The soybean cyst nematode, *Heterodera glycines*, was identified in Minnesota from soil samples collected from a field near Frost in Faribault County in September 1978. Soybean plants on several acres of the field were severely damaged. Additional soil sampling during the fall of 1978 and testing of these soil samples during the winter identified 14 more infested fields in a radius of seven miles from the initial find. The soybean cyst nematode (SCN) was also found in several soil samples from adjacent parts of Iowa.

In 1979 an extensive aerial and ground survey by the Minnesota State Department of Agriculture revealed SCN infestations in 6 additional counties (Brown, Cottonwood, Freeborn, Kandiyohi, Martin, and Waseca).

The extent and severity of the infestation indicate that the SCN had been present in the original affected area for at least 10 to 12 years. This much time is typically required for the population to build up in a two-year corn-soybean rotation to cause the observed symptoms.

Field Symptoms

The above-ground parts of soybean plants damaged by SCN have no unique symptoms. They are short and unthrifty compared to plants in unaffected parts of the same field. Leaves of severely affected plants turn yellow in late July or August, partly because of a nitrogen deficiency. The affected plants are typically located in oval-shaped areas of various sizes. The long dimension of the area is in the direction of primary soil tillage. The movement of infested soil by tillage equipment spreads the nematodes much faster and farther than they can move by themselves.

The only distinctive symptom is the presence of white soybean cyst nematodes on the roots (figure 1). These are difficult to see in the field because they are small and are easily rubbed off when plants are pulled. Roots must be removed carefully from soil, washed, and then inspected with a magnifier to see these females clearly. If the nematodes are especially numerous and the soil is loose enough so that it readily separates from the roots, then the white, lemon-shaped females attached to the roots can be seen with the unaided eye.

Affected roots are usually rotted, and nodules of nitrogen-fixing bacteria are often destroyed. Symptoms on leaves are the result of this poor root system and reduction of nodules.

Areas of fields affected with SCN may be confused with areas with iron deficiency. Plants in both areas have yellow leaves. Iron deficiency is most severe on low ground or the border area of low ground. SCN is not restricted to any particular topographic feature of the land but may be most damaging and numerous on higher ground.

Verification of an SCN Infestation

Identifying the presence of the soybean cyst nematode can be done in the field during July and August by following the procedures and precautions mentioned above. At other times of the year and for confirmation of a field diagnosis, a soil sample, or preferably soil samples, must be collected and taken to a qualified laboratory.

The Nematode

Soybean cyst nematodes are small round worms about 1/40 inch long when they hatch from eggs (figure 2). After hatching, the nematodes move through the soil and enter the roots of nearby soybean plants or other hosts. About 9 to 12 days after entering the root, the females become flask-shaped and break out through the root but remain attached. The body of the dead female becomes the cyst and may contain 200 or more eggs.

The living female is white. After she dies her body, the cyst, turns tan to brown and finally dark brown (figure 3). Some of the eggs hatch immediately into the small larvae that enter roots. A life cycle may be completed within six weeks.
in warm soil. However, eggs can remain dormant in the cysts for several years, complicating control measures.

**Damage**

The soybean cyst nematode is considered one of the most serious pathogens that attack soybeans. It is most damaging when the crop is under stress from moisture and nutrient deficiencies or other adverse factors. Although yield reductions of up to 90 percent have been measured in other states, such extreme losses have occurred only in severely affected parts of the fields. Heavily infested states like Missouri report annual losses from SCN in the $10s of millions of dollars.

**Spread of the SCN to New Areas**

The SCN is spread to new areas primarily by the movement of infested soil. A major carrier of this soil is machinery, both long distance and local. Some soil is carried on a machine unless it is thoroughly cleaned. Other important means by which the SCN is spread include peds, which are small balls of soil mixed with soybean seeds, and the wind. There is also evidence that this nematode may be spread by migrating birds.

The history of soybean cyst nematode disease gives some idea of its rate of spread over large areas. The soybean cyst nematode was first reported in Japan in 1915. The first report in the United States was in 1954 from North Carolina. Two years later it was found in Tennessee and Missouri. In 1959 it was reported from the southern tip of Illinois. By 1977 SCN had been reported from 43 of the 102 counties of Illinois, and it was about three-fourths of the distance from south to north in the state. The nematode is in advance of the SCN is spread over a field. Prevention or delay of initial infestation on farms and fields that are free from the SCN is worth farmers' time and effort. Some precautions can be taken with moving machinery from farm to farm. A machine that has worked under dry conditions is much more likely to be free of the soybean cyst nematode than one that has mud on it from wet conditions. Cleaning the machinery may be justified in some cases.

