Oregon Wine Advisory Board Research Progress Report

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Pathogenicity and Management of Plant-Parasitic Nematodes on *Vitis vinifera* in Oregon Vineyards

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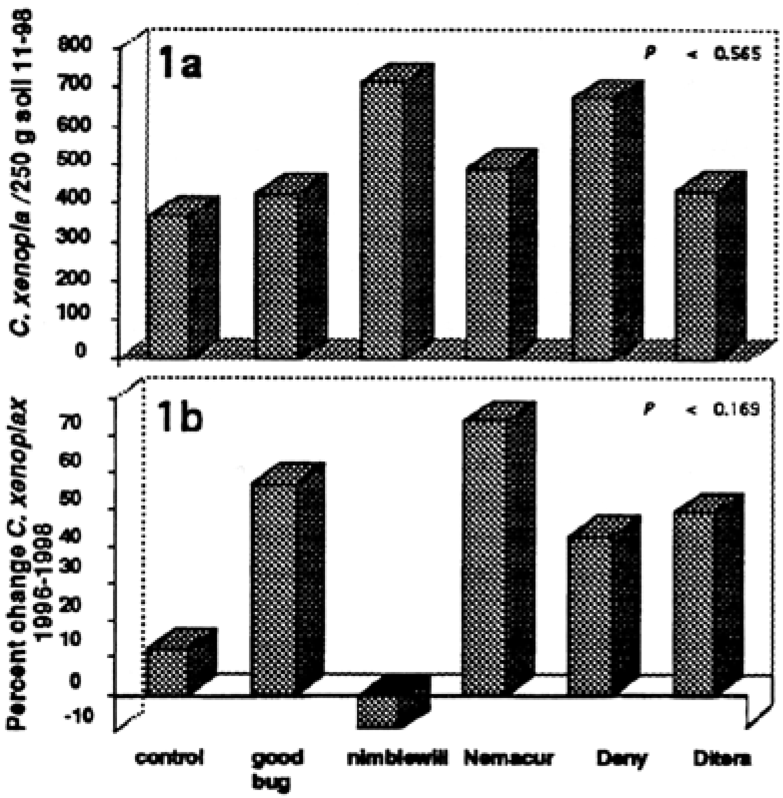
Plant-pathogenic nematodes that cause yield loss in California and European vineyards are found in over 85% of Oregon vineyards. Population densities of *Xiphinema americanum* (dagger nematode) and *Criconemella xenoplax* (ring nematode) were found in 37% of vineyards at levels reported to cause 10-25% 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 determine the relationship between nematode densities and vine health and yield in established and in new or replanted vineyards, 2) to ascertain what conditions, such as management inputs, climatic, or site characteristics, influence this relationships, 3) to evaluate techniques for managing nematode populations and nematode injury to vines, including resistant rootstocks, cultural practices, biological control, and nematicides which are labeled on grape.

ESTABLISHED VINEYARD STUDIES

Woodhall Management Study. In 1996, plots were established at the Woodhall Vineyard in a block of vines with a history of poor vine vigor and yield, and substantial populations of *C. xenoplax*, *X. americanum*, and *Meloidogyne halpa* (root-knot nematode). Five vine blocks were treated as follows: two biological nematicides (Deny or DiTera) were applied in late spring, early summer, and after harvest, Nemacur was applied in early spring, and two ground cover treatments, "Good Bug mix" and nimblewill (a perennial grass reported to be allelopathy to ring nematodes), were planted. The controls were non-treated plots with existing grass-weed cover. The design was a randomized block with six replications.

After three growing seasons, there were no significant differences in population densities of *C. xenoplax* among treatments (Fig 1a). However, *C. xenoplax* population densities tended to increase the least in the nimblewill plots (Fig. 1b). Yield parameters and pruning weights were greater in the nimblewill and ranked second in the good bug mix plots (Figs. 1c and 1d). No significant relationships were observed between population densities of each nematode species and any yield parameter. However, there were significant correlations between population densities of *C. xenoplax* and *X. americanum* and 1998 pruning weights and between *C. xenoplax*, *X. americanum*, and *M. hapla* and the number of canes in November, 1998. Multiple regression models developed for population densities of the three species showed no correlation with yield parameters, but fall 1998 population densities were correlated with 1998 pruning weights (R^2 = 0.314) and shoot number in November, 1998 (R^2 = 0.768).


