

IMPACT OF THE SOYBEAN CYST NEMATODE ON SEEDLING DISEASES OF SUGARBEET

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Soybean cyst nematode (SCN; *Heterodera glycines*) was first reported in North Dakota in 2003 (1) and was also recently discovered in the Red River Valley (RRV) of Minnesota. SCN is now well-established in Cass and Richland Counties of North Dakota and Wilkin, Clay, Norman and Red Lake counties in Minnesota, and is likely to continue to progress northward as long as soybean production continues. The nematode is easily moved from field to field in soil on farm equipment and in harvesting operations. The nematode survives from year to year as eggs within cysts. Although SCN is the most important pathogen of soybean in the United States (3), it is not reported to reproduce on sugarbeets. However, SCN is very closely related to the sugarbeet cyst nematode (SBCN). Indeed, the two species can hybridize to form fertile offspring (2).

When SCN eggs hatch, second stage juveniles (J2) emerge and maneuver through the soil to find a host root (3). Within hours of arriving at the surface of a susceptible soybean root, the nematode has penetrated through epidermal cells and migrated intracellularly to the vascular cylinder of the root. The female juvenile then initiates a permanent feeding site called a syncytium from which it draws nutrients from the plant root for its growth and development. However, when the juvenile arrives at the root surface of a non-host plant, penetration of the root can occur but the syncytium is not established. These larvae will either die or may exit the non-host root.

SCN can build to high populations in field soil in the RRV. In Richland Country, fields have been measured that had average egg densities of over 10,000 eggs/100 cm³ soil, and spots within fields had levels of 30,000 eggs/100 cm³ soil. When sugarbeet is planted into SCN-infested soil, the nematode may attempt to penetrate and establish itself in the sugarbeet roots. Such penetration attempts are likely to create lesions on the root surface. In addition, wounded roots may have an altered production of root exudates that attract sugarbeet pathogens. Since wounding of the sugarbeet root is known to increase disease severity for several sugarbeet diseases, the lesions made from entry by SCN might offer convenient entry points for several sugarbeet pathogens. If penetration by SCN were to occur at high levels, there is a possibility it could increase susceptibility of sugarbeet roots to root pathogens such as *Rhizoctonia solani*, *Aphanomyces cochliformis*, *Verticillium dahliae*, or *Fusarium* species, especially in the seedling stage when plants are more susceptible to pathogens. In soybean, SCN is well-known to increase root diseases caused by fungal pathogens.

OBJECTIVES

The objectives for 2009 were to:

1. Determine if SCN eggs will hatch in presence of sugarbeet roots
2. Determine if juveniles can penetrate sugarbeet root tissue
3. Determine if any growth stages past J2 occur in sugarbeet
4. Determine if there are differences in susceptibility between sugarbeet cultivars

MATERIALS AND METHODS

Females of *Heterodera glycines* (HG type 0) were maintained in the greenhouse on susceptible soybean cultivar Barnes. Mature 30-day-old cysts were crushed to remove eggs for inoculation. The sugarbeet cultivars Beta 932, Beta 1305R (Beta Seeds; Shakopee, MN), Maribo Ultramono, ACH 114, ACH 164, ACH 176, ACH 180 (American Crystal Sugar; Moorhead, MN), and SVDH 46519 (SESVanderHave; Belgium) were used in Petri plate and/or potting soil studies. Sugarbeet cultivars were grown in the greenhouse under standard growing conditions. At two to six weeks post planting, seedlings were removed

from the potting soil, washed, and the roots were submersed in water in Petri plates or were inoculated directly while growing in soil. For Petri plate experiments, 1000 SCN eggs were added to 5 ml of water in which roots were submersed. For experiments in potting soil, 3000 to 8000 eggs were deposited just below the soil surface with a pipette tip. Sugarbeet seedlings were harvested five to fifteen days post inoculation (DPI) and the roots excised, cleared in sodium hypochlorite and stained with acid fuchsin to show the nematodes in the root tissue. The number of nematodes per cm of root tissue was determined using a compound microscope. Further confirmation of nematodes in root tissue was determined with a confocal microscope.

RESULTS

For Petri plate experiments, the cultivars Beta1305R, ACH 114, and Ultramono were used to evaluate whether SCN J2s were able to penetrate sugarbeet root tissue submersed in water. Regardless of the cultivar used, SCN J2s were found in root tissue at a rate of approximately 5 nematodes per cm of root. No infection of root hairs was observed.

Since we observed nematodes inside root tissue in Petri plate experiments, we were interested to determine whether SCN would be able to penetrate sugarbeets actively growing in potting soil. SCN J2s were found in root tissue at a rate of approximately 35 nematodes per cm of root. Penetration events were recorded between 5 and 15 DPI. Seedlings less than 3 weeks old were more susceptible than older plants. There was no indication that any cultivar had increased resistance or susceptibility to SCN penetration. No life-cycle stage beyond the J2 stage was observed.

DISCUSSION

Pre-infection by SCN is well-known to increase disease severity and occurrence in soybean. Since SCN is establishing itself in the RRV sugarbeet growing region, we were interested to find out if pre-infection by SCN increased disease susceptibility to diseases of sugarbeet. To initiate this study, we first set up a series of experiments in Petri plates in which sugarbeet root was submersed in egg-laden water to test whether SCN eggs would hatch and if juveniles would be able to penetrate sugarbeet root tissues. The results of these experiments verified that SCN eggs hatch in the presence of sugarbeet roots and were able to penetrate into the root. To test whether SCN could penetrate sugarbeet roots in the soil, eggs were deposited just below the root surface near the sugarbeet root. We found that nematodes were readily visible in root tissue. The numbers of nematodes in the root tissue correlated positively with the amount of nematodes used for inoculation.

The results of this study demonstrate that SCN has the capability to infect sugarbeet seedlings. Future work will focus on co-inoculating SCN with other sugarbeet pathogens to verify whether SCN increases disease susceptibility. In addition, future studies in field environments will be undertaken to ascertain whether SCN is able to penetrate sugarbeet roots under normal commercial sugarbeet production in the RRV.

LITERATURE CITED

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