PLANT AND SOIL NEMATODES

FREE-LIVING AND OTHER BENEFICIAL NEMATODES: AN IMPORTANT COMPONENT OF THE SOIL BIOLOGICAL COMMUNITY

A wide range of nematodes live in soil but the plant-parasitic nematodes which damage the roots of cultivated crops and reduce their yields receive the most attention. Nematodes that feed on roots but do not cause damage are usually ignored, even though they benefit the plant. Free-living nematodes are also overlooked because the many beneficial roles they play in the soil environment are not widely recognised. This fact sheet provides an overview of both groups of nematodes.

The soil nematode community

Nematodes are found in terrestrial, marine and freshwater environments and are the most numerous multicellular animals on earth. Most terrestrial nematodes are relatively small (0.3 to 0.8 mm long) and live in water films and water-filled pores. There are usually between 1 and 10 million of these nematodes in every square metre of soil but numbers are highest in upper soil layers where plant roots, organic matter and other resources are most abundant. Most of these nematodes play an important role in keeping our plants and soils healthy, but unfortunately, most people are not aware of them.

Plant-parasitic nematodes, and plant associates

Plant-parasitic nematodes are the most widely studied group of terrestrial nematodes because they feed on the roots of plants and reduce the yield of many agricultural crops. However, there is another group of plant-feeding nematodes that are beneficial. They are termed plant associates because they feed on fine roots and root hairs and don't damage the plant. The reason these nematodes are beneficial is that labile carbon is exuded from roots during the feeding process and it helps sustain a microbial community around the roots that provides the plant with nutrients and protects it from pathogens.

Plant associates are sometimes the main component of the nematode assemblage when grasses and other plants that produce relatively fine roots dominate the landscape (e.g. grass pastures and cereal crops). In such situations, these nematodes will be helping to keep the plants healthy.

Fig. 1. A plant associate (family Tylenchidae) showing the stylet used to feed on fine roots and root hairs

Free-living nematodes

The vast majority of terrestrial nematodes feed on other soil organisms, and as they don't use plants as a food source, they are termed free-living nematodes. These nematodes can be subdivided into four functional groups based on their feeding habits, which can be deduced from the structure of the oesophagus and mouthparts (Fig. 2). Nematodes which feed on bacteria are by far the most common trophic group and they either suck bacteria through a tube-like or funnel-shaped mouth, or use their lips to scrape bacteria off surfaces. Fungal feeders are quite different, as they have a delicate spear that is used to pierce fungal hyphae and spores. Predatory nematodes have a broad, open mouth armed with teeth that is used to consume other soil nematodes. Omnivores use a retractable spear to feed on other nematodes, fungi, bacteria, protozoa, and algae, with their food source depending on environmental conditions and food availability.

In addition to having different food sources, free-living nematodes vary in size and the length of their life cycles. Bacterial- and fungal-feeding nematodes are relatively small nematodes, and as they have very short life cycles (often only 5-15 days), populations respond quickly when a new food source becomes available. Omnivorous and predatory nematodes are much larger (commonly 1-3 mm long) and multiply much more slowly, often having generation times of weeks or months.

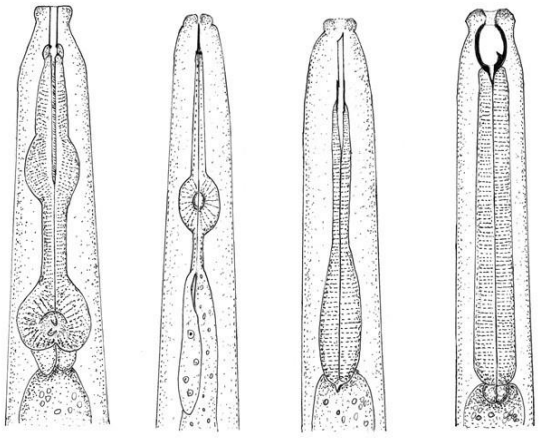
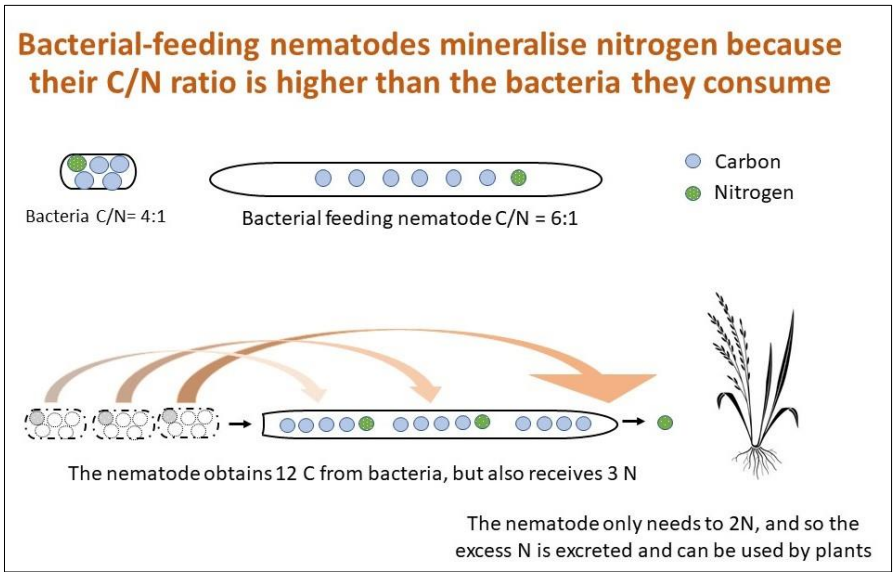


Fig. 1. Mouthparts and oesophagus of the four trophic groups of free-living nematodes (from left to right). Bacterivore, fungivore, omnivore and predator.

Ecological roles of free-living nematodes

Free-living nematodes contribute a variety of functions in soil and play an important role in maintaining soil fertility.

Nutrient mineralisation. The process of converting nutrients from an organic to inorganic form is termed mineralisation and it plays a vital role in keeping plants healthy. Plants primarily take up inorganic forms of nutrients but because most of the nutrients in soil are in in the bodies of soil organisms and are therefore in an organic form, they must be mineralised before plants can use them. Free-living nematodes, especially bacterivores, play an important role in this process because, as shown in the diagram below, nutrients such as N are mineralised when they consume bacteria, and this helps maintain adequate levels of plant-available N in the root zone.



Enhancement of biological activity. When bacterial-feeding nematodes graze on bacteria, they not only enhance nutrient cycling but also rejuvenate old, inactive bacterial colonies. This activates the soil biological community and ensures that organic residues are continually decomposed, and so the nutrients within them do not remain immobilised and unavailable for plant uptake.

Biological control. Predatory and omnivorous nematodes consume other nematodes, including plant-parasitic nematodes, and therefore help to regulate populations of these pests.

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