PLANT DISEASE MANAGEMENT IN SOUTH DAKOTA

Soybean Cyst Nematode

South Dakota Extension Fact Sheet 902-A
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History and Importance of SCN

The soybean cyst nematode (SCN), *Heterodera glycines*, is a serious threat to South Dakota soybean production. It was reported from Japan more than 75 years ago and was first found in the United States in North Carolina in 1954. Currently in North America, SCN occurs in 28 states and one Canadian province. **SCN is the most damaging pest of soybeans in the U.S. Losses from SCN in the U.S. have been estimated at $1 billion annually.** In South Dakota, SCN was first detected in Union County in 1995 and is currently found in 19 counties (Fig 1). While it has not yet been found in all soybean-producing counties, soybean cyst nematodes are hardy and are likely to survive anywhere soybeans are produced in South Dakota.

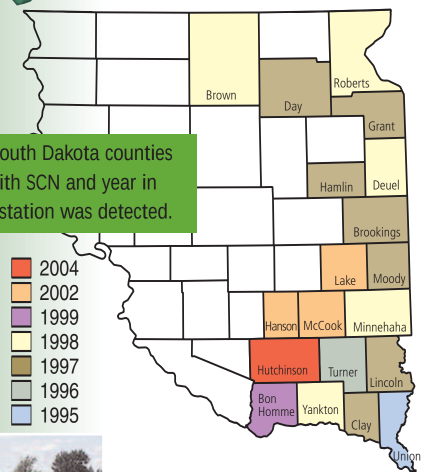

Figure 1. South Dakota counties infested with SCN and year in which infestation was detected.

Figure 2. Unless managed, SCN has the potential to devastate soybean fields. In most instances, SCN damage is not nearly as severe as in this field.

Figure 3. Lower populations of SCN may not cause dramatic above-ground symptoms, but yields are still reduced. The susceptible variety in this photo yielded 28% less than the resistant variety. This photo is more typical of SCN damage.

Figure 4. Uneven growth (roller-coaster effect) and yellowed patches due to SCN.

Injury Symptoms

Very low populations of this nematode do not cause obvious symptoms. In a corn-soybean rotation, it may take 8–12 years for SCN population densities to increase to damaging levels. Continuous cropping of soybeans or rotating soybeans with another susceptible crop such as dry beans will dramatically shorten this time interval. Detection of SCN may be difficult because it can reduce yields by as much as 30% with no obvious symptoms. One indication that SCN may be present is declining soybean yields in portions or all of a field. Symptoms of SCN often include stunting (Fig 2, 3 and 4). The stunting may be fairly general across the field, but it is more often expressed as a roller-coaster effect (Fig 4). Additionally, fields infested with SCN often have areas where the plants are slow to close the rows. Infected plants may become yellow in July or August, and they may have reduced vigor or mature earlier than those in surrounding areas of the field.

Biology of SCN

Nematodes are unsegmented roundworms. Most plant parasitic types are very small and feed on or in roots by means of a stylet (Fig 6 inset), a hollow, needle-like structure used to pierce plant cells and withdraw nutrients. The adult females of SCN are about 1/32 of an inch long and are visible to the unaided eye (Fig 11). Various stages in the life cycle of SCN are shown in Figures 6–10. Under favorable conditions, the life cycle can be completed in 4–5 weeks.

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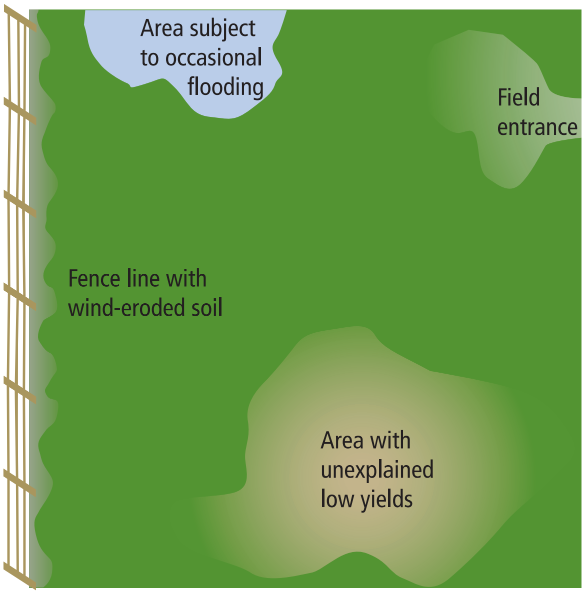


Figure 5. The first step in SCN management is to recognize the problem. Collect soil samples prior to planting or after harvest and submit for analysis. Include soil samples from high-risk areas where nematodes may have been introduced:
- Field entrances
- Fence lines
- Areas subject to occasional flooding
- Areas with unexplained low yields.

