Root knot nematode and grapevine resistance

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Background

Root knot nematode species (*Meloidogyne javanica, M. incognita, M. arenaria* and *M. hapla*) are considered the most important and damaging grapevine plant parasitic nematodes in Australia. Of them, *M. javanica* is predominant in most grape-growing regions in Australia.

The second-stage juveniles (J_2) of the nematode live in the soil and initiate infection in the young feeder roots. Once it enters the roots, the nematode establishes a feeding site within the root tissues and starts drawing the root cell contents from the site into its body.

As a result, rapid cell division and enlargement occurs at the feeding site of an infected root cell. Thus the infected cells swell to form a characteristic 'gall' or 'knot' in the roots, which may contain one or several females.

The 'galls' can be seen if the roots of an infected vine are dug out from soil. Inside the galls, the nutrient-conducting tissues are damaged and thus the roots are unable to take up or transport nutrients or water from the soil to the aboveground parts of the vine.

Once the nematode become well established inside the roots over time, external symptoms such as stunted growth, leaf yellowing and yield decline become evident.

Yield loss can range from 7% to 20% in most cultivars but may increase up to 60% over time, depending on the susceptibility of the cultivars and the duration and severity of nematode infection. In severe cases of infection, a vineyard will require replanting with a resistant rootstock.

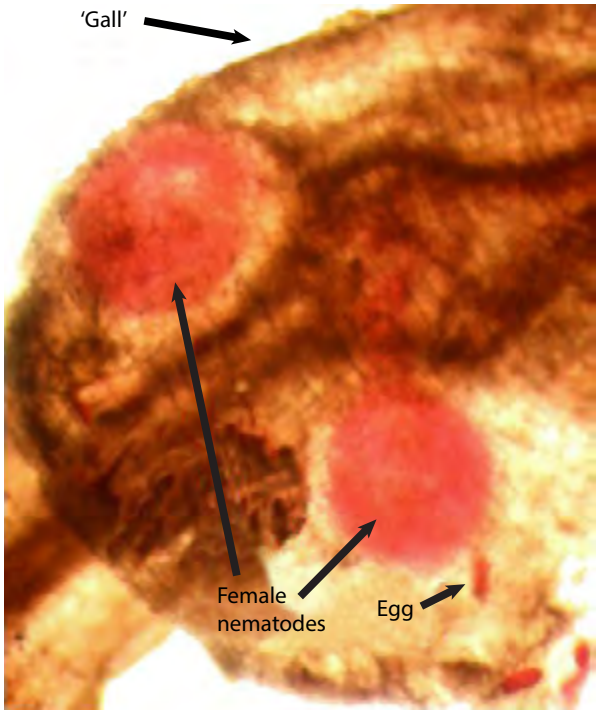
Life cycle

Because root knot nematode species are internal parasites of roots, they develop and reproduce inside the roots.

There are six developmental stages: the eggs, four juvenile (J) stages and an adult stage. The J_1 stage develops inside the egg and hatches out as the J_2 stage. The J_2 stage lives in the soil, enters the young feeder roots and develops into the J_3 and J_4 stages (immature females) and adult female stage inside the roots.

The adult females lay eggs into a gelatinous matrix, where they are protected and can survive under adverse conditions. The female nematodes with the egg masses

Grapevine root with root knot nematode 'galls'.
Photo: Loothfar Rahman



Females of root knot nematode inside the gall of a vine root.
Photo: Loothfar Rahman

protrude through the outer cell layer of the roots; thus the eggs are released into the soil.

These developmental phases are repeated again and again. The average generation is about 3 to 5 weeks, depending on the environmental conditions.

A single female nematode may produce several hundred eggs at a time; thus a low population at planting can build up to a high population over time. This population increase will also increase yield loss gradually in a vineyard planted with a susceptible cultivar. The nematode is less active in winter.

Management options

Complete eradication of the root knot nematode from a newly planted or established vineyard is very unlikely.

