



NORTHERN

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# GRDC™ GROWNOTES™



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GRAINS RESEARCH  
& DEVELOPMENT  
CORPORATION

# CHICKPEA

## SECTION 8

## NEMATODE MANAGEMENT

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| MANAGEMENT | WHAT ARE RESISTANCE AND TOLERANCE? | VARIETAL  
RESISTANCE OR TOLERANCE | DAMAGE CAUSED BY NEMATODES | NEMATODES  
AND CROWN ROT

## SECTION 8

# Nematode management

## More information

[K Moore, K Hobson, S Harden, L Jenkins, R Brill \(2014\), Chickpea yields with and without \*Pratylenchus thornei\* – Coonamble & Trangie 2013 p128](#)

[B Burton, L Bailey, K Adhikari \(2016\), Impact from \*Pratylenchus thornei\*, Macalister 2015](#)

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 AU\$38 million<sup>1</sup> 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%<sup>2</sup> 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).<sup>3</sup>

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<sup>4</sup>

## 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*.<sup>5</sup>

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.

## More information

<https://grdc.com.au/Resources/Factsheets/2015/03/Root-Lesion-Nematodes>

<sup>1</sup> 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>

<sup>2</sup> 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.

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

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

<sup>5</sup> KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

## Fact sheets

[Soil Quality Pty Ltd  
nematode survey results](#)

[GRDC Parasitic Plant  
Nematodes \(Northern  
Region Fact Sheet\)](#)

[http://www.daf.qld.gov.au/\\_data/assets/pdf\\_file/0010/58870/Root-Lesion-Nematode-Brochure.pdf](http://www.daf.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.<sup>6</sup>

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.<sup>7</sup>

*P. thornei* populations greater than 40,000 per kg at harvest will require a double break of around 40 months free of a host to reduce the population below the accepted threshold of 2000 Pt/kg.

*P. thornei* populations greater than 10,000 per kg at harvest will require a single break of around 30 months free of a host to reduce the population below the accepted threshold of 2000 Pt/kg.<sup>8</sup>

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.

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

<sup>7</sup> R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.

<sup>8</sup> J Whish, J Thompson (2016), How long does it take to reduce *Pratylenchus thornei* (Root lesion nematode) population in the soil? <https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/02/How-long-does-it-take-to-reduce-Pratylenchus-thornei-populations-in-the-soil>



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.<sup>9</sup>



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, DAFF)

### Testing service

[http://www.sardi.sa.gov.au/products\\_and\\_services/entomology/diagnostic\\_services/predicta\\_b](http://www.sardi.sa.gov.au/products_and_services/entomology/diagnostic_services/predicta_b)

## 8.3 Symptoms in chickpeas

Severely affected plants are stunted and may have some yellowing of their foliage, but often have no obvious foliar symptoms of disease. Diseased plants usually have shorter lateral roots and fewer root hairs.

Where many nematodes invade chickpea roots, the affected tissues sometimes turn dark brown–black, giving alternating sections of healthy and discoloured root tissue. Often discoloration may appear as brown or black stripes along the roots. In severe cases young roots die.

Microscopic examination of the root system is required to confirm the presence of the nematode (Figure 3).

*Pratylenchus* impair root function, limiting water and nutrient uptake by the plant. Affected plants may show general unthriftiness, or symptoms of nitrogen deficiency. Symptoms are increased when plants are subjected to water and nutrient stress, or if there is also root damage caused by fungi.

Symptoms of infection on root systems include:

- disintegration of outer layers of root tissue
- reduction in root hairs and/or nodules
- a lack of or stunting of side (lateral) roots
- brown lesions and discoloration of roots

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

Root symptoms are often difficult to diagnose in the field and are usually not seen until plants are older than 8 weeks. Root symptoms are generally more obvious in plants grown in sandier soils.<sup>10</sup>



Figure 3: *Pratylenchus* (root-lesion nematode) lesions on chickpea roots. (Photo: SARDI)

### 8.3.1 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.<sup>11</sup>

<sup>10</sup> Pulse Australia (2013) Northern chickpea best management practices training course manual—2013. Pulse Australia Limited.

