Resistance of rootstocks depends on the vineyard populations of Root-knot Nematode

New research challenges industry perception of rootstock resistance against the threat of Root-knot Nematodes and increased the need to look overseas for rootstocks with higher resistance.

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Root-knot Nematodes (RKN; Meloidogyne species) are commonly found in vineyard soils and can cause serious damage to vines, especially in lighter soil types. The most cost-effective remedy has for many years been the use of grafted, resistant rootstocks of American Vitis parentage. However, we have known for some time that RKN populations exist in the field that can overcome the resistance even of generally resistant rootstocks such as Ramsey (Walker 1997). Furthermore problems have been reported in vineyards with rootstocks such as 1103 Paulsen. Continuous use of rootstocks with the same parentage promotes the development of resistant races.

The experiment reported here demonstrated greatly varying levels of resistance to RKN depending on the species and population present. In particular, a population of *M. arenaria* was found to be highly aggressive compared to a population of the most commonly occurring species, M. javanica. These findings have important implications for industry, particularly in South Australia where previous surveys have shown species other than *M. javanica* are present in some vineyards.

The experiment

A pot experiment was conducted in a shadehouse to compare the growth and resistance of Sauvignon Blanc grapevines grafted on the commonly-used rootstocks 101-14 (*Vitis riparia* × *V. rupestris*), *Ramsey* (*V. champinii*), 140 Ruggeri (*V. berlandieri* × *V. rupestris*), Schwarzmann (*V. riparia* × *V. rupestris*), 5C Teleki (*V. berlandieri* × *V. riparia*), 110 Richter (*V. berlandieri* × *V. rupestris*) and 1103 Paulsen (*V. berlandieri* × *V. rupestris*).

Grafted vines were grown in two different vineyard soils from the Riverland region, South Australia: one from Winkie (previously shown to harbour an aggressive population of the Root-knot Nematode species *M. arenaria*, identified using DNA-based tests), one from Murtho (previously shown to harbour a 'standard' or less aggressive population of the more commonly occurring Root-knot Nematode species *M. javanica*, also identified by DNA tests); and one from the McLaren Vale region (thought to be *M. javanica*, but not DNA-tested). Soils were either left untreated, or chemically treated by fumigation with a broad-spectrum soil fumigant before planting, or treated with a nematicide after planting.

Key facts

- Root-knot Nematode species found to have high and varying effect on existing rootstock – including Ramsey.
- Ramsey particularly susceptible to South-Australian (Winkie-based) nematode species (M. arenaria)
- New rootstocks with higher levels of resistance are needed.
- DNA-based tests to help identify RKN species are being developed by SARDI.
- SARDI recommends growers use existing tests to determine population levels of parasitic nematodes present in vineyards – before replanting.

After 17-weeks growth in a shadehouse over late spring-summer at the Plant Research Centre, Adelaide, vines were harvested; shoot and root weights determined and nematodes extracted from the roots of each vine.

Results and discussion

Although the initial population of Root-knot Nematode in the Winkie soil was only a fifth of that in the other two soils, the final population on vine roots was 2 to 4 times higher on average than the other two soils, indicating the higher multiplication and aggressiveness of this population.

Ramsey was much more susceptible to the Winkie (*M. arenaria*) population than to the other two populations, and was overall the least resistant rootstock to this nematode population. While vines on Ramsey would be highly resistant if planted in the Murtho and McLaren Vale vineyards, this rootstock would be highly susceptible if planted at the Winkie vineyard. Scion growth on Ramsey was higher in fumigated compared with untreated Winkie soil, but not in the other two soils (Table 1), suggesting that not only was Ramsey not resistant to this population, but that vine growth was adversely affected in this soil.

Only 110 Richter and 101-14 showed higher resistance than 1103 Paulsen to the Winkie population, suggesting that these two rootstocks would be the most useful ones from amongst those tested in this experiment against *M. arenaria*, however, their level of resistance was not considered to be high. Rootstocks with higher resistance will need to be either imported (for example, new US rootstocks from Dr A Walker's group) or bred, or RS-3 and RS-9 rootstocks may be useful in some situations as they have demonstrated high levels of resistance in pot experiments with the Winkie and other local populations (G. Walker, see article in Grapegrower's next issue, April 2011).

In contrast, all rootstocks (viz. 101-14, Ramsey, Schwarzmann, 5C Teleki, 110 Richter) showed a higher resistance than 1103 Paulsen to the Murtho population of *M. javanica*. The exception to this was 140 Ruggeri. Ramsey was significantly more resistant than 1103 Paulsen to the McLaren Vale population, and all other rootstocks also developed lower populations than 1103 Paulsen.

It was noteworthy that 1103 Paulsen had relatively low resistance to all three Meloidogyne populations when ranked by final nematode populations at harvest. It confirms that industry perceptions of this rootstock's resistance may have been too high.

Soil fumigation stimulated shoot growth (by 30% in the Winkie soil compared with 11 and 15% in the Murtho and McLaren Vale soils respectively), indicating that soil-borne pathogens including nematodes were adversely affecting vine growth in all three soils. However, shoot growth stimulation was significantly higher (statistically-speaking) only in the Winkie soil, likely reflecting the higher aggressiveness of the M. arenaria population in this soil.

Scion growth was consistently highest on Ramsey rootstock, followed by 140 Ruggeri. Overall, scion growth was lowest on 5C Teleki rootstock.

Fumigation stimulated root growth in Winkie, Murtho and McLaren Vale soils by 25, 42 and 51% respectively, indicating ▶

Table 1. Average numbers of Root-knot Nematodes on root systems of vines at harvest after growing in three different (untreated) vineyard soils in a shadehouse. The Winkie soil contained an aggressive population of M. arenaria.

