Oregon Wine Advisory Board
Research Progress Report

1992 - 1993

Grape Phylloxera Biology and Management in Oregon

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INTRODUCTION AND OBJECTIVES

Grape phylloxera *(Daktulosphaira vitifoliae),* a root-feeding aphid-like insect, is the most important pest of European winegrape vineyards worldwide. They cannot be controlled on infested vines which eventually die. There are currently no satisfactory chemical or biological control methods for this pest; its management throughout the world has been by planting resistant rootstocks and through techniques that seek to limit the rate of spread.

Although it has been in California since the mid- I 800s, phylloxera was discovered for the first time in a commercial vineyard in Oregon in 1990 and in Washington in the late 1980s. Seven vineyards are now known to be infested. With over 95 percent of Oregon's 6,000 acres of grapes being own-rooted, susceptible vines, the potential for serious economic loss to the industry is great. Infested vineyards will have to be replanted on grafted vines (resistant rootstock) at a cost of over $1 1,000 per acre for re-planting and years out of production. Rate of spread of this insect within a vineyard is estimated to be 2 times to 4 times in Oregon -- thus at the very least, a 1/8 acre infestation will be I acre in size in 3 years. Phylloxera can be spread from one vineyard to another on infested soil or plant material.

The life cycle of this insect varies with location. Our findings indicate the presence of sexual, winged forms in the Pacific Northwest. The relevance of this discovery to viticulture here is unknown but may be important to insect population variability and movement (greatly increase rate of spread). Because distribution of phylloxera in the Pacific Northwest is currently limited, characteristics of its current distribution and movement are necessary to limit movement in the future.

Although replanting vineyards on phylloxera resistant rootstock is the long term, preferred and inevitable mechanism for control of the pest, there is a large number of resistant rootstocks to choose from, but none of which have yet been characterized as suitable for production systems in Oregon.

Existing phylloxera infestations must be managed to decrease the rate of spread, within and among vineyards. Delaying the need for the industry to replant on resistant rootstock is essential, as growers will have to make educated decisions on what stocks are best for Oregon. Our industry does not want to be faced with having to replant 80 percent of existing vineyards because of inappropriate initial rootstock recommendations, a situation now in effect in California's Napa and Sonoma counties. Research on phylloxera biology, rate of spread, and its association with other pests in Oregon is needed to better manage this insect. We need sufficient time to conduct concurrent research on rootstocks resistant to variations of phylloxera, resistance to other pests such as nematodes and fungal pathogens, and suitability for our viticultural region. Studies on other traits of rootstocks, to provide consistent

productivity and quality perfection for Oregon conditions has the potential to make Oregon's change to rootstocks a positive development and an enhancement of long-term competitiveness.

Additional information on phylloxera biology, rate of spread, methods to decrease the rate of spread, and rootstocks for Oregon vineyards is available in the Oregon Winegrape Growers' Guide (1992).

The objectives of our research were to determine when phylloxera hibernants (over-wintering populations) become active in the spring and how populations change throughout the season. This would not only determine the number of generations a year, but also when spread can begin in the spring. Also, it's important to be able to estimate the rate of spread as accurately as possible so that growers may predict replanting date and the industry can forecast spread within the Oregon. We also wanted to determine whether we have a winged form of phylloxera in Oregon, because this could greatly affect the rate of spread of this pest. Determining the low temperature tolerance of phylloxera found in Oregon is necessary to better estimate number of generations per year and the potential amount of population die-back in cold winters. Finally, we planned to determine the resistance of rootstocks to biotype(s) of phylloxera found in Oregon.

RESULTS AND DISCUSSION

Two infested vineyards were selected for this study, one in Lane County and the other in Marion County. The Lane County site has 8-year-old Riesling and Gewurztraminer and the Marion County site has 10-year-old 'Pinot noir' infested with phylloxera. These two sites are distinctly different, especially with regards to microclimate. We have been monitoring soil (30 cm) and air temperatures at each site since the beginning of June 1991.

The Lane County site was pulled in April 1992 and research was begun at two Yamhill County sites. Yamhill I is a 20-year-old 3-acre unirrigated vineyard of Pinot noir managed organically. Yamhill 11 is a much larger vineyard site with 15-year-old Riesling on drip irrigation (not irrigated in 1992). The Marion County site will remain in the study with two border rows (of the lens of infestation) planted with a rootstock trial.

Population levels throughout the season

Growth of field populations (reproductive potential) was determined by sampling the two infested sites every four weeks from June 1991 through June 1992. The Lane County site was pulled in April 1992, so research was moved to two Yamhill County sites. In June 1992, sampling was increased to every two weeks based on recommendations from entomologists Jeff Granett (UCD) and Glenn Fisher (OSU).

At each vineyard site, soil (400 ml) and root samples (100 g) were collected from ten vines from the periphery of the lens of infestation, using a shovel and pruners. Samples were collected at soil depths of 15 and 30 cm beginning in July 1992 and were brought to the laboratory for extraction of phylloxera using a wet sieve sucrose centrifuge. Populations extracted were then separated by life stage and counted. Root pieces were measured in 1992 and checked for nodosities and tuberosities.