<sup>11</sup> 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

[J Whish, J Thompson \(2016\), How long does it take to reduce \*Pratylenchus thornei\* \(Root lesion nematode\) population in the soil?](#)

[N Seymour, G Stirling, J Li \(2016\), Biological suppression of root lesion nematodes in northern grain growing soils](#)

[T Dixon, E Berry \(2015\), Can wild chickpeas reduce the nematode problem in Australian crops?](#)

## 8.4 Management

There are four key strategies for the management of RLN (Figure 4):

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](http://www.nvtonline.com.au)). Tolerant varieties grow and yield well when RLN are present.
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 fertiliser is applied at the recommended rate so that the yield potential of tolerant varieties is achieved.<sup>12</sup>

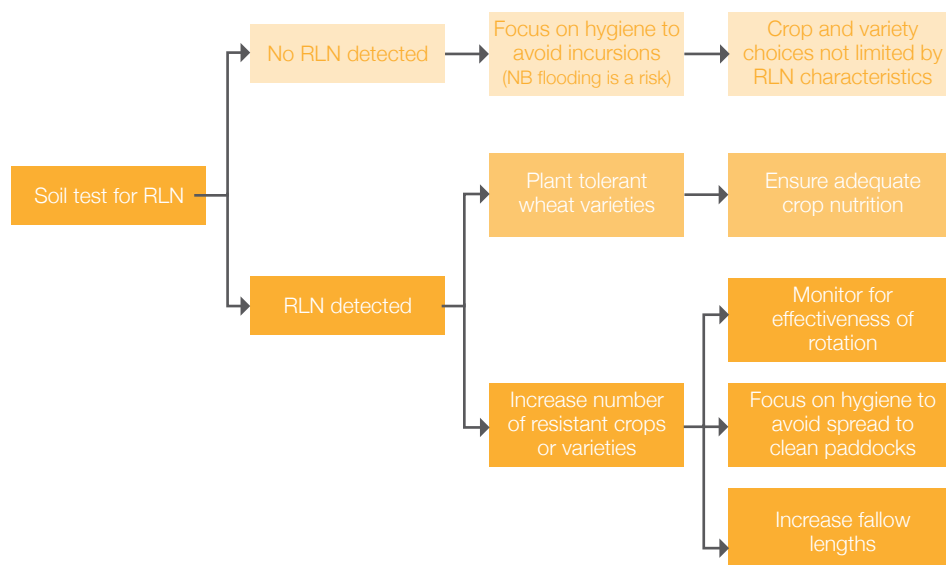


Figure 4: Root-lesion nematode management flow-chart

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.<sup>13</sup>

<sup>12</sup> KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

<sup>13</sup> R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.



Table 1: Susceptibility and resistance of various crops to root-lesion nematodes<sup>14</sup>

| RLN species         | Susceptible  | Intermediate  | Resistant   |
|---------------------|--|---|---|
| <i>P. thornei</i>   | 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 |
| <i>P. neglectus</i> | 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             |



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, DAFF)

### 8.4.1 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. Populations increased from 3.1 times after MR32<sup>Ⓢ</sup> (4,400 *P. neglectus*/kg soil) to 7.3 times after MRGoldrush<sup>Ⓢ</sup> (10,400 *P. neglectus*/kg soil) compared to soil at planting (1,400 *P. neglectus*/kg soil).<sup>15</sup>

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.<sup>16</sup>

### GRDC Update Paper

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

<sup>14</sup> KJ Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

<sup>15</sup> <http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/07/Summer-crop-decisions-and-root-lesion-nematodes>

<sup>16</sup> 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.

