49. Nematodes of Broadleaf Trees

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The root zones of trees in nurseries, windbreaks, and natural stands in the Great Plains are inhabited by various microorganisms, including nematodes (fig. 49–1). Nematodes are an important part of the microscopic fauna of these sites; those associated with tree roots include plant-parasitic, mycophagous, bacteriophagous, and predaceous forms. Plant-parasitic nematodes puncture and feed on root cells, and contribute to poor growth and premature decline of trees.

Hosts and Distribution

Cottonwood, green ash, golden willow, and post oak are favored hosts of the dagger nematode, *Xiphinema americanum*. This nematode is widespread and is probably present in most windbreaks on the Great Plains. This association with trees and the high populations in weed-free windbreaks indicate that various other tree species used in such plantings may be hosts for this nematode. Preferring undisturbed sites, dagger nematodes seldom are a problem in nurseries in the Great Plains.

Roots of apple, black locust, black walnut, American elm (fig. 49–2), catalpa, green ash, and multiflora rose have been parasitized by root-knot nematodes, *Meloidogyne* spp., in nurseries in the southern Great Plains. Root-knot nematodes rarely are found on trees in windbreak plantings, however. Apple, black locust, and black walnut also have been parasitized by root-lesion nematodes, *Pratylenchus* spp., in nurseries. Root-lesion nematodes also cause damage to spruces, pines, and junipers (see Article 64). American elm has been damaged by lance (*Hoplolaimus* sp.) and spiral (*Helicotylenchus* spp.) nematodes in nurseries. Other forms that occasionally injure tree roots include stunt (*Tylenchorhynchus* sp.), ring (*Criconemoides* sp.), and stubby-root (*Trichodorus* sp.) nematodes.

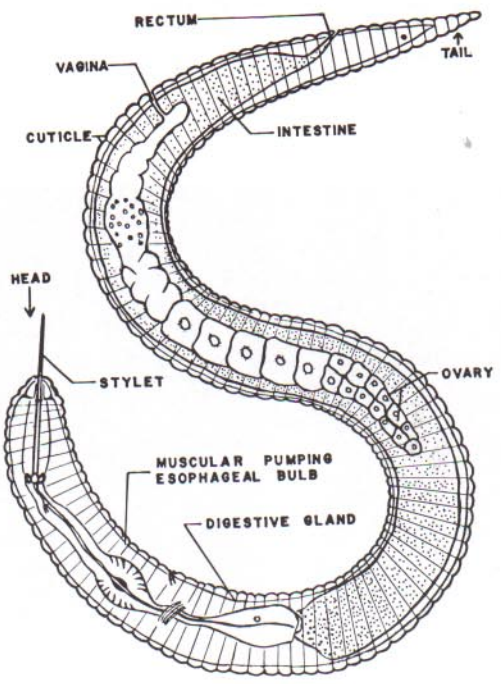

Figure 49–1. The principal parts of a nematode (female).

Symptoms and Signs

Above-ground symptoms on seedlings parasitized by nematodes resemble those on plants lacking an adequate and properly functioning root system. Affected seedlings are characterized by low vigor, stunting, and small, discolored foliage. Below-ground symptoms on feeder roots include root swellings, root proliferation, surface necrosis, lesions, and stubby-root condition resulting from root-tip injury and cessation of growth. Heavily parasitized root systems are discolored and poorly developed. Similar root symptoms occur on established trees.

Diseases caused by nematodes usually cannot be diagnosed by the symptoms described above because other soil-borne pathogens and some environmental factors cause similar symptoms. Various types of injury may be present on roots because of the combined effects of more than one nematode species; for example lesions and stubby-root condition may be present on roots parasitized by both root-lesion and stubby-root nematodes. In addition, nematode injury may increase the incidence of other root diseases by facilitating entry of their causal organisms.

Disease Cycle

The life cycle of plant-parasitic nematodes consists of eggs, four larval stages, and adults. Females lay eggs that hatch into juveniles. These juveniles are similar to adults in appearance and structure in most species; during their growth and development they undergo four molts. After the fourth molt, the individual is an adult. Mature females then lay eggs and the cycle is repeated. Root-knot nematode larvae of both sexes undergo the same development into the last larval stage. At the final molt, the male emerges as a slender eel-shaped adult, while the female becomes pear-shaped or sometimes almost spherical.

There are two general modes of feeding among plant-parasitic nematodes. Ectoparasitic species, such as dagger nematodes, live in the soil and feed externally on succulent root tissue. Through their stylets they inject digestive enzymes into root tissues, making the contents of cells easier to ingest and assimilate. Endoparasites, such as root-knot and root-lesion nematodes, enter and

Figure 49–2. Roots of American elm infected with root-knot nematode. Left, noninfested roots; right, infested roots with swollen tips.

Figure 49–3. Root-knot nematode female (lower right) with giant cells developed in clusters immediately adjacent to its lip region. The sedentary nematodes feed on these giant cells.

complete most of their life cycles inside roots. The secretion injected into surrounding cells by root-knot nematodes modifies the development and maturation of those cells, causing them to form specialized tissue containing "giant cell" (fig. 49–3).

Damage

Endoparasitic nematodes feed on and move through tissues of the root, causing mechanical damage. Root-lesion and lance nematodes may cause substantial mechanical injury to rootlets. Much of the damage by both endo- and ectoparasitic nematodes are due to reaction of root tissues to secretions injected into roots while the nematodes are feeding. The specialized tissue induced by root-knot nematodes disrupts root absorption and translocation of moisture and nutrients. Weakened root systems may result in enhanced winter injury, increased susceptibility to canker pathogens, branch dieback, and premature decline.

Nematodes have caused severe damage to broadleaf seedlings in some Great Plains nurseries and to trees in windbreaks. The extent of injury to seedlings depends upon type of nematode, degree of infestation, and species and age of seedlings. Damage in infested seedbeds usually is first evident in irregularly shaped spots. These spots enlarge and coalesce over a number of years as nematodes multiply and spread throughout the seedbed. Pathogenic fungi often enter roots through wounds made by nematodes, and the resulting disease complex often causes considerably more loss to a seedling crop than would be caused by either acting alone.

Many windbreaks in the northern Great Plains are planted in habitats favorable for dagger nematodes. Native grasses and alfalfa are hosts of this nematode, and trees planted on such sites are exposed immediately to high nematode populations. In these situations premature tree decline is common, and occasionally tree mortality is high 2 or 3 years after planting. Populations as high as 13,300 per pint of soil have been reported around roots of cottonwood in windbreaks in South Dakota.

Control

Plant-parasitic nematodes can be controlled by cultural or chemical methods. Crop rotation with non-host cover crops may be used to reduce populations of certain species. For example, where root-knot nematodes are a problem, rotation with fescue (a non-host) is recommended over soybeans (a host). Summer fallow, accompanied by frequent tilling, will reduce populations of nematodes by starvation and desiccation in areas of low or seasonal rainfall and high soil temperatures.

Preplant soil fumigation provides excellent control of nematodes in nurseries. Volatile, halogenated hydrocarbons such as methyl bromide are widely used. In South Dakota, soil fumigation of windbreak planting sites with 1,3–dichloropropene and related chlorinated C_3 hydrocarbons (1,3-D) increased growth of green ash and golden willow over a 4-year period on land infested initially with low populations of dagger nematodes, but did not affect growth of cottonwood, Siberian peashrub, or honeylocust. Root-knot nematode on hardwood seedlings can be controlled by dipping infected roots in organophosphate nematicides prior to transplanting.

Selected References

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