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Pathogenicity and management of plant-parasitic nematodes on *Vitis vinifera* in Oregon vineyards

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BACKGROUND AND PROBLEM

Plant-pathogenic nematodes that cause yield loss in California and European vineyards are found in over 85 % of Oregon vineyards. Population densities of *Xiphinema americanum* (dagger nematode) and *Criconebella xenoplax* (ring nematode) were found in 37% of vineyards at levels reported to cause > 10-25% loss in California vineyards. However, these nematode species were rarely associated with poor vine vigor in Oregon vineyards. It is unclear whether established vineyards will succumb to nematode damage over time or if the high vigor of vines in Oregon allow them to compensate for damage caused by nematodes. Even if older vines can withstand nematode parasitism, vines replanted in infested soil with high population densities of plant-parasitic nematodes may not fare as well. The objectives of this research are: 1) to ascertain if and under what conditions plant-parasitic nematodes can reduce the vigor of established grapevines, 2) to evaluate techniques for managing nematode populations and nematode injury to vines, and 3) to develop strategies for replanting grapevines in nematode infested ground.

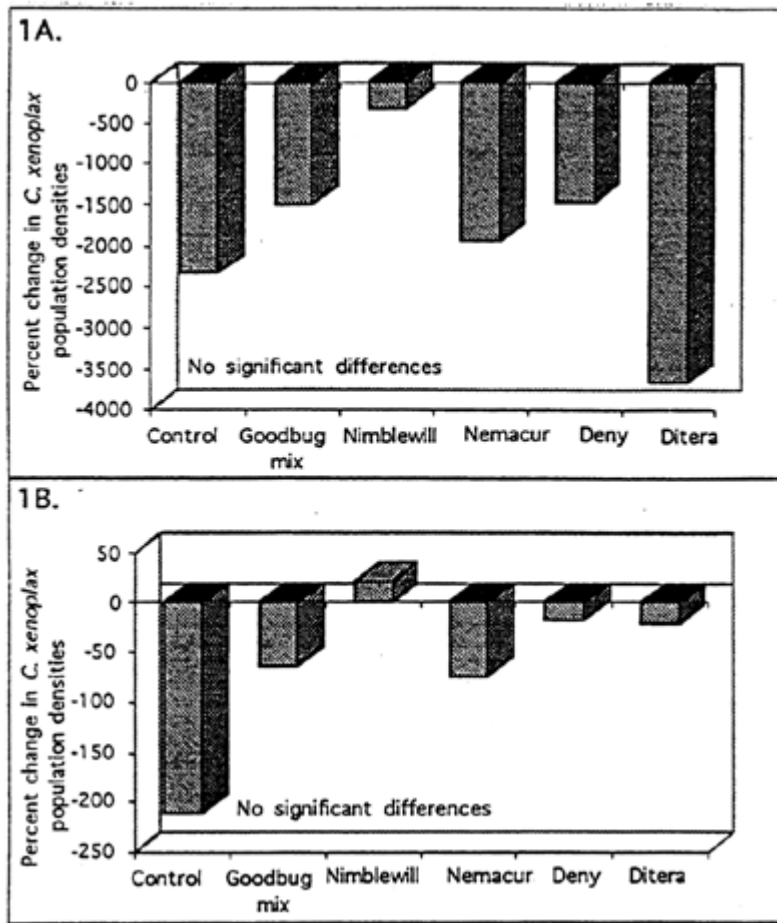
ESTABLISHED VINEYARD STUDIES

Woodhall Management Study

Plots were established at the Woodhall Vineyard in a block of vines with high and moderate population densities of *C. xenoplax* and *X. americanum*, respectively, and a history of poor vine vigor and yield. The experiment, established in 1996, was designed to evaluate the effects of ground covers ("Good bug mix" or nimblewill) and application of biological nematicides (Deny or Ditera) or Nematicur on plots with existing grass cover. The controls were nontreated plots with existing grass cover. The design was a randomized block with six replications. In May and October 1997, the two biological nematicides were applied as band broadcast in the vine row in May and October and incorporated by rainfall. In June, Deny and Ditera were applied by drip irrigation. Nematicur was applied according to the labeled rate in a band application only in May, 1997.