### 8.4.2 Sowing time

Wheat variety choice can have a great impact on yield loss to *P. thornei* (up to 43% yield loss in intolerant bread wheat varieties in 2011), and yield losses from *P. thornei* can be exacerbated by delayed sowing and drier conditions.<sup>17</sup>

New South Wales Department of Primary Industries (NSW DPI) winter cereal time-of-sowing trials at Coonamble, Mungindi, Trangie, Come-by-Chance and Gurley, NSW, in 2011 showed the following:

- Winter crop type and variety choice have a large effect on the build-up of nematode populations in the soil due to differences in their resistance to *P. thornei*.
- This was most pronounced in bread wheat where the variety choice:
  - » increased the *P. thornei* population by 1.8–3.6 times (9737 up to 19,719 *P. thornei*/kg soil) at Coonamble, and
  - » decreased the *P. thornei* population by 64% between the most susceptible and most resistant varieties at Mungindi (25,448 v. 9050 *P. thornei*/kg soil).
- *Pratylenchus thornei* populations were six times larger in the most susceptible variety, Lincoln<sup>(b)</sup>, than in the most resistant variety, Gauntlet<sup>(b)</sup>, at Trangie.
- Earlier sowing generally increased the build-up of *P. thornei* populations at Trangie, especially in the most susceptible variety.
- The build-up of *P. thornei* populations in the field trial is broadly in line with published resistance ratings, but discrepancies appear to exist, especially with LongReach Spitfire<sup>(b)</sup>, which appears better than its current rating of very susceptible.
- Both *P. thornei* and crown rot (caused by *Fusarium pseudograminearum*) cause significant yield loss in intolerant/susceptible varieties alone or in combination, as shown at Gurley.
- *Pratylenchus thornei* and crown rot did not reduce grain protein levels at the Gurley site.
- Some recently released varieties appear to combine improved tolerance to *P. thornei* with increased resistance to crown rot, which provided a yield advantage of up to 109% at the Gurley site in 2012.
- Reliable resistance ratings appear to be produced under both large and moderate starting populations of *P. thornei* at Mungindi. Hence, National Variety Trials (NVT) are a potentially useful source of reliable field-based assessments.<sup>18</sup> Visit [www.nvtonline.com.au](http://www.nvtonline.com.au)

#### More information

[Northern Grains Region trial results autumn 2013](#)

[L Serafin, S Simpfendorfer, M Sissons, A Verrell, G McMullen \(2015\), Northern grains region trial results Autumn 2015](#)

#### Delayed sowing

In two trials conducted in 2011, *P. thornei* was demonstrated to reduce yield by up to 43% under large starting populations with delayed sowing and drier growing conditions. Delayed sowing into late autumn/winter is likely to see crops initially develop under cooler soil temperatures, thus reducing the rate of root development. Conversely, earlier sown crops establish under warmer soil conditions and have more rapid, early root growth if adequate moisture is available.

Drier soil conditions during crop establishment and early growth, for example with the second sowing time (22 June) at Coonamble in 2011, are also likely to restrict early root development. In theory, any restriction to root development is likely to inhibit a crop's ability to compensate for *P. thornei* feeding upon these root systems. Variety choice can have a large impact on yield and, hence, profitability when cropping in soils with large populations of *P. thornei*. To date, these trials have only examined the relative tolerance of varieties to *P. thornei*. It should be stressed that a variety's resistance to *P.*

<sup>17</sup> S Simpfendorfer, M Gardner, G McMullen (2012) Impact of sowing time and varietal tolerance on yield loss to the root-lesion nematode *Pratylenchus thornei*. GRDC Grains Research Update, Goondiwindi, March 2012.

<sup>18</sup> NSW DPI (2013) Northern Grains Region trial results autumn 2013. NSW Department of Primary Industries.



