



Nematodes in the Soil

Kurt Nagel

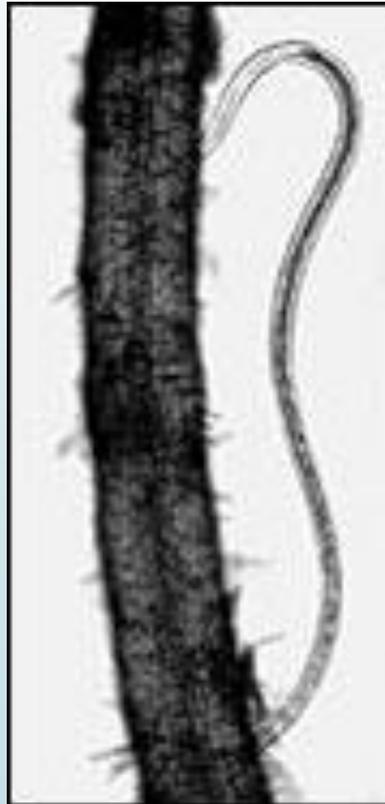
University of Missouri Extension

Agronomy Specialist

What is a Nematode?



USDA-ARS micrograph



U. Zunke, Institut für Angewandte Botanik photo

- Nematodes are roundworms in the animal phylum Nemata
- Present on all farms in soils, plants and animals
- Range in size from several centimeters long to microscopic

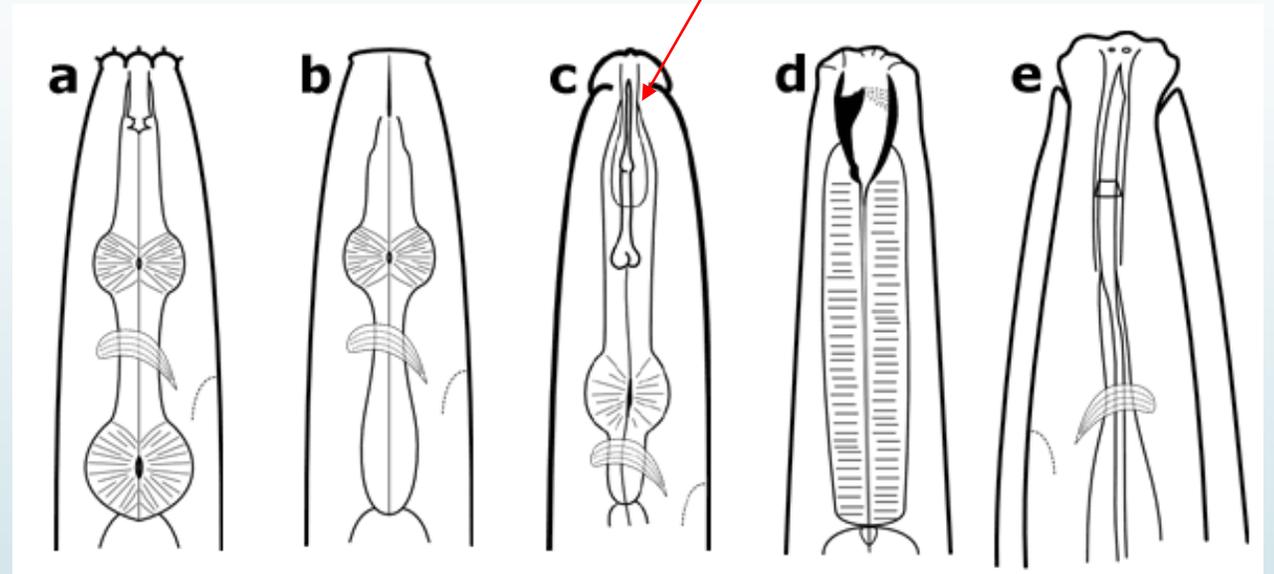


Where are they found in the Soil?

