SOIL SAMPLING FOR NEMATODE PEST MANAGEMENT IN ALFALFA

Peter B. Goodell
Area IPM Specialist
University of California, Kern County

I appreciate the opportunity to address this Symposium on the subject of soil sampling for nematode pest management. I was asked to present the subject since my Master's research involved just this area. However, as I reviewed the material, I realized several things; first my research was specific to the area and the field on which I sampled, and second even if specific recommendations or suggestions could be made regarding nematode sampling, our knowledge of the exact detrimental effects of specific nematode pests is so limited as to make the effort almost meaningless.

What I propose to do is to give some basic guidelines to follow when preparing to take a soil sample for nematode analysis. I hope to give you some appreciation of the sampling problem and some insight into methods of solving these problems. I have extensive data and experience with a single field of alfalfa and this will be used for illustration.

BACKGROUND

The objective of any sampling process is to achieve an estimate of the population density which is representative and reliable enough to make a sound economic decision. Nematode sampling is more complex than other pest management sampling procedures because of the soil inhabiting nature of the pests, their microscopic size, and the limited number of trained people for identification. Nematode sampling therefore requires a three step process including collecting the soil sample, processing it to extract the nematodes from the soil, and identifying the pests present. My presentation will focus on the collection of the soil sample, but I will discuss the importance of proper extraction as well.

Alfalfa roots are a host for many species of nematode pests including Root Knot (Meloidogyne), Lesion (Pratylenchus), Stubby Root (Trichodorus), Spiral (Helicotylechus) and Stunt (Tylenchorhynchus). It is not uncommon to find all of these pests present in a field and perhaps in high numbers. These are all obligate parasites and require the presence of some host for their continued existence. The biology of an individual pest varies as some are ectoparasites, grazing on the roots while remaining outside in the soil, and others are endoparasites, spending most of their life cycle inside the root tissue. The importance to sampling and extraction of these individual differences will be discussed later.

COLLECTION OF SOIL SAMPLES FOR NEMATODE ANALYSIS

Distribution of nematodes in a field is one of the most important considerations in soil sampling. Nematodes are not located in a uniform or random manner in a field, but appear clumped in their distribution. This clumping is due to the individual biology of the pest and the actual distribution of the host's roots in the soil. Alfalfa is broadcast throughout the field and its roots tend toward a more uniform coverage of the field than a row or tree crop. Since these nematode pests depend on the roots for food, their distribution will be determined by the rooting pattern in the field. Each nematode pest is influenced differently by the soil environment. Such environmental factors include soil texture, areas of the field with compaction, irrigation, or salinity problems, and the cropping history of the field.

For this reason within an individual field, the distribution of different nematode pests may be very different. Figure 1 illustrates the distribution pattern for five nematode pests in a 17 acre alfalfa field in the Palo Verde Valley. Some of the differences between the species can be explained by soil texture preferences, as in Spiral and Stunt nematodes in the heavier soil. Here the population is almost entirely located within the clay streak (Figure 2). The other three species in this field were not as dependent on soil texture and are found throughout the field.

Another obvious difference is the population density between the various species and within an individual species in the field. Each point in Figures 1 and 2 is separated by six meters. The height of the peak in Figure 1 represents the density of the population at that point. Note how the density can radically change between sample points.

Both the abundance and location in the field would greatly influence the strategy to be used in sampling. If a field contains variation in soil texture, crop history, or vigor these areas should be sampled separately from the main portion of the field. If nematode distribution is influenced by these field variations, taking samples from the different areas and keeping the samples separate will aid in defining areas of high or low nematode population. Stratifying the samples in this manner will increase the value of the field sample.

It is best to have many individual sample points which can be bulked together and subsampled before submission of the sample to a laboratory for analysis. As can be seen from Figure 1, if soil was removed from just one point in that field, it may not truly represent the nematode populations for the whole field. It is important to get a representative sample and this can be done by collecting soil from many points. Soil can be collected with many tools. The most widely used in row and field crops is some type of a soil probe which removes a soil core. These cores are generally small enough to allow 20 - 30 to be collected in a bucket. The soil in the bucket is thoroughly mixed and a quart of soil is removed for analysis by a laboratory. In general, the most expensive part of the soil sampling procedure is the laboratory analysis. For this reason it is less expensive to increase the number of sample points and subsample than to increase the number of samples to be submitted.

The soil should be sampled when it is moist but not saturated. It should be sampled to a depth of at least 18 inches. In alfalfa with its deep root system, nematodes will be found below that depth but the major portion of the population will be between 0 and 18 inches. Be sure and include roots in the sample for the extraction of endoparasitic nematodes. About one quart of soil should be submitted to the diagnostic laboratory. The sample should be protected from direct sunlight and maintained between 50° and 60° F.

EXTRACTION

The extraction of nematodes from soil and their identification requires a level of skill and expertise generally not available to everyone. The availability of nematode diagnostic laboratories in California is increasing and the quality is improving. However, the laboratory requires essential information about the soil sample to choose the most appropriate extraction technique possible for that soil sample. As mentioned before, there are a variety of nematode pests in alfalfa roots and soil, and these can be recovered with a variety of methods. It is essential that proper information be included with the soil sample when submitted to the diagnostic laboratory. Such information includes:

- Date of sample
- Location of field
- Soil texture
- Description of any symptoms
- Field history - Past crops, current crop, next crop
- Last fumigation
- Suspected nematode pests if known

Time of year is an important consideration for choosing the proper extraction technique. For example, if the sample is taken in winter the Root Knot population may be mainly in an egg stage. Many techniques will not recover the eggs and the population may be greatly underestimated.