However, application of chemicals (e.g. Nemacur®) in the soil, cultivation of biofumigation crops (e.g. mustard, turnip) in the inter-row space and incorporation of organic amendments (e.g. mustard seed meal, chicken litter, biochar) into the undervine and/or inter-row soil for a few consecutive years may reduce the population density to below the damage-risk threshold (<200 J_2 individuals/kg dry soil).

Alternatively, despite its high initial cost, planting resistant rootstocks is a sustainable and long-term solution to overcome the root knot nematode problem in an infested vineyard.

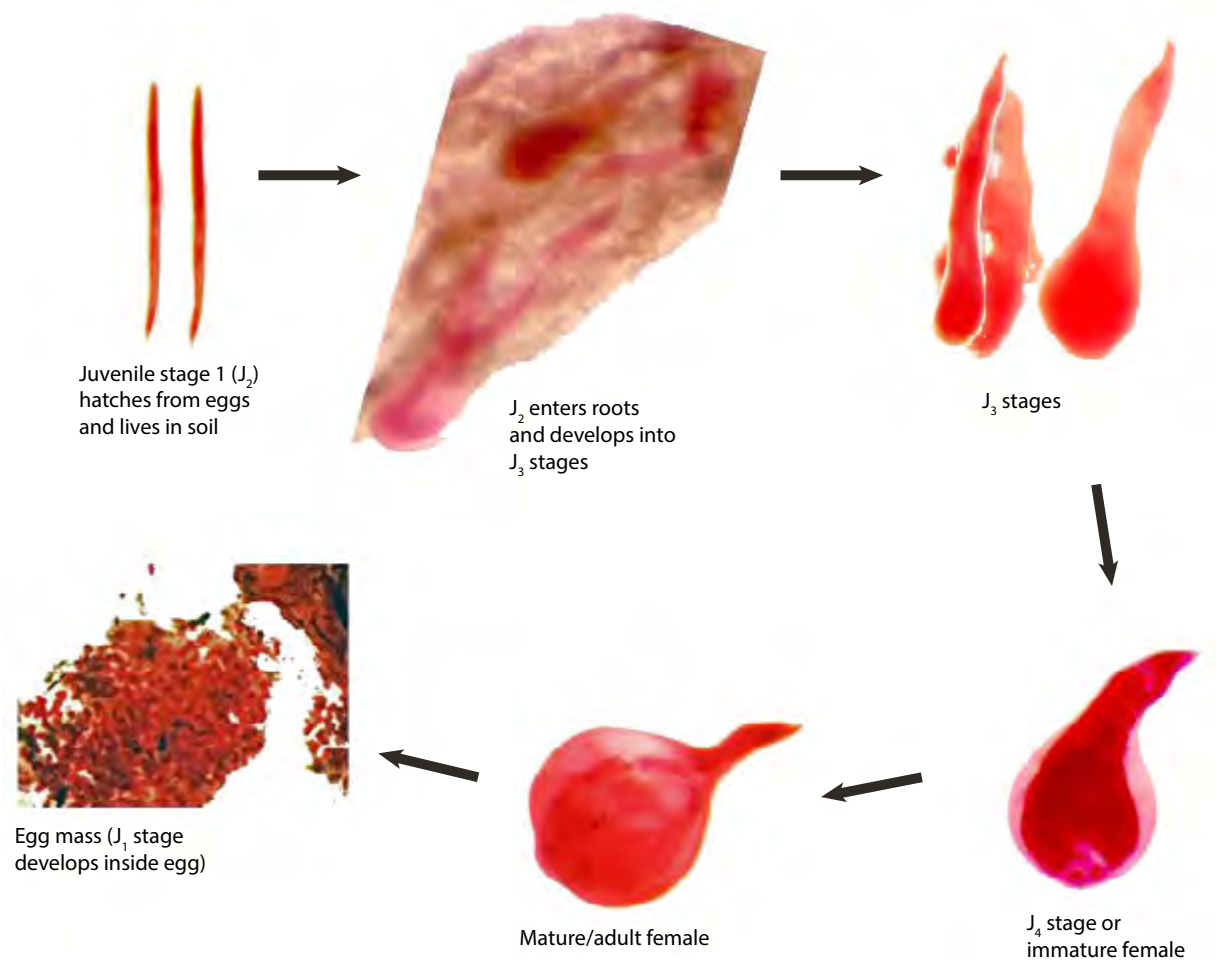
Several root-knot-nematode-resistant rootstocks have been developed and are commercially available in Australia (see below). In contrast, it is believed that all own-rooted cultivars are susceptible to root knot nematode. However, the degree of susceptibility may vary between cultivars.

