Pasteuria bacteria are most likely to multiply when a controlled traffic and minimum till farming system is adopted.

Beneficial bacteria can help reduce losses from nematode pests

Project details

Key Focus Area

Soil health, nutrient management, and environmental sustainability

Project name

Regenerating a soil food web

Project number

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Chief investigator

Graham Stirling

Scientists have been studying the biocontrol capacity of an underground bacteria that has the potential to deliver productivity improvements to the Australian sugar industry, with their research also suggesting that it is only likely to be effective when best-practice farming systems are used.

Soil biologists have dug deeper into their understanding on the interaction between the bacteria Pasteuria penetrans *and its impact on plant-parasitic nematodes, providing useful information for sugarcane growers and millers.*

The bacteria – called *Pasteuria penetrans* – is a natural parasite of root-knot nematodes, which are microscopic creatures that can damage the roots of sugarcane, resulting in lost production for sugarcane growers and millers.

In new collaborative research conducted at SRA's Woodford pathology research station, scientists have discovered that when there is a high concentration of *Pasteuria* in the root zone of sugarcane plants, the bacteria significantly reduces populations of root-knot nematode, one of the most damaging pests of sugarcane.

Project leader Dr Graham Stirling said that root-knot nematode is widespread in light-textured cane-growing soils and managing the pest is challenging because current sugarcane varieties are susceptible. There are also no economically-effective control measures.

The researchers said that the key message from their research was that the bacteria was most likely to multiply when a controlled traffic and minimum till farming system is adopted. When soil is cultivated, the interaction between *Pasteuria* and its nematode host is disrupted and this prevents the parasite reaching the high densities required to achieve nematode control.

Another important message was that water and nutrient inputs had to be optimised, as this reduced losses from the nematode while the beneficial bacteria were multiplying.

"Importantly, some growers are already using best practice farming systems like this and – provided they are maintained for several sugarcane crop cycles – we would predict that *Pasteuria* will gradually increase to levels that will suppress root-knot nematode," Dr Stirling said.

The research was led by Dr Graham Stirling of Biological Crop Protection as part of the SRA-funded project *Regenerating a soil food capable of improving soil health and reducing losses from soil-borne pests and pathogens of sugarcane*.

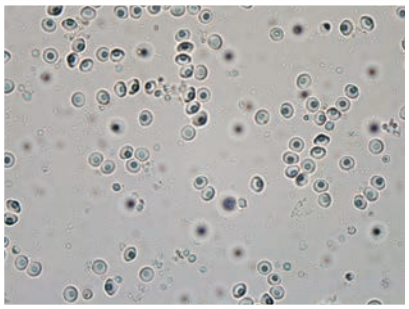
The experiments involved collaboration with SRA Leader for Disease Traits, Dr Shamsul Bhuiyan, and Dr Jay Anderson from the University of Queensland.

Soil was collected from a field in Bundaberg where root-knot nematode was heavily-infested with *Pasteuria*. When it was used in a pot experiment at SRA's Woodford glasshouse, the results showed that the parasite was having a major impact on root-knot nematode populations. The nematode was inoculated into *Pasteuria*-infested and *Pasteuria*-free soil and when nematode populations were checked 19 and 37 weeks later, 96 percent and 99 percent fewer root-knot nematodes were recovered from the naturally-infested field soil than from the soil that did not have *Pasteuria*.

In another experiment, sugarcane was grown in sand containing a range of spore concentrations and the effects of *Pasteuria* were assessed after 6, 13 and 20 months. The results showed that the severity of root galling and the number of nematode eggs produced per plant decreased as the spore concentration increased. At the highest spore concentration (50,000 spores/gram soil), root-knot nematode populations were reduced by more than 80 percent.

Dr Stirling said that, collectively, these results show that *Pasteuria* is a useful biocontrol agent, as it can markedly reduce populations of root-knot nematode in cane-growing soils.

"*Pasteuria* has the potential to provide significant economic benefits, as nematodes are costing the sugar industry more than $80 million per year in lost production," he said.



Pasteuria spores – after the spores germinate, the parasite spreads through the nematode's body, preventing reproduction.

Above: Root-knot nematode.

Above: Nematode infected with the *Pasteuria* bacteria.

What is *Pasteuria penetrans?*

- *Pasteuria* are specialised parasites of nematodes. Spores of the bacteria attach to the nematode as it moves through soil. After the spores germinate, the parasite spreads through the body of the nematode and prevents it from reproducing.
- The bacterial genus *Pasteuria* contains hundreds of nematode-attacking strains that are relatively specific to particular hosts. The bacteria infects all important nematode pests and because it prevents its host from reproducing and its endospores are resistant to environmental stresses such as heat and dryness, it is one of the most useful biological control agents of plant-parasitic nematodes.
- A recent survey of sugar production areas in Australia showed that *Pasteuria* was present in more than half the fields sampled, with spores being seen on root-knot (right), root-lesion, stunt, and spiral nematode. In most cases infestation levels were relatively low, with less than 5 percent of the nematodes having spores attached. However, several sites had relatively high infestation levels, indicating that when appropriate management practices are used, *Pasteuria* will multiply and provide some control of nematode pests.

Roots with galling from root-knot nematode.