NORTHERN
JUNE 2018

GRDC
# GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

# VETCH

## SECTION 8

## NEMATODE CONTROL

KEY MESSAGES | ROOT-LESION NEMATODES | STEM NEMATODES

# Nematode management

**Key messages:**

- Nematodes are microscopic organisms that can cause significantly yield losses to susceptible crops.
- There are two species of Root-lesion nematodes (RLN) that can cause damage to susceptible crops in the Northern region; *Pratylenchus thornei* and *P. neglectus*.
- Vetch is rated as moderately susceptible to *Pratylenchus neglectus* and susceptible to *P. thornei*.
- *P. thornei* and *P. neglectus* have been detected at potentially damaging levels in nearly 30% of paddocks in the northern part of the Northern Region, and can be common throughout the southern part of the Northern region.
- There is no easy solution to RLN infestation. Variety and crop rotation are currently the major management tools.
- Predicta B soil testing to detect the presence and abundance of nematode populations is a critical step to minimise the risk of damage.

Nematodes or 'Eelworms' are found in all soils in high numbers and with high diversity. They are microscopic unsegmented roundworms that are one of the most numerous life forms on earth. While many species are free-living and play an important part in organic matter recycling, other species are parasitic to either plants or animals. Plant parasitic nematodes live in plant roots and other plant parts, causing disease. Parasitic nematodes have many hosts and are seldom plant-specific.

Root-lesion nematodes (RLN) can cause damage to vetch crops and vetch can host RLN leading to damage in following crops. Small numbers of the oat race of stem nematode can sometimes be found in Blanchefleur, Languedoc and Namoi vetch. [1]

The aboveground symptoms of disease caused by nematodes can be difficult to detect, and may be often confused with symptoms of nutrient deficiency. Typically, plants do not thrive, are paler than normal, and may wilt in the heat of the day. Affected plants are often dwarfed, with small leaves. Sometimes, when infected plants are growing in moist, fertile soil, or during cool weather, the aboveground parts can still appear healthy. [2]

## 8.1 Root-lesion nematodes

Key points:

- *Pratylenchus neglectus* and *P. thornei* are the main root-lesion nematodes (RLN) that cause yield loss in the northern agricultural region of Australia. They often occur together.
- Root-lesion nematodes cost Australian growers in excess of $250 million a year.
- Root-lesion nematodes reduce the development of lateral roots, and this decreases the ability of plants to extract water and nutrients.
- Traditional break crops can also be hosts, and the host range varies for each *Pratylenchus* species.
- Yield losses can be reduced by rotation with resistant and tolerant crops and varieties, good nutrition, sowing early and testing soil.

The root-lesion nematodes are a genus of soil-borne, microscopic plant parasites that are migratory. They are widely distributed in the wheat-growing regions of Australia, the two common species in the Northern Region being *Pratylenchus thornei* (*Pt*) and *P. neglectus (Pn)*. *P. thornei* is the most damaging species and occurs commonly

1 S Taylor. GRDC GroundCover Issue 22: Stem nematode. https://grdc.com.au/resources-and-publications/groundcover/ground-cover-issue-22/stem-nematode

2 C. Wilkinson. (2014). Nematodes. DAFWA. https://www.agric.wa.gov.au/nematodes/nematodes

## VIDEOS

WATCH: GCTV6: Root-lesion nematodes


WATCH: Understanding root-lesion nematodes


in the northern part of the Northern region (Photo 1). [3] *P. neglectus* occurs less frequently in this area, but is common and can be damaging in the southern part of the Northern region.

