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Evaluation of Grape Rootstocks for Resistance to Crown Gall and Nematodes

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Grafted grapevines will become increasingly important in Oregon vineyards in order to prevent loss of plants to phylloxera infestations. Several rootstocks are now being evaluated in Oregon for horticultural traits and characteristics related to wine quality. Resistance or tolerance to other plant diseases affecting grapevines needs to be examined as well. Both crown gall and nematode infestations have been shown to reduce plant vigor. In addition, nematode infestations may increase the incidence of crown gall by wounding the plant tissue. Wounds allow entry of *Agrobacterium* vitis, the causal agent of crown gall, into plant cells and provide sites for tumor development (7).

There are several important factors to consider when testing resistance to crown gall disease. These include: a) type and number of rootstocks, b) type and number of *Agrobacterium* strains, c) method of bacterial inoculation, d) reproducibility of results, e) reliability of grape genotype identification and f) growth rate of plants.

Studies on the resistance of grapevines to crown gall have been conducted in Hungary, South Africa and the United States, but there was considerable variability in the results. In the Hungarian study, the Vitis *riparia* clones such as Gloire, Gloire K and selecta were the most resistant and the V. *berlandieri X R. riparia* crosses Teleki 5BB, 8B and 5C were the most susceptible (8). In the South African study, the V. *rupestris X V. berlandieri* genotype Paulsen 775 was immune, V. *riparia X V. berlandieri* 125 AA and 5BB, V. *riparia X V. rupestris* 3309 C and 101-14 Mgt were resistant and the most sensitive were V. *rupestris X V. berlandieri* 99 R and 11OR(l). In the U.S. study, 3309 C and T5C were the most resistant rootstocks, Paulsen 775 and 101-14 Mgt were of moderate resistance, and 420 A was one of the most susceptible genotypes tested (6). There are several possible causes for the variability seen between these three studies including the choice of bacterial strains used and the different methodologies for testing. Regardless of the causes, it is hard to generalize about appropriate rootstocks for Oregon vineyards because of the variable results reported.

In Oregon vineyard trials the rootstocks Harmony, T5C and 420A Mgt have had a high incidence of crown gall while the disease has not been reported in 3309 C, 101-14 Mgt or 44-53 M. A more thorough assessment of resistance to crown gall is in progress at Oregon State University using an *in vitro* method. Genotypes for testing are now growing in the greenhouse and include *Vitis riparia* Gloire, V. *rupestris* Saint George, V. *riparia X V. berlandieri* S04, T5C, 420A Mgt, *V. riparia X V. rupestris* 3309 C and 101-14 Mgt. We are also including the native species V. *californica* collected in Douglas County, Oregon. A. vitis strains have been isolated from 18 vineyard sites in Oregon. There are now over 5,000 isolates from which to choose in testing the rootstocks. Because of the considerable variability found among agrobacteria, initial testing is being conducted with five strains listed in the following table.

The method for testing grapevine resistance to crown gall is to obtain cuttings from greenhouse propagated plants. The cuttings are surface sterilized and cut into *5* cm sections including one leaf and one node. Segments are then transferred to tissue culture medium without hormones. A bacterial suspension is made up to a concentration of 108 colony forming units per ml and 10 microliters of the suspension is applied to wounded plant surfaces. Plants are observed for two months and evaluated by number of plants infected, size and weight of tumors. Genotypes that are most resistant to the five agrobacteria. strains listed in Table 1 will be further screened against a wide range of strains from the major vineyard locations in western Oregon.

Table 1. Agrobacterium strains selected for resistance testing of grape rootstocks

Strain	Biovar	Source[1]	Location	Sensitivity[2]
D4/94	2	T5C	Salem	HLB-2, E26
O508/93	3	(A.v.) PN/101-14	Salem	HLB-2
P3/93	1	PG/3309C	Salem	K84, E26
Q113/93	3	Grenache/T5C	Eugene	K84
T219/94	3	Gewurztraminer	Medford	N.T.

1. Grapevines from which bacterial strains were isolated.
2. Sensitivity to *Agrobacterium* strains that are used as biological control agents.

Criconemella xenoplax is a widely distributed nematode species in vineyards in the USA, South Africa, and Europe. Depression of vine growth has been associated with *C. xenoplax* in European, Californian, and Washington vineyards. In California, McKenry (3) reported a *10-25* percent reduction in grapevine yields with *>500C. xenoplax* per kg soil based on empirical observations. In Oregon, *C. xenoplax* was found in *85%* of 70 vineyards surveyed and population densities 1000 per kg soil were associated with stunted vines in some vineyards (4). In greenhouse experiments, *C. xenoplax* was reported to attack selected areas of young roots and lignified roots *(2).* In a short time nematode feeding caused local darkening and destruction of root tissue and ultimately the roots shriveled. Root growth was reduced with fewer feeder roots produced. Shoot growth also was reduced.

Most vineyards in Oregon are less than *20* years old. Our industry is an infant compared to other regions where nematodes have become a major disease problem. Nematode damage may be expressed in older vineyards or young vines that are replanted in vineyard soils infested with high densities of nematodes. Data on the level of resistance or tolerance to *C. xenoplax* may be of value when selecting phylloxera resistant rootstocks for replanting in many Oregon vineyards.

Rootstocks evaluated for crown gall resistance will also be screened for *C. xenoplax* resistance in greenhouse experiments. This permits evaluation of a known nematode density (stress), on plant growth, and also provides data on the host status of the plant, as measured by nematode reproduction. In *1995,* a population of *C. xenoplax* was collected from a vineyard that had population densities of *2,000-5,000* per *250* g of soil and stressed vines with a history of low yields. This suggests that grape is a good host and that this population is a pathogen of grape.

Pure cultures of the population have been established on peach trees at the USDA ARS laboratory.

In late spring 1996, 5,000 nematodes will be inoculated onto the roots of one-month-old grapevines planted in 3 liter pots of pasteurized loam: sand soil. An equal number of vines of each rootstock will serve as noninoculated controls. After four months the plants will be removed from the pots, soil shaken from the roots, and vines destructively harvested. The parameters that will be measured are shoot and root weights, root damage and necrosis, and nematode population densities. Plant resistance will be

determined by calculating the reproductive index (final population density/initial population density). A RI < 1 defines a plant stock as resistant. Tolerance will be determined by calculating the difference between shoot and root dry weights (DW) of inoculated and noninoculated controls vines for each plant stock. If the RI >1 and DW is near 0, the plant stock will be defined as tolerant. Based on these data, we can determine if further evaluation in field plots is warranted.

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