PLANT AND SOIL NEMATODES

BURROWING NEMATODE (*RADOPHOLUS SIMILIS*), THE MOST IMPORTANT NEMATODE PEST OF BANANA IN AUSTRALIA

Burrowing nematode (*Radopholus similis*), root-knot nematode (*Meloidogyne* spp.), spiral nematodes (*Helicotylenchus dihystera* and *H. multicinctus*), lesion nematode (*Pratylenchus goodeyi*) and reniform nematode (*Rotylenchulus reniformis*) are the most common plant-parasitic nematodes on banana in Australia. This fact sheet focuses on burrowing nematode, as it is by far the most important nematode pest.

Life cycle of burrowing nematode

R. similis is a migratory endoparasite that completes its life cycle in roots. Males have poorly developed stylets and probably do not feed, but the females live in roots and lay 4-5 eggs per day over a period of about 2 weeks. The life cycle takes 20-25 days at temperatures between 24°C and 32°.

Symptoms of damage

Burrowing nematode invades roots and feeds on cortical tissue, producing obvious lesions that eventually coalesce and kill the root. Fungal pathogens may also colonise nematode-damaged root systems and hasten the destruction of roots. Red, purple, and black lesions are a characteristic symptom, and since affected roots do not function effectively, stools lack vigour and produce small bunches. Plants also topple over in wet, windy weather.

Burrowing nematodes feed on cortical tissue as they migrate through banana roots, causing distinct lesions that eventually girdle the roots. The damage is so severe that the root system can no longer anchor the plant, and so mature plants topple over in tropical storms.

Integrated management of burrowing nematode

In the early 1990s, non-volatile organophosphate and carbamate nematicides were the primary nematode control tactic in bananas. However, concerns that field staff would be exposed to chemicals known to be toxic to humans; that the nematicides would move off-site following periods of high rainfall; and that they would lose efficacy due to enhanced microbial degradation; led the industry to establish a research and extension program aimed at developing sustainable management practices. The result was an integrated management program with several components.

Clean planting material and prevention of spread

Tissue-cultured plantlets that are free of *R. similis* play a key role in preventing the nematode being moved to locations where bananas have never been grown previously. Many growers use nematode-free plantlets to establish their plantations, while others plant them in nurseries dedicated to producing vegetative planting material that is free of plant-parasitic nematodes. Some owners of new plantations have also established quarantine procedures that prevent the introduction of *R. similis* on machinery and footwear.

Nematode monitoring

Monitoring is an important component of an integrated nematode management program because it enables a grower to check whether burrowing nematode is likely to be affecting yield. Roots are collected from a field and split longitudinally, and damage ratings are assigned according to the extent of necrotic lesion development in the root cortex. The results are then used to calculate a Disease Index. Studies have shown that for every increase of 1 in the Disease Index, there is a loss of about 0.5% of the bunch weight. Thus, a Disease Index greater than 10 indicates that some yield loss is likely to be occurring, while an index of 30 indicates that losses will be significant. However, the environment in which the crop is grown will influence actual losses to some extent.

The Disease Index method is a relatively simple and rapid test, and most growers either assess their crops every 3-6 months or have it done by a commercial monitoring service. The main benefit is that it allows growers to determine whether the control measures they are using in a particular area are effective.

Removal of volunteer bananas and crop rotation

The volunteer bananas that grow during the fallow period between cropping cycles are a major cause of carryover of burrowing nematode from one crop to the next. Eliminating these volunteers with herbicides will help reduce populations. A nematode-resistant rotation crop can also be used to reduce numbers of *R. similis*. Several grasses and various brassicas are poor hosts, but the crops that have proved most acceptable are Rhodes grass for fallows greater than 12 months, and *Brassica* spp. for a short winter fallow. Some growers also use sugarcane as a long-term rotation crop, but it is important that appropriate cultivars are selected.

Retention of crop residues, and inputs of organic amendments

The crop residues that accumulate on the soil surface due to de-leafing, de-suckering and harvest operations typically amount to 10-25 t dry matter/ha. If these residues are allowed to accumulate around the base of the banana plant, then the soil becomes a more favourable environment for the natural enemies of nematodes, and so populations of plant-parasitic nematodes, including *R. similis*, will decline. The application of organic amendments such as grass hay, mill mud (a by-product from sugarcane mills) and compost, has a similar effect.

Enhancing nematode-suppressive services and improving soil health

When used collectively, practices such as crop rotation, retention of crop residues, and organic amendments will increase soil carbon levels, and this will have flow-on effects to the soil such as lower bulk density, improved aggregate stability, better aeration, improved water-holding capacity, better water infiltration and drainage, and greater mineralisation of nutrients. These improvements in the soil's physical and chemical properties mean that the plant will be in a better position to tolerate the damage caused by *R. similis*. Another important outcome of greater inputs of organic matter is that the natural suppressive services which regulate populations of plant-parasitic nematodes begin to operate more effectively, and so numbers of *R. similis* will decline. Thus, improving the health of a soil is an important component of integrated management programs for *R. similis*.

Nematicides

The organophosphate and carbamate nematicides previously used in the Australian banana industry have been phased out due to their toxicity to humans. Several new nematicides have been developed by the agrochemical industry but because an effective integrated nematode management program is now in place, it remains to be seen whether they will be registered on banana.

Further reading

Stirling GR, Pattison AB (2008) Beyond chemical dependency for managing plant-parasitic nematodes: examples from the banana, pineapple and vegetable industries of tropical and subtropical Australia. *Australasian Plant Pathology* 37, 254-267.

Pattison AB, Cobon JA, Araya-Vargas M, Chabrier C (2023) Towards sustainable management of nematodes in banana. In Drenth A, Kema G (eds.) *Achieving sustainable cultivation of bananas Volume 3: Diseases and pests*. Burleigh Dodds Science Publishing (in press).

Fact sheet PSN 036. Updated 3 February 2023

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