

Plant Nematode Biology and Root-knot Nematode Symptoms ¹

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- **Plant-parasitic nematodes** (Plate 1) are very small, .25 mm to 3 mm long, and colorless, so they are almost invisible. They feed on plant juices by piercing cells with their needle-like *stylets*. They damage roots by injuring the cells they feed on, by stealing nutrients, by distorting root growth and by making it easier for other pathogens and pests to get into the roots. Many kinds of nematodes damage plant roots, but *root-knot nematodes* cause about 75 percent of all nematode damage to landscape ornamentals and annual crops in warm climates.
- **Nematode life cycle** (Plate 2). All nematodes reproduce by laying eggs (1) usually shorter than .065 mm. A first-stage juvenile develops then molts while still in the egg to become a second-stage juvenile, which hatches from the egg (2). It finds a feeding site on or in fresh root tissues and molts three more times to reach adulthood (3, 4). Eggs are deposited in the soil or plant tissues where the nematode lives, or accumulate in a gelatinous mass attached to the female (4).
- **Root-knot nematodes** (Plate 3). In this piece of heavily galled root, each of the small, pearl-white dots above the thumb is a fully grown root-knot nematode. Few plant-parasitic nematodes get larger. Because plant-parasitic nematodes are so small, most diagnosis must be done by recognizing the symptoms they cause in plants and by laboratory analysis of soil and/or plant tissues to make it possible to see, identify and count them.
- **Nematodes on and in roots** (Plate 4). Some nematodes live in the soil around roots and on root surfaces, feeding only in cells they can reach from outside. These ectoparasites do not penetrate into the root. Endoparasites move into root tissues, feeding on cells as they burrow through them or sliding between cells until they reach specific cells on which they will feed for the rest of their lives.
- **Rhizobium nodules/nematode galls** (Plate 5). Root-knot nematodes are easy to recognize by the symptoms they cause on roots. Swollen "knots" or "galls" usually form where root-knot nematodes feed and develop (right). Taking a

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gall from the root usually tears the root apart. Galls vary in size and shape, and have firm tissues. Some swellings that occur on plant roots are beneficial. The most common are nitrogen-fixing *Rhizobium* nodules (left) found on roots of plants in the bean family. They normally are more uniform in shape and size than nematode galls, are very loosely attached to the main root, and are hollow with a milky liquid in the center.

- **Root-knot nematodes on cucumber** (Plate 6). Root-knot nematode galls are formed in the same way but are not the same shape or size on all kinds of plants they affect. Plants in the cucumber and squash family are some of the most sensitive, producing large, irregularly shaped galls, as shown on the roots of this cucumber.
- **Root-knot nematodes on pepper** (Plate 7). Root-knot nematodes can infect and reproduce well on roots of peppers, but normally form much smaller galls on peppers than on cucumbers and many other susceptible plants. On these pepper roots, galls are small, elliptical swellings just slightly larger around than healthy roots.
- **Root-knot nematodes on potato** (Plate 8). The surface bumps and pits on this potato tuber are a typical effect of root-knot nematode infection of the tuber. Other kinds of nematodes may cause rough surfaces, small "pimples," or small, sunken, dark-brown, dry lesions.
- **Root-knot nematodes on impatiens** (Plate 9). Impatiens are popular flowering bedding plants, but are very susceptible to root-knot nematodes. Impatiens that wilt prematurely and recover slowly when watered often have stunted roots with numerous galls. Other annuals commonly damaged include coleus and snapdragons.
- **Root-knot nematodes on ligustrum** (Plate 10). Galling of ligustrum roots by root-knot nematodes is similar to that on many woody ornamentals. Above-ground symptoms include yellowing and loss of leaves, stunted top growth, and die-back of twigs on severely affected plants.