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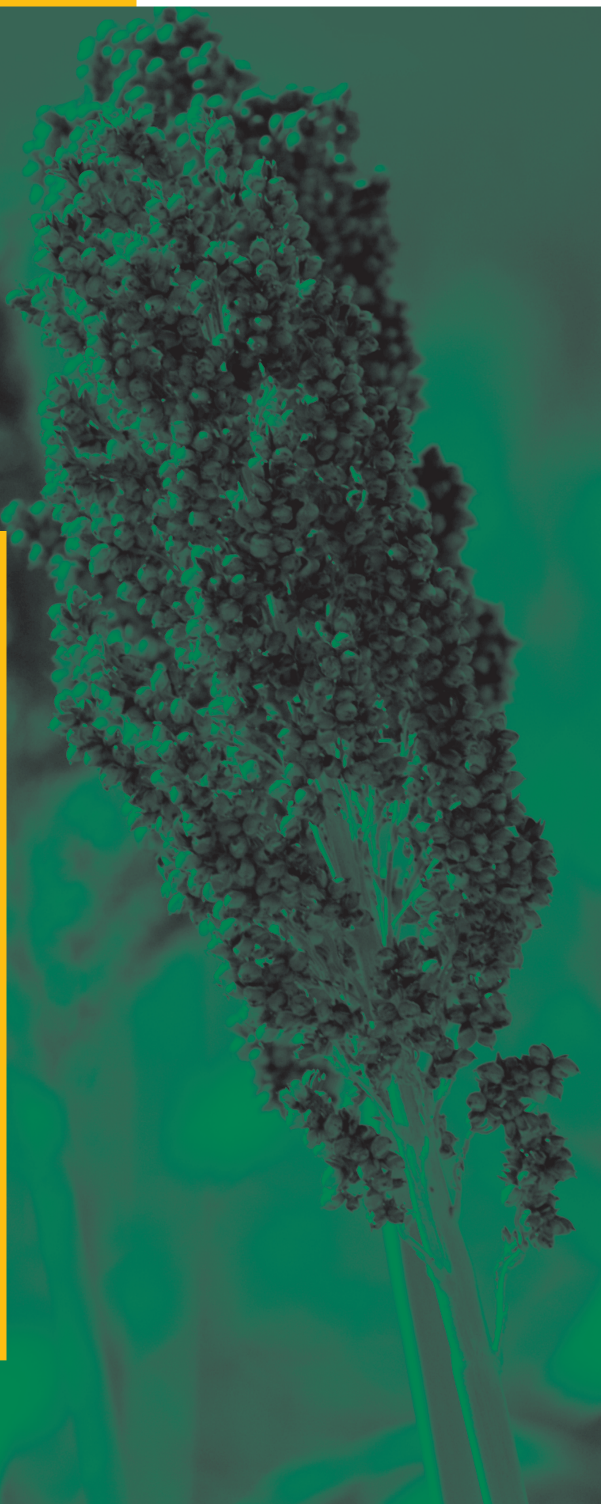

SORGHUM

SECTION 8

NEMATODE MANAGEMENT

BACKGROUND | SYMPTOMS AND DETECTION | MANAGEMENT | VARIETAL RESISTANCE OR TOLERANCE

Nematode management

MORE INFORMATION

vGRDC Tips and Tactics: Root-Lesion Nematodes

MORE INFORMATION

http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/03/How-nematodes-reduce-yield

Root lesion nematodes importance impact and management

Root-lesion nematodes (RLN; *Pratylenchus* spp.) are microscopic, worm-like animals that extract nutrients from plants, causing yield loss. In the northern grains region, the predominant RLN, *P. thornei*, costs the wheat industry A$38 million [1] annually, and including the secondary species, *P. neglectus*, RLN are found in three-quarters of fields tested.

Intolerant crops such as wheat and chickpeas can lose 20–60% [2] in yield when nematode populations are high. Resistance and susceptibility of crops can differ for each RLN species; for example, sorghum is resistant to *P. thornei* but susceptible to *P. neglectus*. A tolerant crop yields well when large populations of RLN are present (the opposite is intolerance). A resistant crop does not allow RLN to reproduce and increase in number (the opposite is susceptibility). [3]

Successful management relies on:

- farm hygiene to keep fields free of RLN
- growing tolerant varieties when RLN are present, to maximise yields
- rotating with resistant crops to keep RLN at low levels [4]

Nematodes reduce yields in intolerant wheat cultivars and reduce the amount of water available for plant growth.

Nematodes also impose early stress that reduces yield potential despite the availability of water and nutrients.

Maintaining a low nematode population improves crop yields. [5]

8.1 Background

Root-lesion nematodes use a syringe-like 'stylet' to extract nutrients from the roots of plants (Figure 1). Plant roots are damaged as RLN feed and reproduce inside plant roots. *Pratylenchus thornei* and *P. neglectus* are the most common RLN species in Australia. In the northern grains region, *P. thornei* is the predominant species but *P. neglectus* is also present. These nematodes can be found deep in the soil profile (to 90 cm depth) and are found in a broad range of soil types, from heavy clays to sandy soils. Wheat is susceptible to both *P. thornei and P. neglectus*. [6]

New CSIRO research funded by the Grains Research and Development Corporation (GRDC) is examining how nematodes inflict damage by penetrating the outer layer of wheat roots and restricting their ability to transport water.