- ▶ Nematodes inhabit the water films around soil particles and soil organic matter as well as the water filled pore spaces found in soil
- ▶ Their populations are greatest in the upper layers of a soil profile where plant roots, organic matter, insects and other food sources are most abundant
- ▶ Will often occur in patches or “hot spots”
- ▶ Are more prevalent in certain soil conditions
 - ▶ Ex. Soybean cyst nematode in sandy areas

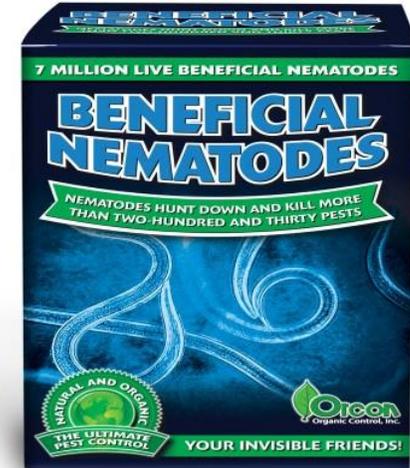
Types of Nematode

- a.) Bacterivore
- b.) Fungivore
- c.) Herbivores
- d.) Carnivore
- e.) Omnivore
- d.) Parasites



Carnivores

- ▶ Feed on nematodes, insects
- ▶ Can be beneficial when they target herbivorous plant pest nematodes
- ▶ Some companies market them as a biological control option for certain nematode and insect pests



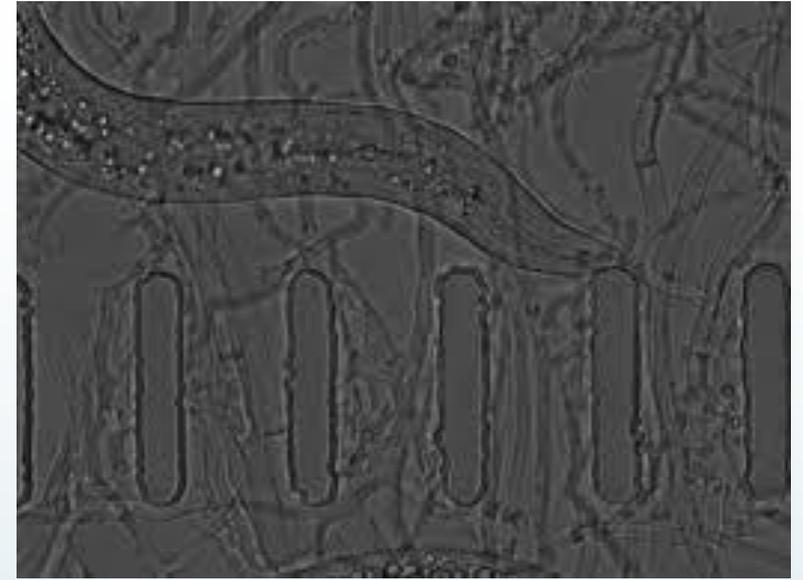
Bacteriovore

- ▶ Hunt and consume bacteria in the soil water solution
- ▶ Not a pest of most agricultural activities
- ▶ May even be beneficial when consuming some bacteria
 - ▶ Ex. Bacteria involved in denitrification



Fungivore

- ▶ Feed on fungal hyphae similarly to herbivorous nematodes with plant roots
- ▶ Often the predator and prey relationship is reversed