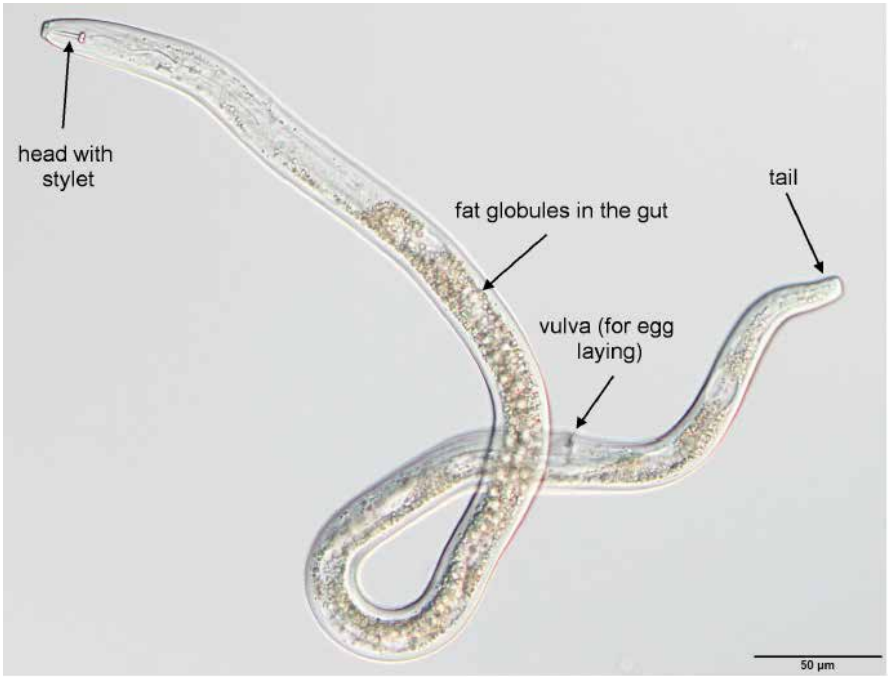


**Photo 1:** *A Pratylenchus thornei adult female viewed under the microscope. The nematode is approximately 0.65 mm long.*

Source: GRDC

Both species grow to ~0.5–0.75 mm in length and feed and reproduce inside the roots of susceptible crops (and other plants). They penetrate the plant root, digesting the cells' contents and laying eggs within the roots (Photo 2). [4] Nematode multiplication differs both between and within host species.

*Pratylenchus thornei* occurs throughout the root zone while *P. neglectus*, tends to be concentrated in the top 15 cm of the soil.

*P. neglectus* and *P. thornei* have a wide range of hosts and infect legumes (including vetch), oilseeds and all cereals. This species impairs root function, limiting water and nutrient uptake, and leads to poor growth and yield decline.

Big populations develop quickly following planting, so that the root systems quickly become inefficient in absorbing water and nutrients. [5]

3 GRDC (2015) Root-lesion nematodes, Northern Region. Tips and Tactics. GRDC, https://grdc.com.au/resources-and-publications/all-publications/factsheets/2015/03/tt-rootlesionnematodes

4 J Thompson, K Owen, T Clewett, J Sheedy, R Reen (2009) Management of root-lesion nematodes in the northern grain region. DAF Queensland, https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/crop-diseases/root-lesion-nematode

5 GRDC (2015) Root-lesion nematodes, Northern Region. Tips and Tactics. GRDC, https://grdc.com.au/resources-and-publications/all-publications/factsheets/2015/03/tt-rootlesionnematodes

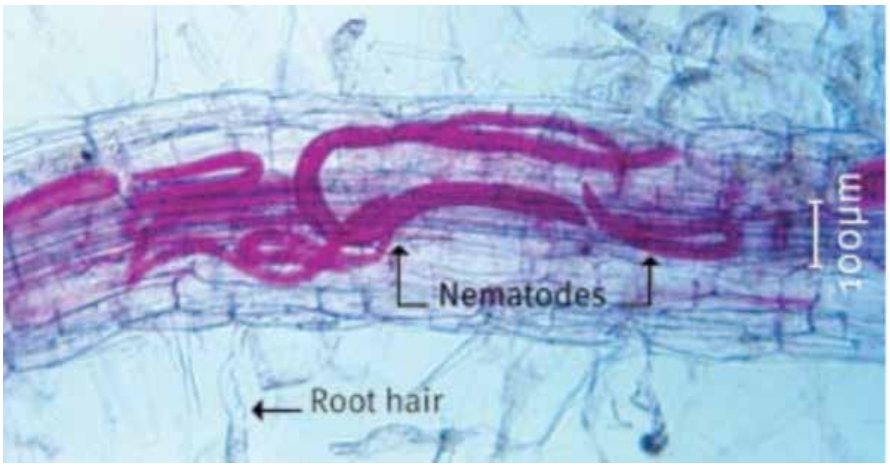


**Photo 2:** *Nematodes (stained to make them easy to see) in a cereal-plant root.*

Source: DAF Queensland

In 2015, SARDI generated maps of the distribution of *P. thornei* and *P. neglectus* from samples submitted for PreDicta B tests (Figure 1). [6] Results from the autumn samples show that in the northern part of the Northern Region, *P. thornei* (Pt) is more widely distributed and found in greater, more damaging populations than *P. neglectus* (Pn). In this region, paddocks with more than 15 *P. thornei*/g soil or 15,000/kg soil (ascertained by the PreDicta B test) are considered high risk for crops. However, populations of *P. thornei* classified as being of medium risk, that is 2–15/g soil or 2,000–15,000/kg soil, can cause substantial yield loss in intolerant varieties in the warm, wet growing seasons that are conducive to nematode reproduction. [7]

