Root-knot Nematode on Soybean

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The root-knot nematode (RKN), specifically the southern root-knot nematode (*Meloidogyne incognita*), is a yield-limiting nematode present in many Delaware fields. It is particularly damaging to soybean and can be a chronic pest if not managed properly. This factsheet reviews how to identify root-knot nematode on soybean, explain its lifecycle, and go over management options.

Identification

Root knot nematode, as the name implies, attacks the roots of soybean. Affected root systems contain irregular, large growths, called galls. Galls can be distinguished from beneficial nitrogen fixing bacterial nodules by breaking open the structure; galls will be colorless to milky white inside, whereas nodules will be pink. Galls are also generally much larger than nodules. Severely affected root systems are often swollen, knotty, and irregular in shape (Figure 1). Plants affected by RKN may become chlorotic and/or stunted due to reduced access to water and in severe cases plant death may occur.

Figure 1. A soybean plant with a heavily galled root system (red arrows) caused by root-knot nematode.

Lifecycle

RKN overwinters in the soil as eggs. Root exudates from a susceptible host (i.e. soybean) will trigger RKN juveniles to hatch if soil temperature exceeds 50°F. Once hatched, the juveniles seek susceptible host tissue and a suitable entry point, usually at the root tip just behind the root cap. After the nematode penetrates the root, it establishes a feeding site (gall) and becomes sedentary. Females eventually lay eggs in a gelatinous matrix outside of the root, which may hatch and infect more roots as long as soil temperatures remain conducive, or may lay dormant for years until proper host and environmental conditions are satisfied. Females can produce eggs asexually, and

males play little to no role in reproduction. The timespan from egg to an adult, egg-laying female can be as short as 21-28 days depending on soil temperature.

Management

If fields are not properly managed, root-knot nematode populations will continue to increase and limit yield. A combination of cultural practices in conjunction with appropriate variety selection will help manage root-knot populations and protect soybean yields. Determining the severity of root-knot infestation in a particular field may be helpful in determining the appropriate management tactic. The University of Delaware Nematode Assay Service can determine nematode populations in your soil for a fee. Sampling instructions can be found at http://extension.udel.edu/ag/plant-diseases/nematology/

Crop Rotation

Rotating soybeans with small grains can help prevent the buildup of root-knot eggs in the soil. Most all major agronomic and vegetable crops grown in Delaware are susceptible to root-knot (see table 1); however, there are resistant and/or tolerant varieties of some crops (check seed company for more information). Rotate with *M. incognita* resistant or tolerant varieties in infested fields whenever possible.

Table 1. List of common crop and weed host species for *M. incognita* in Delaware.

Agronomic and Vegetable Crop Species	Weed Species
soybean (*Glycine max*)	dandelion (*Taraxacum spp.*)
snap bean (*Phaseolus valgaris*)	mallow (*Malva neglecta*)
watermelon (*Citrullus lunatus*)	purslane (*Portulaca oleracea*)
cucumber *(Cucumis sativus*)	pigweed (*Amaranthus spp.*)
tomato (*Solanum lycopersicum*)	prickly sida (*Sida spinosa*)
pepper (*Capsicum spp.*)	morning glory (*Ipomoea spp.*)
sorghum & sudangrass (*Sorghum spp.*)	
lima bean (*Phaseolus lunatus*)	
pea (*Pism sativum*)	
cantaloupe & muskmelon (*Cucumis melo*)	
pumpkin & squash (*Cucurbita spp.*)	
potato (*Solanum tuberosum*)	
corn (*Zea mays*)	

Resistant Varieties

Plant soybean varieties that have good resistance or tolerance to root-knot nematode. The southern root-knot nematode is the major root-knot nematode species affecting soybeans grown in the southern United States, therefore many of the resistant varieties are group V soybeans and up, but there are some resistant group III and IV varieties. Consult your seed company for varietal resistance ratings.

Cover Crops and Biofumigation

Cover crops and biofumigation can be used as part of an integrated approach for managing root-knot nematode. Planting and incorporating a biofumigant-type mustard with high glucosinolate production can potentially fumigate root-knot nematode eggs in the soil and reduce root-knot damage on a subsequent crop. Mustard varieties can be sown in early spring or fall (if the variety has good overwintering properties). Mustards should be flail chopped two weeks prior to full bloom for maximum biofumigation potential and immediately incorporated into the soil using a disk or chisel within 20 minutes of chopping. Ideally, approximately ½ inch of water should follow incorporation, which is necessary to seal the soil surface and synthesize the biofumigant gasses. If done correctly, studies have shown that biofumigant mustards can significantly reduce root-knot populations [2]. It should be noted that some mustard species are hosts for *M. incognita*, so root-knot populations could actually increase if the biofumigation crop fails or is not properly incorporated.

Additional cover crops have been bred for nematode management. Some of the oilseed-type radishes (*Raphanus sativus var. oleifera*) are not hosts for *M. incognita* but have the ability to induce egg hatch. Root exudates trigger root-knot eggs to hatch but the juveniles quickly die because they cannot penetrate, feed, or produce eggs on the radish roots, therefore reducing root-knot populations in the soil. The effectiveness of oilseed-type, trap crop radishes on *M. incognita* populations in Delaware remains unknown, but research is ongoing.

Seed Treatments

There are a bevy of seed treatments marketed at reducing nematodes, including RKN. These products may have some utility in fields with low populations of RKN, but will not be effective in heavily infested fields. In addition, the effects of seed treatments are short lived, and therefore only act to protect the plant in the very early stages of development.

References

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2. Monfort, W., Csinos, A., Desaeger, J., Seebold, K., Webster, T., and Diaz-Perez, J. 2007. Evaluating Brassica species as an alternative control measure for root-knot nematode (*M. incognita*) in Georgia vegetable plasticulture. *Crop Protection*. 26:1359-1368.