Soil type	Rootstock	Numbers of RKN per root system*	% weight increase in fumigated vs. untreated soil**	
			Shoots	Roots
Winkie	101-14	708 de	81	10
Winkie	Ramsey	2948 a	29	33
Winkie	140 Ruggeri	1921 b	68	–
Winkie	Schwarzmann	2455 ab	21	67
Winkie	5C Teleki	1648 bc	–	42
Winkie	110 Richter	675 de	–	37
Winkie	1103 Paulsen	2376 ab	32	39
Average		**1819**	**30.3**	**25.4**
Murtho	101-14	812 de	–	12
Murtho	Ramsey	0 e	–	6
Murtho	140 Ruggeri	2538 ab	24	78
Murtho	Schwarzmann	659 de	39	31
Murtho	5C Teleki	103 de	83	107
Murtho	110 Richter	511 de	–	27
Murtho	1103 Paulsen	2313 ab	32	75
Average		**883**	**10.6**	**41.6**
McLaren Vale	101-14	121 de	23	69
McLaren Vale	Ramsey	7 e	–	42
McLaren Vale	140 Ruggeri	308 de	–	49
McLaren Vale	Schwarzmann	612 de	68	–
McLaren Vale	5C Teleki	524 de	39	90
McLaren Vale	110 Richter	321 de	–	52
McLaren Vale	1103 Paulsen	976 cd	48	70
Average		**410**	**15.4**	**51.5**

*within-column averages followed by different letters are significantly different at 5% level of probability; the overall average for Winkie soil was significantly higher than those for the other two soils at 5% level of probability.
**– = average weight either not increased, or decreased, versus untreated

the potential for preplant soil fumigation to improve the root growth of vine replants in diverse South Australian vineyards.

Amongst rootstocks, root growth was highest overall in 101-14 followed by 110 Richter, and was lowest in Schwarzmann and Ramsey.

Currently, it is difficult to test for the presence of different RKN species in soil, and even more difficult to test for different populations or races. Protein (enzyme) profiling has been used in the past, and DNA-based tests for the most common species are being developed by SARDI.

Further work will be needed to commercialise these tests before use by growers, but they may enable growers to make better decisions on rootstock selection tailored to their specific situations.

In most states, *M. javanica* was found to be the predominant species present in previous surveys. However, other species including M. arenaria are certainly present in South Australia, and even in the other states, these other species could potentially spread more widely in future.

Summary

The resistance of seven commonly used rootstocks to Root-knot Nematodes in three vineyard soils varied greatly according to the population of nematode present. One soil used, from Winkie, contained an aggressive population of *M. arenaria*, a species particularly known for developing such populations.

While Ramsey was highly resistant to 'standard' populations in a Murtho soil (containing the commonly occurring species, M. javanica) and a McLaren Vale soil, it was highly susceptible to the aggressive Winkie population. 1103 Paulsen had relatively low resistance to all three nematode populations.

Only 110 Richter and 101-14 showed higher resistance than 1103 Paulsen to the Winkie population, suggesting that these two rootstocks would be the most useful ones against *M. arenaria* from amongst those tested in this experiment. However, their level of resistance was not considered to be high, and new rootstocks with higher levels of resistance are needed.

Although it is expected that the most commonly occurring species, M. javanica, predominates in many vineyards, other species are definitely present in some South Australian vineyards, and anecdotal reports suggest that some other states may have similar problems with aggressive populations. This is another reason why it is important to prevent spread of these nematodes, particularly on planting material.

It can therefore be important for growers to know what species of these nematodes are present in their soils. Currently, it is difficult to test for the presence of different RKN species in soil. DNA-based tests for the most common species are being developed by SARDI, which could potentially enable growers to make better decisions on rootstock selection tailored to their specific situations. However, further work will be needed to commercialise this technology for use by growers.

It is recommended that testing be done before replanting to determine population levels of parasitic nematodes present in vineyards – this test is currently available.

Read more: Greg Walker will present his research on RS-3 and RS-9 rootstocks which have demonstrated high levels of resistance in pot experiments with the Winkie and other local populations of nematodes in the next issue of *Grapegrower & Winemaker.*

Reference

Walker, GE (1997). Ramsey is not resistant to all local populations of root-knot nematode. *Australian Grapegrower and Winemaker* 402A: 113-115.

Australia reaps emerging market rewards

Rabobank has released its latest quarterly report, regarding the international wine market.

The report, which is based on the last quarter in 2010, looks at industry trends in the international wine trade. Contained in the report is a review of the current price versus volume output of the major wine producing countries, emerging markets, and impact of foreign exchange rates.

A brief summary of the report follows.

Emerging markets

The UK, the world's largest wine importer (by value), is facing serious structural issues. Seeing their profitability threatened in a market they'd come to rely on, major suppliers have turned their attention to finding new markets. The figures in the 2011 Wine Quarterly show Australia, Argentina, Chile and Spain reporting double digit growth in wine exports to China, Russia, Brazil and/or Mexico in 2010.

But even with the astounding growth of wine consumption in emerging markets, it will be years before the volumes sold there match traditional import markets. Although Australia is proving an interesting exception. According to the report, Australia receives some of its highest average prices in its emerging markets.

Pricing trends

In recent years, the pricing power of Australian wine exporters to the UK and the US was hurt by continued discounting to offload overproduction. In contrast, Australian wine now commands much higher prices in emerging markets than wines from Spain, Chile, Argentina and France. The report found Australia's per litre prices of wine sold in Brazil, Russia, India and China were 102%, 73%, 86% and 5% above its average export price, respectively.

A more detailed report is available on the website: http//www.rabobank.com.au