1 GM Murray, JP Brennan (2009) The current and potential costs from diseases of wheat in Australia. Grains Research and Development Corporation Report. https://www.grdc.com.au/~/media/B4063ED6F63C4A968B3D7601E9E3FA38.pdf

2 KJ Owen, T Clewett, J Thompson (2013) Summer crop decisions and root-lesion nematodes: crop rotations to manage nematodes – key decision points for the latter half of the year, Bellata. GRDC Grains Research Update, July 2013.

3 KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

4 R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.

5 GRDC (2014), How nematodes reduce yield. http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/03/How-nematodes-reduce-yield

6 KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

MORE INFORMATION

Soil Quality Pty Ltd nematode survey results

GRDC Parasitic Plant Nematodes (Northern Region Fact Sheet)

http://www.daff.qld.gov.au/__data/assets/pdf_file/0010/58870/Root-Lesion-Nematode-Brochure.pdf

Figure 1: *Microscope image of a root-lesion nematode. Notice the syringe-like 'stylet' at the head end, which is used for extracting nutrients from the plant root. This nematode is less than 1 mm long.*

Photo: Sean Kelly, Department of Agriculture and Food, Western Australia

8.2 Symptoms and detection

Root-lesion nematodes are microscopic and cannot be seen with the naked eye in the soil or in plants. The most reliable way to confirm the presence of RLN is to have soil tested in a laboratory. Fee-for-service testing of soil offered by the PreDicta B root disease testing service of the South Australian Research and Development Institute (SARDI) can determine levels of *P. thornei* and *P. neglectus* present. [7]

Similar results can be obtained by soil testing either by manual counting (under microscopes) or by DNA analysis (PreDicta B), with commercial sampling generally at depths of 0–15 or 0–30 cm. [8]

Vertical distribution of *P. thornei* in soil is variable. Some paddocks have relatively uniform populations down to 30 cm or even 60 cm, some will have highest *P. thornei* counts at 0–15 cm depth, whereas other paddocks will have *P. thornei* populations increasing at greater 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 *P. thornei* confirmed by sampling at 0–15 or 0–30 cm depth.

Signs of nematode infection in roots include dark lesions or poor root structure. The damaged roots are inefficient at taking up water and nutrients—particularly nitrogen (N), phosphorus (P) and zinc (Zn)—causing symptoms of nutrient deficiency and wilting in the plant shoots. Intolerant wheat varieties may appear stunted, with yellowing of lower leaves and poor tillering (Figure 2). These symptoms may not be present in other susceptible crops such as barley and chickpea. [9]

7 KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

8 R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.

9 KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

MORE INFORMATION

http://www.sardi.sa.gov.au/products__and__services/entomology/diagnostic_services/predicta_b

Figure 2: *Symptoms of root-lesion nematode infection of an intolerant wheat variety include yellowing of lower leaves, decreased tillers and wilting. There are no obvious symptoms in the susceptible chickpea and faba bean plots on either side of the wheat.*

Photo: Kirsty Owen, QDAF

8.2.1 What is seen in the paddock?

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

Damage from RLN is in the form of brown root lesions but these can be difficult to see or can also be caused 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. The RLN create an inefficient root system that reduces the ability of the plant to access nutrition and soil water.

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

In the early stages of RLN infection, localised patches of poorly performing wheat may be observed. Soil testing of these patches may help to confirm 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. [10]

MORE INFORMATION

GRDC Update Paper: High performance crop sequences for Southern Queensland

8.3 Management

There are four key strategies for the management of RLN (Figure 3):

1. Test soil for nematodes in a laboratory.
2. Protect paddocks that are free of nematodes by controlling soil and water run-off and cleaning machinery; plant nematode-free paddocks first.
3. Choose tolerant wheat varieties to maximise yields (www.nvtonline.com.au). Tolerant varieties grow and yield well when RLN are present (Figure 4).
4. Rotate with resistant crops to prevent increases in RLN (Table 1, Figure 5). When large populations of RLN are detected, you may need to grow at least two resistant crops consecutively to decrease populations. In addition, ensure that

10 R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.

MORE INFORMATION

http://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2014/03/Latest-nematode-summer-and-winter-crop-rotation-results

fertiliser is applied at the recommended rate so that the yield potential of tolerant varieties is achieved. [11]