*thornei* (build-up of nematode populations within the soil) should also be an important consideration in variety choice.<sup>19</sup>

#### Interaction with crown rot

Crown rot remains a significant disease in the region, with losses dependent on soil moisture and temperature stress experienced during flowering and grain-fill. Crown rot caused yield losses of up to 37% in durum varieties at the Coonamble site in 2011, but cooler, wetter conditions limited the expression (yield loss) of this disease at Mungindi in 2011. Averaged across the different winter cereal types, crown rot reduced yield by 18% in barley, 27% in durum wheat and 22% in bread wheat at Coonamble in 2011. Research conducted by NSW DPI and the Northern Grower Alliance (NGA) across 11 sites in northern NSW in 2007 demonstrated that crown rot caused average yield losses of 20% in barley (up to 69% under drier conditions and hotter temperatures during grain-fill), 25% in bread wheat (up to 65%) and 58% in durum (up to 90%).

The Coonamble site trial demonstrates that the tolerance of wheat varieties to crown rot does not appear to be related to their level of tolerance to *P. thornei*. Yield losses to both diseases in intolerant varieties can be significant (up to 43% for *P. thornei* and up to 37% for crown rot at Coonamble in 2011) under high levels of inoculum. However, the benefit obtained from sowing a more tolerant bread wheat variety appears greater for *P. thornei* (up to 43%) than for crown rot (up to 21%). Another way of expressing this is that the difference in tolerance levels between wheat varieties appears larger for *P. thornei* than for crown rot.<sup>20</sup>

#### Selecting tolerant varieties

Selecting tolerant wheat varieties is one of the main options for maintaining profit in the presence of high populations of *P. thornei*. By contrast, even the most crown rot resistant/tolerant commercial wheat variety can still suffer up to 50% yield loss under high levels of inoculum when hot/dry conditions occur during grain-fill. Variety selection is not a primary strategy for managing crown rot. Hence, where soil populations of *P. thornei* are large, more emphasis should be placed on a wheat variety's tolerance to *P. thornei* than to crown rot. Rotation to non-host crops remains the primary management tool for crown rot and can also be a valuable strategy to reduce or maintain *P. thornei* populations below the threshold (<2,000 *P. thornei*/kg soil) for yield loss in intolerant wheat varieties.<sup>21</sup>

#### Current industry knowledge

In 2010, the NGA conducted a survey of current levels of knowledge about nematodes (particularly RLN) in northern broadacre farming systems and the management practices being employed. The results are being used to prioritise research and development activity.

## 8.5 What are resistance and tolerance?

### 8.5.1 Resistance: nematode multiplication

- Resistant crops do not allow RLN to reproduce and increase in number in their roots.
- Susceptible crops allow RLN to reproduce so that their numbers increase. Moderately susceptible crops allow increases in nematode populations but at a slower rate.

### 8.5.2 Tolerance: crop response

- Tolerant varieties or crops yield well when sown in fields containing large populations of nematodes.

<sup>19</sup> NSW DPI (2013) Northern Grains Region trial results autumn 2013. NSW Department of Primary Industries.

<sup>20</sup> NSW DPI (2013) Northern Grains Region trial results autumn 2013. NSW Department of Primary Industries.

<sup>21</sup> S Simpfendorfer, M Gardner, G McMullen (2012) Impact of sowing time and varietal tolerance on yield loss to the root-lesion nematode *Pratylenchus thornei*. GRDC Grains Research Update, Goondiwindi, March 2012.

#### GRDC Update Paper

<http://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2012/04/Impact-of-sowing-time-and-varietal-tolerance-on-yield-loss-to-the-root-lesion-nematode-pratylenchus-thornei>

#### Survey results

[www.nga.org.au/results-and-publications/download/49/surveys/root-lesion-nematode-survey.pdf](http://www.nga.org.au/results-and-publications/download/49/surveys/root-lesion-nematode-survey.pdf)

- Intolerant varieties or crops yield poorly when sown in fields containing large populations of nematodes.

