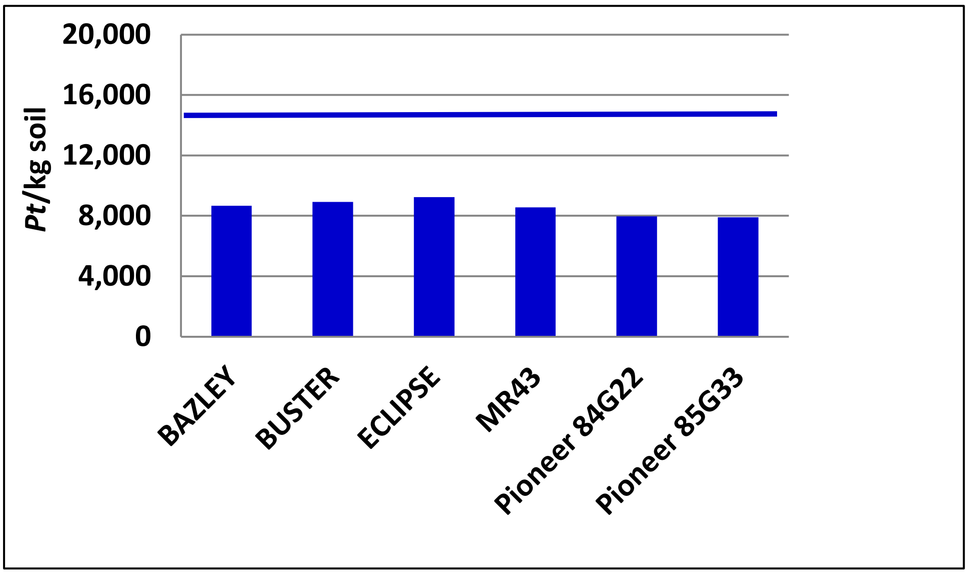

Figure 6: Comparison of *Pt* population remaining in March /April 2013 following different sorghum hybrids, summer 2012/13
The solid blue horizontal line indicates the **mean *Pt* level in Oct/Nov 2012**

Summary

RLN are key constraints of crop production in the northern grains region. The level of economic impact on intolerant wheat varieties is well understood but there have been concerning impacts also seen in chickpeas. Once RLN are established in a paddock the key management tools are crop rotation with an increase in frequency of resistant crops required. Recent research has shown that in addition to resistant crops, there are consistent and useful levels of difference in resistance within key 'susceptible' crops such as wheat and chickpeas. Growers and their advisers need to know the paddocks with RLN issues and focus on crop and variety selection to best minimise both short and long term economic impact.

Acknowledgments

Thank you to Bill Yates and Sean Coleman for their co-operation in very large and complex trials. In addition, our thanks to Steven Simpfendorfer and Kevin Moore (NSW DPI) and Kirsty Owen (DAFF QLD) for trial data included in summaries and assistance in interpretation. Thanks also to AGT, HSR, Pacific Seeds, Pioneer, Seedmark, Seednet, the University of Sydney PBI and Viterra for providing seed or research input and to Rachel Norton for her management of the dedicated RLN trials.

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