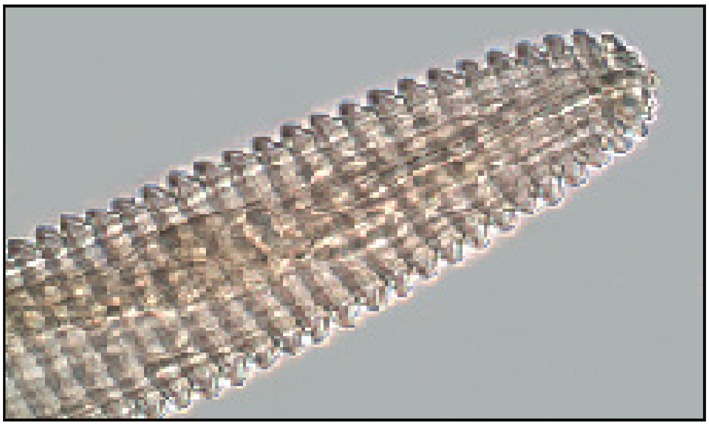
Ring nematode



Why is ring nematode so problematic?

Sheila Storey
www.nemlab.co.za

INTRODUCTION

There is a general feeling that over the last few years the ring nematode has become an increasingly difficult problem on vines and stone fruit. This is especially true for the 'buite gronde' of the Lower Orange River and certain areas along the Breede and Berg Rivers. This is despite concerted efforts by producers to address the problem with the continuous use of nematicides. Results are often less satisfactory than anticipated. A situation then arises where the ring nematode becomes the dominant nematode and reaches population densities which are unacceptable.

This sentiment regarding the ring nematode was recently shared by growers in California who convened a workshop to address the issue of "nematodes becoming an increasingly vexing problem for grape growers in California" (Franson, Wines & Vines, 2009).

Is there a reasonable explanation?

OCCURENCE IN VINEYARDS AND STONE FRUIT ORCHARDS

The ring nematode (*Criconemoides xenoplax*) has a cosmopolitan distribution throughout the world's vine and stone fruit production regions and is a known parasite of vines and stone fruit. In Oregon, ring nematode was present in 81% of the vineyards sampled (Pinkerton, *et al.*, 1999). The samples received at the diagnostic centres (Nemlab and ARC Infruitec-Nietvoorbij) in the Western Cape confirm a similar situation exists in South Africa (H J Hugo, pers. comm.).

HOST STATUS AND DAMAGE

According to Pinkerton *et al.* (2005) populations greater than 125 ring nematodes per 250cc of soil can reduce yields by 10 - 25%. This was confirmed by pot trials where it was established that after three years ring nematode was able to reduce the yield per vine by more than 32%. Ring nematode populations in South Africa can exceed 2000 per 250cc of soil but no estimate of the damage caused has been made.

However reports on ring nematode damage are conflicting. The reports differ from cases where symptoms include stunting of the tops; darkened, small root systems with plenty of branching and significantly reduced root lengths (Fig. 1) to cases where neither reduced root weight nor noticeable symptoms are found. Established vines often produce typical yields even where high population densities of the ring nematode are present. However the consensus is that high densities definitely affect vineyard establishment with a very negative impact in the first three years.

It has been suggested that vigorously growing vines are able to tolerate nematode-induced stress. The pathogenic effects of nematodes only become apparent when vine vigour is reduced by other stress factors such as water stress. Therefore where vineyards are managed for 50% of the crop-load (e.g. in Oregon) very little effect of the nematodes is seen.

To further complicate matters, the effect of ring nematode vines appears to vary among different geographic regions, soil characteristics and management regimes (Pinkerton *et al.*, 2005).

A more direct effect of the ring nematode feeding is the alteration that takes place in the roots. The first is the decreased root elongation and the second is the reduced nutrient transfer between mycorrhiza and the host plant.

These effects make plants more sensitive to water and nutrient stress. Schreiner & Pinkerton (2008) demonstrated that ring nematodes can reduce arbuscular mycorrhizal fungi (AMF) arbuscules in the fine roots. There is an associated decrease of starch in the fine roots, reduced P, K and S uptake and increased Fe uptake by the vine despite the presence of mycorrhiza. This is particularly true at high ring nematode densities.

Nyczepir *et al*., (1987) found that ring nematode decreased the reducing sugars (glucose) in the roots of peaches. Glucose is the primary source of energy for a plant cell. Insufficient glucose in turn predisposes the peach tree to injury from environmental and biological stresses such as bacterial canker. The same could possibly be true for vines.