Most pulses have good resistance to both species of *Pratylenchus* and so reduce nematode populations in cropping rotations; exceptions are chickpeas (with both species), and vetch (with *P. thornei*) (Table 2).<sup>22</sup>

Table 2: Resistance and tolerance ratings of pulses to root-lesion nematode

Chickpea varieties have a range of resistance and tolerance to *Pratylenchus* species. S, Susceptible; R, resistant; I, intolerant; T, tolerant; M, moderately; V, very

| Pulse                   | <i>Pratylenchus neglectus</i> |           | <i>Pratylenchus thornei</i> |           |
|-------------------------|-------------------------------|-----------|-----------------------------|-----------|
|                         | Resistance                    | Tolerance | Resistance                  | Tolerance |
| Chickpeas               | S–MR                          | MI–T      | VS–R                        | MI–T      |
| Faba beans              | R                             | –         | MR                          | MI        |
| Field peas              | R                             | –         | R                           | T         |
| Lentils                 | R                             | T         | R                           | MT        |
| Vetch var. Blanchefleur | MR                            | T         | S                           | I–MI      |
| Vetch var. Languedoc    | MR                            | T         | MS                          | I–MI      |
| Vetch var. Morava       | MR                            | T         | MS                          | I–MI      |

## 8.6 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) (Figure 6.)

**There are four possible combinations of resistance and tolerance:**

**Tolerant-resistant**

e.g. sorghum cv. MR43 to *P. thornei*  
and wheat breeding lines released for development

**Tolerant-susceptible**

e.g. wheat cv. EGA Gregory to *P. thornei*

**Intolerant-resistant**

No commercial wheat lines in this category

**Intolerant-susceptible**

e.g. wheat cv. Strzelecki to *P. thornei*

Figure 6: Combinations and examples of tolerance and resistance<sup>23</sup>

Tolerance and resistance of wheat varieties to RLN are published each year at [www.nvtonline.com.au](http://www.nvtonline.com.au) or in *Wheat varieties for Queensland*.

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 DAFF 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*.

<sup>22</sup> QPIF (2009) Root lesion nematodes. Management of root lesion nematodes in the northern grain region. Department of Agriculture, Forestry and Fisheries, [http://www.daf.qld.gov.au/\\_data/assets/pdf\\_file/0010/58870/Root-Lesion-Nematode-Brochure.pdf](http://www.daf.qld.gov.au/_data/assets/pdf_file/0010/58870/Root-Lesion-Nematode-Brochure.pdf)

<sup>23</sup> 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.

GRDC-funded researchers are currently incorporating *P. thornei* resistances found in a wheat line selected from the variety Gatcher<sup>(b)</sup> 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<sup>(b)</sup> and EGA Wylie<sup>(b)</sup>, to produce parents that are adapted to the northern region.<sup>24</sup>

### 8.6.1 Tolerance

Wheat breeding has provided a number of varieties with moderate or higher levels of tolerance to *P. thornei*, e.g. Sunvale<sup>(b)</sup>, Baxter<sup>(b)</sup>, EGA Wylie<sup>(b)</sup> and EGA Gregory<sup>(b)</sup>. 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* (about 2,000 and 19,000 nematodes/kg soil). Figure 7 shows the impact of *P. thornei* on yield of varieties with a range of tolerance levels.

