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Root Knot Nematodes

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Root knot nematodes cause major damage in soybean in the southern United States. In Indiana, damage by these plant parasites is limited to areas with light-textured soils that have higher sand content, and where crop sequences with highly susceptible hosts are used. This group of plant-parasitic nematodes is a notorious problem because of its wide host range. In addition to many common crop plants, it infects many weed species commonly present in agricultural fields.

Figure 1a. *Root knot nematode symptoms in a soybean field. This image shows a healthy soybean field.*

Symptoms

In the field, one of the first indicators of root knot nematode infection are areas of depressed growth, where plants are shorter and less vigorous than healthy ones (see Figures 1 and 2). In hot, dry weather, these infected plants wilt more readily than noninfected plants. In severe cases, infected plants are stunted and chlorotic because of water and nutrient deficiencies. Severely infected plants often die long before maturity and fail to produce seed.

Figure 1b. *Root knot nematode symptoms in a soybean field. This image shows a field infested with root knot nematodes. Note the stunting and wilting of the soybean plants.*

Susceptible soybean plants can be infected at any stage of development. Aboveground symptoms can be easily confused with other soil-related plant growth suppressing factors. For example, excessive soil moisture or drought at any soybean growth stage, extreme soil pH values, or radical soil texture differences within a field (such as nearly 100 percent sand in some areas of a field while the remainder of the field is made

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up of sandy loam soil), may be confused with root knot nematode damage.

To confirm root knot nematode infection, it is necessary to excavate root systems and examine them for root galling (see Figure 3). Nematode-induced galls consist of globular, irregular deformations within the root architecture. These swellings are easily distinguished from nodules that are a normal part of soybean root systems. These normal nodules result from infection by beneficial, symbiotic bacteria that fix atmospheric nitrogen for the plant and receive photosynthates in return. Beneficial nodules are nearly spherical structures about ¼ inch in diameter that are attached to the outside of roots. Root knot nematode galls, on the other hand, range from ⅛ inch to 1 inch in diameter, and are swellings of the root itself.

Causal Agent

Root knot nematodes belong to the genus *Meloidogyne*. The four most common species are *M. incognita*, *M. hapla*, *M. javanica*, and *M. arenaria*, but only *M. incognita* and *M. hapla* have been found in Indiana. *M. hapla*, (also called northern root knot nematode because of its temperature requirements) is generally considered less damaging on soybean than *M. incognita* (known as southern root knot nematode).

Disease Cycle

Root knot nematodes are obligate parasites (meaning, they must have living host plants to reproduce), but they can survive as eggs in the soil for several years. These eggs contain the nematodes in their infective stage: second-stage juveniles. When soil conditions are favorable (when soil temperatures are more than 50°F) and a host plant is grown, juveniles hatch from the eggs and move through soil in search of host plant roots.

When a juvenile finds a suitable root location (generally near the growing tip), it penetrates the root and becomes sedentary. After several molts, a juvenile develops into a mature female, which in turn, produces an egg mass containing several hundred new nematode eggs in a gelatinous matrix deposited on the outside of the root. At this point, juveniles either immediately hatch from their eggs or remain dormant within the egg until infection conditions are favorable. The gelatinous matrix is thought to protect the eggs from soil organisms that might otherwise consume the eggs and suppress the nematode's initial inoculum level.

Figure 2. *Soybean plants taken from a field with root knot nematode hot spots. The plants on the left are healthy, the ones on the right are infected with root knot nematode.*

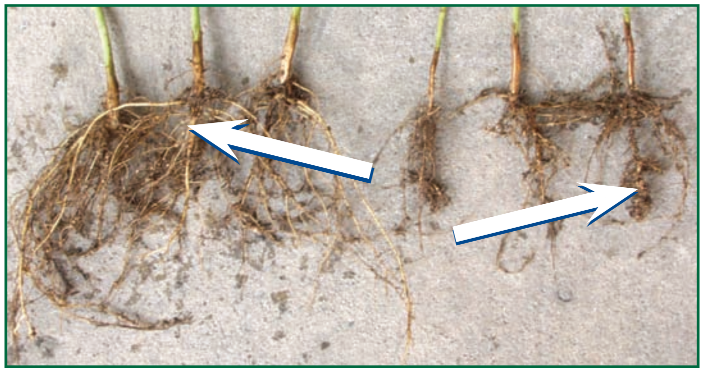

Figure 3. *The root systems of soybeans infected with root knot nematodes (right) have galls. The plants on the left are healthy. Note the deformed taproots of the infected plants. The arrow on the right points to a nematode-induced cluster of galls. The arrow on the left points to beneficial nodules.*

Management

In most crops, root knot nematode damage is quantitatively related to the initial numbers of the nematode in soil. Management strategies are aimed at reducing these initial numbers. Because root knot nematodes need host plant roots to propagate, management tactics include destroying potential hosts. That means destroying crop plants, particularly the roots, as soon as possible after harvest to avoid the build-up of nematodes in the soil on agronomically unproductive plant roots. It also means proper weed control is essential in nematode-infested fields.

Spread of the nematode is mostly passive. To avoid moving root knot nematodes from infested fields to noninfested fields, remove soil and plant roots from tillage and planting equipment before using them in another field. Similarly, clean shoes and other implements that may carry soil from infested fields into noninfested areas.

Management strategies and their relative effectiveness are discussed in more detail below.

Planting

Planting date, row spacing, and plant populations per acre probably have limited effect on the risk for damage from root knot nematodes.

Tillage

Tillage operations move soil in fields. In infested fields, tillage may be omitted to avoid spreading nematode-infested soil (provided other agronomic practices permit it). On the other hand, uprooting susceptible crops or weeds will reduce the build-up of nematode populations. Cleaning tillage equipment is essential before moving it from one field to another.

Rotation

In general, crop rotation is a very effective means of managing plant-parasitic nematodes. Although most grass crops are unfavorable hosts for root knot nematodes, recent observations in Indiana have confirmed that reproduction on corn is possible and that the nematode population in corn may increase to levels that can damage susceptible soybean. In areas where winter cover cropping is common, choose cover crops that are the most antagonistic to nematodes or are poor hosts to reduce the risk of root knot nematode damage to the subsequent cash crop.

Resistant Varieties

Traditionally, root knot nematodes have been a more damaging factor in southern states, and many soybean cultivars of maturity groups 5-8 have been characterized according to their levels of susceptibility to root knot nematode. In lower maturity groups, Purdue Extension has identified a number of varieties that allow for reduced nematode reproduction.

Biological and Chemical Control

Chemical control of root knot nematode may be possible with some nonfumigant nematicides, but the current costs for these materials do not make it cost effective for treatment in soybean. Currently, biological control is not practical for root knot nematode control in soybean.

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