US rootstocks could add new defence in nematode battle

Kate Foreman

New rootstock research by the South Australian Research and Development Institute has identified a potential new line of defence against root-knot nematodes (*Meloidogyne* species).

Rootstock selection is the traditional and primary means of controlling root-knot nematodes (RKN).

Also known as eelworms, the microscopic worm-like animals are present in many Australian soils and damage vines by feeding on roots, reducing yield and causing water and nutrient stress in vines.

Dr Gregory Walker from SARDI's Plant Research Centre is heading up the research.

Unfortunately, Dr Walker says, some of the Australian species have developed increased virulence and can multiply even on grapevine rootstocks previously regarded as highly resistant.

"There was a myopic tendency to assume [rootstock selection] meant the problem is solved for all times, but this was never the truth," Walker said.

"No current rootstock is fully resistant to all parasitic nematodes... nematodes are an evolving threat, requiring ongoing monitoring and research effort."

Dr Walker has trialled two new rootstock varieties, known as the RS series and developed in the US, and found them to possess greater resistance to local RKN populations.

"The rootstocks will not solve all nematode problems at all sites," he said, but he hoped the findings would help encourage further research and funding support from industry bodies like the Grape and Wine Research and Development Corporation.

The following research article by Dr Walker details the trials and findings, and he says the potential success of the RS series in Australia could be good news for Australia's grape and wine industry.

research

Resistance of RS-3 and RS-9 rootstocks to local nematode populations

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A number of species of root-knot nematodes (RKN; *Meloidogyne* species) have been recorded on grapevines worldwide and in Australia. *M. javanica* is the most common species found in Australian vineyards and many of the recommendations given to growers about which rootstocks to use are based on resistance to this species. However, a population of *M. arenaria* in a Winkie (Riverland) vineyard soil was found to be highly aggressive compared with a population of the most commonly occurring species, *M. javanica*. This makes rootstock selection more difficult, as even rootstocks that are commonly regarded as highly resistant, such as Ramsey, are not resistant to these aggressive populations (Walker 1997).

The University of California developed the RS series rootstocks, RS-3 and RS-9 [as hybrids of the better known American rootstocks, Ramsey, *Vitis champinii* (*V. candicans V. rupestris*), and Schwarzmann, *V. riparia V. rupestris*] that are resistant to many nematodes, including aggressive RKN populations in the US (Anwar *et al*. 2002).

RS-3 is moderately vigorous and is recommended in the US for use in coarse to fine sandy loam soils, with some resistance claimed to dagger nematode (*Xiphinema index*), citrus nematode (*Tylenchulus semipenetrans*), some lesion nematodes (*Pratylenchus*) and ring nematode (*Criconemoides*). RS-9 is less vigorous, but with similar nematode resistance reported in the US except that it does not have resistance to ring nematode.

Table 1. Numbers of Root-knot Nematode juveniles detected in roots of RS-3 and RS-9 rootstocks after growth in disinfested sand infected with 4, 500 juveniles per pot

RKN population	Mean number of RKN juveniles per root system*	
	RS-3	RS-9
Winkie	0.9	0.5
Loxton	2.5	1.1
McLaren Vale	–	–

*RKN juveniles detected were dead or in a poor condition, suggesting unfavourable conditions for multiplication; for purposes of comparison, numbers per root system detected in Paulsen 1103 infected with the Loxton population averaged 5,250 and most of these were alive.

These two rootstocks have recently been tested against some local populations of nematodes including *M. javanica,* from Riverland and McLaren Vale vineyards, and *M. arenaria,* from a Winkie vineyard. DNA-based tests were used to identify some of these populations. The Winkie and Loxton vineyards had previously reported growth problems on Paulsen 1103 rootstock, but there was no association with this rootstock at the McLaren Vale vineyard (which was selected as a 'control' population). Vines were either grown in disinfested soil to which known numbers of RKN juveniles were added, or they were grown in naturally-infested Winkie soil containing a number of different nematodes.

RS-3 and RS-9 rootstocks were highly resistant to the RKN populations tested, including the aggressive *M. arenaria* population (Tables 1 and 2). RKN juveniles were not detected in roots of RS-3 and RS-9 rootstocks inoculated with the McLaren Vale population (Table 1), possibly indicating that this population was less aggressive than the two populations selected from 'problem sites'.