Figure 1: Root damage caused by ring nematode

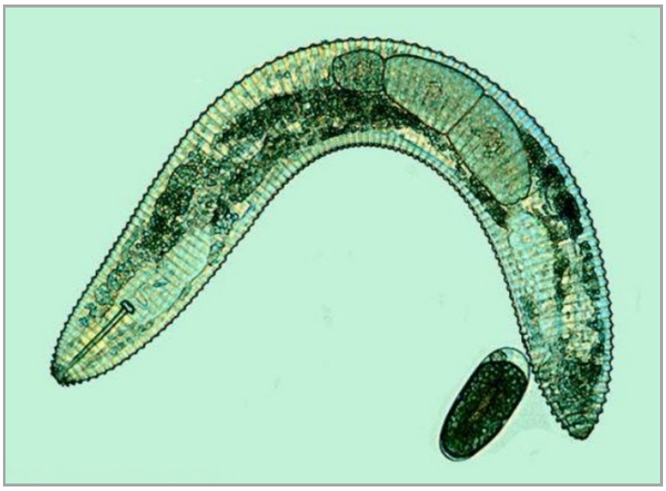


Figure 2: Ring nematode showing annulations(Photo: AP Malan)

BIOLOGY

Conditions favouring the rapid multiplication of ring nematode include:

a) Rootstocks

Ring nematode is primarily found on woody/herbaceous root systems. In the western and northern Cape the favoured hosts are stone fruit and vine rootstocks. In resistance testing of the rootstocks in the USA it was found that 101-14 Mgt and Richter 110 showed good resistance while Richter 99 and Ramsey were regarded as susceptible. These two rootstocks showed an almost eight-fold increase in ring nematode numbers in eight months. Some trials over longer periods showed increases that varied from 32-fold, to 44-fold and 52-fold. The irony is that these rootstocks were developed as root-knot nematode resistant rootstocks.

In the case of stone fruit it is the root-knot nematode resistant rootstock, Marianna which is very susceptible to ring nematode. Young plum trees, aged 2 – 7 years, on Marianna rootstock and with high densities of ring nematode very often succumb to bacterial canker. This is referred to as plum death syndrome. Again the importance of the ring nematode must not be underestimated.

b) Temperature

Temperatures of 25 – 28℃ favour nematodes and lead to the rapid completion of their life cycles. These temperatures are often created in the micro-environment around the roots by the new shallower rootstocks, drip irrigation and mulch. These management practices have a very definite effect on temperatures by preventing extremes and favouring the desired temperatures conducive to rapid multiplication of the ring nematode. Drip irrigation in small amounts on a regular basis favours constant temperatures. Mulching leads to a much shallower root system and an increase in soil temperatures.

c) Soil type

It would appear that ring nematode is more prevalent in soils which are coarser and which contain a shale or small stone fraction. This is in contrast to root-knot nematode which multiplies rapidly in a sandy soil. This concept is not understood and urgent research is required to explain this phenomenon.

d) Nematode shape and structure

The ring nematode has many horizontal annulations in which particles can get lodged. This makes it difficult for direct contact with the nematicides (Fig. 2). In a comparative study done in the laboratory in Chile it was shown that the ring nematode requires much higher rates of a nematicide to be lethal than that required by other nematodes (Table 1).

Table 1: Minimum ppm required by nematicides against various nematodes

	Minimum dpm for 100% immobility (after 24 hrs)			
Nemati-cide	Root-knot	Dagger	Citrus	Ring
A	50	>150	>150	>150
B	1500	>1500	1500	1500
C	15	80	80	>100
D	1	80	100	>100
E	5	50	100	>100

Aballay, E. 2004. Lab tests. Univ of Chile

NEMATICIDE APPLICATIONS

Nematicide applications are more effective if care is taken regarding the following:

- The applications must be timed to coincide with the root flushes. The point is to protect the new root flush from nematode attack.
- For the reasons described under structure and shape the correct rates must always be used.
- Since the majority of the nematicides are slow movers through the soil profile sufficient water must be applied to wash the nematicide through the desired root profile.
- Nematicides adsorb to organic material so the presence of weeds, a slashed living mulch, compost or mulch will have a negative effect on the efficacy of the product being applied.
- Accelerated microbial degradation (AMD) is a reality. By continuously using the same product the micro-organisms responsible for their breakdown will increase to levels where the breakdown takes place within a very short time span rendering the product ineffective.

CONCLUSION

The ring nematode is an extremely difficult nematode to control. In California it is suggested that three changes in grape growing have exacerbated the problem in recent years. In the past fields were fumigated prior to planting the vines, a practice which has become rare. Increased stress that weakens the vine includes leaving grapes to hang too long and deficient irrigation. The modern rootstocks are shallower. Research is required on ring nematode/vine interactions, and also regarding the biology of the ring nematode.

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