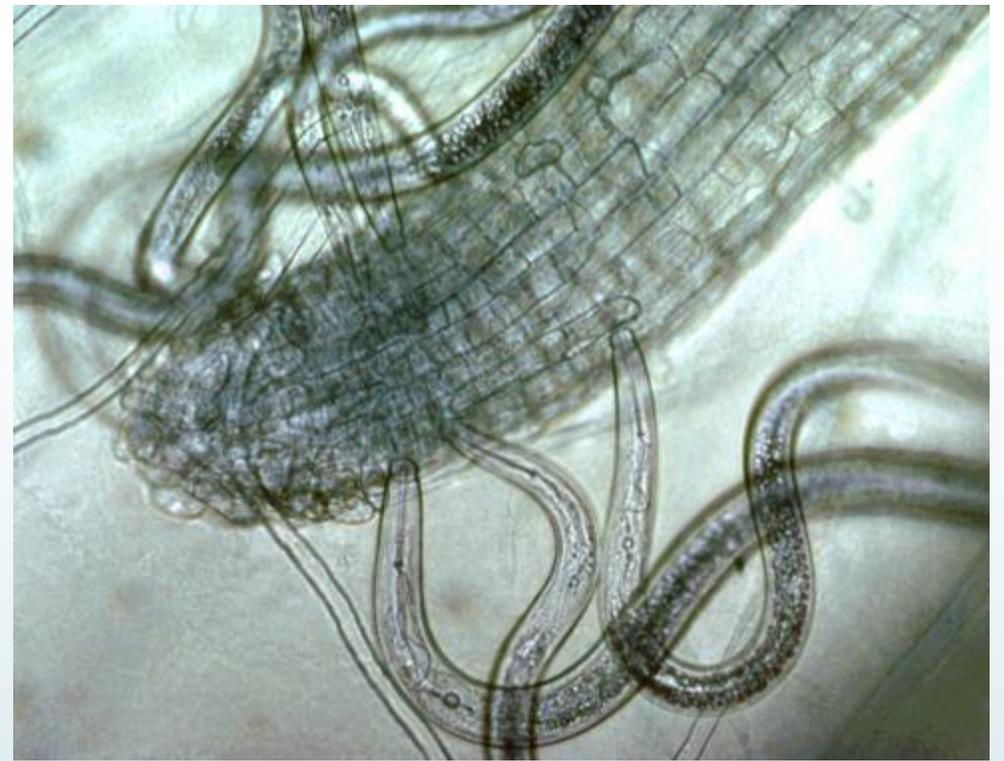
Parasites

- ▶ For some nematode species this is only one stage of their life cycle
- ▶ Can be very beneficial when they parasitize insect pests
- ▶ Are also a cause of disease in humans and animals



Herbivores

- ▶ These are some of the most problematic for agricultural producers
- ▶ They feed via a “Stylet”, a needle like mouth part adapted to piercing plant tissue and extracting the cytoplasm from cells
- ▶ These feeding activities are injurious to plants, and in some cases deadly



http://civr.ucr.edu/sting_nematode.html

How do Nematodes Effect My Operation?



- Can be a pest of many agricultural plant species
 - Can be the cause of disease, or a vector for other pathogens
- Are an important part of soil ecosystems and nutrient cycling
- In some cases can be beneficial by preying on other nematodes, parasitizing insect pests