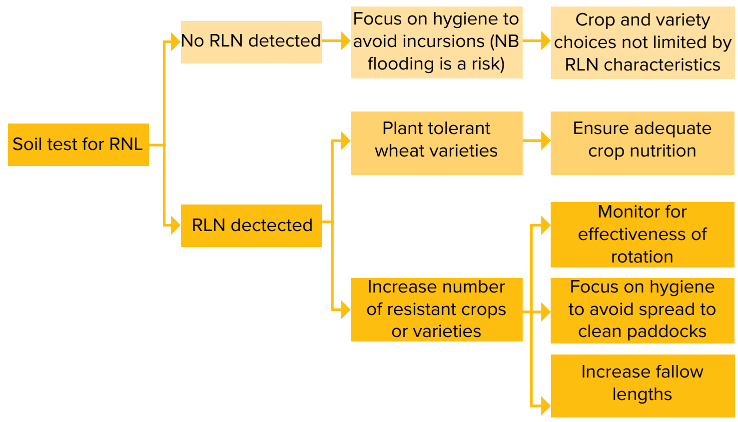

Figure 3: *Root-lesion nematode management flow-chart.*

Other considerations include:

- **Nematicides.** 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.
- **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 unlikely to compensate for a poor variety choice.
- **Variety choice and crop rotation.** These are currently our most effective management tools for RLN. However the focus is on two different characteristics: tolerance, i.e. ability of the variety to yield under RLN pressure; and resistance, i.e. impact of the variety on RLN build-up. Note that varieties and crops often have varied tolerance and resistance levels to *P. thornei* and *P. neglectus*.
- **Fallow.** Populations of RLN will decrease during a 'clean' fallow, but the process is slow and expensive in lost 'potential' income. Additionally, long fallows may decrease arbuscular mycorrhiza (AM) levels and create more cropping problems than they solve. [12]

Table 1: *Susceptibility and resistance of various crops to root-lesion nematodes.* [13]

RLN species	Susceptible	Intermediate	Resistant
P. thornei	Wheat, chickpea, faba bean, barley, mungbean, navy bean, soybean, cowpea	Canola, mustard, triticale, durum wheat, maize, sunflower	Canary seed, lablab, linseed, oats, sorghum, millet, cotton, pigeon pea
P. neglectus	Wheat, canola, chickpea, mustard, sorghum (grain), sorghum (forage)	Barley, oat, canary seed, durum wheat, maize, navy bean	Linseed, field pea, faba bean, triticale, mungbean, soybean

11 KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

12 R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.

13 KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

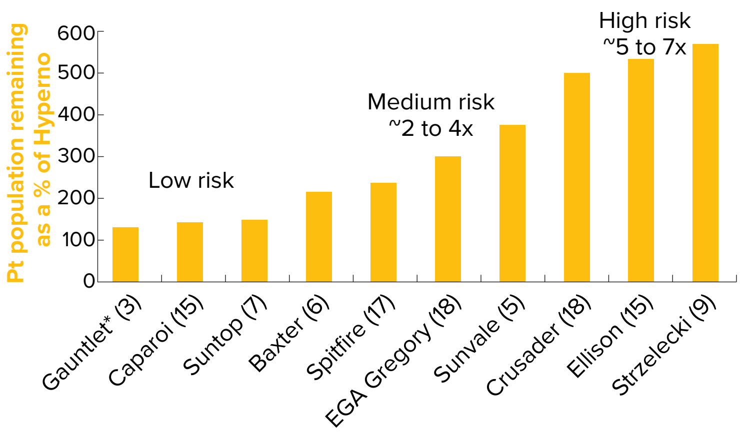

Figure 4: *Impact of crop varieties on RLN multiplication, Brendan Burton, Northern Grower Alliance.* [14]

Figure 5: *Crop rotation to manage root-lesion nematodes depends on the nematode species present in your field. Mungbeans (left) are susceptible to* P. thornei *but resistant to* P. neglectus. *By contrast, sorghum (right) is resistant to* P. thornei *but susceptible to* P. neglectus.

Photo: Kirsty Owen, QDAF

Canola is now thought to have a 'biofumigation' potential to control nematodes, and a field experiment has compared canola with other winter crops or clean-fallow for reducing *P. thornei* population densities and improving growth of *P. thornei*-intolerant wheat (cv. Batavia) in the following year.

Immediately after harvest of the first-year crops, populations of *P. thornei* were lowest following various canola cultivars or clean-fallow and highest following susceptible wheat cultivars (1957–5200 *v.* 31,033–41,294 *P. thornei*/kg dry soil). Unexpectedly, at planting of the second-year wheat crop, nematode populations were at more uniform, lower levels (<5000/kg dry soil), regardless of the previous season's treatment, and remained that way during the growing season, which was quite dry.

Growth and grain yield of the second-year wheat crop were poorest on plots previously planted with canola or left fallow due to poor colonisation with AM fungi, with the exception of canola cv. Karoo, which had high AM fungal colonisation and low wheat yields. There were significant regressions between growth and yield

14 http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/03/Impact-of-crop-varieties-on-RLN-multiplication

parameters of the second-year wheat and levels of AM fungi following the pre-crop treatments.

Canola appears to be a good crop for reducing *P. thornei* populations, but the dependence of subsequent crops on AM fungi should be considered, particularly in the northern grains region. [15]

8.3.1 Crop rotation

P. neglectus was found in 32% of paddocks (often in combination with *P. thornei*) in the northern region in a survey of 800 paddocks (Thompson *et al.* 2010). Summer crops that are partially resistant or poor hosts of *P. neglectus* include sunflower, mungbean, soybean and cowpea. When these crops are grown, populations of *P. neglectus* do not increase because the crops do not allow the nematode to reproduce.