6 K Owen, T Clewett, J Sheedy, J Thompson (2016) Managing grain crops in nematode fields to minimize loss and optimise profit. GRDC Update Paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/03/Managing-grain-crops-in-nematode-infested-fields-to-minimise-loss-and-optimise-profit

7 K Owen, T Clewett, J Sheedy, J Thompson (2016) Managing grain crops in nematode-infested fields to minimise loss and optimise profit. GRDC Update Paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/03/Managing-grain-crops-in-nematode-infested-fields-to-minimise-loss-and-optimise-profit

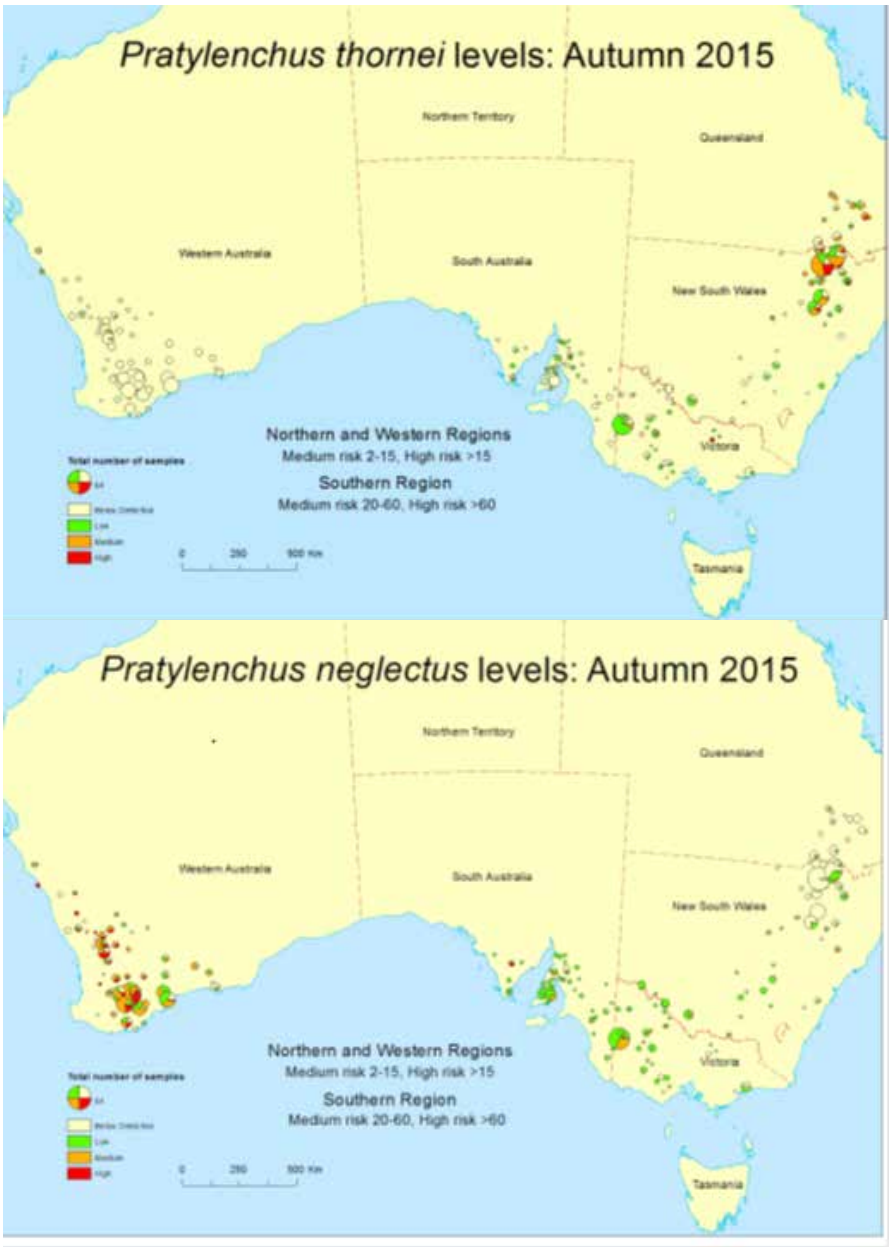


**Figure 1:** *The distribution of RLNs and risk of yield loss, from samples submitted for PreDicta B tests to SARDI in autumn 2015 for (top) Pratylenchus thornei and (bottom) P. neglectus.*