However, RS-3 and RS-9 rootstocks were highly susceptible to the *Praylenchus* population in the Winkie soil (Table 2, page 36), indicating potential problems with some lesion nematode species.

The aggressiveness of some South Australian (*P. zeae*) populations of these nematodes to many existing rootstocks has already been reported (Walker 2002). There was also little evidence for higher resistance to other nematodes such as citrus nematode (*T. semipenetrans*), compared with current rootstocks Schwarzmann and Paulsen 1103 (Table 2). RS-3 and RS-9 rootstocks are known to lack resistance to the particular species of dagger nematode (x.americanum) present in this soil. Although the soil population of ring nematode (*C. xenoplax*) associated with RS-9 was higher than that of RS-3, supporting the lower resistance observed in the US, the resistance of both rootstocks was about the same as Paulsen 1103 and less than Schwarzmann in this experiment (Table 2).

Table 2. Numbers of nematodes detected in roots and soil from RS-3 and RS-9 rootstocks after growth in naturally-infested Winkie soil (containing initial population levels of 32 *Meloidogyne*, 34 *Pratylenchus*, 20 *C. xenoplax*, 2 *T. semipenetrans*, and 2 *X. americanum* per 100 g of soil), and for purposes of comparison, Schwarzmann and Paulsen 1103 growing in the same soil. This soil contained an aggressive population of *M. arenaria*.

Nematode	Numbers of nematodes in roots and soil by rootstock			
	RS-3		RS-9	
	Per g roots	Per 100 g soil	Per g roots	Per 100 g soil
Root-knot (*Meloidogyne*)	0	2	0.6	22
Lesion (*Pratylenchus*)	1,836	5	821	44
Ring (*C. xenoplax*)	7.2	314	–	522
Citrus (*T. semipenetrans*)	0.8	89	0.9	17
Dagger (*X. americanum*)	2.6	10	1.2	22
	Schwarzmann		Paulsen 1103	
Root-knot (*Meloidogyne*)	756	63	2,795	309
Lesion (*Pratylenchus*)	39	10	191	27
Ring (*C. xenoplax*)	–	53	–	299
Citrus (*T. semipenetrans*)	2	19	2	2
Dagger (*X. americanum*)	3	20	3	6

Initial populations of some of these other nematodes were low in the soil used, and more testing may be required.

Ramsey and Schwarzmann (the parent rootstocks of RS-3 and RS-9) tend towards higher potassium uptake, compared with other rootstocks, with potentially adverse effects on grape juice pH. While this is not an issue in the soils of California (which tend to be low in potassium), if grown in Australian soils (which tend to be higher in potassium) there is potential for the use of RS-3 and RS-9 rootstocks to lead to higher juice/wine potassium levels and associated problems with high wine pH and colour instability (N. Dry pers. comm. 2011).

Summary

RS-3 and RS-9 rootstocks, although new to Australian growers, are hybrids of the well-known American rootstocks Ramsey and Schwarzmann. They are reported to have broad-spectrum resistance to many nematodes in the US, including aggressive populations of RKN.

The resistance of these rootstocks was tested against local nematode populations in pot experiments. They were highly resistant to three local RKN populations, including an aggressive population of *M. arenaria*. These rootstocks could, therefore, be useful to Australian growers, particularly those experiencing problems with aggressive RKN populations.

However, they were highly susceptible to a local population of lesion nematode, and did not display higher resistance to several other nematodes than some existing rootstocks, indicating that RS-3 and RS-9 rootstocks will not solve all nematode problems at all sites.

The potential for these rootstocks, in Australian soils with their relatively high levels of potassium, to cause problems with excess potassium and high grape juice pH needs to be determined before they can be recommended for use in different soil types.

The success of the RS series rootstocks under Australian conditions may provide a significant opportunity for the wine industry. They have the potential to provide a new defence strategy against nematodes, in particular virulent RKN populations that have overcome resistance to the more commonly used grapevine rootstocks.

Further reading

Anwar SA, McKenry MA and Ramming D (2002) A search for more durable grape rootstock resistance to root-knot nematode. American Journal of Enology and Viticulture 53: 19-23.

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

Walker GE (2002) Lesion Nematodes: identification of grapevine resistance. GWRDC final report, Project SAR 99/5.