PLANT AND SOIL NEMATODES

INTEGRATED NEMATODE MANAGEMENT

This fact sheet explains how multiple tactics can be used to control plant-parasitic nematodes. A more sustainable approach that only uses tactics that improve rather than degrade the soil biological community is covered in another fact sheet entitled Integrated Soil Biology Management (PSN 012).

Integrated pest management (IPM)

IPM has been promoted as a means of managing pests for more than 60 years and is now used to reduce losses from many different pests, including insects, weeds, rodents, and plant pathogens. Essentially, it is a pest control strategy that uses ***all possible means in a compatible manner to maintain pest population densities below levels that cause economic damage***.

A key feature of IPM is that chemical intervention is not the only control option. Instead, a variety of techniques are used to reduce pest populations to tolerable levels. Chemical pesticides are only applied as a last resort.

Although effective IPM programs are now available for most pests, there are many situations where calendar-based application of chemicals remains the rule rather than the exception. Nematode management in vegetable crops is a typical example. Rotation crops and nematode-resistant varieties are sometimes used but control is largely achieved with soil fumigants and nematicides.

The need for more sustainable management systems

Although soil fumigants and nematicides usually provide satisfactory levels of nematode control, there are many reasons why growers should consider integrating other practices into their management programs.

- Over-use of a nematicide often results in loss of efficacy due to enhanced biodegradation. When a nematicide is repeatedly applied, soil microorganisms capable of utilising the chemical will multiply and rapidly reduce its concentration to levels that are no longer effective. Enhanced biodegradation caused a widely used nematicide (Nemacur®) to become ineffective on some farms in the 1990s, and it is also known to reduce the efficacy of metham sodium, a fumigant that is currently registered in Australia. After using nematicides for more than 60 years, we now know that if a chemical is regularly applied, its efficacy will eventually be limited by enhanced biodegradation.
- There is no guarantee that chemicals registered today will be available tomorrow. Three widely used nematicides (ethylene dibromide, methyl bromide and fenamiphos) were removed from the marketplace because they were found to be detrimental to human health or the environment. Thus, adoption of IPM should be viewed as a risk management strategy. Growers who use multiple tactics to achieve nematode control will be in the best position to cope if a nematicide they often use is de-registered.
- Some nematicides are ineffective when nematode population densities are high. Thus, the best way to use them successfully is to introduce other control practices so that the nematicide is more likely to be effective.
- All nematicides, but particularly the soil fumigants, are detrimental to the naturally occurring organisms that recycle nutrients and prey on nematode pests. Growers who wish to retain these beneficial organisms and improve the biological health of their soil need to become less reliant on nematicides and develop more sustainable nematode management programs.

Nematode-resistant cultivars and rootstocks are another example of single tactics that are often used to control nematodes. Although usually successful in the short term, nematode resistance sometimes fails in the long-term because resistance-breaking biotypes of the nematode eventually develop.

Key components of an IPM program for nematode pests

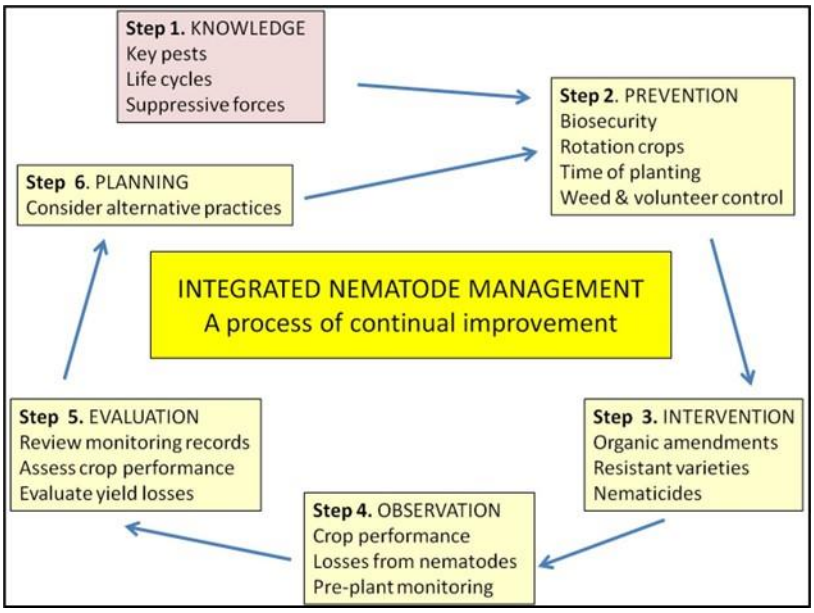
The tactics that can be used to minimise losses from nematode pests will differ from crop to crop and farm to farm, but several of the practices listed below should ideally be included in an IPM program.

- An **on-farm biosecurity system** to prevent the introduction of plant-parasitic nematodes that are not yet present but would cause crop losses if they were introduced

- A **nematode monitoring program** to identify the plant-parasitic nematodes present on the farm, map their distribution, and indicate fields where populations are high and control measures are required
- A **rotation and cover cropping program** in which nematode-resistant crops suitable for the local environment are grown to reduce populations of the key nematode pest and also improve soil health
- **Antagonistic or biofumigant rotation crops** that release substances that are toxic to nematodes when they are growing, or when they are decomposing
- **Modifications of planting times** so that crops are planted when soil temperatures are less likely to favour multiplication of a damaging nematode pest
- **Solarisation, tillage, and bare fallowing** to reduce nematode population densities prior to planting
- A control program to **eliminate weeds** that may carry over the key nematode pest from one crop to the next
- **Organic amendments** and **biomass inputs from plants** that will improve the soil's physical chemical and biological properties, increase the number of organisms that parasitise or prey on nematodes, and enhance the soil's capacity to suppress plant-parasitic nematodes
- **Nematode-resistant cultivars** that will prevent the pest nematode from multiplying to high population densities and causing damage
- **Optimal fertiliser inputs and irrigation practices** to help the crop compensate for nematode damage
- Use of methods such as hot water treatment to ensure that **planting material** (e.g. seeds, corms, tubers, rhizomes or rootstocks) is **nematode-free**
- **Chemical and biological nematicides** that can be used as a last resort if additional control is required

Implementation of IPM

The practices listed above will reduce nematode populations when used individually, but multiple tactics have a greater impact. However, growers wishing to establish an IPM program for nematodes must first determine which combination of practices provides an economically acceptable level of control. Also, growers who decide to move down the IPM pathway need to accept that their management practices must be continually evaluated and refined (see the figure below). Provided this is done for a few years, the ultimate reward is an effective nematode control program that will reduce the need for chemical nematicides.



Further reading

Sikora RA, Roberts PA (2018) An overview of integrated nematode management technologies. In Sikora et al. (eds.) Plant parasitic nematodes in subtropical and tropical agriculture. CABI, Chapter 23.

Author: Graham R Stirling, Plant and Soil Nematodes. **Contact details:** graham.stirling@biolcrop.com.au