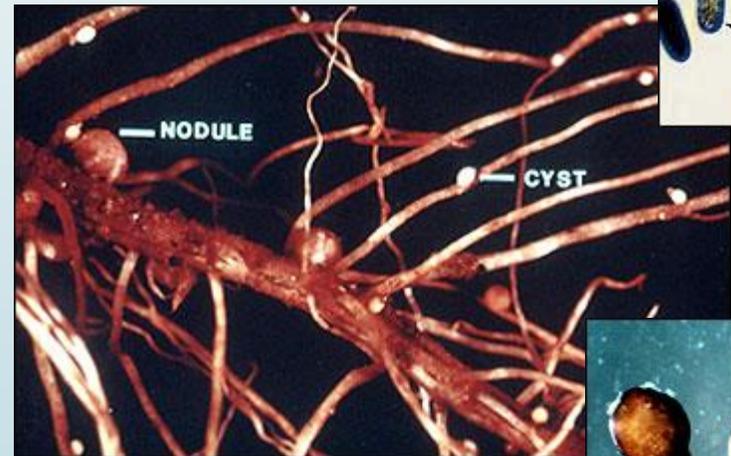
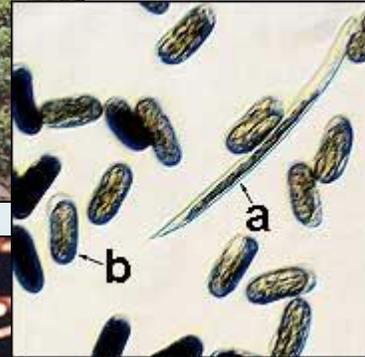
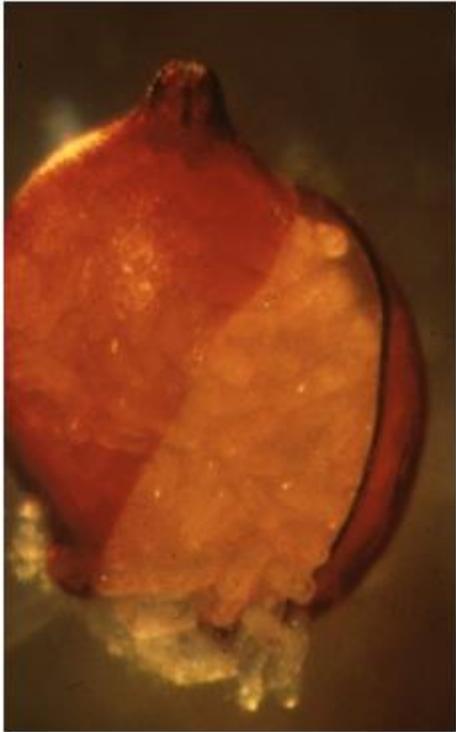


Plant Parasitic Nematodes in Missouri

- Awl nematode
- **Cyst nematodes**
- Dagger nematode
- Foliar Nematodes.
- Lance nematodes
- Lesion nematodes
- Needle nematode
- Pin nematode
- Pinewood nematode
- Reniform nematode
- Ring nematode
- **Root-knot nematode**
- Sheath nematode
- Spiral nematodes
- Stem and bulb nematode
- Sting nematode
- Stubby root nematode
- Stunt nematodes

Soybean Cyst Nematode

- ▶ Damaging pest of soybean crops
- ▶ Can cause significant yield loss when present in high concentrations
- ▶ Management strategies limited



A dark blue arrow points to the right from the left edge of the slide. Below it, several thin, curved lines in shades of blue and grey sweep across the left side of the slide, creating a dynamic, abstract background element.

SCN Facts

- ▶ Yield loss of 30 percent of your crop is possible without any obvious problem until harvest.
- ▶ Eggs can survive in the soil for many years even when a host plant is absent.
- ▶ Nematode reproduction occurs on resistant soybeans.
- ▶ SCN can move every way that soil moves.
- ▶ SCN can be present in a field for many years before it is detected.
- ▶ SCN symptoms may look like those due to other causes



Host/Non-Hosts

Host Species

- ▶ Beans (snap, bush, green, mung, kidney)
- ▶ Birdsfoot trefoil
- ▶ Clover (alsike, crimson, scarlet)
- ▶ Common and mouse-ear chickweed
- ▶ Common mullein
- ▶ Ground cherry
- ▶ Henbit
- ▶ Lespedeza
- ▶ Peas
- ▶ Pokeweed
- ▶ Purslane
- ▶ Vetch (common, hairy, winter, crown)

Non-Host Species

- ▶ Alfalfa
- ▶ Barley
- ▶ Canola
- ▶ Clover (red, white, ladino)
- ▶ Corn
- ▶ Cotton
- ▶ Forage grasses
- ▶ Oats
- ▶ Rye
- ▶ Sorghum
- ▶ Tobacco
- ▶ Wheat

Management Options

- ▶ Preventing establishment of SCN
- ▶ Rotating with non-host crops
- ▶ Planting resistant varieties, rotating resistance traits
- ▶ Suppressing host weed species



Root Knot Nematode



Simeon Wright, from University of Missouri Extension



Society of Nematologists, from University of Missouri Extension

- Primarily a pest of vegetable crops
- Causes lesions or “knots” to develop on roots inhibiting the plants ability to take up nutrients and perform other necessary functions



Root Knot Nematode Facts

- ▶ Over 2,000 potential host species
- ▶ Broccoli and cauliflower are two notable non-host species
- ▶ Warmer winters have contributed to increased prevalence.
- ▶ A week of subzero temperatures is sufficient to kill a root knot nematode population in bare soil.

