

Tiny worms: Nematodes in Australian cotton

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Nematodes might be considered by some as tiny worms, but they're not true worms — and they are not always tiny. The world's biggest nematode, *Aniskis physeteris*, has been measured at up to 13 metres long! The good news is that you are unlikely to see it because it's a sperm whale parasite.

It is nematodes that occur in the soil that concern cotton growers. Most of these are less than one mm, but they can be tremendously important. Did you know that nematodes are the most abundant soil animals! In fact nematodes are so numerous that if the entire terrestrial ecosystem was removed, apart from nematodes, you would still be able to make out the continents from space.

Not only are they present in soil in large numbers, but there are also many different types of nematode. They can be carnivorous, omnivorous, herbivorous (plant parasitic and plant associated), bacterial feeders, fungal feeders, or parasitic (both to animals and insects) and play an important role in a number of ecosystem functions. Nematodes, like so much of the microscopic life in soil, really are quite amazing.

Why should you care about nematodes?

There are two main reasons — one good and one not so good. Good news first: the

majority of soil nematodes perform functions that are of tremendous benefit to soil, such as nutrient cycling. The bad news is that, in some instances, plant parasitic nematodes have become pests of certain crops including cotton. This is a brief overview of these two functions of nematodes from an Australian cotton production perspective.

The not so good news

In the US and India, plant parasitic nematodes present a problem for cotton production. They do this in two ways.

Some plant parasitic nematode populations are large enough to cause a yield loss through damage to cotton roots. There is also evidence that the severity of some plant diseases caused by fungal pathogens can be increased by the presence of plant parasitic and plant associated nematodes, again affecting yield.

Over the Past couple of years, we have looked more closely at nematode populations in the Namoi valley. The reasons for this were two fold — to establish if there were differences in nematode populations in the soil under different cotton varieties and to see if there was an interaction between nematode populations and incidence of Verticillium wilt.

To date we have seen little to no difference in populations under different cotton

varieties and no evidence of an interaction with Verticillium. But we did make some interesting observations about the parasitic nematodes found in our samples.

- Plant parasitic nematodes made up a very small percentage (less than 0.5 per cent) of the total number of nematodes recovered (Figure 1);
- The plant parasitic spiral nematode, *Helicotylenchus dihystera*, was observed within cotton roots (Figure 2);
- The stunt nematode, *Tylenchorhynchus ewingi*, was found in soils associated with cotton production (Figure 3); and,
- Nematodes belonging to the genus *Pratylenchus* were recovered in some cotton soil samples where wheat was grown in rotation.

The good news

Most nematode populations are comprised of different species that feed on bacteria, fungi, other nematodes, and plants, with the bacterial feeders being the most numerous, followed by the fungal, plant and nematode feeders, respectively. This is in keeping with most of the observations we have made (Figure 1).

The importance of this population structure is that there are a lot of nematodes feeding on other soil organisms, digesting them and excreting valuable waste products often rich in nitrogenous compounds. Nematodes therefore play an important role in nutrient cycling, a key component in sustainable and healthy crop production.

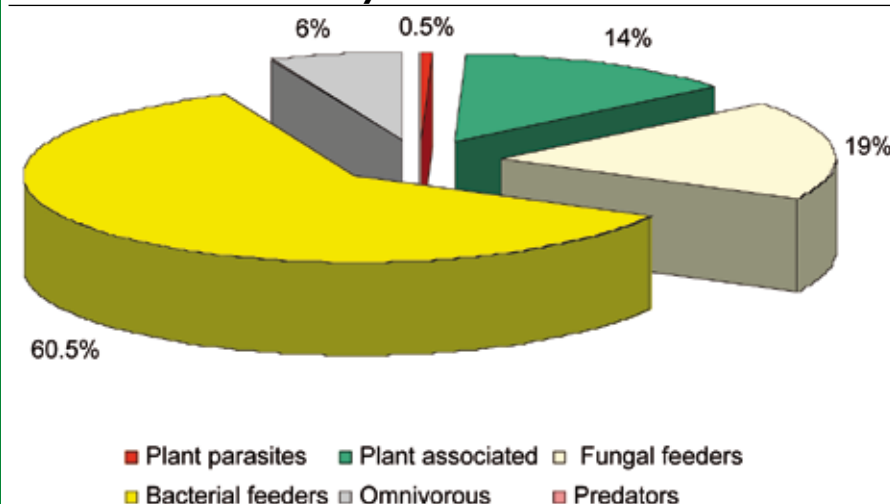
Nematodes also distribute bacteria around the soil. The overall importance of this is not fully understood, but the movement of bacteria by nematodes to areas richer in nutrient may have further implications for nutrient cycling and other soil functions.

