Factsheet

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Cover crops and plant-parasitic nematodes

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Introduction

Nematodes are wormlike invertebrate animals that are unsegmented. They are cold-blooded, so their metabolic rate and activity are lower in cold conditions. Of the known nematode species, approximately 14 per cent are plant parasites and 25 per cent are free-living, feeding on fungi, bacteria or detritus (Westerdahl *et al.* 1998). In vineyards, many of the soilborne nematodes are desirable species, which add to the faunal biodiversity, but the plant-parasitic species can cause considerable damage to grapevines. Walker and Stirling (2008) estimated production losses in the range of 5–15 per cent in most grapegrowing districts of Australia, making them a pest deserving of investigation and management to reduce their populations. Scholefield and Morison (2008) estimated that root-knot and other nematodes cost the industry $14 million per year, with losses varying across zones according to the cost of replanting with resistant rootstocks as well as the yield loss.

In addition to causing crop losses directly, plant-parasitic nematodes can act indirectly as virus vectors and may combine with other nematode species or fungal pathogens to exacerbate root malfunction (Walker & Stirling 2008). Badly infected vines will show poor vigour, have stunted growth and yield poorly

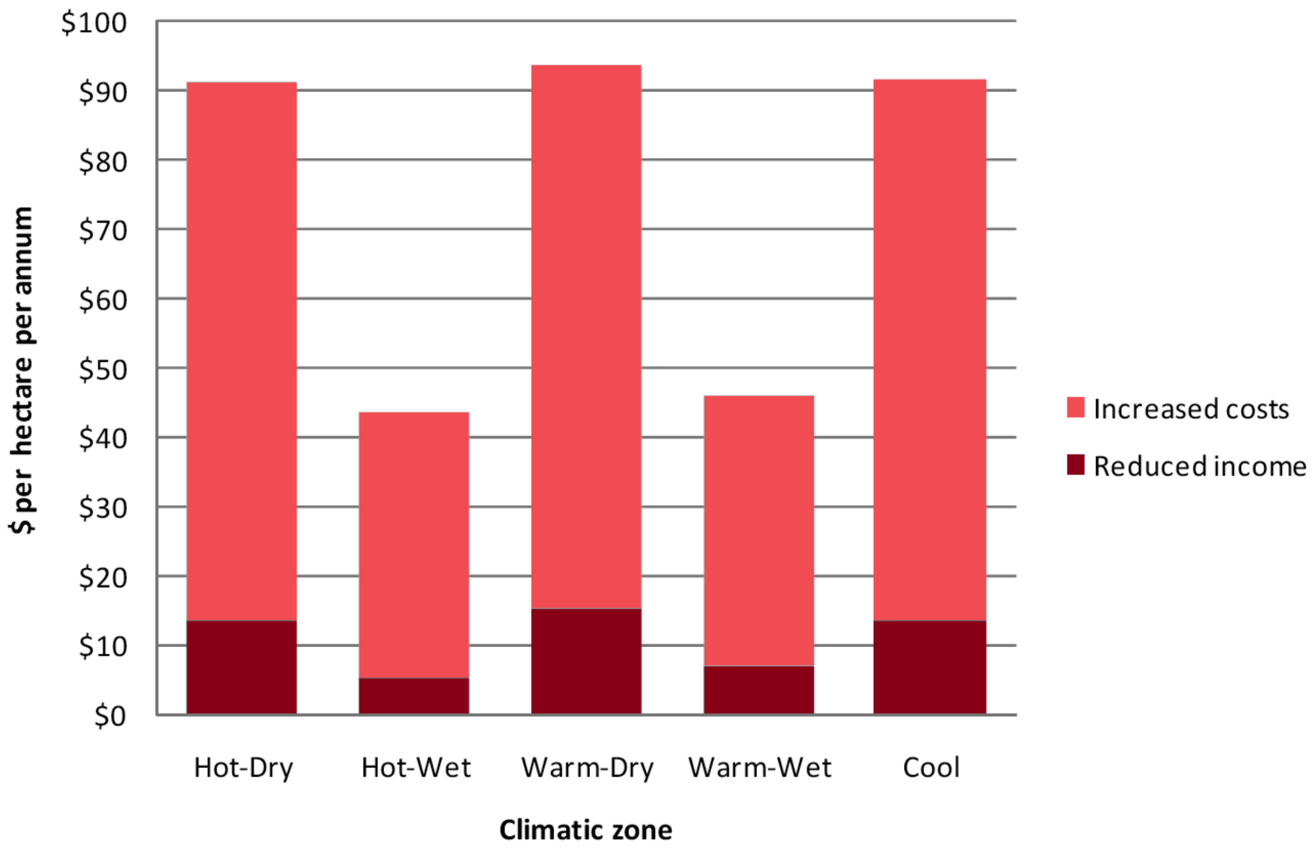

Figure 1: Average vineyard-level economic impact of root-knot and other nematodes, by climatic zone. Estimates are annual avrages over a period of 15 years, in constant 2009 dollars. (Adapted from Scholefield & Morison 2008, Figure 23).

(Rahman & Somers 2005). A factsheet produced by the CRC for Viticulture, entitled Nematodes in Australian Vineyard Soils, provides more background information on these pests (Riley & Walker 2006).

Walker and Stirling (2008) reported the outcome of surveys of soil texture and its influence on nematode populations. Root-knot nematode (*Meloidogyne* spp.) was more prevalent in coarse-textured sand and sandy loam soils, whereas citrus nematode (*Tylenchulus semipenetrans*) and root lesion nematode (*Pratylenchus* spp.) were equally at home in finer-textured loams and clays. While using resistant rootstocks may be very effective in suppressing the impact of nematodes, there will be times when infected vines require attention that does not involve replanting. The cultural management of nematodes via the growth of resistant species in the mid-row may provide a mechanism for constraining their populations.

Figure 2: **Nemfix mustard growing in a biofumigation trial on the southwest slopes of NSW. (Photo courtesy Tony Somers).**

Cover crop effects on nematode populations