Management of Soybean Cyst Nematodes (SCN)

The overall objective of SCN management is to reduce the nematode population below the level that may result in significant yield losses. Once SCN has become established, there is no practical way to eliminate it from a field. SCN can, however, be effectively managed through combined use of the three Rs:

- Recognition of the problem.
- Rotation with a non-host crop.
- Resistant soybean varieties.

SOIL SAMPLING

The first and most important step in management of SCN is recognition of the problem. Soil sampling will determine the presence of the nematode and its population levels. Soil samples can be collected any time, but fall sampling is generally preferred because it provides adequate time to employ SCN management techniques.

The Soybean Cyst Nematode (SCN) Soil Sampling Information Sheet, available at county extension offices or online at: agbiopubs.sdstate.edu/articles/PSstl-scn.pdf, provides a convenient method for supplying the necessary information (field location, cropping history, grower's address, etc.) when submitting a sample. The reverse side of the sheet contains instructions for collecting the soil sample. Samples for SCN analysis should be collected to a depth of 6 inches and do not need to be air dried before mailing to the **Nematode Testing Services, PSB 117, Box 2108, SDSU, Brookings, SD 57007.** Areas of a field where SCN may have been introduced should be included in soil sampling (Fig 5). The presence of SCN can also be confirmed by carefully digging plants in late July or August and examining roots for white females (Fig 11).

CROP ROTATION

Crop rotation using non-host crops to reduce SCN populations is an essential component of SCN management. High SCN population densities (above 1000 eggs per 100 cm^3 soil—less than a half cup) are best managed by rotating to a non-host crop such as corn, small grains, sunflowers, flax, canola, or alfalfa followed by a SCN-resistant soybean variety. If adapted, SCN-resistant varieties are not available, longer rotations with non-host crops will be required between soybean crops. Dry beans are an excellent host for SCN and should not be rotated with soybeans.

RESISTANT VARIETIES

SCN-resistant soybean varieties, in combination with crop rotation, are a very important management tool (Fig 12). Planting SCN-resistant soybean varieties will reduce yield loss due to SCN and also will reduce SCN population densities. In field plot tests conducted over an eleven-year period, yields of SCN-resistant lines have been 23–63% higher than susceptible (Fig 13). It is best to plant a SCN-resistant variety in fields where SCN has been detected even when population densities are low (less than 150 eggs per 100 cm^3 soil). If a susceptible variety is planted the SCN population will rapidly increase to very damaging levels. Fields with extremely high SCN populations (greater than 5000 eggs per 100 cm^3 soil) should be rotated to non-host crops to reduce SCN numbers before planting resistant soybean varieties.

STAGES IN SCN LIFE CYCLE

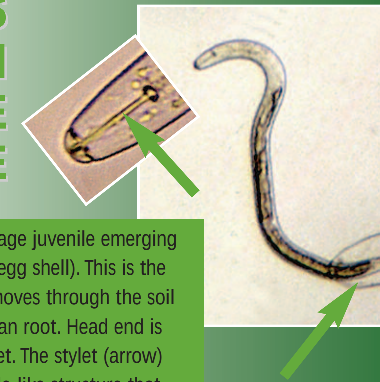


Figure 6. Second stage juvenile emerging from an egg (note egg shell). This is the infective stage. It moves through the soil and enters a soybean root. Head end is enlarged in the inset. The stylet (arrow) is the hollow, needle-like structure that the nematode uses to pierce plant cells and withdraw nutrients.

Figure 7. As the nematode feeds within the soybean root, it gradually enlarges.

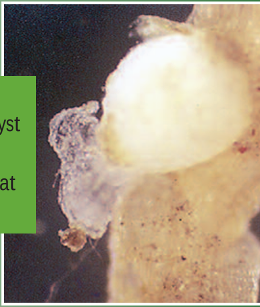


Figure 8. Freshly emerged female cyst nematode. Note gelatinous matrix at rear of nematode.