In a field experiment, populations of *P. neglectus* increased after growing grain sorghum (Figure 4). Populations increased from 3.1 times after MR32⦇ (4,400 *P. neglectus*/kg soil) to 7.3 times after MRGoldrush⦇ (10,400 *P. neglectus*/kg soil) compared to soil at planting (1,400 *P. neglectus*/kg soil). [16]

Summer crops have an important role in management of RLN. Research shows that when *P. thornei* is present in high numbers, two or more resistant crops in sequence are needed to reduce populations to low enough levels to avoid yield loss in the following intolerant, susceptible wheat crops. [17]

Key points

- One resistant crop in sequence may not be enough to decrease damaging populations of *P. thornei*.
- Management of *P. thornei* by growing several resistant crops works, and populations can be reduced to very low levels. However, ongoing vigilance by testing soil for nematodes is essential when susceptible crops are planted.

8.3.2 Latest summer-crop rotation trial

Two summer-crop rotation trials were conducted by QDAF in adjacent fields in December 2011:

- The first field had low *P. thornei* populations (<125/kg soil or 0.125/g soil). The previous cropping history was five resistant crops since 2004 (cotton, maize and sorghum).
- The second field had moderate *P. thornei* populations (range 2000–3000/kg soil (or 2–3/g soil) at 0–90 cm soil depth). The previous cropping history was wheat, sorghum, wheat (Figure 6).

Several cultivars of mungbeans, soybeans, sunflowers, maize and sorghum were planted in each field in December 2011 in a replicated design with sufficient plots to plant wheat cvv. EGA Wylie⦇ (tolerant) and Strzelecki⦇ (intolerant) in 2013. There was also an unplanted, bare fallow treatment. After harvest of the summer crops, nematode populations were recorded to 120 cm soil depth.

MORE INFORMATION

https://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/07/Summer-crop-decisions-and-root-lesion-nematodes

http://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-109-Mar-Apr-2014/Variety-choice-and-crop-rotation-key-to-managing-root-lesion-nematodes

http://www.nga.org.au/results-and-publications/download/325/grdc-update-papers-diseases/root-lesion-nematodes-in-winter-cereals/grdc-grower-update-paper-spring-ridge-warialda-burren-junction-warra-condamine-jul-aug-2014.pdf

15 KJ Owen, TG Clewett, JP Thompson (2010) Pre-cropping with canola decreased *Pratylenchus thornei* populations, arbuscular mycorrhizal fungi, and yield of wheat. *Crop & Pasture Science* 61, 399–410.

16 http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/07/Summer-crop-decisions-and-root-lesion-nematodes

17 K Owen, T Clewett, J Thompson (2013) Summer crop decisions and root-lesion nematodes: crop rotations to manage nematodes – key decision points for the latter half of the year, Bellata. GRDC Grains Research Update, July 2013.

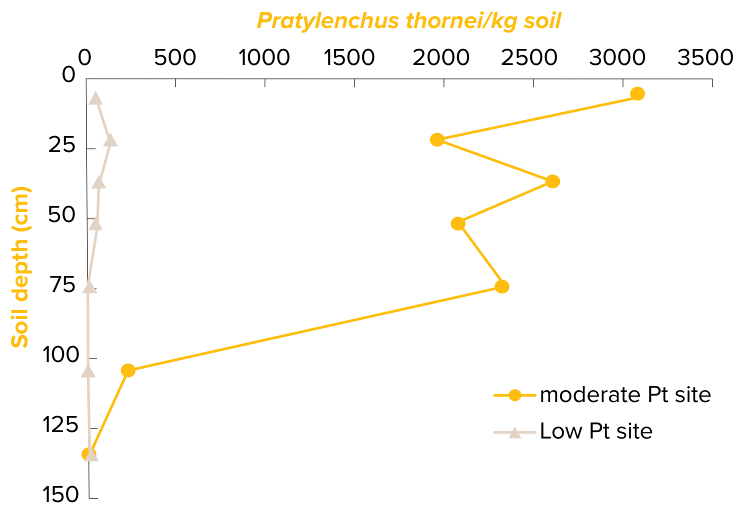

Figure 6: *Starting populations of* Pratylenchus thornei *(Pt) in the summer crop rotation experiments in adjacent fields.*

Moderate P. thornei site

Pratylenchus thornei was found to 90 cm soil depth and populations were greatest at 0–15 cm soil depth (Figure 7).

Populations of *P. thornei* after growing sorghum, sunflowers and maize were similar to populations after bare fallow (range 2900–4500/kg soil at 0–15 cm; Figure 7). There were no significant differences between varieties within each of these crop species (Figure 8).

By contrast, populations of *P. thornei* increased after growing mungbeans or soybeans compared with sunflowers, sorghum, maize or clean fallow (Figure 7). There were also differences between varieties of soybean and mungbean (Figure 8).

Soybean cv. Soya791⦇ was moderately resistant (4800 *P. thornei*/kg soil at 0–15 cm) and its effect did not differ significantly from the fallow treatment. However, all other soybean varieties were very susceptible. Populations of *P. thornei* increased 4–6.7 times to 12,000–20,600 *P. thornei*/kg soil at 0–15 cm (Figure 8).