Susceptible Species

| Very susceptible | Somewhat susceptible ¹ | Fairly resistant | Resistant ² |
|------------------|-----------------------------------|------------------|--------------------------|
| Tomatoes | Swiss chard | Broccoli | Globe artichoke |
| Okra | Peas | Brussels sprouts | Jerusalem artichoke |
| Beans | Parsnips | Mustard | Asparagus |
| Squash | Irish potatoes | Chives | Horseradish |
| Peppers | New Zealand spinach | Cress | Some lima bean varieties |
| Carrots | Fall-grown turnips | Garlic | Onion |
| Cucumbers | Fall-grown spinach | Leek | Rhubarb |
| Muskmelons | | Groundcherry | |
| Eggplant | | Rutabaga | |
| Watermelons | | | |



What can You do to Control them?

Cultural Practices

- ▶ Do not introduce it to your soil. Be careful about moving soil from different areas that are either known to be infected or potentially are.
- ▶ If galls or knots are found on your plant roots, remove as much of this root material as possible from the garden. These roots should not be composted. They can be dried and burned or bagged and properly disposed of.
- ▶ Allow cold winter temperatures to act on the nematodes. Keep plots weed free and consider a winter tillage operation to expose more soil to freezing temperatures.
- ▶ Plant early. Root knot nematodes do not become active until soil temperatures reach 64 degrees.
- ▶ Plant resistant cultivars when possible.
- ▶ Keeping a garden fallow will reduce nematode numbers, as long as it is kept weed (alternative host) free.



What can You do to Control them?

Treatments/Moving

- ▶ Soil solarization. Soil temperatures that reach 125 degrees F for 30 minutes.
- ▶ Biofumigating plants. Some species of Marigolds and mustards.
- ▶ Rotating sections of the garden between resistant varieties, fallow, solarization, biofumigants and susceptible varieties can usually control root-knot nematodes.
- ▶ Agricultural nematicides, other chemicals or fumigants, microbial pathogens and plant derived organic substances. All have limited success.
- ▶ Your best option may be to move the plot to a different area if possible. Plant the old plot with grass (a non-host).

How Can you Determine if You Have an Infestation

- ▶ Above ground symptoms of Soybean Cyst and Root Knot nematodes are easily confused with other agronomic issues such as nutrient deficiency and disease
- ▶ Infestation can go unnoticed until it is severe
- ▶ Cysts may be apparent on roots of infected plants, but can be difficult to identify as well without knowing what you are looking for
- ▶ There are testing services available that can determine the species and population density of nematodes in your soil
- ▶ Your local extension specialists may be able to help identify a nematode infestation as well



