

# Parasitic Nematodes in Soybeans

Parasitic nematodes are microscopic, thread-like, worms that live in the soil and feed on plant roots. Many plant-parasitic nematodes can attack a wide host range, including soybeans. Damage occurs as nematodes penetrate and feed on soybean roots, reducing the plant's ability to utilize water and nutrients, and may create an entry-point for other pathogens. Parasitic nematodes can cause significant yield loss to soybeans without displaying any above-ground symptoms, going undetected by farmers year after year.<sup>1,3</sup>

## Life Cycle and Environment

Plant-parasitic nematodes spend their entire life in the soil. They are classified by where they live while feeding on the plant, which is important when sampling for nematodes.<sup>1</sup> Endoparasitic nematodes, like soybean cyst nematode (SCN) or root knot nematodes (RKN), live within the root structure and require sampling of the root, while ectoparasitic nematodes live in the soil outside of the root and only require soil samples.

The presence of nematodes may vary based on soil type, environmental conditions, and the presence or absence of actively growing host plants. Many species thrive in sandy soils, though soybean nematodes can be found almost anywhere, including heavier soils. Under favorable conditions, most parasitic nematodes can complete their lifecycle (egg, four juvenile stages, egg-producing adult) in about one month, and may complete four or more lifecycles in one growing season.<sup>1</sup> Mature females of some species can produce hundreds of eggs, leading to rapid growth of population densities.

## Symptoms



Figure 1. Symptoms of root knot nematode in a soybean field. Photo courtesy of Edward Sikora, Auburn University, Bugwood.org

Significant yield loss and damage can occur in a field without any above-ground symptoms. When above-ground symptoms appear, it often indicates a long-term problem that is just being recognized.<sup>1</sup> Environmental stresses, such as drought, can accentuate the effects of nematode damage. Infected soybean plants have poorly developed root systems, reducing the plants

ability to efficiently utilize water and nutrients. Stunting, yellowing, early death, and low yields are common symptoms of nematode injury in soybean (Figure 1). These symptoms may be hard to distinguish from other stresses like nutrient deficiency, soil compaction, or chemical injury; therefore, fields should be sampled to confirm the presence of nematodes.

Below-ground symptoms include dark-colored roots, poorly developed root systems and reduced nodule formation. Openings on plant roots created by nematodes can serve as an entry-point for other pathogens, for example, brown stem rot and sudden death syndrome. Some species, like RKN and SCN, have distinct symptoms on soybean roots which can aid in diagnosis. Nematode damage symptoms are often found in irregular or oval shaped patches, and not across a whole field. Symptoms are likely to first occur near field entrances, compacted headlands, flooded areas, knolls, and fence rows.

## Soybean Nematodes

Soybeans are host to many plant-parasitic nematodes. SCN is a major yield-limiting pest of soybean; however, because of its importance, other nematodes that attack soybeans are often overlooked. These include root knot, reniform, lesion, lance, sting, stunt, and pin nematodes.

**Soybean Cyst Nematode (SCN)** The soybean cyst nematode is generally considered the most important pest of soybeans in the United States. Attracted by a chemical release from the soybean, the juveniles move short distances through the soil to penetrate soybean roots and establish a feeding site within the vascular tissue.<sup>1</sup> Adult females remain sedentary within the roots and take on a lemon-shape as they grow and swell. When fully developed, the female's body will break through the root surface, becoming visible from the outside of the root, yet remain attached to the feeding site. SCN females can produce hundreds of eggs, some of which are deposited on the outside of their body; as the eggs hatch they will begin a new lifecycle resulting in new infections. Not all of the eggs produced by the female will hatch the same year, and will remain in the female's body. SCN females turn white in color as they mature, and turn brown after they die. This is what is considered the cyst, and serves as the overwintering structure for the eggs.

