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SOUTH PACIFIC COMMISSION

ROOT-KNOT NEMATODES

Left: Root-knot nematode galls on tomato roots.

Right: Cracks and swellings on yam tuber caused by root-knot nematode infection.

The **ROOT-KNOT NEMATODES** (or eelworms), *Meloidogyne incognita, M. javanica* and *M. arenaria* are widespread and important plant pests in the area of the South Pacific Commission. Root-knot disease is common on many crops including banana, carrot, cucumber, ginger, lettuce, okra, tomato, tobacco, pulse crops and yams.

SYMPTOMS

Galls on infected roots are the characteristic symptoms. On some plants such as tomato and cucumber, the swellings are very clear; but on others, including banana, sweet potato and taro, they are less noticeable. Crops of the grass family (for example rice, maize, sugarcane) have very small galls. Galls are best seen if roots are washed free of soil and examined while in water.

Above-ground symptoms are similar to those caused by lack of nutrients and water or by some soil diseases. Plants may be small, yellow and wilted. Heavily diseased plants do not respond to water or fertilizers.

Root-knot nematodes are present in many soils, but severe disease tends to be limited to sandy and free-draining soils. Disease may be patchy, or entire crops can be infected.

Fig. 1: A single female *Meloidogyne* and egg mass on a small root with minimum gall formation (enlarged).

EFFECT OF ROOT-KNOT NEMATODES

Infection causes poor root development, reduced nutrient and water uptake and weak support for the plant. Food produced by the plant goes to the nematode galls instead of the leaves and fruits. Root-knot infections encourage fungal and bacterial diseases. Crop yields are reduced, and harvested produce is of poor quality.

NEMATODE BIOLOGY

Root-knot nematodes can only live as parasites of plants. Microscopic, eel-shaped larval nematodes hatch from eggs left in the soil from earlier infections; they enter and feed on growing plant roots. Larvae then stop in one place within the roots and grow into pear-shaped females which produce hundreds of eggs **(Figs. 1 and 2).** Eggs are either buried inside gall tissues or stand out in small groups which can barely be seen on the surface of the galls. Males do not cause disease symptoms.

A life cycle from egg to egg-laying adult takes about one month. Several to many generations are possible during the life of the crop, and millions of nematodes can be associated with a mature plant. Nematodes remain in the soil for six months or more after an infected crop, but they decrease rapidly in number, especially if land is left fallow.

Nematodes in general are able to infect many different plants, but each species has a different host range. If the species present in an area are identified, crop rotations which will decrease nematode numbers can be recommended. For identification of species, galled roots should be put in four per cent formalin and sent to a specialist.

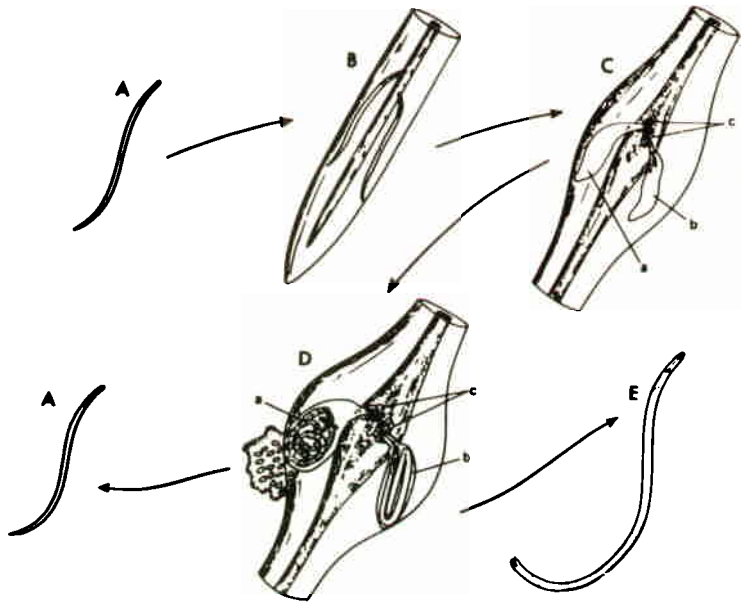

Fig. 2: Life cycle of a *Meloidogyne* species (schematic). A. Preparasitic second stage larva. B. Two larvae which have entered a root, become stationary and start to feed. C. Gall formation and development of larvae (a, b) and specialised 'giant cells' of root where nematodes feed (c). D. Gall with mature female and egg mass (a), male (b) and giant cells (c). E. Male free in soil.