1a
P < 0.565
C. xenopla /250 g soil 11-98
800
700
600
500
400
300
200
100
0
1b
P < 0.169
Percent change C. xenoplax 1996-1998
70
60
50
40
30
20
10
0
-10
control
good bug
nimblewill
Nemacur
Deny
Ditera

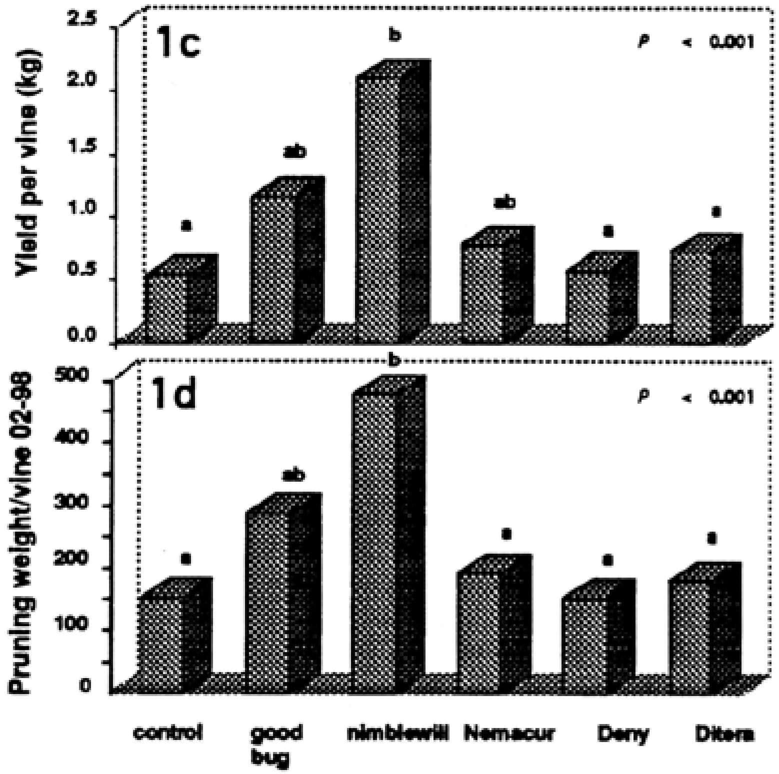


Fig. 1. Woodhall management study:
A. Population densities of *C. xenoplax* in November 1998.
B. Change in population densities of *C. xenoplax* from March 1996 before treatments were applied to November 1998.
C. Yield per vine in October 1998.
D. Pruning weight per vine in February 1998.

Many leaves on vines in the areas with high nematode population densities developed dark red margins, followed by chlorosis in the center of the leaf, and finally early defoliation. These symptoms were not observed in other areas of the Woodhall vineyard. There was a weak, but significant, correlation between population densities of *C. xenoplax* in April, 1998 and the incidence and severity of leaf scorch symptoms. Leaf scorch tended to be greater on vines in nimblewill plots. Although the cause of leaf scorch is not known, we hypothesize that it resulted from an interaction of biotic (including nematode parasitism) and abiotic (soil conditions and drought) stresses during the abnormally hot, dry, summer.

Commercial vineyard study
Observation plots were established in 16 commercial vineyards with high *C. xenoplax* populations. In each vineyard, 4-12 plots (each 4 rows x 10 vines) were sampled for nematodes and evaluated for vine health by interviews with the manager and/or observations on vine vigor. No consistent relationship between nematode population density and vine health was apparent.

Hypothesis

Although population densities of nematode species are present at densities reported to cause 10-25% loss in California vineyards, the mild, wet climate and heavy soil found in Oregon promote vigor and mask damage caused by nematode parasitism. This was supported by data collected at the Woodhall vineyard. In the nimblewill plots, and to a lesser degree in the Good Bug" plots, removing grass competition and watering improved vine vigor and yield, even in the presence of high nematode population densities. The effect of nematodes is exacerbated in these plot because of shallow soils.

REPLANT STUDIES

Microplot study

In July 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 *C. xenoplax* at low, medium, and high densities, 7, 150, and 750 nematodes per 250 g soil, respectively. Plots filled with non- inoculated soil served as controls. A single Pinot noir or Chardonnay vine was planted in each plot. The design was a randomized block with 9 replicates. Population data were collected in May and November, 1998. Pruning weight data will be collected in February, 1999. After two growing seasons, final population densities of *C. xenoplax* were independent of the initial densities, reaching 1460 to 1600 per 250 g soil in the three inoculated treatments (Fig 2). Control plots had 1 nematode per 250 g soil. Population increase was similar with the two cultivars. These data demonstrate the rapid rate of population increase of *C. xenoplax* on grape. The relationship between nematode densities, plant vigor, and yield will be investigated in these plots during the next 3-5 years.

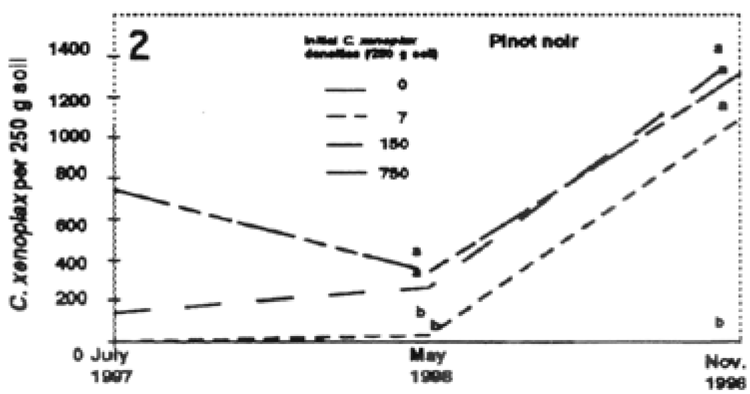


Fig. 2.Woodhall microplot study. Population dynamic of *C. xenoplax* on Pinot noir inoculated with three nematode densities.