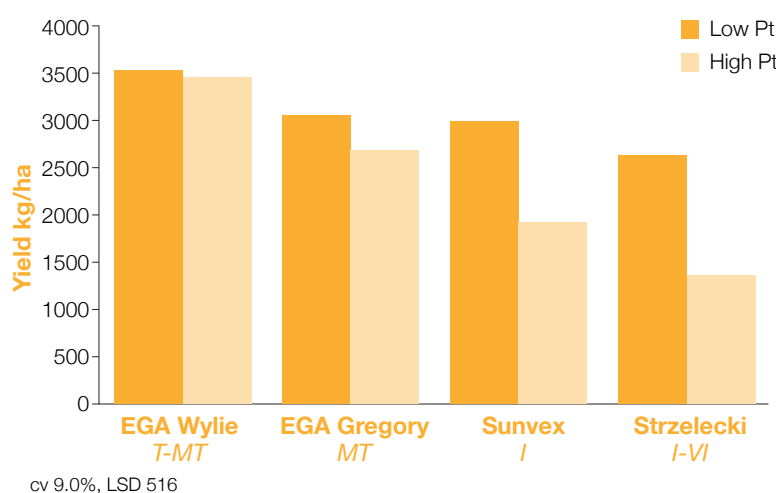


Figure 7: Comparison of wheat variety yields under 'low' and 'high' starting population densities of *P. thornei* (Pt) near Yallaroi 2012 (Trial RH1213)

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

Codes below variety names are the DAFF 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.<sup>25</sup>

The varieties rated as *P. thornei* intolerant (Strzelecki<sup>(b)</sup> and Sunvex<sup>(b)</sup>) suffered significant yield reductions of 35–48 % in this trial when grown in the 'high' *P. thornei* plots. Yield losses of about 1–1.25 t/ha were recorded, with economic losses >\$250/ha. The two varieties that were more tolerant (EGA Wylie<sup>(b)</sup> and EGA Gregory<sup>(b)</sup>) 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.<sup>26</sup>

<sup>24</sup> 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.

<sup>25</sup> K Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

<sup>26</sup> R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013.



### 8.6.2 Resistance

Figure 8 shows the mean *P. thornei* population remaining after a range of winter crops was grown in 2011. Although all crops were sown in individual trials (to enable weed and pest control), the data should generally reflect the resistance differences between these crops.<sup>27</sup>

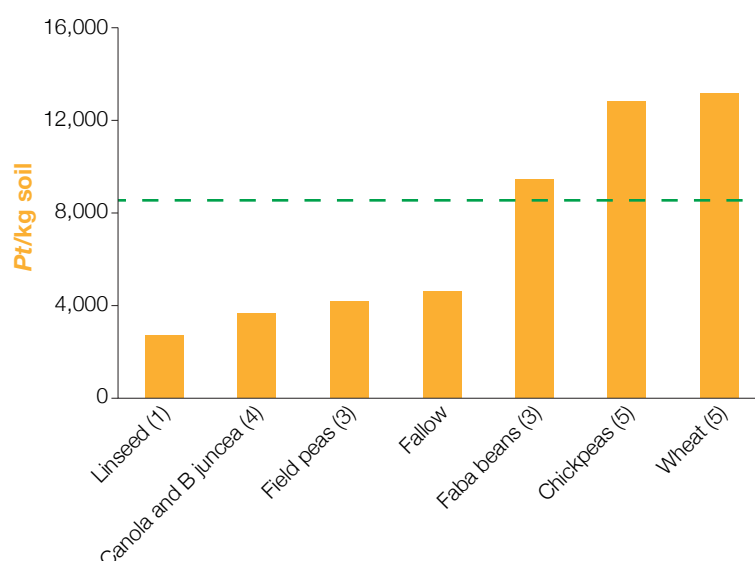


Figure 8: Comparison of *P. thornei* (Pt) population remaining in March–April 2012 following different winter crop species near Weemelah, NSW, 2011 (Trials RH1101–1109). Values in parentheses are the number of varieties of each crop. The solid blue horizontal line indicates the mean *P. thornei* level in March 2011.

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

*Pratylenchus thornei* does not die out completely even after five successive resistant crops. Management of RLN is ongoing and requires regular soil tests to monitor nematode populations.

### 8.6.3 Resistance differences between Desi chickpea varieties

Recent field data are showing consistent differences in Pt resistance between commercial chickpea varieties. Figure 9 shows a summary of the performance of a range of chickpea varieties in 9 trials, during 2010–2014, conducted by DAFF QLD, NSW DPI or NGA.