CONTROL

Root-knot disease can become severe when the natural balance of soil microorganisms is upset by such practices as monocropping, short rotations and repeated growing of susceptible crops without any fallow periods. Nematodes can also be brought in on infected planting material. All these practices must be avoided. There are also chemicals which can be used for control. Good nematode pest management uses as many of the following methods as possible:

Seedbed sanitation and prevention of spread: Seedbeds should be placed where susceptible crops have not been planted for several years. Preparation of the beds by turning the soil several times kills nematodes by leaving them to get hot and dry on the soil surface. Nematodes (and some pathogenic fungi) may be controlled if soil is covered with a thin (50 microns) layer of polythene in direct sunlight for 4-6 weeks. Soil fumigation may be possible and will kill nematodes as well as control some diseases and weeds.

Planting material infected with nematodes must not be used. Infections in vegetatively propagated crops such as banana, ginger, potato and yam are recognized by swollen or cracked surfaces on corms, rhizomes, roots or tubers. Hot water treatment can kill nematodes in infected planting material. For example ginger is treated by putting the rhizomes in water at

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51°C for ten minutes, but if the temperature is higher or the rhizomes are left in longer the planting material will also be killed.

Land management and cultural practices: Methods that make the soil less favorable for nematode growth and reproduction reduce their numbers or prevent them from increasing. Clean or weed fallows stop them from feeding (although some weed species are susceptible). Using resistant cover crops is useful so as to get a return from the land at the same time. For example green panic (*Panicum maximum* var. *trichoglume*) or a mixture of green panic and siratro (*Macroptilium atropurpureum)* gives good root-knot control.

As with seedbeds, thorough land preparation helps in nematode control.

Some plants (for example, eggplant, tobacco, tomato) will continue to grow after the final harvest. Their early removal and destruction of crop residues is important so that nematodes do not continue to reproduce on living roots. Nematodes uncovered when crop residues are turned up will die in the sun, and so infection of later plantings will be reduced.

Practices giving a rapid start and good crop growth will help overcome harmful effects of nematodes. Proper watering, drainage, fertility and weed control in crops selected for local conditions will all be helpful.

Resistant plants: In infested soils resistant varieties will usually yield more than susceptible ones so should be used whenever possible. A few local examples are given here.

Peanuts are generally very resistant to the races and species of *Meloidogyne* in the region and so is yellow passionfruit. Many tobacco and tomato cultivars are resistant to *M. incognita* and some to *M. javanica.* The tomato variety UHN-52 grown in some parts of the Region is one example. There are bean *(Phaseolus vulgaris)* cultivars resistant to both these species, and there are several cowpeas (*Vigna unguiculata)* resistant to *M. incognita.* In Fiji cassavas 'Merelesita Hybrid', 'Vulatolu' and 'Yabia Damu' are moderately resistant to *M. javanica.* Among sweet potatoes in Fiji, 'Drivi Drivi' is moderately resistant to *M. javanica,* 'Illiula' highly resistant and 'Navuso Local' moderately resistant to *M. javanica* and *M. incognita,* while 'Samoa Pink' is highly resistant to *M. javanica* and moderately so to *M. incognita.* More research along these lines with local varieties of crops is needed.

Chemical control: There are nematicides which kill soil nematodes before or at planting time. They are poisonous to man and animals so people using them must understand and follow instructions on pesticide labels.

Good yields often follow nematicide applications; but nematode numbers at harvest can return to levels as high as, or higher than, in untreated crops. So, additional control measures are needed when planting again on previously treated land.

Fumigant nematicides are applied before planting, leaving time for poisonous gases to escape so that crops are not damaged. Methyl bromide, an important chemical for seedbed treatment, must be applied under gas-proof covers because it is very poisonous and also because it otherwise escapes too quickly.

An alternative, safer compound for use in seedbeds is dazomat (Basamid), a granular material that releases methyl isocyanate gas when incorporated in moist soil. Best results are obtained if the treated area is covered with a polythene sheet for a few days.

Granular, non-volatile, non-phytotoxic nematicides, such as carbofuran (Furadan), phenamiphos (Nemacur) and oxamyl (Vydate), can be used before or at planting or in established crops.

Strict precautions must be taken whenever these chemicals are used. It is essential that protective clothing is worn. It is important to consider the effects that these chemicals might have on the environment and water

supply; this is especially important on atolls. It is not appropriate for village gardeners to use nematicides but they could, perhaps, be used by licensed operators or under the close supervision of trained agricultural staff in crops grown commercially.

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Black leaf streak of banana (SPC Advisory Leaflet 1, 1976, Revised 1984)
Banana bunchy top virus (SPC Advisory Leaflet 2, 1977)
Taro leaf blight (SPC Advisory Leaflet 3, 1977)
Coconut palm rhinoceros beetle (SPC Advisory Leaflet 4, 1977)
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