After two years, there were no significant changes in population densities of *C. xenoplax* among treatments. Population densities of *C. xenoplax* decreased in all treatments during the first two years (Fig. 1a). However, *C. xenoplax* population densities increased slightly in the nimblewill plots in 1997 (Fig. 1b). Nimblewill has been reported to be antagonistic to *C. xenoplax* in the southeastern USA. These data suggest that populations in different geographic regions may have distinct host ranges. Most yield parameters and pruning weights were greater in the nimblewill and good bug mix plots (Figs. 1c and 1d). This effect was most likely a result of removing the competition from the grass during the period when

these ground covers were planted. Regression analysis of nematode population data on yield parameters showed weak positive ($R = 0.16 - 0.18$) correlations, which may result from vigorous plants being able to support higher population densities of nematodes than weakened vines. All treatments will be applied again in 1998 and yield and nematode data data will be collected.



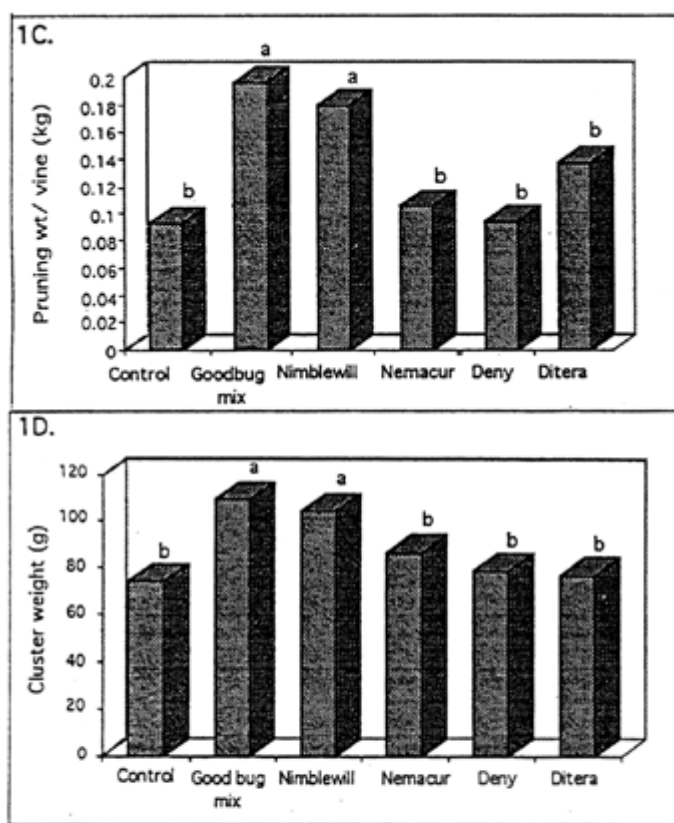


Fig. 1. Woodhall management study:

A. Percent change in population densities of *C. xenoplax* from March 1996, before the first treatments were applied, to November 1997.

B. Change in *C. xenoplax* population densities during the 1997 growing season, March through November 1997.

C. Cluster weight, October 1997.

D. Pruning weight per vine, February 1997.

Commercial vineyard study

Approximately 104 plots, four rows by ten vines, were established in 20 commercial vineyards in which high *C. xenoplax* populations were observed during the survey. Data will be collected on vine health and nematode population densities each year to ascertain whether the nematodes are affecting the health.

REPLANT STUDIES

Cave junction replant study

This study was established on a site with a history of crown gall and nematode infestation. After two acres of vines were removed during the winter of 1995, blocks were fumigated in May with metam sodium, either incorporated by rototilling or through irrigation water. In June, vines were planted in the fumigated blocks, in nontreated control blocks, and also interplanted in a row of mature vines. From July through September 1995, additional blocks either were solarized or maintained as clean fallow. In 1996, the solarized and fallowed blocks were planted and the mature vines were removed from the interplanted row. Five vine blocks of the one-year-old interplanted vines were solarized from July through September 1996, or left as nonsolarized controls. All treatments were replicated six times.

Interplanted vines that had been solarized had significantly more growth than nonsolarized vines and

growth was equal to vines planted in fumigated soil (Fig. 2a). Population densities of *C. xenoplax* declined from April 1996 to November 1997 in the plots solarized and fallowed in 1995 and the plots of interplanted vines, but increased in the metam fumigated and control plots (Fig. 2b). Fumigation has been observed to promote an increase of certain nematode populations, possibly because natural enemies of nematodes are also reduced by fumigation (McKenry, Personal communication). Solarization shows promise for the control of nematodes in vineyards and warrants additional research.