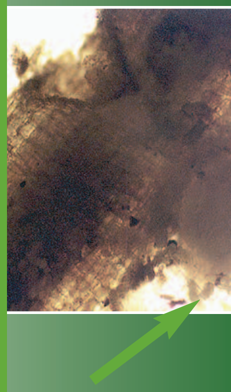
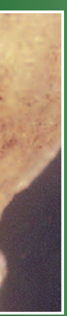


Figure 9. Cyst nemtode attached to root opposite a large scar where another cyst nematode emerged. Some of the eggs are laid in the gelatinous matrix (arrow). As the nematode matures, her body covering becomes tougher and thicker and forms a protective cyst for the eggs inside.

Figure 10. Ruptured cyst. The cyst is a dead female nematode that may contain several hundred eggs. Eggs within cysts may remain viable for as long as 10 years.

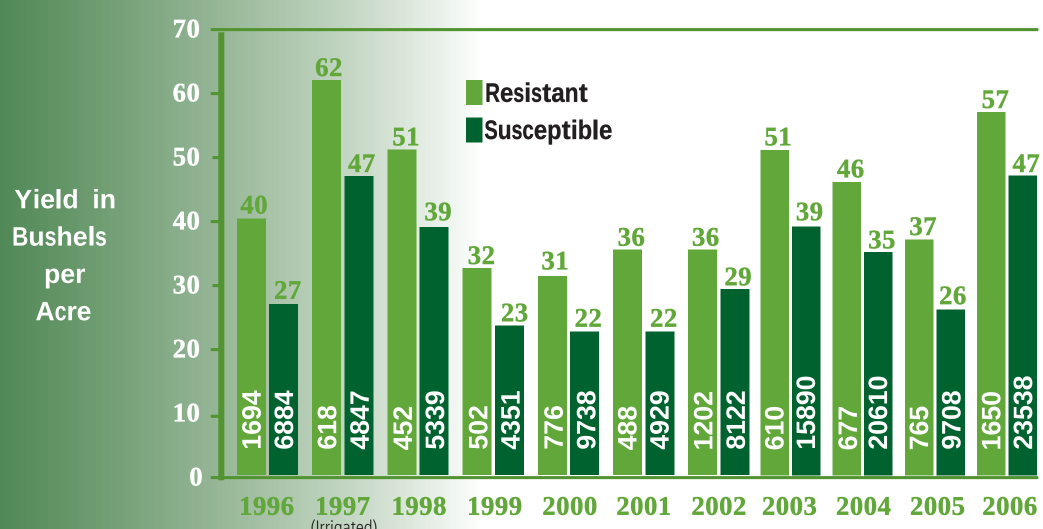
Figure 11. The presence of SCN can also be determined by carefully digging roots and looking for white females. Examine roots for SCN from mid-July – August.

Figure 12. Resistant varieties are one component of effective SCN management. Yield of the resistant variety in this photo was three times that of the susceptible variety.



Photos: J.D. Smolik

Figure 13. Average yield of resistant and susceptible soybean varieties in test plots in Clay, Roberts, Turner, and Union counties, South Dakota, 1996–2006.



* Numbers inside columns are population densities of SCN eggs plus second-stage juveniles per 100cm[3] soil at harvest.

PLANT HEALTH

Providing optimal growing conditions for the crop will reduce stress and yield loss due to SCN. Careful seedbed preparation and adequate soil fertility will improve plant growth and development. Management of weeds, diseases, and insects reduces plant stress and minimizes SCN damage.

SANITATION

Anything that moves soil can move SCN. Avoid spreading SCN from infested to uninfested fields. If possible, uninfested fields should be planted first and equipment should be power-washed after working infested fields. Soil peds in seed stocks may contain SCN; therefore, plant only properly cleaned seed. Tillage practices that reduce wind and water erosion also can slow the spread of SCN.

NEMATICIDES

Nematicides have not been tested for control of SCN in South Dakota. Data from other states indicates nematicides can suppress early-season SCN populations and increase yields. However, nematicides may not provide season-long SCN control, and final nematode populations may be as high or higher in nematicide-treated areas as in non-treated. Also, nematicides increase production costs and are extremely toxic. Longer-lasting and more economical control can be achieved with rotation and resistant varieties.

