

Impact of plant-parasitic nematodes on grapes in Washington

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Nematodes are the most plentiful animals on earth. Most taxa of these roundworms are free-living, feeding on bacteria, fungi, or other microscopic animals in water or in the soil. Free-living nematodes are believed to be important in nutrient cycling in the soil. Some taxa of nematodes are parasites of animals and plants. Nematode parasites of vertebrates are of veterinary and medical importance. A few nematode parasites of insects are used for biological control. My presentation will focus on microscopic plant-parasitic nematodes, which are responsible for nearly 100 billion dollars of crop losses annually.

Plant-parasitic nematodes have one common feature, the stylet, a hypodermic-like mouthpart. The stylet is used to puncture plant cells and suck out the cell contents. Nematode feeding can cause direct damage by stopping root elongation, killing plant tissue, changing growth patterns of roots, and by removing plant nutrients. These changes result in dysfunction of nutrient and water translocation in roots, and ultimately result in reduced plant vigor and yields. Nematodes also can cause indirect damage to plants by vectoring viruses, such as Grape Fanleaf Virus and TomRSV in grape production, or by increasing the severity of other plant diseases.

Plant-parasitic nematodes are present in nearly all natural and agricultural soils. In soil, the nematodes live and move in the film of water surrounding soil particles. Under adverse conditions, such as drought or absence of a host, nematodes may become quiescent and resistant to environmental stresses. Under optimal conditions, most plant-parasitic nematodes complete their lifecycle in 20 to 40 days. The length of time depends on soil conditions, temperature, and the suitability of the host. There may be 4 or more generations per year with each generation of females producing up to several hundred eggs. Thus, population densities may increase to high levels within a season after treating the soil. Nematode movement is restricted to ca. 1' horizontally and 3' to 6' vertically. Vertical migration is important because nematodes may survive below the treated soil profile and migrate back into the root zone. Man's activities are responsible for transporting nematodes within and between fields in infested soil on tillage and harvesting equipment, on infested nursery stock, and in surface water (run off and irrigation).

The first step in managing plant-parasitic nematodes is to determine the population densities of the species in a field. Since nematodes are not uniformly distributed in fields, the precision of estimations of population levels increases with the number of subsamples collected. A general rule is to collect at least 20 cores along a "W" walk pattern in 2 – 5 acre areas of a field. Large fields should be partitioned by differences in soil type and crop history. Samples should be collected in the region of most root growth, at depths of 8" to 18". Nematode population densities vary throughout the year and these patterns may differ between years. The best time to collect samples is in the fall when densities of many nematode species are at their highest. Fall sampling also provides timely data on which to base management decisions before the next season, i.e. fall fumigation.

Here are some points to consider when interpreting nematode test reports. Even with the best sampling techniques, nematode population data are only estimations. In addition, laboratories

may use different nematode extraction techniques, with different efficiencies, and report the results in different units. Assuming that a nematode density on a report is accurate, what level of economic loss is to be expected? In the case of perennial crops, plants often may support and compensate for high nematode densities without noticeable loss of vigor. Over time, however, the cumulative stress of nematode feeding results in lower vigor and yields. The rate of decline and extent of plant damage also is a function of other biotic (pests and diseases) and abiotic (soil type, water, cold) stresses. For example, population densities of several plant-parasitic nematode species in many Oregon vineyards are much greater than damaging levels reported in California, but they appear to cause no economic loss. We believe that the minimal impact that these nematodes have on vines is the result of the lower total stress on vines in Oregon compared to California, i.e. much lower crop loads, milder climate, heavier soils with greater soil moisture levels. Therefore, the situation in a specific planting must be considered when using the nematode damage thresholds for grapes listed in Table 1.

Table 1. Damage thresholds for plant-parasitic nematodes affecting grapes.

Nematode	Nematode/250 g soil	
	California >10% ^v	Washington ^w
Root-knot	< 6-35 ^x	100 ^y
Dagger (<i>X. americanum</i>)	25	25 ^z
Ring	12-125	300
Root-lesion (<i>P. vulnus</i>)	5-25	not present

^vMcKenry, M. 1992. Grape Pest Management. Publication No. 4105. Division of Agricultural Science, University of California

^w Santo, G. Personal communication.

^x Threshold depends on host and soil type. Threshold based on *Meloidogyne javanica*, *M. arenaria*, *M. incognita*, and *M. hapla*.

^y Based only on *M. hapla*.

^z Only *X. pachtaicum* was found in our survey. The relative pathogenicity of this species compared to *X. americanum* is unknown.