In summary, the good points about nematodes in Australian cotton soils are:

- Most soil populations are largely comprised of bacterial feeding nematodes;
- These are important for nutrient cycling as they convert the resources stored in the bacteria to forms accessible by plants;

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FIGURE 1: The mean percentages of the various nematode trophic groups recovered from 42 soil samples taken under cotton in the Namoi Valley in the 2005–06 season



- The heavy clay soils often found in cotton production areas do support nematode populations and populations of all free-living nematodes increase after defoliation in response to the addition of carbon from leaves (Figure 4);
- There are very few plant parasitic nematodes in these populations under cotton and their presence was not associated with problems in the crop or with yield losses;
- No association has been observed between Verticillium wilt and nematodes, although plant parasitic nematode populations were very low; and,
- *H. dihystra* and *T. ewingi* are considered to be only weakly pathogenic in US cotton production.

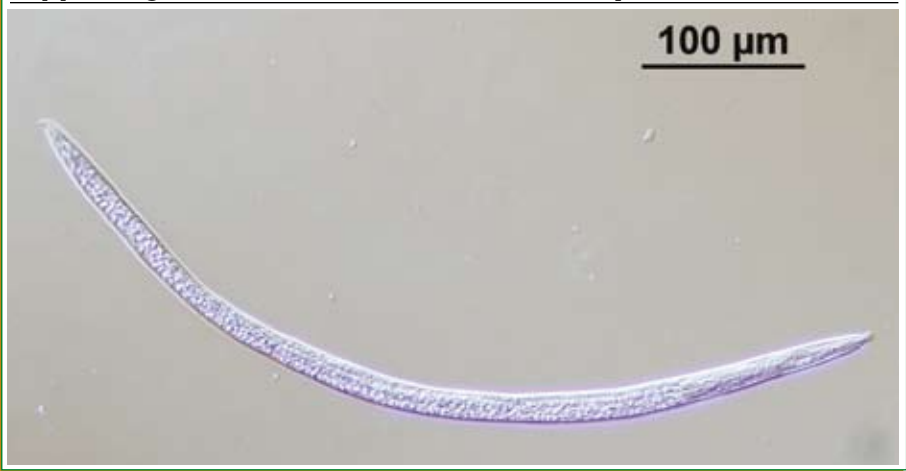
Nematodes in other Australian crops

Root-lesion nematodes (*Pratylenchus thornei* and *P. neglectus*) are widely distributed in the wheat-growing regions of Australia and can reduce grain yield by up to 50 per cent in many current wheat varieties. *P. thornei* is the most damaging species and occurs commonly in the northern grains region.

P. neglectus occurs less frequently than *P. thornei*, but is still quite common. A third nematode, *Merlinius brevidens* (stunt nematode), is the most commonly identified plant-parasitic species but is not thought to be economically damaging to wheat.

Although wheat is the preferred host for root-lesion nematodes, other crops like

FIGURE 3: *Tylenchorhynchus ewingi* isolated from soil supporting cotton in the lower Namoi Valley



chickpea and mungbean also suffer yield loss and are good hosts of these nematodes. Some crops like sorghum and sunflower are poorer hosts and are therefore thought to be useful in rotations to manage the root-lesion nematodes.

Within the range of wheat varieties available to be grown, there is a range of tolerance to this pest. It is important therefore for wheat producers to be aware of the presence of root-lesion nematodes in their soil, and to know whether these nematodes are at levels that can cause potential grain yield loss.

A tale of woe from overseas

So there isn't a nematode problem in our Australian cotton systems. Most of our nematodes are doing good things, and the plant parasitic ones that are in the soil currently aren't in high enough numbers to be

causing a problem with cotton. So should cotton growers be wary?

The reniform nematode, *Rotylenchus reniformis*, is the most damaging nematode of cotton in Alabama, Louisiana and Mississippi. In Alabama, *R. reniformis* is estimated to reduce yield across the state by nine per cent. It was first discovered there in a few fields in 1958, but it was not until 1986 that substantial yield losses in a few fields were attributed to this nematode.

By 2003, *R. reniformis* was found at levels high enough to be considered a threat to economic production in 46 per cent of fields sampled across the state and reduced yields by 20 per cent in nearly half of those fields.

