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Collecting Samples for Corn Nematode Analysis

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Recommendations for collecting soil and root samples for nematode analysis, including guides to field sampling as well as timing, handling and storage of samples to ensure accurate assessment.

It is not possible to diagnose nematode problems in corn based only on plant symptoms. Some nematodes in corn cause symptoms which mimic those caused by numerous other problems, such as nutrient deficiencies, insect injury, herbicide damage or soil compaction *(Figure 1)*. Because of this, nematodes are difficult to diagnose and, consequently, often overlooked.

Nematodes can cause tremendous damage to corn with reported yield losses exceeding 50 percent in severe cases. It is important not to disregard them, especially since recent changes in cropping practices may favor nematodes. The use of transgenic insect-resistant corn and the shift in soil insecticide chemistries to pyrethroids do not deter nematode feeding, in contrast to the more traditional carbamate and organophosphate soil insecticides that are toxic to nematodes. Nematode damage is likely increasing in many areas, making it more important to monitor populations. Samples must be collected and submitted to a testing laboratory for nematode analysis in order to make a confirmed diagnosis. This publication makes recommendations for collecting and submitting samples for corn nematode analyses.

There are two purposes for sampling a field and submitting samples for nematode analysis. First, samples may be collected to establish a baseline estimate of nematode populations or to identify the presence of a certain nematode(s) as part of a field survey. Second, samples may be collected from a symptomatic area for diagnostic purposes. Fortunately, sample collection for corn nematode analysis is similar to that for nutrient analysis or for soybean cyst nematode analysis with a couple of major exceptions.

Soil and Root Samples

The goal of sample collection when surveying a field is to collect enough subsamples from across the field to create a single composite sample that is representative of that section of the field. Samples must be collected without bias and should not represent more than 20 acres. Nematode population densities can vary widely across a field. Therefore, the accuracy of nematode analysis estimates decreases with increasing field size.

Figure 1. Severe nematode damage in corn.

Sampling in one of several suggested arbitrary patterns in a field will result in a sample that should be a representative average of the population densities of nematodes in that location. Some suggested sampling patterns are shown in *Figure 2*. Soil samples should be collected from the root zone of living plants to target the most nematodes. The size of the root zone is determined by the age and size of the plants. Collection of at least 20 soil cores with a traditional "T" sampling probe to a depth of 8 inches is adequate for most nematodes. A minimum of two cups of soil is necessary for most labs to conduct a nematode analysis.

Although nematodes may occur throughout the field, the highest population densities tend to be randomly aggregated in clumps, which may cause the development of "hot spots" such as the one shown in *Figure 1*. Sampling a severely affected area such as this requires a different approach. The health of plants in the center of severely affected areas can be compromised with severely damaged roots that have reduced feeding area available to nematodes. Nematode densities in