**Development of an SCN Infestation in a Field**

The nematode begins to increase after infested soil is brought to a field. Growing susceptible host crops, particularly soybeans, is the greatest factor in nematode increase. Other highly susceptible crops are beans, such as snap, field, kidney, and lima. Less susceptible crops are cloves, including crimson, scarlet, and alsike; sweet clover; birdsfoot trefoil; crownvetch; and pea. None of our common field weeds is presently considered susceptible.

The frequency of soybean crops is the most significant factor in the development of SCN population in this area. When corn and soybeans are grown in alternate years, the fourth or fifth crop can be expected to show severe damage from the nematode. An individual nematode may move only an inch or two through the soil during its lifetime as the result of its own activity. The movement of infested soil by tillage equipment is the greatest factor in spreading the infestation over a field. The infested area will enlarge in an oval shape with the long dimension in the direction of primary tillage. Small centers of infestation can be expected to develop in other parts of the field, and eventually the entire field can be infested.

**Prevention or Delay of Infestation**

The prevention or delay of initial infestation on farms and fields that are free from the SCN is worth farmers' time and effort. Some precautions can be taken with moving machinery from farm to farm. A machine that has worked under dry conditions is much more likely to be free of the soybean cyst nematode than one that has mud on it from wet conditions. Cleaning the machinery may be justified in some cases.

**Control of SCN**

The suggestions on control of SCN are based on information obtained from other states where SCN has been a problem for many years. Present controls are based on cultural practices, since adapted varieties with resistance are not yet available and the usefulness of various nematocides in Minnesota has not been determined. Suggested controls are:

1. Know the status of fields. Determine the cause of areas of poor soybean growth. The presence or absence of SCN in a field will affect the management of that field, particularly the cropping sequence.
2. Grow three or more non-host crops between soybean crops if SCN is present. This is intended to reduce the population of nematodes between soybean crops. Corn, cereal grains, sunflowers, and grass hay are some crops considered to be non-host crops for SCN. There may be others. Sunflowers build up white mold that can attack soybeans. Generally, legumes should be avoided. However, alfalfa is not listed as a host among susceptible plants. The number of non-host crops between crops of soybean that will reduce the SCN population to safe levels is not well established and will probably differ from one field to another.
3. Maintain good soil fertility. Nematodes reduce the effective root system, and thus limits the absorption of nutrients. Adequate levels of nutrients in the soil give the crop a better chance to produce a profitable yield.

**Soil Sample Collection**

Soil samples for SCN testing should be collected from soybean fields during the last half of the growing season, but before leaves turn yellow at maturity. From mid-July to the end of August, the affected areas will be most obvious with yellow leaves on stunted plants. Several soil samples should be taken from the plant rows to a depth of 8 to 10 inches. These samples should be mixed and at least a pint of soil sent in for the test. County Extension Directors and many chemical dealers have the appropriate instructions for collecting soil samples.

Although accurate field diagnosis can be made on the basis of the presence of white female nematodes attached to soybean roots, laboratory diagnosis is usually desirable. Positive identification of the soybean cyst nematode requires that the cyst be examined microscopically and certain characteristics of the larvae be carefully measured at a magnification of x1000.

**Testing Laboratories**

The following non-commercial laboratories are available in Minnesota to do cyst nematode testing:

1. Minnesota Department of Agriculture Greenhouse
   830 West 6th Street
   Shakopee, MN 55379
   Samples for this test may be moist or dry. There is no charge.
2. Plant Nematology Laboratory
   Department of Plant Pathology
   University of Minnesota
   1619 Gortner Avenue
   St. Paul, MN 55108
   Samples for the University of Minnesota test must be kept cool and moist in a plastic bag. Plant parasitic nematodes present in the sample will be identified and their numbers calculated. Recommendations pertaining to the significance of the nematodes on soybeans and other crops will be made. There is a $3 charge for this test. Make checks payable to the University of Minnesota.
3. Various commercial laboratories have started or will begin offering a nematode analysis service.