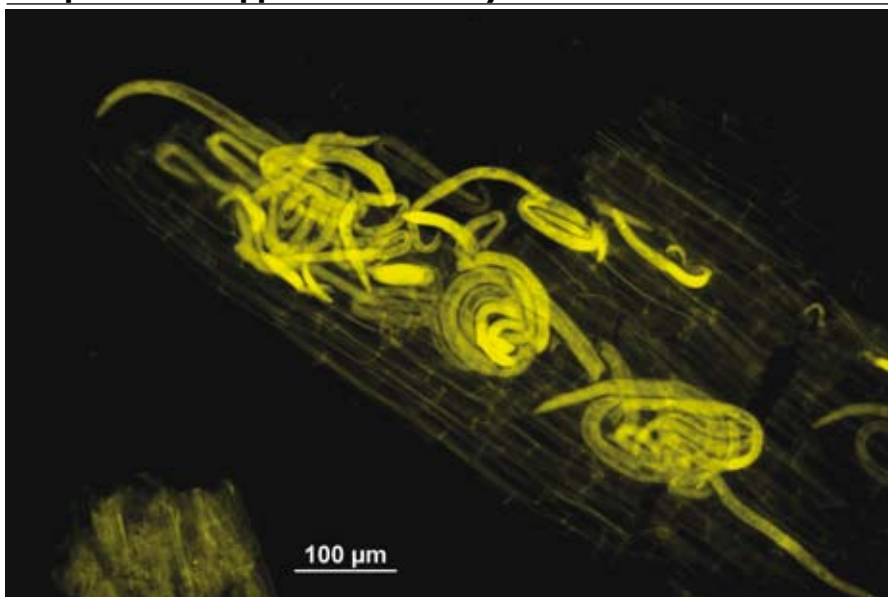
What's the lesson to be learned? *R. reniformis* has and continues to be spread in the US by surviving in soil attached to farm equipment and vehicles. Exclusion is the best form of defence so remember to come clean, go clean.

Current cotton management practises

It might seem surprising, but while there are nematode issues in many crops in Australia, including several grown on soils that also support cotton production, we have not as yet had an incidence of nematode problems in Australian cotton.

What are the reasons for this? We don't actually know, but there are a few possibilities. Firstly, the populations of what might be considered potential pathogens are low. Secondly, the soils we favour for cotton production and the flood irrigation practises might be helping to limit the potential for plant parasitic nematodes to interact with the crop. Thirdly, the widespread use of the insecticide, aldicarb, in cotton production is probably having a huge impact

FIGURE 2: *Helicotylenchus dihystra* within a cotton root sampled in the upper Namoi Valley



on the nematode populations as well as a number of other crop pests.

This is hardly surprising given that aldicarb was originally licensed as a nematicide. Whatever the reason, Australian cotton production is not presently threatened by a serious nematode pest.

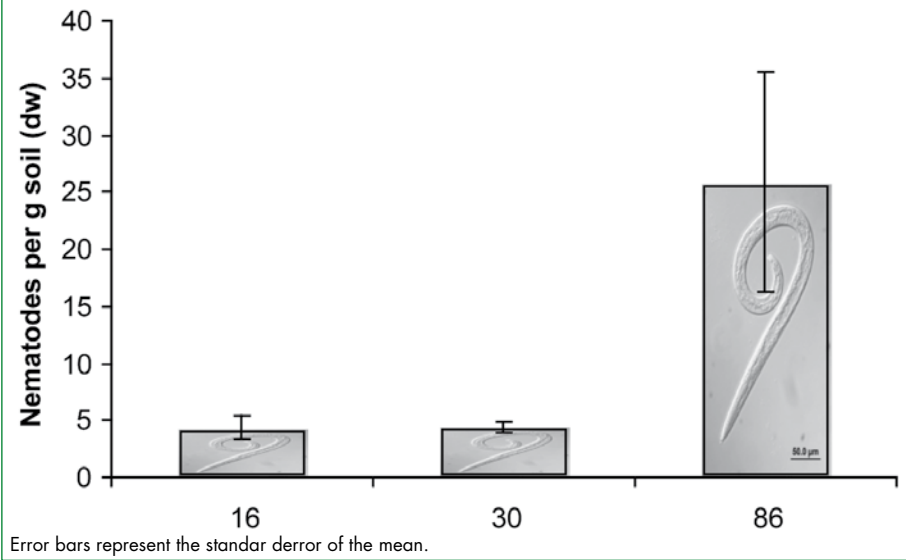
The take home messages

- There are nematodes in Australian cotton production systems, but most of these are of tremendous benefit to a healthy soil and crop production;
- There are some potentially pathogenic nematodes in cotton soils, but so far these do not pose a problem under our current crop management practices (that is, flood irrigation and aldicarb use may be important in controlling populations of plant pathogenic nematodes in cotton); and,
- Keep it this way. Remember to come clean, go clean!

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FIGURE 4: The average number of nematodes recovered from soil sampled from under cotton plants following defoliation



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