Photo. 1. View of part of a nematode soil community under the microscope (25X).
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Nematodes as suitable indicators for soil health

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During the Greenresilient project, nematode communities (photo 1) will be characterized at the beginning, in the middle and at the end of the field trials to identify shifts in their community. These shifts will be analysed to determine whether the chosen 'innovative' methods tested in the project are beneficial for soil health, causing an increased resilience to pests and diseases and a more balanced nutrient supply, for more sustainable and high-quality crop production. This leaflet explains why nematodes can be excellent indicators for soil health.

Soil nematodes are small but diverse, abundant and everywhere

Nematodes are simple, worm-like creatures. Most of them are only 1 mm long. Hence, nematodes are largely unknown to many people. However, they belong to the most diverse and abundant group of animals on earth. More than one million species are estimated to exist and a soil nematode community can contain densities of up to 20 million individuals per square meter. Nematodes can be found in almost all habitats from deep sea to deserts, and from the tropics to polar permafrost.

Soil nematodes feature varying life characteristics

Different nematodes have a different preference for food resources (photo 2). Most soil nematodes feed on bacteria or fungi, stimulating these populations of microorganisms to renew constantly and thus maintaining the release of nutrients at an efficient high level. A number of soil nematodes are predators or omnivores, feeding on other nematodes, insect larvae, slugs and snails. If these prey organisms are plant pests, the predators and omnivorous nematodes play a role in biological control. Other nematodes feed on plant material. Some species are plant-parasitic causing yield and quality loss to many different agricultural crops.

Photo 2. Different nematode species. From left to right. *Pratylenchus penetrans* (plant-parasitic), *Diploscapter* sp. (bacterial feeder), *Aporcelaimellus* sp. (predator)
Source: ILVO, Flanders Research Institute for Agriculture, Fisheries and Food ©.

Soil nematodes vary in terms of size, length of life and fecundity. They are also more sensitive to changes in soil environment than other organisms due to their permeable body wall. As a consequence, nematode species differ with respect to behavior towards external disturbance. Indeed, when tillage, mowing, fertilization practices, etc. follow each other rapidly, the group with a longer life span and low fecundity has no time to recover and will eventually be eradicated. This has an immediate effect on soil biodiversity and soil health.

Soil nematodes as an indicator of soil health

Due to the different characteristics in soil nematode communities, assessment of nematodes has the potential to provide unique insights into many aspects of soil processes. Furthermore, their generation time (days to years) is longer than metabolically active microorganisms (hours to days) making them temporally more stable, not simply fluctuating with nutrient flushes. Moreover, nematodes are easy to extract from the soil using simple extraction procedures and they can be sampled in all seasons, making them ideal test subjects.

Example of nematodes as an indicator of soil health

Organic and ecological farmers provide nutrients to the soil by incorporating green manure cover crops, decomposed or partially decomposed animal manure, compost, and other sources of organic material. Although various organic amendments can have differential effects, all tend to increase microbial biomass and abundance of bacterivorous and fungivorous nematodes. After a couple of years, an increase in number of omnivore and predatory nematodes can occur as well. It has been demonstrated that this effect can suppress the plant-parasitic root-lesion nematode *Pratylenchus penetrans* (photo 2, left), a nematode causing damage to vegetables and a decrease in quality and yield (photo 3). So, the presence of omnivore and predatory nematodes points to healthier soil, which is able to suppress nematode (and other) pests.

Photo 3. Young black salsify plants (*Scorzonera hispanica*) infected by an increased number of *Pratylenchus penetrans* nematode individuals. The plant on the left is unaffected.
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