NEMATODES—NEW SOUTH WALES

Key points
- Thousands and thousands of nematode species live in soil. Most of them are beneficial while others are harmful to plants.
- Pest nematodes feed on plant roots and cause yield loss.
- Beneficial nematodes feed on fungi, bacteria and other soil organisms, and help to suppress the activity of pest nematodes.

Background
Nematodes are the most abundant multicellular animals on earth. They are small, non-segmented worm-like animals about 0.3–5 mm long, sometimes called eelworms. Most nematode species have a beneficial role in the soil, but a few are pest species that feed on plant roots, and damage roots directly or make them more susceptible to fungal diseases. Beneficial nematodes are important in controlling the pest species and improving the soil health.

As with most soil organisms, nematodes are concentrated in the top few centimetres of the soil (0–20 cm) and in the rhizosphere around plant roots. They live in the thin films of water surrounding soil particles, as they require water to move. More nematodes are found in well-structured soils with large pore spaces, or coarser soils.

How do beneficial nematodes help soil fertility?
Nutrient cycling
Nutrients, including nitrogen and phosphorus, stored in the bodies of bacteria, fungi, and other organisms are released when nematodes eat and digest them. The bacteria and fungi contain more nutrients than the nematodes need so the excess is released into the soil in a form that can be used directly by plants. Some beneficial nematodes physically break down organic matter, which increases its surface area, making it easier for other organisms to break it down further. This promotes the cycling of carbon and nutrients in the soil.

Dispersal of microbes
Bacteria and fungi cannot move around in the soil without ‘hitching a ride’ inside or on the back of nematodes. Nematodes are parasitised by some bacteria and fungi, which helps their dispersal as nematodes move in the soil.

Insect and pest control
Some predator nematodes attack and kill a range of pests such as borers, grubs, thrips and beetles with negligible effects on other organisms (figure 1). These nematodes use two strategies to find their prey. Some species wait for their prey to move past them in the soil and locate them by direct contact: This is called ‘ambushing’. The ambushers function at the soil surface where they attack highly mobile pests such as cutworms. Others actively search out their prey using a ‘cruising’ strategy. They function at various depths in the soil and prey on slow moving targets such as grubs and weevil larvae. These nematodes are known as ‘entomopathogenic’ nematodes.

Suppression of plant parasitic nematodes
Since effective chemical control of pest nematodes is not practical in most farming situations, managing pest nematodes relies primarily on crop rotations using non-host varieties and resistant cultivars. Some soils are ‘suppressive’ and can prevent the development of pest and disease problems in crops, even when the pathogens and favourable conditions are present. The mechanisms of suppressive soils, and the management techniques that support the process are currently being researched, but common features are high levels of soil carbon, and an active and diverse soil biology.

Diverse populations of beneficial nematodes help suppression by predating the generally smaller plant parasitic nematodes. These nematodes are highly abundant in soil rich with organic matter. The natural tendency of beneficial nematodes to concentrate around the active roots of plants means they are placed to reduce the access of the parasitic nematodes to the roots and protect them from attack (figure 2).

**Figure 1:** Predatory Nematodes attacking a fungus Gnat Larvae. Photo: Ontario Ministry of Agriculture
Soil high in organic matter also harbours many fungi that parasitise the females and eggs of pest nematodes, while others can trap and consume them (figure 3).

**Management effects on nematodes**
Agricultural cultivation tends to encourage an increase in plant parasitic nematodes over other species. This is partly because cultivation is more disruptive to larger soil organisms than small ones, and so favours the smaller plant parasitic nematodes. Cultivation also disrupts soil fungi, which are the food source for many beneficial nematodes. Nematicides applied to target plant parasitic nematodes can also reduce the population levels of beneficial nematodes. Other agricultural chemicals produce ‘non-target’ effects that also reduce beneficial nematode populations both directly and indirectly by reducing their food sources.

To ensure beneficial nematodes remain abundant in the soil, or to allow damaged populations to recover, they need food (organic matter and other soil organisms), water, and minimal disturbance of the soil. Management options that support beneficial nematodes in soil also support soil biology in general.

**Nematodes as indicators**
Analysis of the diversity and complexity of nematode communities in the soil is a valuable tool, which indicates soil biological fertility, or soil health. The different ratios of bacterial, fungal feeders and other types indicate the type of soil functions that are occurring. Varying ratios can indicate the types of food web (carbon or nitrogen based) and the status of disturbance, maturity, structure or degradation.

Further reading and references
This factsheet is adapted from the Soil Biology Basics information series. The New South Wales Department of Primary Industries has soil biology information, including the complete Soil Biology Basics series (online).

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**Figure 2:** A predatory nematode from the family Mononchidae feeding on another smaller nematode. Photo: Nikki Seymour

**Figure 3:** A nematode trapped by a fungal network. Photo: Nikki Seymour