Mungbean cv. Emerald⦇ was moderately resistant (3400 *P. thornei*/kg soil) and its effect did not differ significantly from the fallow treatment. However, all other mungbean varieties tested were susceptible, and *P. thornei* populations increased 2.2–3.8 times to 6700–11,700 *P. thornei*/kg soil at 0–15 cm (Figure 8).

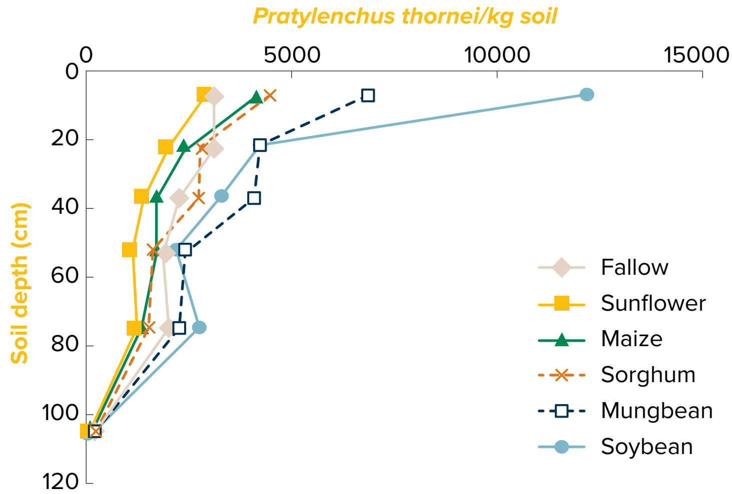

Figure 7: *Populations of* Pratylenchus thornei *increased after growing mungbeans and soybeans. After growing sunflowers, maize and sorghum, populations were similar to the bare fallow (blue line). Means of varieties within each crop are presented for the moderate* P. thornei *site.*

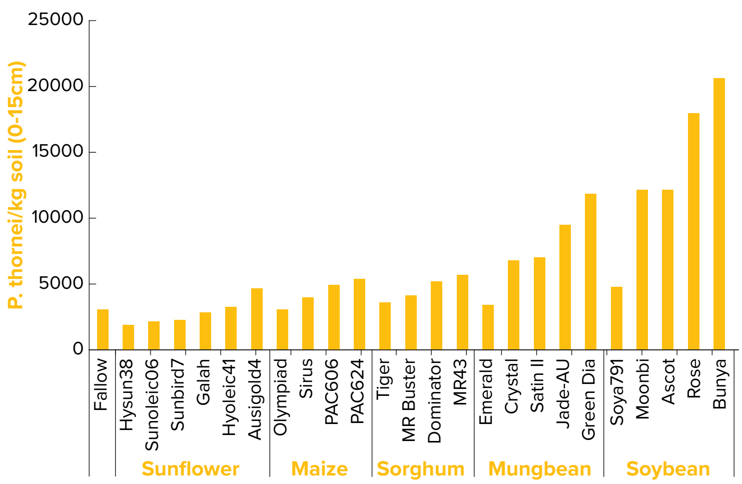

Figure 8: *After harvest of the summer crops,* Pratylenchus thornei *was found in highest populations at 0–15 cm soil depth. Varieties of sunflowers, maize, sorghum, mungbean cv. Emerald⦶ and soybean cv. Soya791⦶ did not differ significantly from the fallow treatment. 'Green Dia' is mungbean cv. Green Diamond⦶.*

Low P. thornei site

Pratylenchus thornei was detected to 60 cm soil depth; below that depth, populations were very low or zero (Figure 9).

There were no significant differences in *P. thornei* populations after the different summer crops or the varieties.

Overall, populations increased five times compared with those before planting the summer crops, but remained below 250/kg soil (Figure 9).

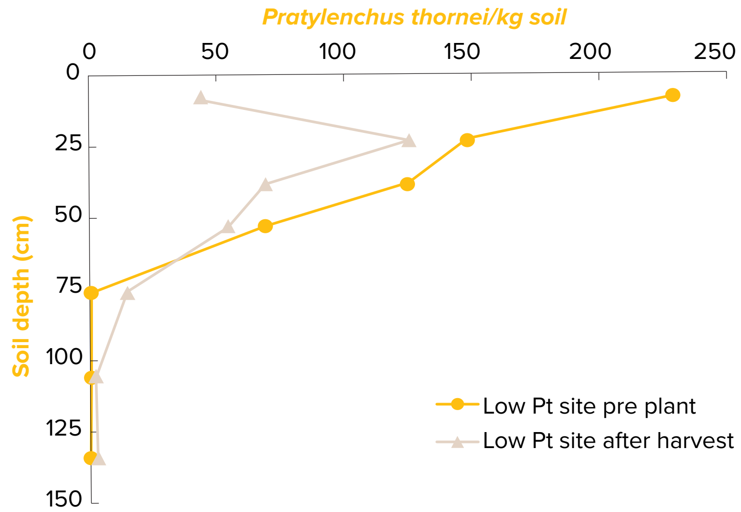

Figure 9: Pratylenchus thornei *(Pt) populations after harvest of the summer crops at the low Pt site. Mean data for all crops are presented; there were no significant differences between crops or varieties.*

Summer crop biomass and yield

There were no differences in biomass or grain yield of the summer crops between the low and moderate *P. thornei* sites. The summer crops used were tolerant to *P. thornei* so they did not suffer yield loss.