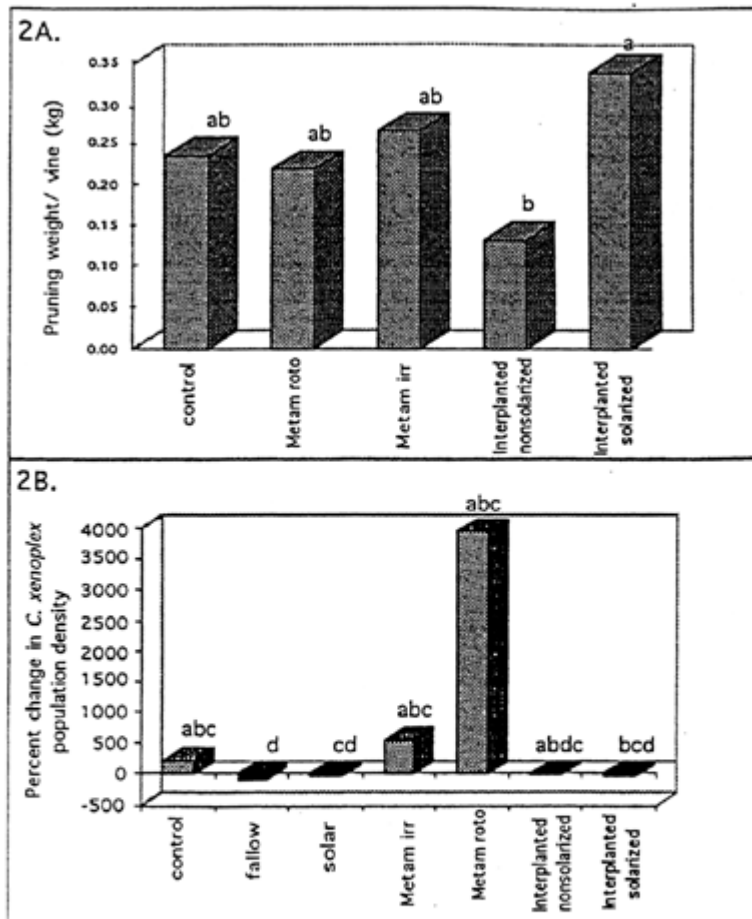


Fig. 2. Cave Junction preplant management study:

A. Pruning weights of vines planted in May 1995 in areas where vines had been removed or interplanted in rows between mature vines, January 1998.

B. Change in population density of *C. xenoplax* in soil from areas where vines in May 1995 had been removed and replanted, April 1996 to November 1997.