Source: GRDC

In a survey of soil samples from 596 paddocks in southern Queensland and northern New South Wales cropping areas consistently show *P. thornei* presence in ~60–70% of paddocks. *This nematode is* frequently present at concerning levels, detected at over 2 *Pt*/g soil in ~30–40% of paddocks. In this survey, it was found that 42% of paddocks tested had *P. thornei* alone, 27% had both species, 6% had *P. neglectus* alone, and 26% had neither species (Figure 2). [8]

## MORE INFORMATION

Managing grain crops in nematode infested fields

8 J Thompson, K Owen, T Clewett, J Sheedy, R Reen (2009) Management of root-lesion nematodes in the northern grain region. DAF Queensland, https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/crop-diseases/root-lesion-nematode

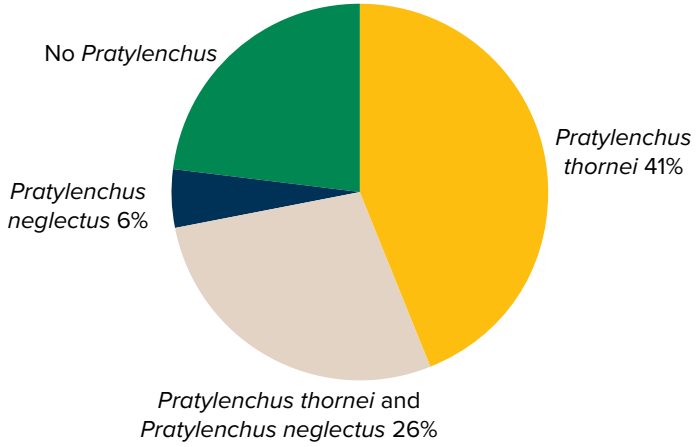


**Figure 2:** *A survey of nematodes in 596 paddocks in the Northern Region revealed that P. thornei is the most commonly found root-lesion nematode in the region (prior to recent region boundary changes) and that P. neglectus is also present.*

Source: DAF Queensland

## 8.1.1 Varietal resistance or tolerance

Some crops, varieties and plant types have different levels of resistance to different species of the *Pratylenchus* family. Vetch is moderately susceptible to *P. neglectus* and susceptible to *P.thornei*. Vetch can be a host to RLNs and is not considered a break crop against RLNs.

### What does resistance and tolerance mean?

Resistant varieties will result in fewer nematodes remaining in the soil to infect subsequent crops. Tolerant varieties are able to perform well in the presence of the nematode, but they may allow nematode populations to build up.

Nematode Resistance relates to the effect of the variety on the nematode density present within the paddock (Table 1).

**Table 1:** *Standard disease ratings.*

| Uniform rating | Management option description | In the paddock | Management action |
|---|---|---|---|
| Resistant | Growing these varieties will reduce the density of the nematode in question and so reduce yield loss in subsequent intolerant crops. | There will be a reduction in nematode densities when these varieties are grown. | Use these varieties in rotation with non-host crops to reduce nematode infestations. If using R varieties in paddocks with high nematode infestations make sure variety is also tolerant to prevent significant yield loss. |

| Uniform rating | Management option description | In the paddock | Management action |
|---|---|---|---|
| Moderately resistant | Growing these varieties will, to a lesser degree than growing a resistant variety, reduce the density of the nematode in question and, therefore, reduce yield loss in subsequent intolerant crops. | There will be a reduction in nematode densities when these varieties are grown. | These varieties are suitable to be grown in paddocks with high nematode infestations as they reduce nematode densities. They will, however, not reduce nematode densities to the same degree as a resistant variety. Note that if nematode densities are high tolerant to minimise yield loss. |
| Moderately susceptible | Growing these varieties will result in a small increase in nematode densities during the season. | Growing these varieties will increase the nematode density. However, unless the season is exceptionally favourable, growing these varieties in paddocks with low level nematode densities will only increase densities to moderate levels. If nematode densities are already moderate these varieties may result in high densities that may cause substantial loss in a following intolerant variety. | These varieties are suitable to be grown in paddocks with low nematode densities. They will, however, increase nematode densities which may be a problem for a following intolerant crop. |
| Susceptible | Growing these varieties will increase nematode density which may then cause problems to a following intolerant crop. | Growing these varieties will result in increases in the density of the nematode in question. However, unless the season is exceptionally favourable, growing these varieties in paddocks with a low level will only result in moderate levels. If nematode densities are already moderate these varieties can result in high levels that may cause substantial loss in a following intolerant variety. | These varieties will increase the density of nematodes in a paddock that may be of concern to a following intolerant crop. If nematode densities are high following a susceptible crop, growers should avoid intolerant crops in the following year and select a resistant crop to reduce nematode densities. |

| Uniform rating | Management option description | In the paddock | Management action |
|---|---|---|---|
| Very susceptible | Growing these varieties will support large multiplication rates of the nematode. It may take more than one year of a resistant variety/non-host crop to reduce the nematode densities to a level that will not affect the yield of an intolerant crop. | These varieties will support large increases in nematode numbers when grown in infested paddocks. | Growers should where possible avoid growing these varieties in infested paddocks. Also avoid growing intolerant varieties after VS varieties due to the potential for significant yield loss. A tolerant non-host crop/ resistant variety should be used following VS varieties to reduce nematode densities. If nematode densities are very high it may take more than two years of non-host/resistant varieties to reduce nematode levels to low risk densities. |

Source: NVT Online)

Nematode Tolerance relates to yield of the variety in the presence of the nematode (Table 2).

