PLANT PATHOLOGY NOTE: NO. 26

NEMATODES - A THREAT TO CROP YIELD

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INTRODUCTION

Plant parasitic nematodes can be serious pests of crops in Papua New Guinea. They are one of the most difficult pest problems in agriculture. Over 100 species of nematodes are known to attack crop plants. Among the best known are:

- Stubby root nematode of vegetables, *Trichodorus christiei*
- Potato cyst nematode, *Heterodera* sp.
- Root knot nematode, *Meloidogyne* sp.

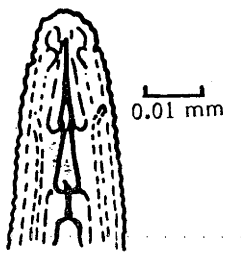
In the UK and USA entire potato crops have been destroyed by nematodes. In Papua New Guinea the amount of damage caused by nematodes, and the effect on the economy are still not known exactly.

DESCRIPTION

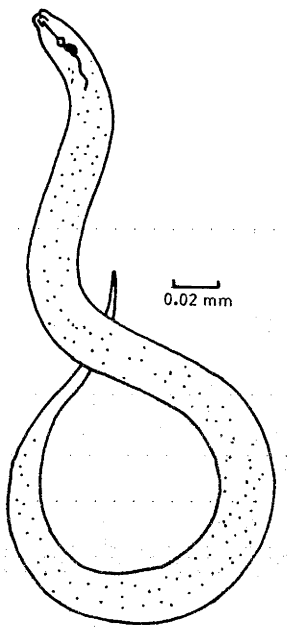
All species of plant parasitic nematodes have creamy-white, thin, worm-like bodies. The size of different species varies from 0.2 mm to over 10 mm long, with an average length of about 1 mm. The females of some species are pear-shaped or lemon-shaped.

In plant parasitic species, the mouth is armed with a 'stylet'. The stylet is a hollow, needle-like structure which is used to pierce plant cells and suck out the juices. When the stylet is not being used it is retracted (pulled in) so it cannot be seen.

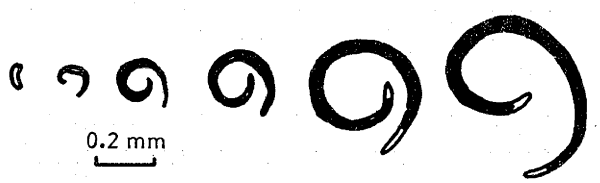
The life cycle of nematodes consists of the egg, 4 larval stages and the adult. The larvae look like the adults, but are smaller.



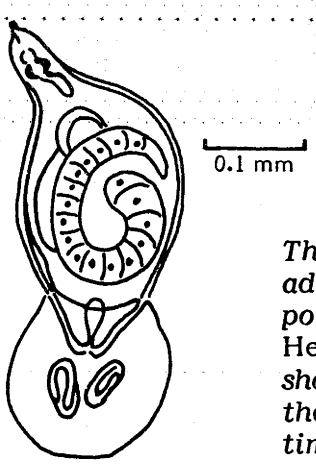
Head region with the retracted stylet of a typical plant parasitic nematode



Right: A typical adult male nematode, about 300 times natural size



Stages in the development of nematodes from egg to adult



The lemon shaped adult female of the potato cyst nematode Heterodera *sp., showing the eggs inside the cyst. About 140 times natural size.*

GROUPS OF PARASITIC NEMATODES

Generally the parasitic nematodes can be divided into four groups, based on their habitat in the host plant:

1. Ectoparasitic nematodes - feed on the root surface and normally do not enter the root tissue.

2. Endoparasitic nematodes - enter the root tissue or permanently attach themselves to it.

3. Above ground feeders - feed within the plant tissue above the ground.

4. Cyst forming nematodes - form cysts covering their eggs. The larvae live within the root tissue, and the adults live outside the root.

ECONOMIC IMPORTANCE

Plant parasitic species of nematodes can cause major problems for farmers by reducing crop yield. They feed on a wide range of host plants, including: coffee, peanut, potato, cabbage, tea, tomato, and many other vegetables, ornamentals, trees, forage grasses, field crops and weeds. Plant parasitic nematodes have been found to attack different plant parts such as leaves, flowers, grains, stems and bulbs, roots, and underground vegetables (tubers, corms).

Plant parasitic nematodes use their stylet to pierce plant tissues and suck out plant juices. At the same time they inject into the cells of plants poisonous digestive substances which stop or greatly alter plant growth.

Damage levels vary according to the species of nematode, the number present, and the part of the plant attacked.

Root feeding nematodes

The ectoparasitic, endoparasitic and cyst forming nematodes are all included in the root feeding nematodes. Because root feeding nematodes damage or destroy roots, any above-ground symptom that might result from a damaged root system could be caused by nematodes. The most obvious above-ground symptoms are plant wilting and plant stunting (small or dwarf-like plant growth).