Impact on the next wheat crop

At the site that started with moderate *P. thornei* populations, the yield of the intolerant wheat cv. Strzelecki⫽ was reduced by 49% compared with the tolerant wheat cv. EGA Wylie⫽ (1900 kg/ha after Strzelecki⫽ compared with 3700 kg/ha after EGA Wylie⫽). By contrast, at the site that started with low *P. thornei* populations, there was only a 4% difference in yield between cvv. Strzelecki⫽ and EGA Wylie⫽ (3600 and 3700 kg/ha, respectively). The yield of cv. Strzelecki⫽ increased 47%, or 1700 kg/ha, at the low *P. thornei* site compared with the moderate *P. thornei* site (Figure 10).

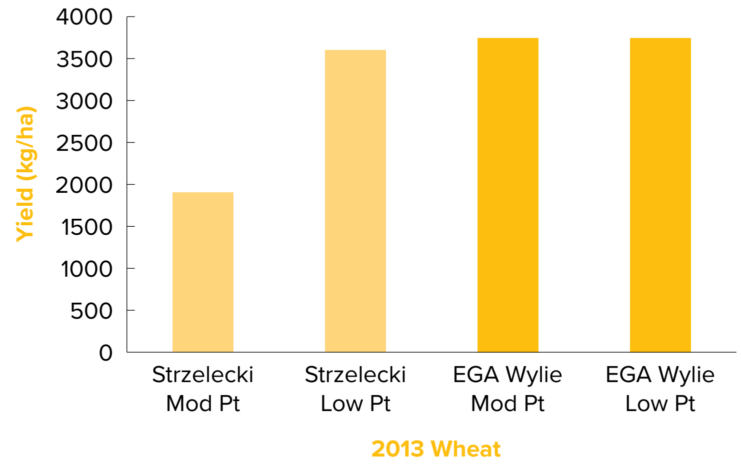

Figure 10: *Yield of the intolerant wheat cv. Strzelecki⦇ was reduced by 47% in the experiment that started with moderate* P. thornei *populations (Mod Pt; 2000–3000/ kg soil before the trial started) compared with the low* P. thornei *site (Low Pt; <125/ kg soil before the trial started). ⦇ All varieties listed are protected under the Plant Breeders Rights Act 1994.*

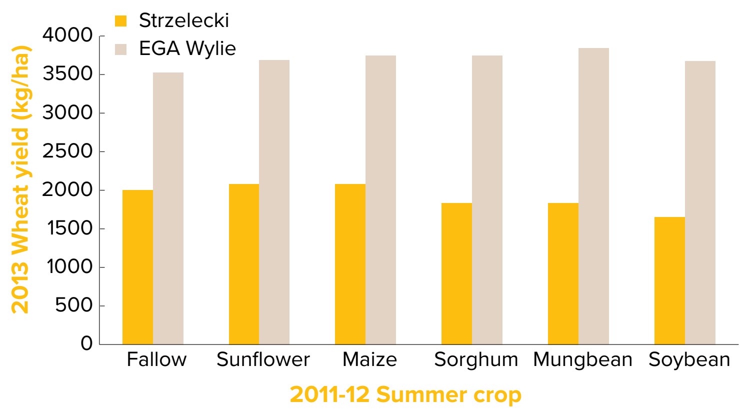

Figure 11: *Yield of the 2013 intolerant wheat cv. Strzelecki⦇ and tolerant cv. EGA Wylie⦇ at the site that started with moderate* P. thornei *populations (2000–3000/kg soil at 0–90 cm soil depth) before planting the summer crops in 2011–12.*

Yield of wheat cv. Strzelecki⦇ was lowest following soybean (1600 kg/ha) and highest following maize and sunflowers (2100 kg/ha) (Figure 11). An unexpected result was that there were no significant differences in yield of cv. Strzelecki⦇ after fallow, sorghum and mungbeans. This result may be partly due to dry conditions during the 2011–12 summer and following winter season, which limited nematode multiplication, particularly after the susceptible mungbean.

Additionally and importantly, the results support that one resistant crop in sequence was not enough to reduce populations of *P. thornei* sufficiently. Nevertheless, there was a strong negative relationship between populations of *P. thornei* after the summer crops and yield of the following intolerant wheat cv. Strzelecki⦇. By contrast, there was no relationship between populations of *P. thornei* and yield of tolerant wheat cv. EGA

Wylie⦻ (Figure 12), which is an expected result because of the high level of tolerance of EGA Wylie⦻ to *P. thornei*.

At the low *P. thornei* site, there was no relationship between yields of the tolerant and intolerant wheat and populations of *P. thornei* after growing the summer crops. Populations were below the damage threshold for wheat cv. Strzelecki⦻.