**Table 2:** *Standard disease ratings.*

| Uniform rating | Management option description | In the paddock | Management action |
|---|---|---|---|
| Tolerant | Variety will not lose yield in the presence of the nematode, even at high nematode densities. | The crop will not be affected by the presence of the nematode. | No economic management decisions required. |
| Moderately tolerant | These varieties can generally be sown in paddocks with low to medium levels of nematode infestations without a significant effect on grain yield occurring. These varieties can suffer yield loss (up to 10%) in the presence of high nematode densities. | Minimal yield loss will occur in the presence of the nematode (i.e. < 5%), except when nematode densities are high when up to 10% yield loss may occur. | Do not grow these varieties in paddocks with high nematode densities present. Suggest follow management recommendations to minimise yield loss for the nematode of concern. |

| Uniform rating | Management option description | In the paddock | Management action |
|---|---|---|---|
| Moderately intolerant | These varieties should not be grown in paddocks with medium to high nematode densities. In the presence of high nematode densities in a paddock these varieties will lose up to 30% yield. | In the presence of the nematode and in seasons conducive to disease, these varieties will lose yield and may show symptoms consistent with root damage. The expression of symptoms will be greater in paddocks with higher nematode densities. | These varieties should not be grown in paddocks with medium to high nematode densities. In the presence of high nematode densities in a paddock these varieties can lose up to 30% yield. Suggest follow management recommendations to minimise yield loss for the nematode of concern. |
| Intolerant | These varieties are prone to yield loss even in the presence of low nematode densities. Such varieties should not be grown in paddocks where nematodes are known to be present. In the presence of high nematode densities yield loss of up to 50% can occur. | In the presence of the nematode symptoms of root disease will often be easily found in the crop. | Do not grow these varieties in paddocks where the nematode is present at medium to high levels. Even paddocks with low nematode densities should be avoided when possible. Suggest follow management recommendations to minimise yield loss for the nematode of concern. |
| Very intolerant | Do not grow this variety unless the paddock is known to be nematode free or present at very low densities. High nematode densities could cause yield losses of greater than 50% to occur. | Symptoms of nematode damage will be present in these varieties even in the presence of low nematode densities. | Do not grow these varieties in paddocks where the nematode is present, even at low levels. If the variety is to be grown a soil test should be conducted prior to sowing to ensure that the paddock is free from the nematode in question. Suggest follow management recommendations to minimise yield loss for the nematode of concern. |

Source: NVT Online

### 8.1.2 Damage caused by pest

In the southern part of the northern region *P. neglectus* can cause major losses to susceptible crops. In southern Australia *P. neglectus* has been known to reduce grain yield by 10–20% and in Western Australia is has been reported to cause losses of up to 15%. [9]

9 V Vanstone, J Lewis (2009) Plant parasitic nematodes Factsheet. GRDC.

In the northern part of the Northern region, intolerant varieties can lose more than 50% in yield when *P. thornei* populations are high. [10]

### 8.1.3 Conditions favouring development

Root lesion nematodes survive summer as dormant individuals in dry soil and roots, and become active after rain. They can survive several wetting/drying cycles. About three generations of the nematodes are produced each season, with the highest multiplication in spring.

Nematodes can spread through a district in surface water (e.g. floodwater) and can be moved from one area to another in soil that adheres to vehicles and machinery. They can also move via soil adhering to vehicles and farm machinery. In uninfested areas, good hygiene should be adopted. Nematodes can be spread in dust when they are in a dehydrated state over summer.

They have the ability to quickly build up populations in the roots of susceptible crops, and remain in the soil during fallow. As a result, the yield of following crops can be significantly reduced.

### 8.1.4 Detection

Soil testing is the best way to diagnose nematode infestations and also to inform growers' management decisions. It is important to know whether nematodes are present and which species these are, a soil test will do this for you. This is important because varietal tolerance information for *P. thornei* does not hold true for *P. neglectus*, so proper species identification can help minimise losses that arise from planting intolerant varieties in nematode-infested land.