Southern Oregon 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 non-treated control blocks, and also interplanted in an adjacent row of matures 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 oneyear-old interplanted vines were solarized from July through September 1996, or left as nonsolarized controls. A randomized block design with six replicates was employed.

Population densities of *C. xenoplax* were lowest in the fallow treatment in 1998 (Fig 3a). However, the change from pretreatment population densities were not significantly different between treatments (Fig. 3b) nor were the weights of prunings collected in February, 1998. In contrast, interplanted vines that had been solarized had significantly more growth for two season than the nonsolarized vines (Fig. 4a) although population densities reach the same levels in the two treatments after two years (Fig. 4b). Solarization shows promise for the establishment of vines in nematode-infested sites.

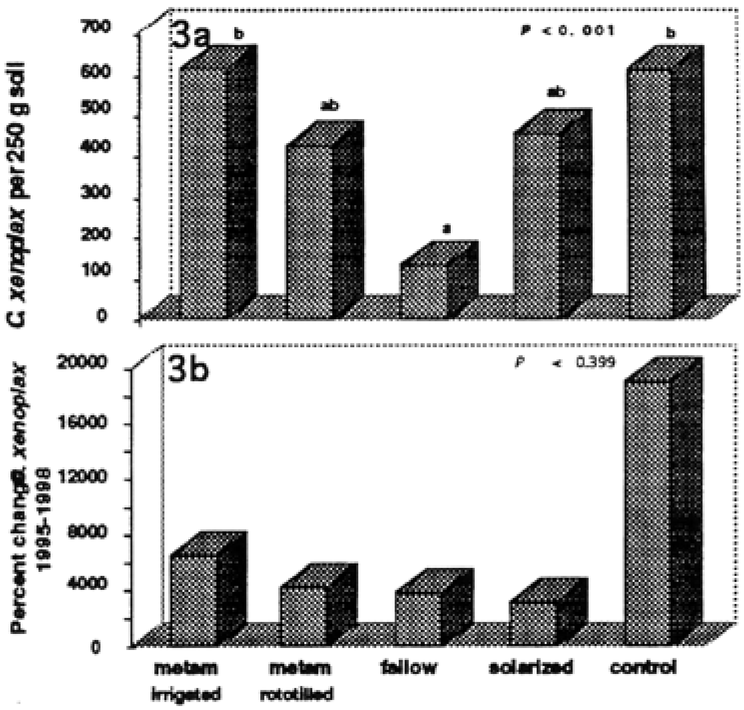


Fig. 3. Cave Junction preplant management study:
A. Population densities of *C. xenoplax* in November, 1998 from soil collected in areas where vines were replanted following solarization, fumigation, or fallow treatments. Treatments were made in 1995.
B. Change in population densities of *C. xenoplax* in soil from April, 1996 to November, 1998 in areas where vines were replanted following solarization, fumigation, or fallow treatments.

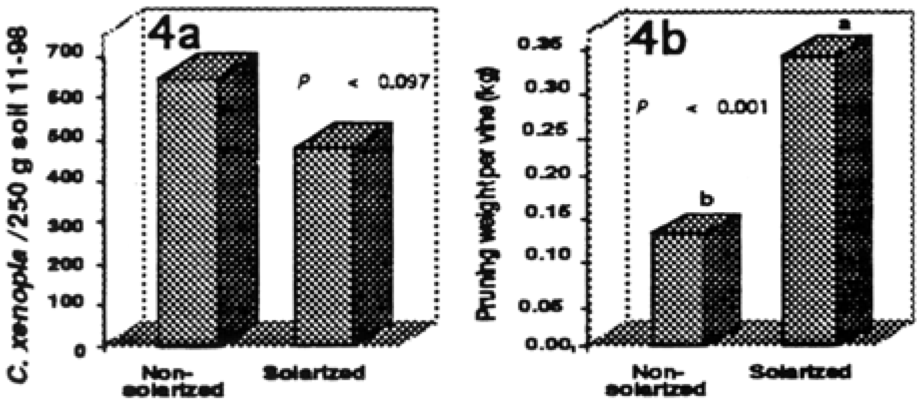


Fig. 4. The effects of soil solarization on vine health and population densities of *C. xenoplax*: Solarization was done from July to September, 1996.

A. Pruning weights collected in January, 1998.

B. Population densities of *C. xenoplax* in soil

In all figures, the variables with different letters were significantly different ($P = 0.01$) according to the Waller-Duncan procedure.

Rootstock Study

As reported last year, eight phylloxera resistant rootstocks and four self- rooted cultivars were evaluated for resistance and/or tolerance to *C. xenoplax.* MG 420A and MG 101-14 were highly resistant, while Chardonnay and Pinot noir were the most susceptible cultivars. This year eight additional rootstocks are being screened. 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.*