Pacific Pests, Pathogens & Weeds - Fact Sheets

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Root knot nematodes (127)

Photo 1. Galls on the roots of *Phaseolus* bean caused by *Meloidogyne* species.

Photo 2. As in Photo 1, galls of *Meloidogyne* sp. on *Phaseolus* bean. Note the galls on the roots of the two plants on the left with smaller root mass compared to the healthy plant on the right.

Photo 3. Root-knot nematode, *Meloidogyne* sp., on ginger. Note that the damage is on the young buds, and that the decay has probably occurred in storage. A healthy rhizome is on the left.

Photo 4. Root knot nematode, *Meloidogyne* species) galls on parsley.

Common Name

Root-knot nematodes

Scientific Name

Meloidogyne incognita and other species.

Distribution

Worldwide. In the tropics and sub-tropics. *Meloidgyne incognita* is recorded from American Samoa, Australia, Fiji, Kiribati, New Caledonia, New Zealand, Niue, Papua new Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu..

Hosts

Many vegetables (beans, capsicum, carrot, celery (**see Fact Sheet no. 254),** cucumber, eggplant, ginger, lettuce, potato, sweetpotato, tomato and yam), fruit crops (melon, papaya, pineapple), ornamentals, and weeds.

Symptoms & Life Cycle

Plants with root-knot nematode infections show poor growth; they are typically stunted with yellowing leaves, and wilt easily. Root systems show characteristic knots or galls, which prevent the uptake of water and nutrients (Photos 1,2&4). Where infection is especially

severe the roots rot and the plants die early. Plants with root-knot nematodes are more susceptible to invasion by disease-causing fungi and bacteria, bacterial wilt especially (**see Fact Sheet no. 146**).

A microscope is needed to see root-knot nematodes; the active stage, the 'larvae' or 'juveniles', are about 0.5 mm long, and they are too small to be seen by the naked eye. Although small, nematodes have a gut, a nervous system, and sex organs. The eggs are laid outside the root, and hatch to release the juveniles, which are mostly female. Males are unnecessary in many *Meloidogyne* species, and the female lays fertile eggs without mating.

The juveniles enter the root at the root tips; this may be the same plant as their parent or they migrate through the soil to find roots of a new host. After traveling a short distance inside the root, they stop, and their presence causes the formation of giant cells, upon which they feed, and which form the characteristic galls. The juveniles in the root moult three times more, and when mature are pear shaped. The females stay inside the root, feeding and laying eggs. Each female lays more than 1000 eggs. The life cycle from egg laying to maturity takes about 30 days.

Spread over short distance occurs as the juveniles move in soil water in search of new roots to infect; over larger distances, spread occurs in the roots of seedlings, young plants or vegetative propagating materials. It is also possible for nematodes to spread in rainwater, and soil on tools, machinery or footwear.

Impact

Root-knot nematodes are common worldwide; most plants are hosts to at least one of the many species, although grasses are generally less susceptible. Many vegetables (beans (Photos 1&2), capsicum, carrot, cucumbers, eggplant, ginger (Photo 3), lettuce, melon, parsley (Photo 4), potato, tomatoes, yam), fruit (banana, papaya, peach, pineapple, strawberry) and ornamentals (*Gardenia*, *Impatiens*, *Coleus)* are hosts. Damage is often severe in sandy soils.

If food legumes (*Glycine max*, *Phaseolus vul*garis, *Vigna unguiculata*) are taken as examples of the effect of root-knot nematodes on yields worldwide, reports suggest losses are up to 60% or more. Root crops, too, are attacked by root-knot nematodes and, apart from lower yields, galls on the surface or distortions affect market price, e.g., yam tubers or sweetpotato storage roots.

Detection & inspection

Look for plants that are growing poorly and wilt readily even though they have adequate nutrition and water. Look at the roots, and check the presence of root knots. Be careful when examining legumes that nitrogen-fixing bacterial root nodules are not confused for root galls caused by nematodes. Break open the galls and look for the swollen females that are just large enough to be seen with the naked eye, or use a hand lens.

Ideally, soil samples should be taken to determine whether nematodes are present and in sufficient numbers to cause damage. Consult your agriculture authorities for methods of sampling and how to send samples to a laboratory for analysis. Usually, several samples are taken at depths of 15-25 cm, across a field, and kept separately in plastic bags. Be careful not to freeze samples, allow them to dry or leave them in direct sunlight.

If laboratory analysis is not available, select plants at random from across the field, shake out the soil, and estimate the level of galling as an indication of the nematode population

Management

BIOLOGICAL CONTROL

The bacterium, *Pasteuria penetrans*, has been long recognised as a potential biocontrol agent for root-know nematodes. Unfortunately, it cannot be grown outside its host. Another biocontrol agent, the fungus *Paecilomyces lilanicus*, is available as a commercial product, often sold in combination with a second fungus, *Trichoderma viride*, which attacks soil-borne pathogens.

CULTURAL CONTROL

Before planting:

- *Potting composts:* in nurseries, use soil-less potting mix, or sterilised/pasteurised soil mixes.
- *Soil solarisation:* kill root-knot nematodes (plus other pathogens and weeds) in the top 30 cm of (especially sandy) soil by using transparent polyethylene covers. Moisten soil and cover for 4-6 weeks.
- *Fallow land:* keep soil bare for 4-6 months, but with frequent cultivation; make sure that weeds are controlled. The method exposes the nematodes to drying by the sun, and to starvation.

- *Rotation:* growing nonhost crops can reduce nematode populations, but there are several species and each has a very wide host range. Some grasses have been recommended for the Pacific islands [e.g., sorghum x Sudan grass hybrids (cv. Jumbo), and green panic (a type of Guinea grass)]. Note, maize and peanuts are poor hosts of *Meloidogyne incognita*, and onions, cabbages and cauliflowers have tolerance.
- *Grow marigolds:* grow a solid planting of e.g., French marigolds for several months.

During growth:

- *Soil amendments:* Add manures or composts to the soil, especially sandy soils, to increase ability of soil to hold water and nutrients.
- *Maintenance:* Aim for optimum plant growth by frequent deep watering, and adding mulches and organic matter.

After harvest:

- Collect the remains of the crop and debris and burn it.

RESISTANT VARIETIES

There are root-knot nematode-resistant varieties of tomato, bean and sweetpotato.

CHEMICAL CONTROL

A wide range of chemicals has been used for the control of root-knot nematodes, e.g., fumigants (methyl bromide, metham sodium, chloropiocrin), liquids and granules (fenamiphos, oxamyl, furadan). Many of these are toxic chemicals that are now restricted or banned. Specialist advice is required to determined what, if any, chemicals are permissable for home or commercial use.

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Information from CABI (2014) *Meloidogyne incognita* Crop Protection Compendium. (http://www.cabi.org.cpc/); and information (and Photo 4) from *Diseases of vegetable crops in Australia* (2010). Editors, Denis Persley, Tony Cooke, Susan House. CSIRO Publishing. Photos 1&2 Gerlach WWP (1988) *Plant diseases of Western Samoa.* Samoan German Crop Protection Project, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) Gmbh, Germany.

Photo 2 John Bridge, Tropical Plant Nematology Advisor, CABI Bioscience, Egham, UK. Produced with support from the Australian Centre for International Agricultural Research under project PC/2010/090: *Strengthening integrated crop management research in the Pacific Islands in support of sustainable intensification of high-value crop production*, implemented by the University of Queensland and the Secretariat of the Pacific Community.