#### More information

<https://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/07/Managing-root-lesion-nematodes-how-important-are-crop-and-variety-choice>

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

<sup>27</sup> R Daniel (2013) Managing root lesion nematode: how important are crop and variety choice? GRDC Update papers July 2013, <https://www.grdc.com.au/Research-and-Development/GRDC-Update-Papers/2013/07/Managing-root-lesion-nematodes-how-important-are-crop-and-variety-choice>

## More information

K Moore, S Harden, R Brill, N Coombes (2013) Increasing numbers of the root lesion nematode *Pratylenchus thornei* did not affect yield of six chickpea varieties— Coonamble 2012.

K Moore, K Hobson, S Harden, L Jenkins, R Brill (2013) Effect of the root lesion nematode *Pratylenchus thornei* on chickpea yield— Coonamble & Trangie 2012.

Both references at:  
[http://www.dpi.nsw.gov.au/\\_data/assets/pdf\\_file/0004/468328/Northern-grains-region-trial-results-autumn-2013.pdf](http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0004/468328/Northern-grains-region-trial-results-autumn-2013.pdf)

<https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/crop-diseases/root-lesion-nematode>

B Burton, Northern Grower Alliance (2015). Impact of crop varieties on RLN multiplication

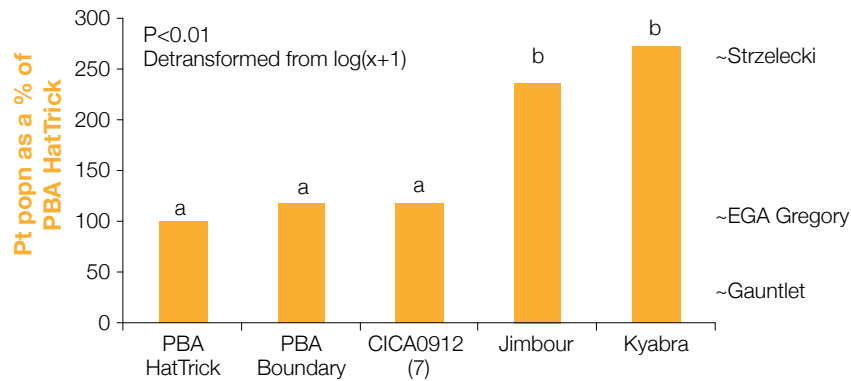


Figure 9: Comparison of Pt population remaining between Desi varieties as a % of PBA HatTrick, 2010-2014. All varieties evaluated in all 9 trials except CICA0912 (only 7 trials).

The position of the wheat varieties on the RHS of the graph indicate the best current estimate of comparison between these varieties for Pt build-up. This data has been generated where Desi chickpeas and wheat have been grown at the same trial site.

Key point: All Desi varieties evaluated to date appear to provide a medium to high risk of Pt build-up. Mean Pt populations after Jimbour and Kyabra have been generally double the level compared to the population remaining after growing either PBA HatTrick or PBA Boundary. Growers with Pt infestations should certainly avoid varieties that support higher populations of Pt.

### 8.6.4 Resistance differences between Kabuli chickpea varieties

Field data has not shown any consistent differences in resistance between the current commercial Kabuli varieties (Figure 10). In general, Kabuli varieties appear to be leaving behind a similar Pt population to the highly susceptible Desi chickpea varieties such as Jimbour and Kyabra. This would suggest all current commercial Kabuli varieties are in the high risk category for Pt build-up.