RLN populations can persist in the soil for a long time. Once a population increases, non-host, resistant crops or fallows are required to reduce the population below the damage threshold. Planting susceptible or tolerant crops within this period will enable the rapid increase in populations to higher levels. [11]

There are two services available to test for RLNs.

#### Leslie Research Centre tests

The Leslie Research Centre of the Department of Agriculture and Fisheries Queensland offers a commercial test for the presence of nematodes in soil.

Since nematodes may not be evenly spread across a paddock, particularly when there are new infestations, it is important to take samples from several locations within a paddock. It is suggested that growers take nine cores in groups of three.

Nematodes are often more numerous in the subsoil than in the topsoil. Although you can have soil to a depth of 120 cm analysed, this isn't necessary. As long as soil is sampled in two layers, topsoil at 0–15 cm and subsoil at 15–30 cm, a useful result can be achieved. Use a hand corer (or a mattock if no corer is available). Topsoil-only samples can give inaccurate results and should always be accompanied by a subsoil sample. If deeper samples are already being taken for other analysis (e.g. nitrate), a nematode assessment can be made from the depths 0–30 cm, 30–60 cm and 60–90 cm.

**MORE INFORMATION**

How long does it take to reduce *Pratylenchus thornei* (root lesion nematode) population in the soil?

Impact from *Pratylenchus thornei*, Macalister 2015

10 B Burton, R Norton, R Daniel (2015) Root-lesion nematode: importance, impact and management. GRDC Update Paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/08/Root-lesion-nematodes-importance-impact-and-management

11 J Whish, J Thompson (2016) How long does it take to reduce Pratylenchus thornei (root lesion nematode) population in the soil? GRDC Update Paper. GRDC, https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2016/02/how-long-does-it-take-to-reduce-pratylenchus-thornei-populations-in-the-soil

MORE INFORMATION

Leslie Research Centre, Test your farm for nematodes

Send samples to:
Soil Microbiology Section
Leslie Research Centre
PO Box 2282
Toowoomba, QLD 4350
13 Holberton Street
Toowoomba

Phone: (07) 4639 8888
Fax: (07) 4639 8800

### PreDicta B tests

PreDicta B is a DNA-based soil-testing service that was developed by the South Australian Research and Development Institute (SARDI) (The B in the name stands for broadacre). The test identifies which soil-borne pathogens pose a significant risk to broadacre crops before paddocks are planted. [12]

PreDicta B can be used to test for Root-lesion nematodes including *P. neglectus* and *P. thornei*.

Growers can access PreDicta B diagnostic testing services through a SARDI accredited agronomist, who will interpret the results and give advice on management options to reduce the risk of yield loss. Samples are processed weekly between February and mid-May (prior to crops being sown).

PreDicta B is not intended for in-crop diagnosis.

## 8.1.5 Thresholds for control

The damage threshold for both RLNs has been estimated at 2,000 nematodes/kg soil (or 2/g soil). Control is warranted for paddocks with populations over this density. [13]

paddocks with more than 15 *P. thornei*/g soil or 15,000/kg soil are considered high risk for crops. However, populations of *P. thornei* classified as being of medium risk, that is 2–15/g soil or 2,000–15,000/kg soil, can cause substantial yield loss in intolerant varieties in the warm, wet growing seasons that are conducive to nematode reproduction. [14]

The number of nematodes in the soil can be determined by conducting soil testing, for example with a PreDicta B test.

## 8.1.6 Management

Key points:

- Know your enemy—test soil to determine whether RLN are a problem and which species are present.
- Select varieties rated as having a high tolerance to minimise yield losses in RLN-infected paddocks.
- To manage RLN populations, it is important to increase the frequency of RLN-resistant crops in the rotation.
- Multiple resistant crops in a rotation will be necessary for the long-term management of RLN populations.
- Avoid crops or varieties that allow the build-up of large populations of RLN in infected paddocks.
- Monitor the impact of your rotation.

