PLANT AND SOIL NEMATODES

DIAGNOSIS OF PROBLEMS CAUSED BY PLANT-PARASITIC NEMATODES

Plant-parasitic nematodes commonly reduce crop yields by 10-15% and sometimes cause severe damage, particularly in vegetable crops. However, because nematodes live in soil and produce symptoms that are often quite subtle, they are some of the most difficult pest and disease problems to diagnose. This fact sheet explains how to determine whether nematodes are causing losses in a particular crop or location.

Symptoms caused by plant-parasitic nematodes on established crops

Aboveground symptoms caused by nematodes will vary with the crop, the nematode causing the problem, and the severity of damage. However, they are generally similar to the symptoms associated with any root injury that interferes with a plant's water and nutrient uptake. Thus, stunting and poor growth is often the first indication that nematodes may be causing damage. Incipient wilting may also occur during the hottest part of the day, with the plant recovering in the evening and at night. Symptoms of nutrient deficiency may also be observed (e.g. yellowing and chlorosis) and yields will be lower than expected. Plant damage usually occurs in patches of varying size, and they tend to be associated with slight changes in soil type or slope, or the way a nematode has been spread from an initial infestation. Weeds will often be present in these patches because they tend to outcompete the poorly performing crop plants.

A few nematode genera invade above-ground parts of plants rather than roots and each of these nematodes produces relatively specific symptoms: twisting, distortion and swelling of leaves (*Ditylenchus*), production of galls in leaves and seedheads (*Anguina*), and deformed leaves and buds (*Aphelenchoides*). However, relatively few crops are attacked by these nematodes in Australia.

Belowground, root symptoms will vary with the nematode that is causing the damage. For example, root-knot nematode will cause galls on roots that differ in number and size, depending on the crop and its age. Symptoms caused by cyst nematodes vary with the host plant, but shallow root systems with shortened taproots or knotted and branched roots are often the first signs of damage. Root-lesion nematode causes lesions on roots but they are usually difficult to see because the lesions tend to amalgamate, and so the root system becomes discoloured and severely damaged roots will die. Ectoparasitic nematodes such as dagger and stubby root nematode cause stunting, swelling and necrosis of root tips, with lateral roots sometimes produced above the damaged tips.

Diagnosing a nematode problem on an established crop

The first step in diagnosing a potential nematode problem is to understand which nematodes are likely to damage the crop at the location of interest and be aware of the symptoms they produce. The next step is to select plants showing aboveground symptoms that vary in severity and have a close look at their root systems. If root symptoms such as those described above are observed on poorly-growing plants and healthy plants are symptomless, it is possible that a nematode is causing the poor growth. However, it is usually difficult to diagnose a nematode problem because the symptoms they produce are similar to those caused by other soilborne pathogens. Also, root damage is often exacerbated by bacteria, fungi and other organisms that are also attacking the roots. Consequently, the best option is to collect soil and root samples and forward them to a laboratory that provides a nematode diagnostic service. Most state Departments of Primary Industries and one private laboratory (Metagen, Gatton, Queensland), provide such a service, but their diagnostic capacity varies with the expertise of their staff.

Sample collection

If young plants are showing aboveground symptoms, carefully retrieve the root systems of several diseased plants, and also collect at least 500 mL of soil from around the roots. Collect a similar sample from healthy plants nearby, as having samples from plants that are not showing symptoms makes it easier to determine whether nematodes are the cause of the problem.

For established crops, ensure the sample collected is representative by retrieving soil and roots from at least ten randomly selected plants. Gently mix the sample in a bucket and keep a sub-sample of about 500 g soil and 100g roots. If there are patches of healthy and poor plants, collect similar samples from both areas.

Monitoring to predict whether nematodes are likely to cause problems in a crop to be planted

When a crop is to be grown in a field where plant-parasitic nematodes could possibly cause problems, it is important to establish a regular sampling program so the nematode population can be monitored over time. One of the most important sampling times is about six weeks prior to planting, as the results can be used to make management decisions before the crop is planted. Use a spade or sampling tube to collect about one handful of soil or a cylindrical core from at least 20 randomly selected points in the field. Place all the soil in a bucket, mix it gently and retain about 500 g for analysis. In situations where there is variability within a field due to differences in soil type, previous cropping history, or some other factor, collect similar samples from each area.

Submission of samples

After samples are collected, do not expose them to excessive heat by leaving them in the sun or inside a closed vehicle. Place each sample in a plastic bag, pack it in a manner that will prevent it being subject to excessive disturbance while in transit and forward the sample via an express courier to the diagnostic laboratory. It is also very important to include the sender's name, address and contact details and all relevant information on each sample (e.g. previous crops grown in the field, present crop or the crop to be planted, how each sample was collected, the history of nematode or soil-borne disease problems in the field, symptoms observed and their distribution, details of any nematicides applied, irrigation practices, nutrient inputs, and the presence of weeds).

Results obtained and their interpretation

A professional diagnostic laboratory should be able to provide a response that indicates how samples were processed, the identity of the plant-parasitic nematodes recovered (at least to genus level), and how many of each nematode were recovered from certain weights or volumes of soil or roots.

Provided the information listed previously was forwarded by the sender, laboratory personnel should be able to check the nematological literature and interpret the result. Although the number of nematodes required to cause damage (often referred to as the 'damage threshold') varies with soil type, environmental conditions, the level of crop management, and many other factors, the analytical report should contain comments on whether one or more of the nematodes found in the sample are likely to be damaging an established crop, or likely to cause yield losses in the crop to be planted.

Responding to a nematode analysis

If the results from a diagnostic laboratory suggest that nematodes may be causing problems, a huge amount of literature on potentially useful control measures is available. Such information can be accessed in this series of fact sheets, and in the two books discussed in Fact sheet PSN 044. Material published by various state government departments and research corporations such as GRDC can also be consulted.

Further reading

The following booklet was prepared for people who provide a nematode diagnostic service. Although it is a little outdated, it contains information that may be useful to someone who is dealing with a nematode problem for the first time. The booklet lists the nematodes of economic importance on field crops, pastures, and horticultural crops in Australia; describes the symptoms they produce; provides estimates of the damage threshold for the main nematode pests of horticultural and field crops; and discusses the management practices that can be used to reduce losses from these nematodes.

Stirling GR, Nicol J, Reay F (2002) Advisory Services for Nematode Pests: Operational guidelines. RIRDC Publication 99/41. https://agrifutures.com.au/product/advisory-services-for-nematode-pests/

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