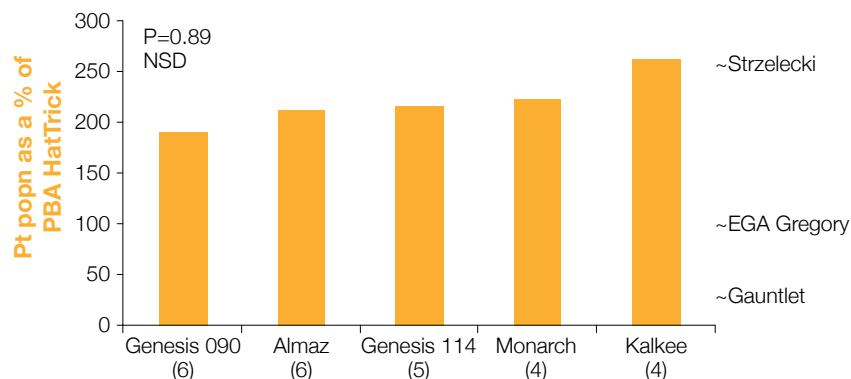


Figure 10: Comparison of Pt population remaining between Kabuli varieties as a % of PBA HatTrick, 2010-2014. (Number) indicates the number of field trials in which the variety was evaluated.

NSD = No significant difference between treatments. The position of the wheat varieties on the RHS of the graph indicate our best current estimate of comparison between these varieties for Pt build-up. This data has been generated where Kabuli chickpeas and wheat have been grown at the same trial site.<sup>28</sup>

<sup>28</sup> B Burton, Northern Grower Alliance (2015), Impact of crop varieties on RLN multiplication. <https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/03/Impact-of-crop-varieties-on-RLN-multiplication>

## More information

[http://www.dpi.nsw.gov.au/\\_data/assets/pdf\\_file/0003/431265/Cereal-pathogen-survey.pdf](http://www.dpi.nsw.gov.au/_data/assets/pdf_file/0003/431265/Cereal-pathogen-survey.pdf)

## 8.7 Damage caused by nematodes

*Pratylenchus thornei* is widespread in the northern grains region, with surveys conducted by DAFF and NSW DPI showing its presence in 50–70% of paddocks. It is frequently at concerning levels, being found at >2,000 individuals/kg soil in about 20 to 30% of paddocks.

Yield losses in wheat of up to 50% are not uncommon when *P. thornei*-intolerant wheat varieties are grown in paddocks infested with *P. thornei*. Yield losses in chickpeas of up to 20% have also been measured in DAFF trials.<sup>29</sup>

## 8.8 Nematodes and crown rot

The NGA has been involved in 22 field trials since 2007, in collaboration with NSW DPI, evaluating the impact of crown rot on a range of winter-cereal crop types and varieties. This work has greatly improved the understanding of crown rot impact and variety tolerance, but also indicates that we may be suffering significant yield 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 *P. thornei* was having a frequent and large impact on wheat variety yield.

These trials were designed to evaluate the effect of crown rot on variety yield and quality. However, they strongly suggest that *P. thornei* is also having a significant impact on yield performance. The results do not compare the levels of yield loss due to the two diseases but do indicate that there is a greater range in variety of *P. thornei* tolerance than currently exists for crown rot tolerance.<sup>30</sup>

### 8.8.1 Importance of variety choice

Variety choice appears a more valuable tool for use under *P. thornei* pressure than for crown rot management. It may be co-incidence, but four of the most widely adopted and successful wheat varieties in the northern grains region (EGA Wylie<sup>(b)</sup>, EGA Gregory<sup>(b)</sup>, Baxter<sup>(b)</sup> and Sunvale<sup>(b)</sup>) are the varieties with the highest currently available level of *P. thornei* tolerance.

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

- Develop sound hygiene practices to help limit further spread and reduce the risk of new infestations
- 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.<sup>31</sup>

<sup>29</sup> K Owen, J Sheedy, N Seymour (2013) Root lesion nematode in Queensland. Soil Quality Pty Ltd Fact Sheet.

<sup>30</sup> R Daniel (2013) Managing root-lesion nematodes: how important are crop and variety choice? Northern Grower Alliance/GRDC Update Paper, 16/07/2013,

<sup>31</sup> R Daniel, S Simpfendorfer, G McMullen, John Thompson (2010) Root lesion nematode and crown rot – double trouble! Australian Grain, September 2010. <http://www.ausgrain.com.au/Back%20Issues/203sogrn10/203sogrn10.pdf>