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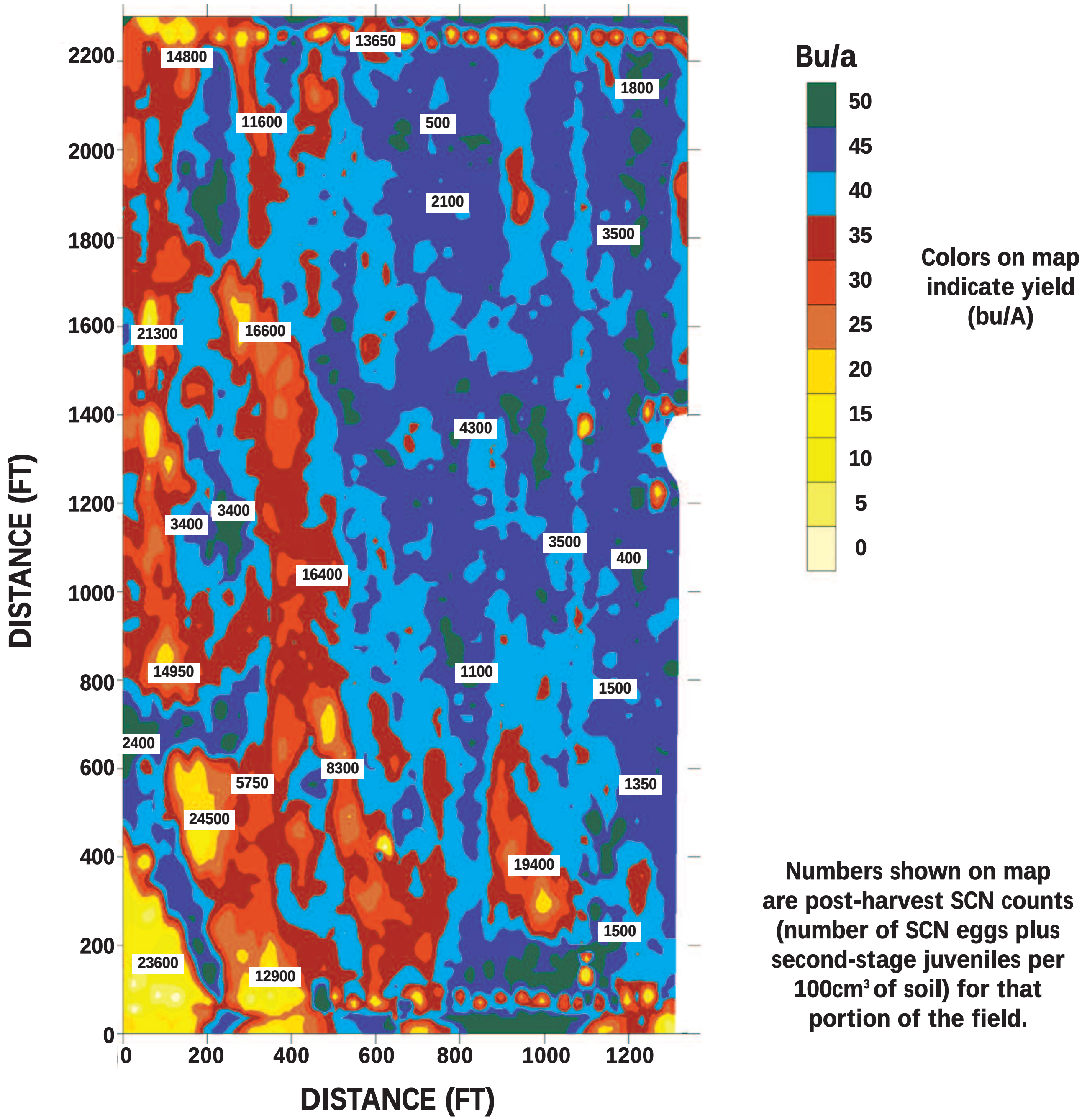
Figure 14. Map of soybean yields and SCN populations, irrigated field, Turner Co.



A yield map was prepared for an irrigated field in Turner County. The field had been planted to corn for the three years prior to planting a SCN-susceptible soybean variety. About mid-August, symptoms typical of SCN damage (stunted, yellow plants) began to appear in the field, especially in the southwest portion.

A yield map of the field (Fig 14) revealed several "pockets" of low- to very low-yielding areas. Soil samples were collected from these pockets and from higher-yielding areas and SCN population densities were measured. In general, there was a good correlation between low-yielding areas and high SCN populations (Fig 14).

The patchy distribution of SCN is typical of well-established SCN infestations encountered in SDSU research surveys and indicates the importance of obtaining representative soil samples. Although SCN damage was obvious in this field for much of the growing season, yield maps such as this may be useful in detecting earlier stages of a SCN infestation.

Also, it should be noted that even though a nonhost crop was planted the previous three years, SCN survived at very damaging levels in much of the field. This is an example of the management difficulties this nematode can present, and indicates the importance of testing soil for SCN.