Recently, at NWGIC we tested six rootstocks and 14 varietal clones to verify their susceptible or resistant reactions to root knot nematode (*M. javanica*) under glasshouse conditions.

All the tested clones are popularly grown across grape-growing districts. We classified the tested rootstocks and varietal clones on the basis of the number of galls present in each root system and the number of J_2 stage and female nematodes per gram of roots (Table 6).

On the basis of this classification, Ramsey A11V2 and Dogridge A6V8 were rated as highly resistant (HR), 5C Teleki 10-48-49 Gm and K-51-40 Lider D13V15 as resistant to highly resistant (R-HR), and 1103 Paulsen 200HT and 140 Ruggeri Q45-3A as moderately resistant to resistant (R).

All the tested varietal clones showed susceptible (S) to highly susceptible (HS) reactions (Table 6).



Life cycle of the root knot nematode.

Photos: Loothfar Rahman

Some suggestions to consider

- Before planting, test your vineyard soil for the presence of nematodes.
- Take appropriate nematode control measures before planting with rootstocks or own-rooted cultivars (if your vineyard soil is infected).
- Check that rootlings are free from any root knot nematode galls before planting.

If you purchase rootlings with root knot nematode galls, ask the nursery whether they have been hot-water-treated, or return them to the nursery. For confirmation, send some root samples to a testing laboratory to examine them for the presence of any live nematodes in the galls. Contact details can be found in the AWRI Research to Practice guide *Nematodes: A sampling method for nematode monitoring* at www.awri.com.au/wp-content/uploads/nematodes_sample_method.pdf

Monitor your vineyard soil and vine roots from time to time if you have planted an own-rooted cultivar in an infested vineyard.

Contact your nearest NSW DPI office to ask where to send your samples for nematode testing.

Table. 6. Host reactions of rootstocks and varietal clones of grapevines to root knot nematode (*Meloidogyne javanica*)*

Rootstock/cultivar	Clone	No. of galls/ root system	No. J_2 / g root	No. females/g root	Range of reaction
Relatively resistant clones					
1103 Paulsen	200 HT	MR	MR	R	MR–R
5C Teleki	10-48-49 Gm	R	HR	HR	R–HR
Ramsey	A11V2	HR	HR	HR	HR
K51-40 Lider	D13V15	HR	R	R	R–HR
Dogridge	A6V8	HR	HR	HR	HR
140 Ruggeri	Q45-3A	R	R	MR	MR–R
Relatively susceptible clones					
Cabernet Sauvignon	125	HS	HS	S	S–HS
Cabernet Sauvignon	G9V3	HS	HS	S	S–HS
Chardonnay	I10V5	HS	HS	MR	MR–HS
Chardonnay	95	HS	HS	HS	HS
Chardonnay	G9V7	HS	S	S	S–HS
Pinot Noir	115	HS	S	S	S–HS
Pinot Noir	MV5	HS	HS	MR	MR–HS
Pinot Noir	MV6	HS	S	S	S–HS
Semillon	82	HS	HS	HS	HS
Semillon	DA16162	HS	HS	S	S–HS
Semillon	T09081	HS	HS	S	S–HS
Shiraz	BVRC12	HS	HS	S	S–HS
Shiraz	ESA03021	HS	HS	S	S–HS
Shiraz	PT23	HS	HS	S	S–HS

* Host reaction was assigned on the basis of either the number of galls per root system, the number of J_2 individuals/g root or the number of females/g root, as follows: 0 = HR; 1–3 = R; 4–10 = MR; 11–20 = S; >20 = HS