12 D Lush (2014) PreDicta B sampling strategy. GRDC, https://grdc.com.au/Media-Centre/Media-News/South/2014/04/PreDicta-B-sampling-strategy

13 GRDC (2015) Root lesion nematodes. Tips and Tactics. GRDC, https://grdc.com.au/resources-and-publications/all-publications/factsheets/2015/03/tt-rootlesionnematodes

14 K Owen, T Clewett, J Sheedy, J Thompson (2016) Managing grain crops in nematode-infested fields to minimise loss and optimise profit. GRDC Update Paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2016/03/Managing-grain-crops-in-nematode-infested-fields-to-minimise-loss-and-optimise-profit

There are four key strategies in reducing the risk of root-lesion nematodes:

1. Have soil tested for nematodes in a laboratory (For more information, see Section 8.1.4 Detection).
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 varieties to maximise yields; National Variety Trials online is a useful resource. Tolerant varieties grow and yield well when RLN are present.
4. Rotate with resistant crops to prevent increases in root-lesion nematodes (Figure 6). When high 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 to ensure that the yield potential of tolerant varieties is achieved. Crop rotation with resistant crops such as grain sorghum, millet, sunflower and lupins will reduce the numbers of nematodes in the soil to a level where susceptible varieties can be grown. However, it will not eliminate them completely. [15]

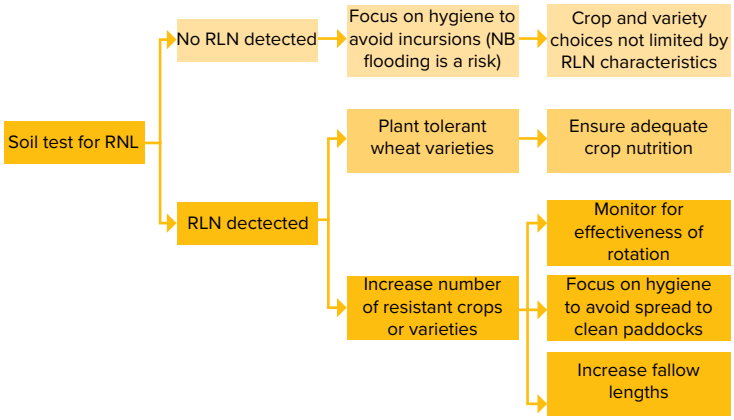


**Figure 3:** *The simplified RLN management flow chart. It highlights the critical first step in the management of RLN is to test soil to determine whether you have a problem to manage. Where RLN are present, growers should focus on both planting tolerant wheat varieties and increasing the number of resistant crops and varieties in the rotation.*

Source: GRDC

## VIDEOS

WATCH: Root lesion nematodes part 3: What can I do?


The first step in management of RLN is to have soil tested to determine whether RLN are present in paddocks. If RLN are detected, the soil test will tell you which of the species is present and the population level in the field. If RLN are not detected, protect those paddocks from contamination by controlling movement of soil and water on the farm. Clean soil from machinery before planting or fertilising, and plant RLN-free paddocks first.

When RLN are detected, rotations and variety choice are central to successfully reducing RLN populations. Only non-host crops or resistant varieties will minimise the build-up of RLN (Tables 3 and 4). Aim to reduce populations to less than 2/g soil. Re-testing of soil after growing resistant crops is recommended, so that crop sequences can be adjusted if populations are still at damaging levels. Avoid very susceptible crops and varieties. [16] Consider re-testing in five years, particularly if there has been flooding, because RLN can move in floodwaters and in soil.

15 DAF Qld (2015) Wheat: diseases, physiological disorders and frost. DAF Queensland, https://www.daf.qld.gov.au/plants/field-crops-and-pastures/broadacre-field-crops/wheat/diseases

16 GRDC (2015) Root-lesion nematodes, Northern Region. Tips and Tactics. GRDC, https://grdc.com.au/resources-and-publications/all-publications/factsheets/2015/03/tt-rootlesionnematodes

**Table 3:** *Susceptibility of some crop and pasture species to root lesion nematode infection.*

| RLN species | Susceptible crops | Moderately susceptible crops | Resistant crops |
|---|---|---|---|
| *Pratylenchus neglectus* | Canola, chickpeas, mustard | Common vetch, lentils | Field peas, narrow leaf lupins, faba beans, triticale, safflower, cereal rye, medic, clover |
| *Pratylenchus thornei* | Chickpeas, vetch, faba beans | Canola, mustard, field peas*, lentils | Field peas*, lupins |

* New field pea varieties are more susceptible to *P. Thornei* than older varieties, so check the classification of each variety.
Source: GRDC

**Table 4:** *Comparison of the risk of build-up of Pratylenchus thornei and P. neglectus in crops.*

| Crop | P.thornei | P.neglectus |
|---|---|---|
| **Cereals** | | |
| Barley | Medium to high | Low to medium |
| Canary seed | Low | Low |
| Maize | Low | Low |
| Millet | Low | Low |
| Oats | Low | NT |
| Sorghum (grain) | Low | Medium to high |
| Triticale | Medium to high | Low |
| Wheat | Low, medium to high | Low, medium to high |
| **Legumes** | | |
| Blackgram | High | Medium (p) |
| Chickpeas | Medium to high | Low to medium |
| Cowpeas | High | NT |
| Faba beans | Medium to high | Low |
| Field peas | Low to medium | NT |
| Navy beans | High | NT |
| Pigeon peas | Low | NT |
| **Oilseeds** | | |
| Canola, mustard | Low to medium | Medium to high |
| Cotton | Low | Low |
| Linseed | Low | Low |
| Soybeans | High | Low |
| Sunflowers | Low | Low |
| **Pastures, forage** | | |
| Brassica (forage) | Low to medium | NT |
| Lablab | Low | NT |
| Sorghum (forage | Low | Medium to high |