It is important that the laboratory report not only the numbers of pest nematodes found and their identification, but the extraction technique used and its recovery efficiency. This is important because no extraction technique recovers 100% of the nematodes present in the soil or roots. The techniques in wide use today recover approximately 10% to 50% of the nematodes in a sample and a correction factor is required to ascertain the original numbers in the sample.

CONCLUSION

This presentation was designed to provide some basic and general information on nematode sampling. It is not by any means the final word nor should be taken as such. Nematode sampling, extraction and most importantly, interpretation of the results is still very much of an art. Soil sampling areas of weak growth in an alfalfa field may help

identify the cause of that lack of vigor, but as yet the information has not been developed to allow the prediction of yield or stand loss with certain levels of nematode pest populations. I hope this presentation has provided some food for thought the next time a nematode sample is required, for alfalfa or most any field crop. The more information a grower or PCA can provide a nematode diagnostic laboratory or nematologist, the more useful the interpretation of the results will be. For further information on nematode sampling, request from your Cooperative Extension office Leaflet 21234, General Recommendations for Nematode Sampling.

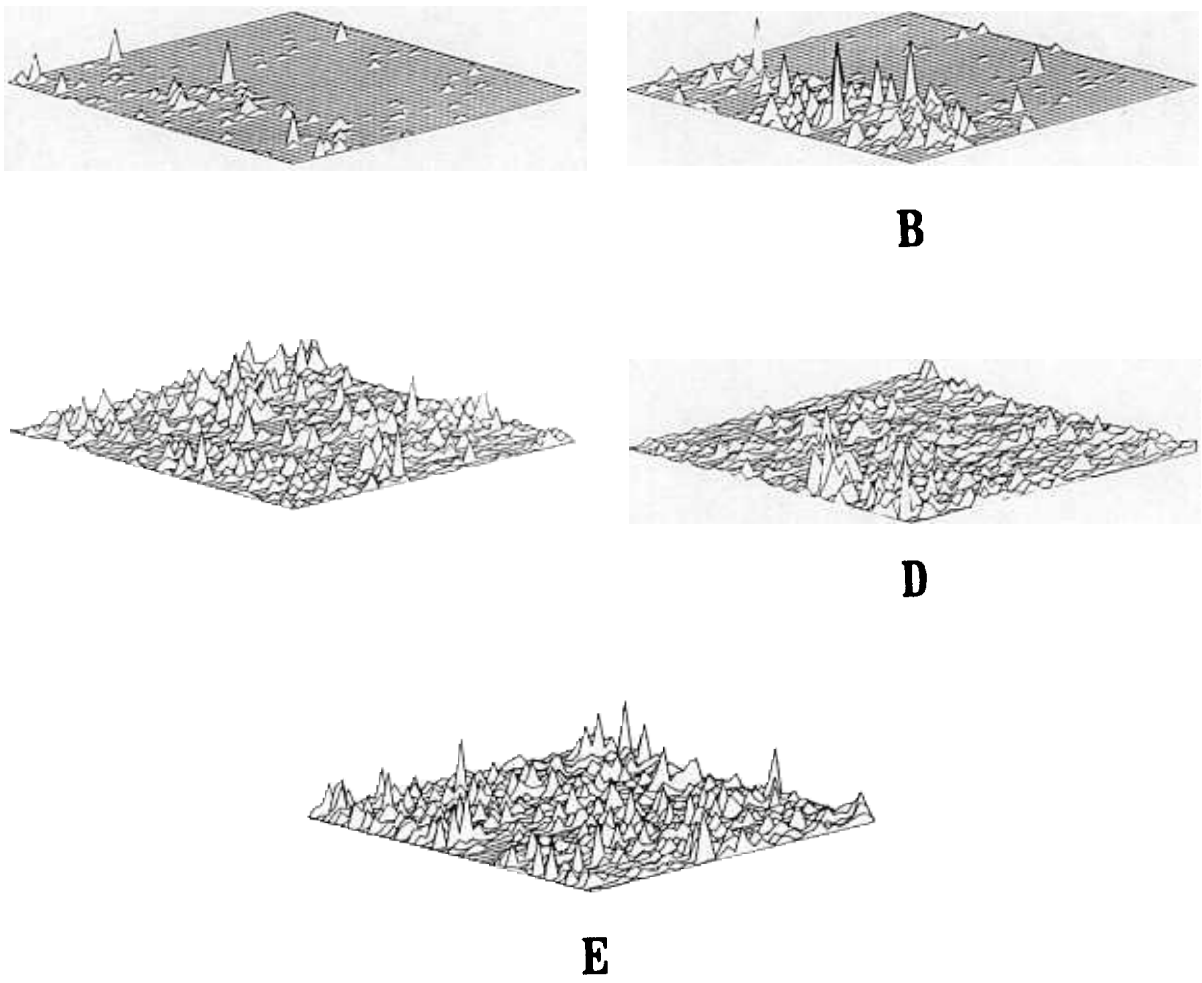

Figure 1. Three dimensional projections of the population density distributions of five nematodes in an alfalfa field. Ridges represent areas of high densities; valleys represent areas of low densities.

A. Stunt Nematode
B. Spiral Nematode
C. Stubby-Root Nematode
D. Lesion Nematode
E. Root-Knot Nematode

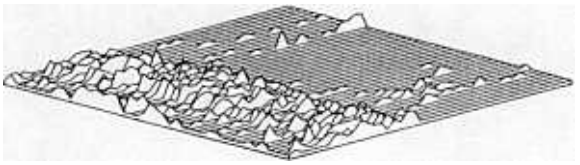

Figure 2. Three dimensional projection of soil texture in the same alfalfa field. Ridges represent areas of clay soils; valleys represent areas of sandy soils.