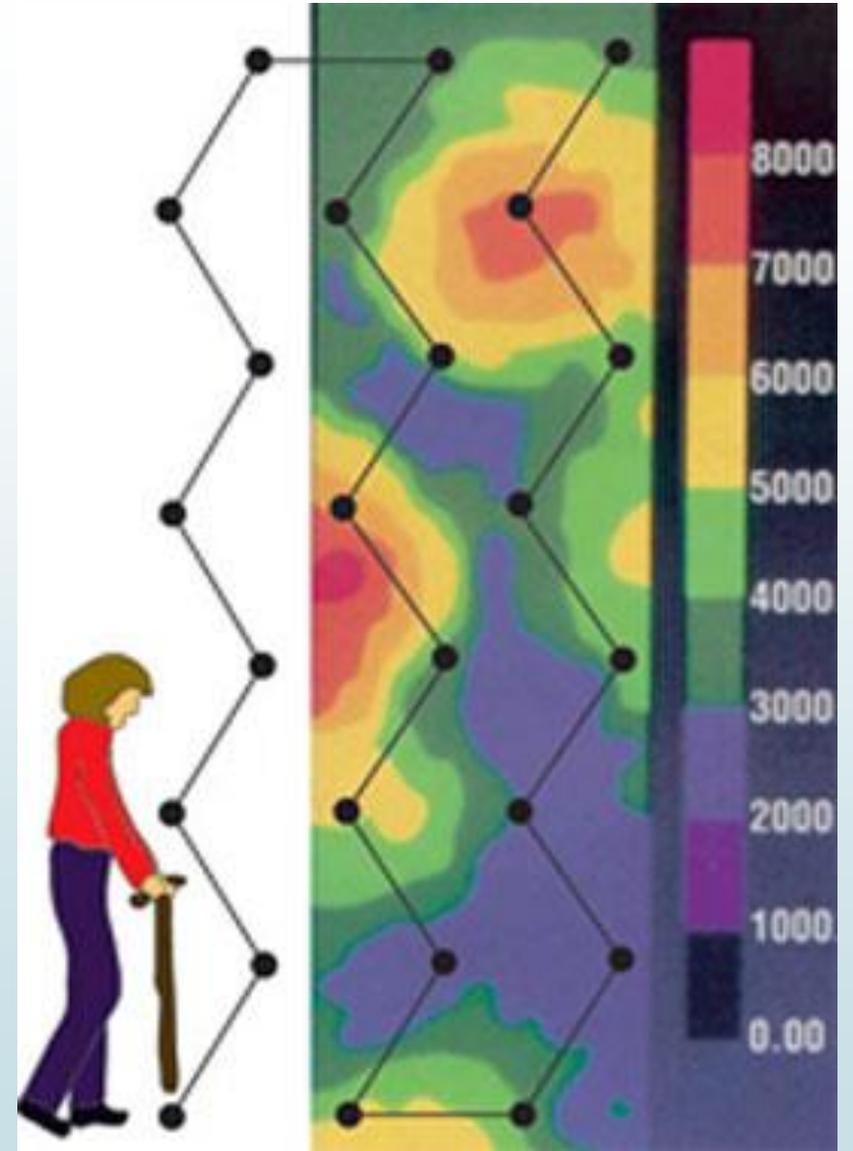


When to Sample

- ▶ If you suspect that you have nematode infestation, there are optimal times to sample
- ▶ Population levels are highest at the end of the growing season. Nematode population levels decrease when host plants are absent, which makes detection difficult and unreliable as a predictor of problems in the next growing season.

How to Sample

- ▶ When sampling fields in row crops, take samples to represent the top 8 inches of soil. When possible, sample directly in the root zone. You can also sample the margins of areas where plants are showing symptoms or declining.
- ▶ For pastures, lawns and other areas in sod, take samples to represent the top 5 inches of soil.
- ▶ For shrubs, take samples from three or more places in the area or around the shrub. Collect the sample to represent the top 6 inches of soil.
- ▶ Roots of declining plants can also be submitted to determine if any plant-parasitic nematodes are in them.





Storage and Handling

- ▶ Take samples when soil is moist. Put samples in plastic bags. Do not let samples dry out.
- ▶ Nematodes are sensitive to heat. Do not leave samples in the sun or other areas of high temperature.
- ▶ Obtain sample submission form online or at your local Extension office
- ▶ Clearly label each sample

A dark blue arrow points to the right from the left edge of the slide. Below it, several thin, curved lines in shades of blue and grey sweep across the left side of the slide.

Nematology Lab

Plant Nematology Laboratory

23 Mumford Hall

Columbia, MO 65211

Phone: 573-884-9118

E-Mail: nematodelab@missouri.edu



Questions?