Brassicas (e.g. mustard, radish, canola) contain compounds called glucosinolates, which provide the spiciness associated with their culinary cousins. These break down to become isothiocyanates, which are the bioactive compounds that act upon soilborne creatures such as nematodes in a process called biofumigation (McLeod & Da Silva 1994). Rahman and Somers (2005) investigated the capacity of *Brassica* plants and their associated seed meals to reduce soil nematode populations in a badly infested vineyard in the Hunter Valley. In a 3-year-old vineyard, they found that the Nemfix cultivar of Indian mustard (*Brassica juncea*), when grown in the mid-row and then side-thrown under the vine, provided a 13-fold reduction in root-knot nematode populations of the vine row 36 weeks after treatment.

In a recent study, Rahman *et al.* (2011) conducted a pot experiment over 3 continuous years, and found that in the third year, Nemfix green manure applied to vines inoculated with *Meloidogyne javanica* increased yield by 69–101 per cent, compared to the unamended control. While this work needs validation in the field, the prospects for nematode populations to be contained and yield impact minimised do seem promising.

What are the practical implications of this research? Even where nematode populations are low, the *Brassica* spp. can provide a valuable break crop in rotation with cereals, due to their biofumigation ability. Oats, ryegrass, fescue and cocksfoot are also non-hosts to root-knot nematodes, but are not biofumigants (Porter 1998). Agronomically, the brassicas are not difficult to grow, but they can be susceptible to red-legged earth mite and do have a healthy appetite for nitrogen. Their rainfall requirements per unit of biomass produced are higher than those of cereals, and they do not perform very well in low-rainfall environments.

As the greatest density of grapevine roots (and hence nematodes) is in the vine row, that is the area requiring treatment. Vanstone and Lantzke (2006) suggest that green manure cover crops need to be covered with soil to be effective. The above-ground biomass must therefore be mown and thrown onto the vine row and covered with soil, as executed with an offset disc by Rahman and Somers (2005). It is therefore possible in many environments to grow the biofumigant and place it where it will effectively reduce nematode numbers. However, despite work showing that biofumigation can reduce nematode populations, there is still no evidence that this has an impact on grape yield. This is not because they are unlikely to have an impact, but it appears that trials have not been carried through to yield determination.

It was recommended that such treatments be applied in consecutive years to have a long-lasting impact on nematode populations. It was also believed that biofumigation would not be as effective in older vines, where female nematodes and their egg masses could be safely buried within root tissues.

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