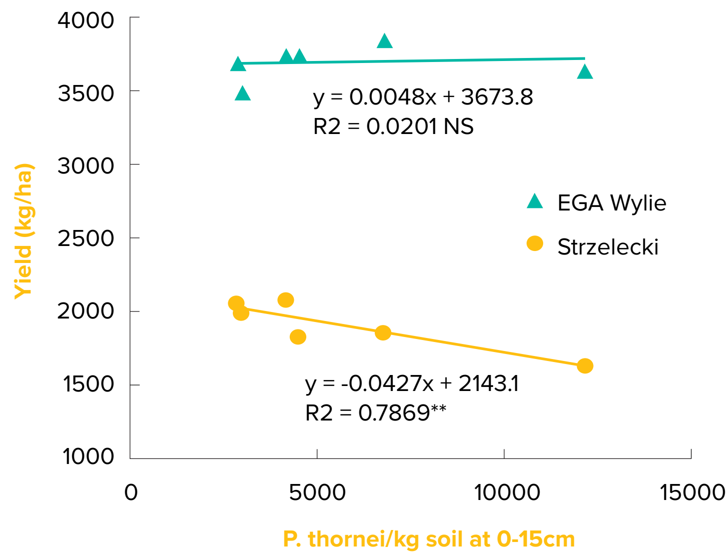

Figure 12: *There was a strong negative relationship between populations of* Pratylenchus thornei *after the 2011–12 summer crops and yield of following wheat cv. Strzelecki⦻ (P = 0.01,n = 6). By contrast, there was no significant relationship between yield of cv. EGA Wylie⦻ and populations of* P. thornei. *Data are from the moderate* P. thornei *site (2000–3000/kg soil at 0–90 cm soil depth before the trial began) and means for five summer crops and a fallow treatment are plotted.*

8.4 Varietal resistance or tolerance

A tolerant crop yields well when large populations of RLN are present (in contrast to an intolerant crop). A resistant crop does not allow RLN to reproduce and increase in number (in contrast to a susceptible crop) (Table 2).

Table 2: *Combinations and examples of tolerance and resistance* [18]

There are four possible combinations of resistance and tolerance:	
Tolerant–resistant	**Tolerant–susceptible**
e.g. sorghum cv. MR43 to *P. thornei and wheat breeding lines released for development*	e.g. wheat cv. EGA Gregory to *P. thornei*
Intolerant–resistant	**Intolerant–susceptible**
No commercial wheat lines in this category	e.g. wheat cv. Strzelecki to *P. thornei*

Tolerance and resistance of wheat varieties to RLN are published each year at www.nvtonline.com.au or in *Wheat varieties for Queensland*.

18 K Owen, T Clewett, J Thompson (2013) Summer crop decisions and root-lesion nematodes: crop rotations to manage nematodes – key decision points for the latter half of the year, Bellata. GRDC Grains Research Update, July 2013.

MORE INFORMATION

Impact of cereal varieties on the build-up of Pratylenchus thornei across three sowing dates – Narrabri 2013: Steven Simpfendorfer, Rick Graham, Guy McMullen p96

Impact of cereal variety and crown rot on the build-up of Pratylenchus neglectus – Bithramere 2013 p99

Impact of wheat variety choice on the build up of Pratylenchus thornei – Wongarbon 2013, Steven Simpfendorfer, Finn Fensbo, Robyn Shapland. p101

Impact of crop varieties on RLN multiplication

Current GRDC-funded research by the NGA and NSW DPI is examining the importance of crop and variety choice. The NGA has run large and complex trials and results are outlined in the GRDC Update Paper.

Growers are advised to recognise that there are consistent varietal differences in *P. thornei* and *P. neglectus* resistance within wheat and chickpea varieties; to avoid crops or varieties that allow the build-up of large populations of RLN in infected paddocks; and to monitor the impact of rotations.

The QDAF and NSW DPI wheat variety guides detail the level of variety tolerance to both species of RLN. Selection of wheat varieties based on these published RLN tolerance rankings is critical to avoid significant yield losses, particularly in paddocks with large populations of *P. thornei*.

GRDC-funded researchers are currently incorporating *P. thornei* resistances found in a wheat line selected from the variety Gatcher⚓ and some wheat landraces from West Asia and North Africa into pre-breeding efforts. Excellent resistance to *P. thornei* and *P. neglectus* has been found in synthetic hexaploid wheats.

Resistances are being incorporated into some of the most tolerant wheat varieties, including EGA Gregory⚓ and EGA Wylie⚓, to produce parents that are adapted to the northern region. [19]

8.4.1 Tolerance

Wheat breeding has provided a number of varieties with moderate or higher levels of tolerance to *P. thornei*, e.g. Sunvale⚓, Baxter⚓, EGA Wylie⚓ and EGA Gregory⚓. These varieties will reduce the level of yield loss due to *P. thornei*.

At a trial site near Yallaroi in 2012, a range of crops and varieties was grown and performance evaluated under relatively 'low' and 'high' starting population densities of *P. thornei* (~2,000 and 19,000 nematodes/kg soil). Figure 14 shows the impact of *P. thornei* on yield of varieties with a range of tolerance levels.