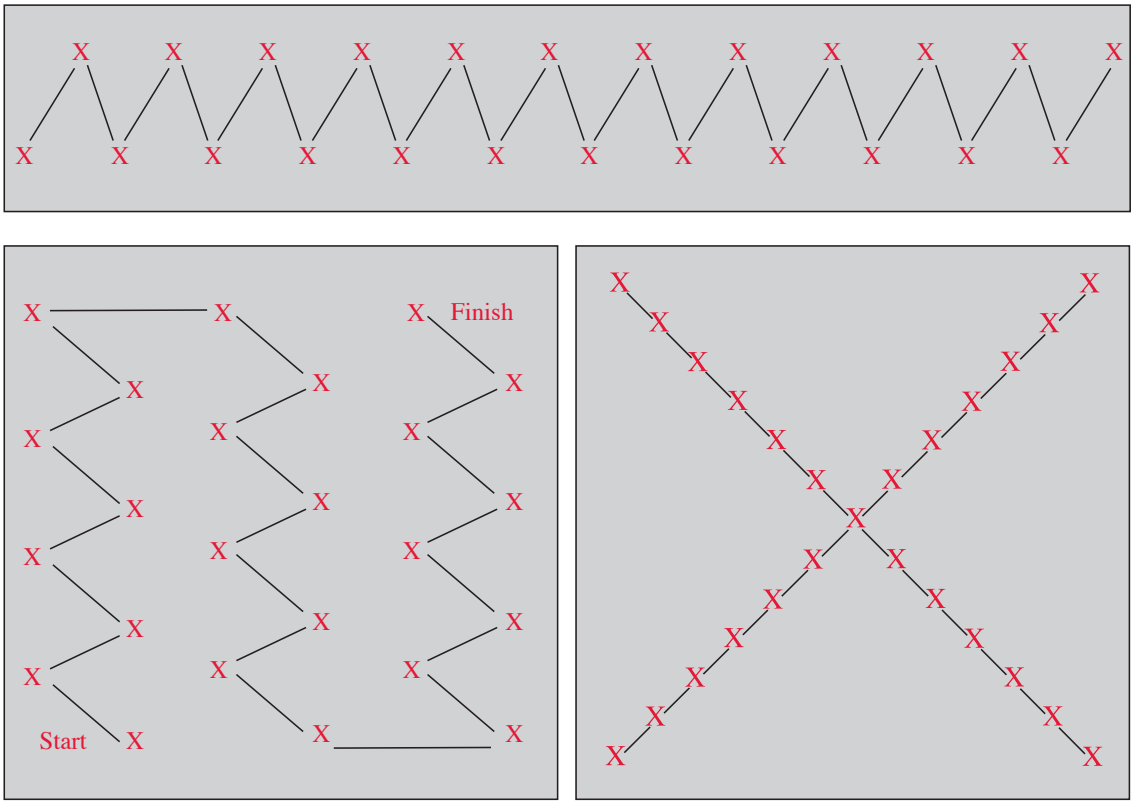

Figure 2. Suggested sampling patterns.

the centers of such areas tend to be lower than expected because many nematodes may have moved out of these areas. Results from nematode samples collected from these areas may be misleading. Nematode densities will be higher in the peripheral edge of severely affected areas, so samples should be taken from this location instead of from the center. *Figure 3* illustrates a suggested sampling pattern for the collection of samples from a severely affected area. If samples are collected for diagnostic purposes, additional samples may be collected from healthy plants outside the symptomatic area to form another composite sample. The results from nematode analyses conducted on separate samples collected from both within and outside symptomatic areas can be compared for a more definitive diagnosis.

There are more than half a dozen genera of nematodes that can damage corn in Nebraska. Two of the most common nematodes of corn in Nebraska, lesion (*Pratylenchus* spp.) and lance (*Hoplolaimus* spp.), spend most of their lives *inside* corn roots. These completely burrow into roots to feed and are referred to as endoparasites because of this characteristic behavior. It is necessary to extract nematodes from roots in addition to soil samples to accurately estimate their population densities. Therefore, it is essential that both root and soil samples be submitted for nematode analysis. The extra effort will be rewarded with more accurate results from the nematode analysis. Some testing labs may only evaluate nematodes from soil samples, so it is important to determine whether the lab you use will extract nematodes from the roots.

There are no data to establish guidelines for the collection of root samples for nematode analysis; however, it is similar to the strategy used to collect soil samples. The accuracy of nematode analysis results improves with increasing numbers of corn roots (subsamples) that are collected from different parts of the field to form the composite sample. The same sample collection patterns illustrated in *Figures 2* and *3* can be used for root sample collection. Typically, the collection of roots from at least six corn seedlings and a portion of the root balls from a minimum of four large plants from different areas of the field should be adequate. A shovel or tile spade works well for digging corn plants. The entire root ball from adult plants is not necessary for analysis; the shovel can be used to divide each root ball into halves or quarters so that only a portion of the roots from several plants is submitted for analysis. The soil on the roots is not necessary for analysis and can be removed by knocking it off to reduce shipping weight.