Source: GRDC

## VIDEOS

WATCH: Crop variety effect on nematodes

### Fallow

RLN populations will generally decrease during a 'clean' fallow but the process is slow and expensive in lost potential income. Additionally, long fallows may decrease arbuscular mycorrhizae (AM) levels and create more cropping problems than they solve.

### Weed control

Weeds can play an important role in the increase or persistence of nematodes in cropping soils. Thus, poor control of susceptible weeds compromises the use of crop rotations for RLN management. Wild oat, barley grass, brome grass and wild radish are susceptible to *P. neglectus*. When a pasture is included in the cropping rotation, weeds strongly influence nematode populations at the end of the pasture phase. Manage volunteer susceptible crop plants that can harbour nematodes. This will be important when growing vetch as it can be a problem volunteer crop. [17]

### Nutrition

Damage from RLN reduces the ability of cereal roots to access nutrients and soil moisture, and can induce nutrient deficiencies. Although under-fertilising is likely to exacerbate the impact of RLN-affected yields, over-fertilising is unlikely to *compensate* for a poor variety choice.

Adequate nutrition (especially nitrogen, phosphorus and zinc) normally allows plants to better tolerate plant parasitic nematodes, although this does not necessarily lead to lower nematode reproduction.

Field trials in areas infested with *P. neglectus* have shown yield losses for intolerant wheat ranged from 12–33% when minimal levels of phosphorus were applied but losses were reduced to only 5% with a high (50 kg/ha) rate of phosphorus.

### Nematicides (control in a drum)

There are no nematicides registered for use against RLN in broadacre cropping in Australia. Screening of potential candidates continues to be conducted, but RLN are very difficult to target because populations are frequently deep in the soil profile. [18]

### Natural enemies

Biological suppression is a potential method of reducing populations of *P. thornei* and *P. neglectus*. Recent research has identified that Northern Region soils are capable of suppressing root-lesion nematodes, especially in the top layer (0–15 cm), and this capacity can be enhanced by increasing the biological activity of that soil, mainly through carbon inputs and minimising soil disturbance.

Several organisms that prey on nematodes have been found in northern soils that have the potential to reduce root-lesion nematode populations. They include the *Pasteuria* bacteria that infect and eventually kill *Pratylenchus* spp. Several species of fungi, including some that trap nematodes, and predatory nematodes have also been found.

Research is continuing to develop methods of increasing biological activity to enhance natural suppression of nematodes deeper in the soil profile.

## 8.2 Stem nematodes

Stem nematode feeds on the emerging shoot, crown and above-ground parts of host plants, resulting in distorted and stunted growth. The population can build up rapidly as the nematode can reproduce four or five times in a season.

**MORE INFORMATION**

Biological suppression of RLN in northern region

National Variety Trials

GRDC Tips and Tactics, Root-lesion nematodes, Northern Region

17 V Vanstone, J Lewis (2009) Plant parasitic nematodes Factsheet. GRDC.

18 B Burton, R Norton, R Daniel (2015) Root-lesion nematode; importance, impact and management. GRDC Update Paper. GRDC, https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/08/Root-lesion-nematodes-importance-impact-and-management

The nematode can survive and spread between districts in infected hay. Localised spread is possible by soil contamination of stock and machinery and in surface water, wind-blown stubble or soil.

Stem nematode can survive in a dehydrated form in hay and seed for 10 years or more. Weeds can play a key role in the survival of stem nematode when there are no host crops. This explains why the nematode can recur after paddocks have not grown susceptible crops for a number of years.

The oat race of stem nematode has the widest host range and high numbers can cause crop failure. Oat race can sometimes be found in Blanchefleur vetch.

### What to look for

- distorted and stunted plant growth — patches of 1–100 m in emerging crops
- a plant or seed test is available through the Field Crops Pathology Unit, SARDI

### What to do

- include resistant crops and varieties in planned rotations
- control host weeds
- observe farm hygiene [19]

19 GRDC Stem nematode https://grdc.com.au/resources-and-publications/groundcover/ground-cover-issue-22/stem-nematode