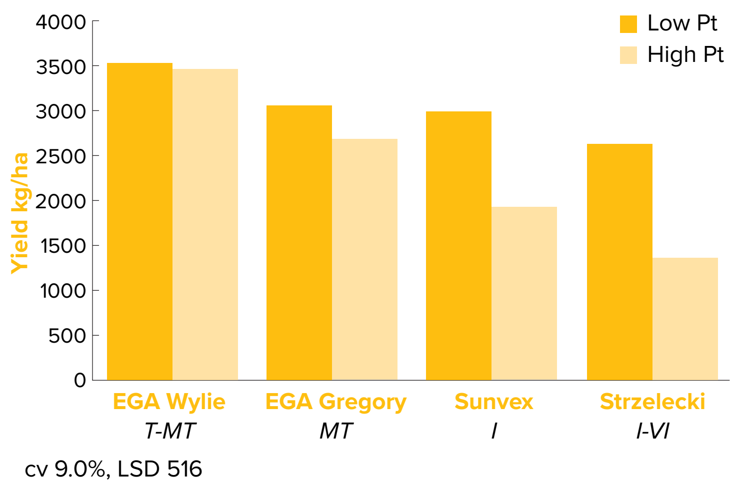

Figure 13: *Comparison of wheat variety yields under 'low' and 'high' starting population densities of* P. thornei *(Pt) near Yallaroi 2012 (Trial RH1213).*

*Indicates significant yield difference within a variety between 'low' and 'high' P. thornei strips at P = 0.05.

Codes below variety names are the QDAF published ratings of P. thornei tolerance: T, tolerant; MT, moderately tolerant; I, intolerant; VI, very intolerant.

NB: What was categorised as the 'low' starting population density of P. thornei 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' P. thornei in this trial is an underestimate of the full P. thornei affect. [20]

19 J Thompson, J Sheedy, N Robinson, R Reen, T Clewett, J Lin (2012) Pre-breeding wheat for resistance to root-lesion nematodes. GRDC Grains Research Update, Goondiwindi, March 2012.

20 K Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

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

Choosing tolerant varieties will limit the yield and economic impact from *P. thornei*; however, some of these varieties still allow high levels of nematode build-up. The second issue to be considered is variety resistance/susceptibility. [21]

8.4.2 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 varieties that have useful levels of *P. thornei* resistance and avoiding varieties that will cause large 'blow-outs' in *P. thornei* numbers.

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 *P. thornei* may be susceptible to *P. neglectus*. Key crops that are generally considered resistant or moderately resistant to *P. thornei* are sorghum, sunflower, maize, canola, canary seed, cotton, field peas and linseed.

Wheat, chickpeas, faba beans, mungbeans and soybeans are generally susceptible, although the level of susceptibility may vary between varieties.

Resistance differences between commercial wheat varieties

Resistance ratings for wheat varieties to RLN 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. These data appear to be a very useful addition to our current knowledge on varietal resistance, with relative variety performance fairly consistent across sites. Figure 15 shows the relative performance of a range of varieties as a percentage of EGA Gregory⟮D⟯ in a wide range of trials during 2009–2012.

21 R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.

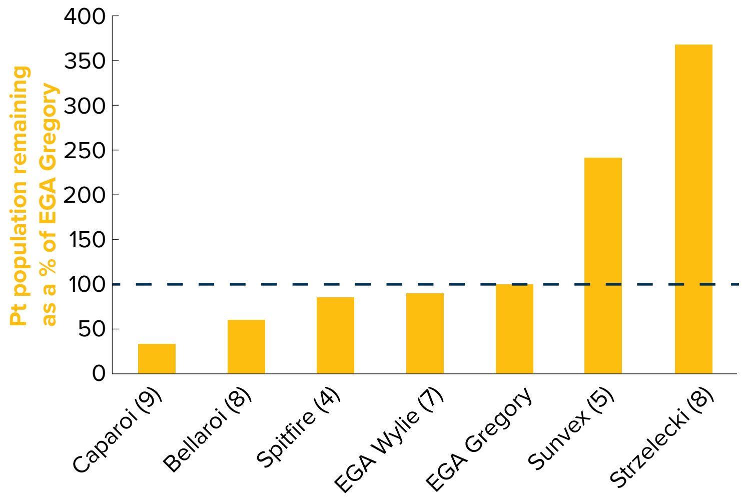

Figure 14: *Comparison of* P. thornei *(Pt) population remaining as a percentage of EGA Gregory⟑, 2009–2012. Values in parentheses are the number of trials in which the variety was compared with EGA Gregory⟑. The red broken line indicates the Pt level remaining after EGA Gregory⟑.*

Bread wheats are generally susceptible to *P. thornei* but there are large differences between varieties in the level of susceptibility. Growers with *P. thornei* infestations must avoid 'sucker' varieties that result in very high levels of *P. thornei* multiplication. Although durum wheats generally restrict *P. thornei* multiplication compared with bread wheats, they are very susceptible to crown rot. [22]

22 R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.