Sample Timing

There is some debate on the best time of the year to collect samples for nematode analysis. Nematode population densities are highest near the middle or end of the cropping season, which is a suitable time to sample for *most* nematodes. However, some nematodes, such as the needle nematode (*Longidorus* spp.) which is present in some Nebraska corn fields, are known to travel deeper in the soil as the season progresses and may be out of range of traditional soil sampling probes. The exact reason for their late season vertical migration in the soil is unknown, but may be in response to changes in temperature or moisture availability or occur as they search for actively growing roots. Results from nematode analyses

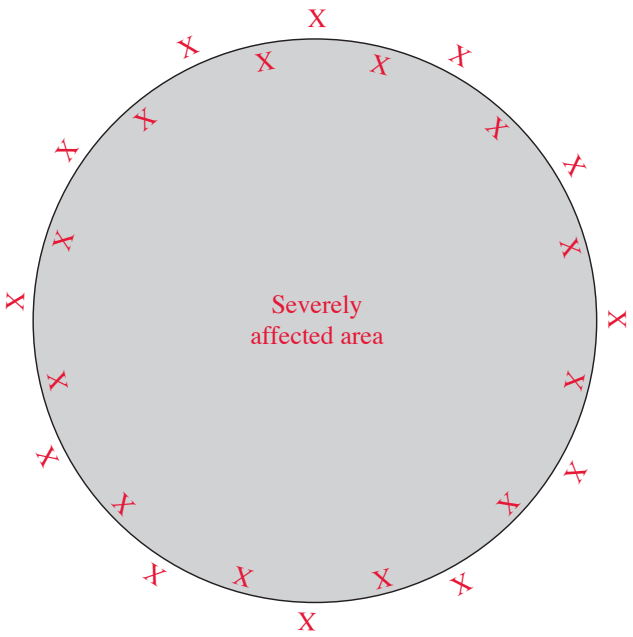

Figure 3. Suggested pattern for the collection of samples from a severely affected area.

conducted on samples collected later in the season may not be accurate because they may contain false negative results for the nematodes that traveled deeper in the soil. It is usually safer to collect samples early in the season within four to six weeks after planting when plant symptoms begin to develop in nematode-infested fields. During this time, we would expect nematodes to still be in the upper eight inches of the soil profile where they can feed on seedling roots.

Handling and Storage

Careful sample handling and storage is important to maintain the sample quality and especially to insure reliability of the results. It is important to keep the nematodes in the samples alive, particularly in root samples, for the extraction and identification processes that will be conducted by the testing laboratory.

Following are some recommendations for submitting samples:

- Plant and root samples should be submitted in separate sealable plastic bags.
- Never add water to either root or soil samples.
- Don't collect soil samples when the soil is excessively wet or dry.
- Prevent exposure of samples to temperature extremes, both freezing and heat, during handling and shipping. If possible, refrigerate the samples until they are shipped. Temperature control is especially important for nematode survival.
- Avoid rough handling that can compromise nematodes sensitive to soil disturbance.
- Ship samples quickly, but not over the weekend, to prevent their exposure to extreme temperatures and to help insure their quality.

Summary

Plant parasitic nematodes of corn often are overlooked as causes of disease and yield loss. In reality, many Nebraska producers face chronic challenges with damage caused by corn nematodes. Estimating population densities in soil and root samples collected from fields can help determine if corn nematodes are a problem in your field. Accuracy of diagnosis is only as good as the quality of the sample that you submit. Additional information is useful to diagnosticians, so please provide as much information as possible about the location, including field and cropping history, pesticide and fertilizer application, and specific conditions or observations, such as plant symptoms and their distribution.

The University of Nebraska–Lincoln Plant and Pest Diagnostic Clinic is one of the laboratories in the state that can conduct nematode analyses for a fee. You can get more information and the forms required for sample submission from your local extension office.

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