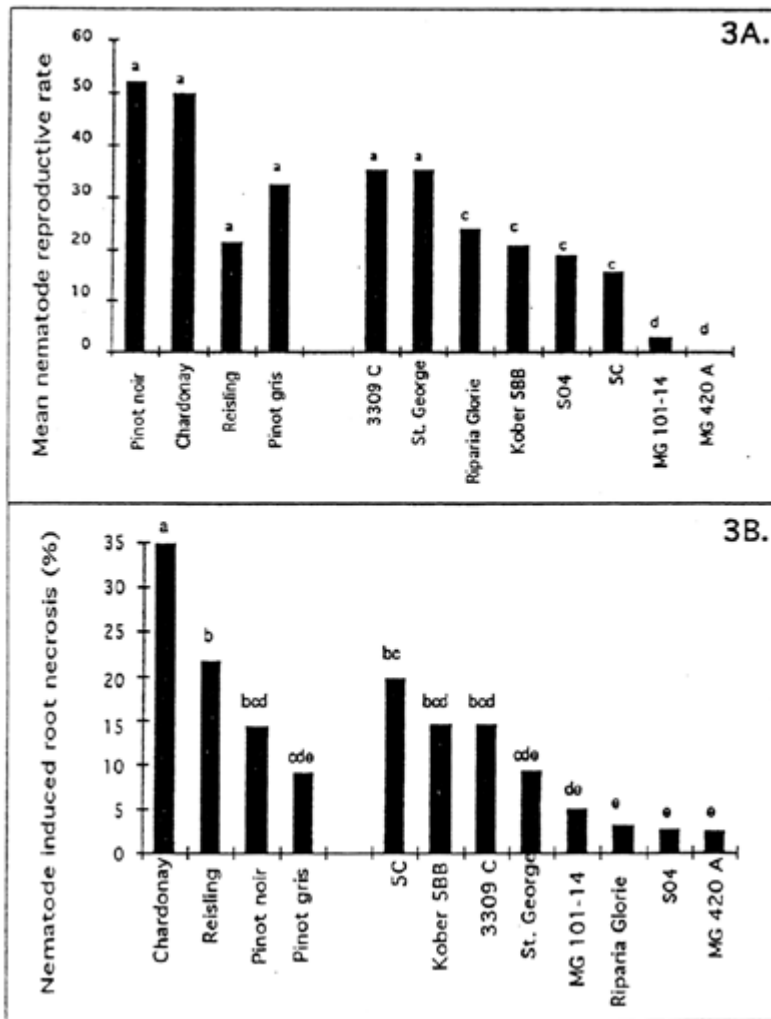
Microplot study

In 1997, a microplot experiment was established at the Woodhall vineyard. Plots consisted of a 2' diameter x 2' deep hole with a rigid fiberglass perimeter which was filled with fumigated field soil that had been inoculated with no, low, medium, and high population densities of *C. xenoplax*. One-half of the plots were planted with Pinot noir vines and the remaining plots were planted with Chardonnay vines. The effects of nematode parasitism on plant growth and yield will be monitored for 3-5 years.

Rootstock Study

Phylloxera resistant rootstocks and self-rooted cultivars were evaluated for resistance and/or tolerance to *C. xenoplax*. Vines were propagated from cuttings and then planted in pots containing 3 liters of sandy

loam soil. Each pot was inoculated with 4000 *C. xenoplax*. After eight months, plants were harvested and evaluated, and nematode populations were quantified. *C. xenoplax* reproduced poorly on MG 420A and MG 101-14, indicating that these rootstocks are resistant (Fig. 3a). Chardonnay and Pinot noir were the most susceptible cultivars. Root necrosis was evaluated by cutting the root system into 1 cm segments and then inspecting approximately 100 segments for necrotic lesions using a grid intercept method. Mg 420A, S04, Riparia Glorie, and Mg 101-14 showed the least amount of root necrosis, while Chardonnay had the greatest necrosis (Fig. 3b). *C. xenoplax* reduced root mass in all but 5C and Mg 420A plants (Fig. 3c). Knowledge of these differences between rootstocks and cultivars, may be used as one criterion for selecting a rootstock when replanting vineyards on sites infested with *C. xenoplax*.



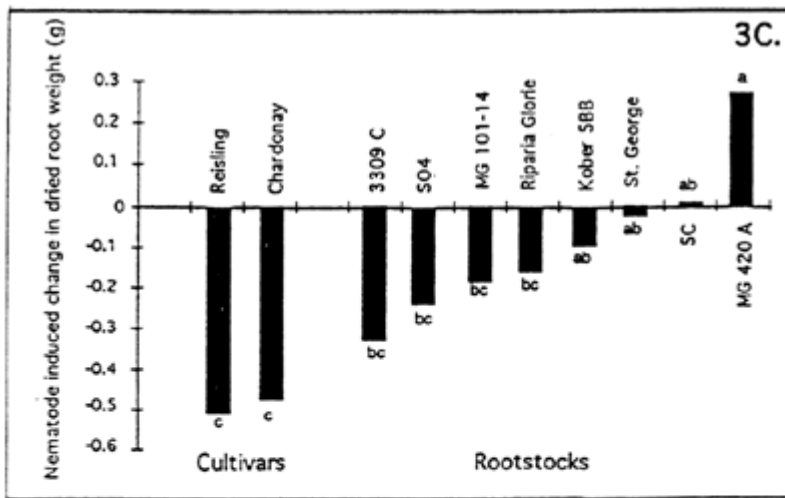


Fig. 3. Interaction of *Vitis vinifera* rootstocks and cultivars with *Criconebella xenoplax*:

A. Comparison of reproductive rates of *C. xenoplax*, with 0 = no reproduction.

B. *C. xenoplax* induced root necrosis; percent of root pieces with necrotic lesions.

C. Differences in root weight between plants inoculated with *C. xenoplax* and non-inoculated control plants.

* Variables with different letters were significantly different ($P = 0.01$) according to the Waller-Duncan procedure.