Well known types of root damage include necrosis (browning) of roots, growth of many small or hairy roots, shortened roots, increase in size and distortion of roots, and the growth of root-knots or galls. The injured roots may not be able to absorb enough nutrients for the plant. Severe damage can cause roots to rot, followed by death of the plant.

Above ground feeders

Above ground feeders feed within the plant tissue above the ground. Nematode damage to above-ground plant parts may cause the plants to grow poorly. An injured stem may mean that the nutrients necessary for plant growth are transported through it too slowly. Damaged leaves and grains reduce the rate of photosynthesis and grain quality, respectively.

Vectors of other diseases

Parasitic nematodes can also act as vectors (carriers) of other diseases. For example, some virus diseases are sometimes passed into the host plants from the digestive system of the nematodes. Root rot diseases, such as Fusarium root rot, are sometimes associated with root-knot nematode.

The wounds made in plants by nematodes are often the entry point for other organisms. Some nematodes can even break down or destroy the plant's natural resistance to diseases. In both cases, as a result of nematode attack, injured plants are quite often more easily attacked by other organisms.

In all cases, severe attack on plants by parasitic nematodes reduces crop yield.

RECOGNISING NEMATODE ATTACK

Many other disorders can cause symptoms like those caused by plant parasitic nematodes. For example, curled leaves can be either caused by damaged roots that can no longer bring enough water to the plant; or they can be caused by dry weather or by

virus infection or attack. Yellowing leaves can result if roots weakened by nematodes are not able to take up nutrients; yellowing leaves can also be caused by a nutrient deficiency (shortage) in the soil. Fusarium root rot, produces above-ground symptoms similar to those produced by the root feeding nematodes.

Sometimes, nematodes may be present in or on the roots, but the crop does not show any signs of damage. This may be because the weather is either too wet or too dry or because the plants are tolerant to nematode attack. However, there may still be a loss in yield.

In diagnosing attack, the most important point is to develop a keen eye for the differences between healthy and unhealthy plants. Both above and below ground plant parts must be examined. The root system should be dug up and washed in water before examining it for signs of damage. Examination of the roots of both healthy and unhealthy plants will help you learn how to recognise diseased roots.

CONTROL

Control measures are needed only when crops are damaged badly enough by the parasitic species for the yield to be reduced too much.

However, before control measures are applied it is best to identify the nematode species involved and the damage it causes. Identifying the nematode species will enable the farmer to use the most suitable method for control.

Listed below are some common control measures used for the control of plant parasitic nematodes.

1. Quarantine or precautionary measures

   Avoid moving planting material from nematode infested sites to new areas.

2. Heat control

   Killing nematodes with heat is one of the oldest methods of control. There are two ways to do this:

   (a) Heat treatment of soil - spread soil in small quantities in thin layers and place in an oven. The easiest method for farmers to use is 'solarisation'. Spread plastic sheeting over soil and leave it for 4 to 5 days - the time taken for the soil to heat up enough depends on the amount of sunshine. For example, if there is continuous sunshine all day, and no rain, it will take 2-3 days.

   (b) Hot-water treatment of plants - dip planting material in hot water for short periods. For example, dip for 25 minutes at $45^{o}C$.

3. Fallow control

   Nematodes can be controlled by removing the plants on which they feed. Remove all plant material after harvest and destroy immediately. Plough or dig the soil to expose roots to wind and sun. The land should not be planted again for 2-4 weeks.

4. Crop rotation

   Grow several (2-5) different crops one after the other on the same piece of land. Choose crops that are not likely to be attacked by the same nematode species. Rotating different crops reduces the chances of a build-up of nematodes in the soil. Growing the same crop continuously allows a build-up of pathogenic (disease-causing) nematodes and therefore increases damage.

5. Resistant varieties

   The use of resistant varieties is also effective for nematode control. Unfortunately not all crops have varieties resistant to nematode damage or infection.

6. Chemical control

   Control of nematodes by chemical means may be the only solution if all other control methods fail. However,

use of chemicals for nematode control can be very dangerous, especially to the person applying the chemicals. Chemical control must be used only if the economic value of the crop is high enough, and the environmental conditions are satisfactory.

IDENTIFYING NEMATODE DISEASE

The Plant Pathology Section of the Department of Primary Industry in Konedobu has a laboratory which is equipped to identify diseases.

If you suspect that nematodes are damaging your crops, you can send samples to the laboratory for diagnosis. Collect samples of both diseased and disease-free plants, including the roots and soil. Seal the samples separately in moistened plastic bags, pack them carefully in cardboard boxes and forward them to:

The Plant Pathology Laboratory
D.P.I., P.O. Box 417
Konedobu

(Tel: 214699 Ext. 317 or 318)

Always telephone to let us know that you are sending samples, and inform us on which plane they are expected to arrive.

Copies of this Plant Pathology Note can be obtained from: The Publications Officer, Publications Section, D.P.I., P.O. Box 417, Konedobu.