Plant-parasitic nematodes were present in all vineyards surveyed in this very limited sample of Washington vineyards. The northern root-knot nematode (*M. hapla*) was found in 66% of the vineyards and 45% of the blocks, with population densities exceeding Dr. Santo's damage threshold in 25% of the blocks (Fig 1.). *X. pachtaicum* was found in 74% of the vineyards and 63% of the blocks, with densities exceeding Santo's threshold levels in 42% of the blocks. *M. xenoplax* was found in only 5% of the blocks and exceeded damage threshold levels in only one block. Because of the limited number of Concord blocks included in the survey, it is not possible to draw any conclusions about differences between distributions of nematode in Concord and wine grape vineyards.

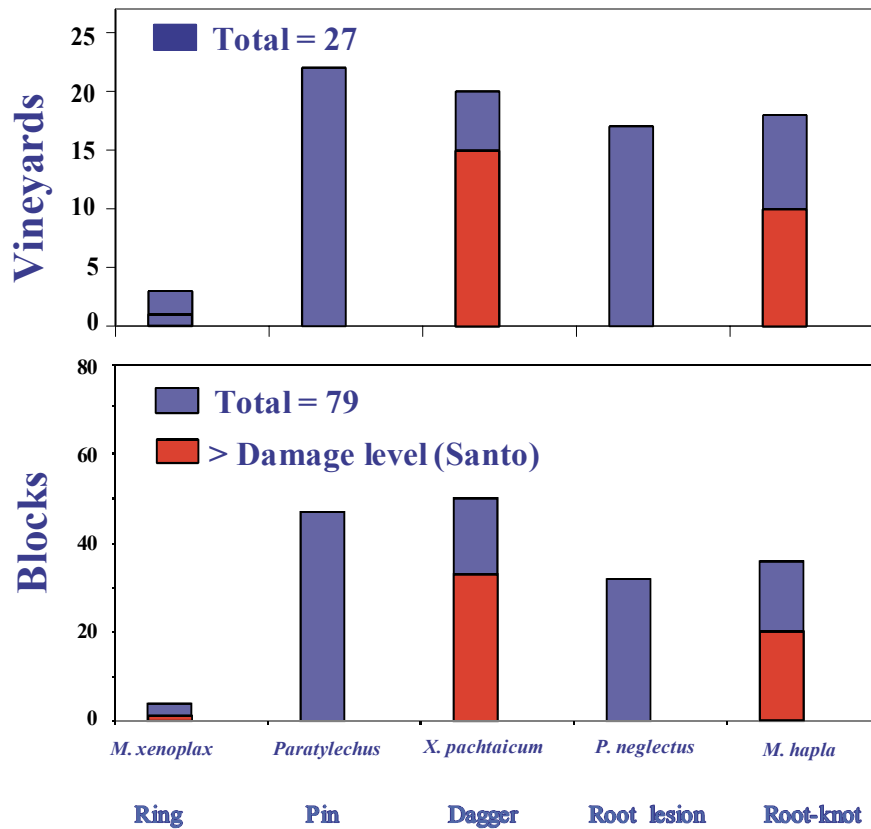


Fig. 1. Occurrence of plant-parasitic nematodes in Washington vineyards. Samples were collected in August 2000. Estimated damage threshold densities are based on observations of Dr. G. Santo.

Because of the increasing demand for grapes to support a booming Washington wine industry, growers have often ignored the long term impacts of pests and diseases on productivity when planting vineyards. In the survey, we noted a number of vineyards with cropping histories of potato or alfalfa that were infested with high population densities of root-knot nematodes. Vineyards planted on old cherry sites may be affected by dagger nematodes and nematode transmitted (NEPO) viruses. The fact that NEPO viruses were found in vineyards surveyed by the Washington Department of Agriculture and WSU (Dr. Ken Eastwell, personal communication) suggests that dagger nematodes may be important in vineyards at densities below the threshold levels reported. At present, it is not known which nematode vectors are present in these virus-infected vineyards.

Plant-parasitic nematodes are a major economic problem in every major grape production region in the world. However, the impact of nematode on Washington grape production is not known. Nematicide tests conducted by Dr. Santo 20 years ago suggest that nematodes reduce Concord and winegrape yields in Washington. Based on our survey data, several participating growers have collected additional soil samples for nematode analysis in their vineyards and found high population densities of one or more nematodes species associated with areas of low vigor. These observations suggest that research is warranted to determine: 1) what population densities of the nematode species found in Washington vineyards cause damage to grapevines, 2) what conditions may exacerbate the damage, and 3) what management inputs can be employed to mitigate the damage. Research also should be directed toward nematode vector-virus relationships and management in vineyards. In

newer production areas, such as Washington, Oregon, and Idaho, plant-parasitic nematodes are widespread in vineyards and may be expected to become a more important constraint in grape production as the industry matures and as vineyards are replanted on nematode infested sites.