Plant Parasitic Nematodes

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Nematodes are a group of animals which, in the past, have generally been neglected in high school and even college biology courses. Nematodes, or eelworms, are representatives of a large group of animals which are commonly called the roundworms. Some are parasites causing such diseases as trichinosis and hookworm in man. Others attack our domesticated and wild animals. Many live in fresh or salt waters and enormous numbers of nematodes live in the soil either as saprogenous or parasitic animals.

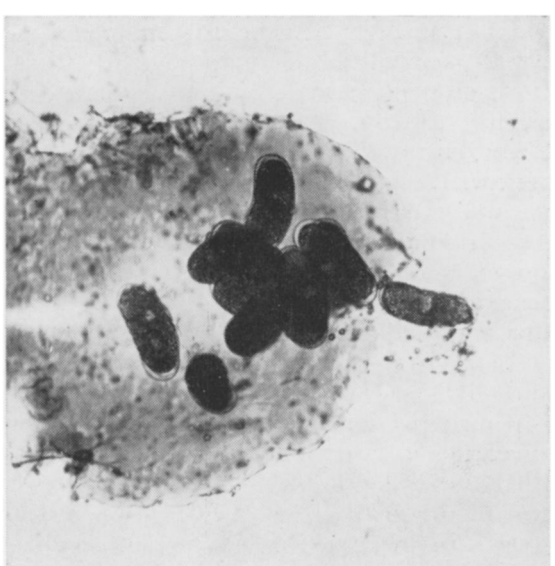
Probably the most important group in the soil are the root-knot nematodes. The root-knot nematodes are parasites living in the roots of plants and capable of distinguishing their hosts by a chemical sense organ. A simple laboratory exercise will be proposed which will demonstrate the activities of these soil nematodes in relation to their host plants.

The plant parasitic nematodes are long, slender animals, whose external surface is smooth and glistening, tapering to a point toward one or both ends. They occur in large numbers in all normal soils where plants are growing. In size they range from less than one sixty-fourth of an inch to approximately one-eighth of an inch in length while their diameter varies somewhat depending upon the particular stage in which they are found. Generally, the male is much smaller than the female. Because of their size they can easily be seen with the low power objective of the miscroscope or with a hand lens.

Their small bodies have specialized organs for feeding, a digestive, muscular, nervous, and excretory systems and a well developed reproductive system. There is no definite circulatory system, and respiratory organs are lacking. The muscular body wall makes it possible for the body to be knotted, curved or bent, and permits the characteristic undulatory movements.

Root knot nematodes.

Shortly after the primary infection is completed the nematodes become sexually mature, they pair and soon the female enlarges and eggs are produced. A mature female may lay as many as 300 to 600 eggs. When the roots are heavily parasitized the females frequently reproduce parthenogenetically.



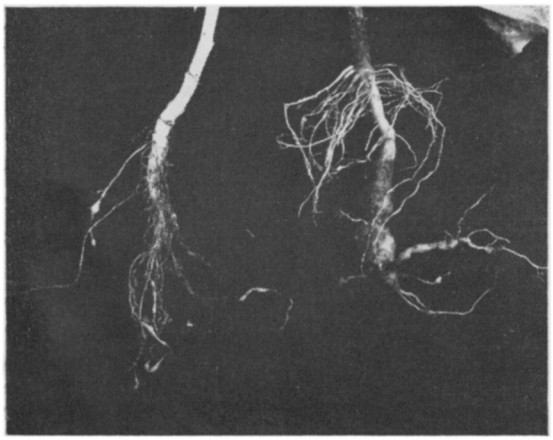
Nematode egg masses in a root knot.

The life cycle of the root knot nematode is relatively simple. After escaping from the egg mass in the soil the young larvae begin immediately to feed upon the roots of susceptible plants. Starting with this initial feeding stage, they pass through several developmental stages. Each larva bores into a young root by the use of its hollow buccal spear and with it sucks up some of the liberated cell contents. Usually the parenchymatous tissue is penetrated, which stimulates the host cells to undergo rapid reproduction. This reproduction results in enlargement and distortion of the invaded tissues. Such an enlargement of the root is commonly referred to as a knot or gall, and because this knot is a characteristic symptom, the nematodes forming it are called the root-knot nematodes. The knots may appear as slight swellings, as small, scattered, tubercle-like growths or as extensive swellings 1 or 2 inches in diameter on either large or small roots. In extreme cases it may involve nearly the complete root system. If the knots are cut across, from one to several dark specks may be noted in the cortex, marking the location of the nematode. In other cases, the organisms may produce an immediate yellowing of the plant which is frequently accompanied by stunting of the whole plant.

Seldom are the host's vascular and woody tissues invaded, although they may be twisted and misplaced through the pressure of the enlarged parenchymatous tissues.

All plant parasitic nematodes are somewhat specific, attacking some plants freely and others not at all. When a resistant host is present, the nematodes live saprogenously in the soil. Approximately one thousand plants are susceptible to nematodes. The algae, mosses and fungi are resistant to attack by nematodes. In fact, numerous species of fungi attack and destroy nematodes.

Early in the fall bring into the laboratory some light, sandy garden soil and place it in a pot. Then plant some seeds of a plant susceptible to infection and water them every other day. After the seedlings are above ground the general appearance of the plant, if the roots are infected, will give the impression that it is suffering from a lack of fertilizer and water, even though they are available in the soil in abundance. The color is a lighter or more yellowish green than normal.



Root knots on tomato plants, caused by nematode infection.

The choice of indicator plants to use to determine if the root-knot nematodes are present in the soil is limited only by one's imagination, but the two plants commonly employed for nematode infection studies are tomato and lettuce. These plants are used because it takes only about 14 days for germination of the seeds and approximately 25 days for the nematodes to complete their life cyle.

After the above symptoms are apparent, pull up the plants with their roots attached, and gently wash them under tap water. The knots or galls are then easily seen. Place a few knots in a watch glass with a few drops of water and tear them apart with needles, and then either place the watch glass under the lower power objective of the microscope or take some of the contents and place them on a slide and observe. What you see will be the complete life cycle of plant parasitic nematodes unfolding before your eyes.

Because of the specificity of nematodes, the soil which is brought into the laboratory may not contain nematodes capable of attacking the indicator plants. If this proves to be the case, some nematode infected plants can probably be obtained from a local greenhouse, as infestation of greenhouse soils and planting stock is very prevalent. An inspection of the roots of plants exhibiting typical symptoms should reveal root knots. Crush the knotted roots and place them in the soil.

Another interesting experiment would be to have students bring in plants from their family garden and check them for nematode infection.