PLANT AND SOIL NEMATODES

ROOT-KNOT NEMATODE: DISTRIBUTION, ECOLOGY AND DAMAGE THRESHOLDS

ROOT-KNOT NEMATODE SPECIES AND THEIR DISTRIBUTION

Worldwide, there are more than 100 species in the genus *Meloidogyne* but Australia has only a limited number of species. Three 'warm climate' species (*M. javanica*, *M. incognita* and *M. arenaria*) are found in all states and territories whereas *M. hapla* and *M. fallax* prefer cooler climates and are mainly found in Tasmania and coastal parts of the southern states. *M. hapla* also occurs in elevated areas of Victoria, NSW, and Queensland.

Biosecurity procedures have kept most *Meloidogyne* species out of Australia but reports that *M. enterolobii* was detected in the Northern Territory in October 2022 and Queensland in February 2023 are a concern. This species is found in China, South America, the USA, Europe, and Africa and in addition to reproducing on a wide range of crops, it damages cultivars that are resistant to the widely distributed species listed above (see Fact sheet PSN 040).

HOST RANGE

As more than 2,000 plant species are known to host root-knot nematode, there are many prospective food sources on Australian farms. The nematode multiplies readily on most of the crops that are planted, and many weeds. Even poor hosts such as nutsedge (*Cyperus rotundus*) can maintain relatively high nematode populations, as they are often present at high plant densities.

An example of one of the many weed hosts of root-knot nematode: green amaranth (*Amaranthus viridus*)

NEMATODE POPULATION DYNAMICS

When vegetables and other susceptible annual crops are planted, root-knot nematodes populations are usually quite low (<50 nematodes/200 g soil). However, because of the nematode's relatively short life cycle and high fecundity, nematode populations increase rapidly. In the 4-5 months that it takes for most annual crops to reach maturity, several generations of the nematode are produced and populations may increase more than a thousand times.

EFFECTS OF ENVIRONMENTAL FACTORS ON NEMATODE MULTIPLICATION

Soil texture and moisture

Root-knot nematode thrives in sandy and sandy loam soils, but usually causes little damage in soils with clay contents greater than about 15%. However, the red volcanic soils (ferrosols) that occur in some areas of Australia are an exception. The permeable nature of these soils and their open physical structure means that the nematode can multiply readily and cause heavy losses.

Nematodes are aquatic animals and are therefore dependent on moisture for activity. In soil, they live and move in the water films which surround soil particles. Thus, root-knot nematodes migrate, invade roots and multiply when the soil is moist. They are metabolically inactive and immobile in dry soil.

Temperature

The impact of temperature on root-knot nematode is best illustrated by its effect on the length of the life cycle (see Table below). In summer, when soil temperatures often range from 24-32°C, a warm climate species such as *M. javanica* will produce a new generation of nematodes every 4-5 weeks. The nematode

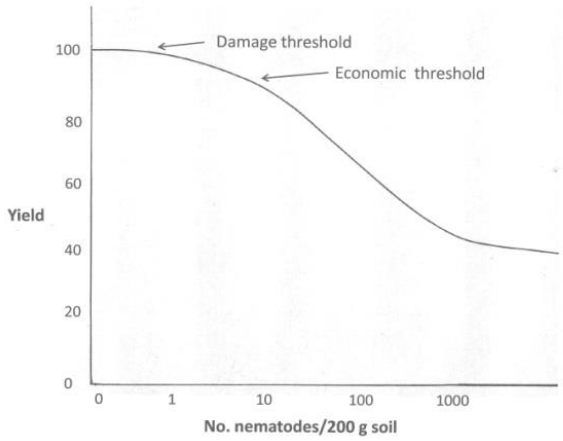
becomes less active as temperatures decline and so in autumn and winter, when soil temperatures may fluctuate between 15 and 20 °C, the life cycle is completed in 3-4 months.

The impact of temperature on the length of the life cycle of two warm-climate species of root-knot nematode (*M. javanica* and *M. incognita*) and one cool-climate species (*M. hapla*)

Nematode	Minimum and maximum temperatures for growth and reproduction	Effect of four **constant** temperatures on the length of the life cycle (i.e. the number of days from invasion of roots until the next generation of juveniles begin to hatch from eggs)					
		10°C	13°C	16°C	20°C	24°C	28°C
M. javanica	13 and 32 °C	-	-	124	53	34	25
M. incognita	10 and 28 °C	-	138	69	41	30	-
M. hapla	8.5 and 28°C	333	111	67	43	32	

IMPACT OF ENVIRONMENTAL AND OTHER FACTORS ON DAMAGE

In annual crops, the severity of damage caused by root-knot nematode is related to the number of nematodes present at planting. At low population densities the crop tolerates any damage caused by the nematode and so there is no effect on yield. However, as the number of nematodes increases, the damage threshold is reached and yield is reduced. Eventually the population reaches a point where crop losses due to the nematode are equal to the cost of control. This is known as the economic threshold.



The damage threshold for root-knot nematode generally ranges from 1 to about 30 nematodes/200 g soil. However, it is important to note that the threshold level is affected by crop, environmental and management factors.

- Short-term crops (e.g. zucchini) have a higher damage threshold than longer-term crops (e.g. tomato and capsicum) because fewer nematode generations can be completed before harvest
- Crops where the marketable product is damaged by the nematode (e.g. potato, carrot, sweetpotato) tend to have a lower damage threshold than other crops
- If a crop is planted when temperatures are ideal for nematode multiplication, the damage threshold will be lower than when temperatures are less favourable
- In soils that are texturally suited to the nematode (e.g. sandy soils and well-structured clay loams), the damage threshold will be lower than in soils that are not conducive to nematode multiplication.
- Well-managed crops that are not suffering nutritional or water stress will cope with higher numbers of nematodes than poorly managed crops (i.e. the damage threshold will be higher)

FURTHER READING

Hay F, Stirling GR et al. (2014) Management of root-knot nematode in vegetable crops. Booklet prepared for project MT09067. Horticulture Australia Limited

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