In some areas, SCN infection may induce iron-deficiency chlorosis (IDC).<sup>7</sup> Adult females that are engorged with eggs and have broken through the root can be observed with the naked eye on soybean roots during the growing season. Plants must be carefully dug from the soil (not pulled up) and the soil removed to expose the lemon shaped nematodes (about 1 mm diameter). They are cream to yellow colored and are smaller than the nitrogen-fixing nodules that have pink centers.

**Root knot nematode (RKN)** There are several different species of RKN, the southern root knot and northern root knot nematodes are the most common, and largely confined to sandy soils. In general, the southern root knot nematode is more damaging than the northern root knot nematode. Look for extremely stunted plants early or early death during bloom and pod fill. Damage can be more serious in drought conditions. Root galls are a distinctive feature of this nematode and make it easy to identify. RKN damage is usually associated with spots or areas within a field and rarely occurs across the entire field.<sup>5,6</sup>

**Reniform** The reniform nematode is found in southern states, and gets its name because the swollen adult female is kidney, or "reniform" shaped. It is more prevalent in silty soils, and is infrequently found in the same fields with root-knot nematode. Reniform nematodes have a short lifecycle, 18-20 days, and can have many generations within one growing season. Corn is moderately tolerant to reniform nematode and can be used in rotation as a control method.

**Lesion** Lesion nematodes are small migratory endoparasites, although not a serious pest of soybean, they are a concern because they feed on a wide variety of plants. They are not typically found in the same field as SCN, and their numbers may increase in the absence of SCN.<sup>5</sup> Lesion nematodes cause lesions on roots, and may give the appearance of root rot.

**Lance** Lance nematodes are relatively large and therefore confined to sandy soils. They can be found throughout soybean growing regions within the U.S., and are a major soybean pest in southern states. Lance nematodes have a wide range of hosts; therefore, rotation is not an effective control method.

**Sting, Stunt, and Pin** These three nematodes are not considered major pests of soybeans. They are all ectoparasites and largely confined to sandy soils. They may cause damage when populations are extremely high, and some laboratories routinely assay soil samples for them.

## Sampling

Soil sampling is recommended to confirm the presence of nematodes in a field. Sampling should be done in the fall after harvest, but can be done at any time during the year as the soil permits. Soil cores should be taken from the top 6 to 8-inches of soil, intersecting the root zone, and 10 to 20 cores per 20-acre area should be collected. Because nematodes are generally not evenly distributed within a field, several composite samples should be taken. Samples from high risk or suspected areas should be included, such as near a field entrance, areas with flooding history, and low-yielding areas of a field.

## Management

Once nematodes are identified in a field, management practices should be used to help minimize crop damage and keep population densities low. Because there are many nematode species, identification is essential for determining the appropriate control option. For certain nematode populations, the best management practice is crop rotation. Soybean management practices that reduce crop stress may help the crop overcome nematode attacks. The following agronomic practices may help farmers manage potential nematode infestations.

**1. Fertilize** Plants suffering from nutrient deficiency are more susceptible to injury.

**2. Weed Control** Weeds are hosts for many nematodes; managing weeds can help keep nematode populations low.

**3. Crop Rotation** For certain nematode species, rotating to a non-host crop can keep population densities low.

**4. Chemical Control** Nematicides and seed treatments may be an effective control measure against soybean nematodes.

**5. Nematode tolerant products** Soybean products with nematode tolerance can be an effective management strategy against certain nematodes. There are different types of tolerance, so these products should be rotated and closely monitored.

**Table 1. Damage thresholds for soybean nematodes**

Nematode (common name)	Damage Threshold (nematodes per 100 cc soil)
Soybean cyst nematode	1
Southern root knot	60
Reniform	1
Lesion	50
Lance	1

Jagdale, G., Davis, R., Bertrand, P., Gay, J., et al. 2013. Guide for interpreting nematode assay results. University of Georgia Extension. and Niblack, T. Nematodes. Generalized population thresholds for risk of damage by plant-parasitic nematodes in Illinois.

## Sources

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For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology, Development, & Agronomy by Monsanto.

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