At each site, soil temperatures were recorded at a depth of 30 cm and air canopy temperature near the infested area every 30 minutes using Omni Data DP 212 data pods. Data were transferred to a computer every 21 days.

Phylloxera hibemants began molting to adulthood in April/May 1992, when mean soil temperatures were between 16 to 21'C (at a soil depth of 15 to 30cm). Population levels increased slowly until June at

all three sites (Table 2). Peak populations occurred in August at the Yamhill County sites and in September at the Marion County site (Table 3; Fig. 1). Peak populations occurred about one month earlier than in 1991. At all sites, except Yamhill- 11, populations decreased after September (Fig. 1). Based on color, sluggish activity, and number of first instar nymphs, we believe hibernation began in early September when mean soil temperatures were between 21 and 24'C. Phylloxera adults and eggs were still present in November extractions, indicating that development of hibernation occurs over a protracted period (data not shown).

Phylloxera populations at the Yamhill-I site were lower than at the Yamhill-11 or Marion site (Tables 2 and 3; Fig. 1). The Yamhill-I site is characterized by its dry, heavily compacted soil. We believe that the summer drought provided little moisture for root growth in this compacted soil, which in turn decreased phylloxera population levels. The Marion county site continues to have show population levels that rise and fall rapidly. Whether this denotes some race difference has yet to be determined.

Rate of spread/winged forms

The rate of spread of phylloxera populations was determined by three methods: trunk wraps to monitor aboveground movement of nymphs, annual rating of aboveground vine symptoms in infested areas, and aerial photography.

Trunk wraps were used to detect crawler (nymph) movement up into the plant canopy. Tape covered with stick-em was wrapped around the base of the trunk. Six traps at each site were checked bi-weekly in June and July 1991, but no crawlers were found. Replicate number was increased to 15 per site from August through October 1991. Three crawlers were found in August 1991, indicating that aboveground movement was occurring. Fifteen trunk wraps were placed at each of the three infested sites in May/June 1992, but no crawlers were found on these in 1992.

Four winged phylloxera were found on trunk wrap in July at the Marion county site. A nyinph with wing pads was found in extractions made in September at this same site, denoting a protracted period in which the winged forms are active. The Marion county site has high population levels per gram of root. The polymorphic responses of aphid-like insects in creating winged forms is believed to come from a crowding effect.

Only trunk wraps will be used to monitor above-ground movement in 1993, because aerial sticky traps and ground emergence traps have proven ineffective.

The significance of finding winged forms in a commercial Oregon vineyard is difficult to ascertain at this stage of our research. If the winged form of phylloxera can only complete its life cycle on American or hybrid type grapes ("Concord", "Niagara", "Marechal Foch") then rate of spread, aerially, can only occur through American rootstock blocks or plantings of these American or hybrid types. Certainly if growers have a self-rooted European vineyard near these types of grapes, they may be at risk. If winged phylloxera can complete their life cycle on European vines, then the implications for a greatly increased rate of spread are obvious. Research is needed in this area.

Above-ground symptoms of phylloxera infestation were rated (0-5 scale) in fall 1990 at one infested site. Ratings from 1990 were compared to those taken in fall 1991 to gauge aboveground rate of spread of this pest. Mapping seemed to indicate a rate of spread of 1.5 to 2 fold; thus a one-eighth acre infestation would be one acre in size in three years. At the Yamhill-If site, 44 percent of the vines rated in August 1992 declined in vigor rating compared to 1991.

Infrared aerial photographs were taken of all infested sites in fall 1990, 1991, and 1992. Aerial photos taken in 1991 indicated a 2 fold rate of spread at some sites. However, in 1992, sites with large infestations are showing rate of spread at 4 fold or greater. Infrared aerial photos were loaded into a digital computer program that will assign a value to the vine color (vigor); this will provide us with a less subjective evaluation of rate of spread.

Two new infested sites (one in Lane and the other in Yamhill County) were confirmed in summer 1992.

Phylloxera populations have been collected from the three infested sites being studied. These populations are currently being reared in a growth chamber on excised root pieces. However, techniques to reduce population fatality still need to be worked out. Spring populations may be needed for this study.

We plan to place laboratory-reared phylloxera eggs on roots at 12, 15, 18, and 21' C. Developmental times and survival to adulthood will be deten-nined. From these data a minimal threshold and degree-days to adulthood will be estimated. These will be used to determine number of generations per year at sites at which soil temperature data is being collected. These predictions will be tested by direct counts in the field (see above). Data will also give us an idea of what temperatures will likely cause population die-back in winter.

We plan test the rootstock resistance to all biotypes found in Oregon. However, to date only biotype A has been found. There is some evidence of at least two strains of biotype A being present, however. At this time we do not know the significance of this. Rootstock selections have been propagated and are sufficiently old for greenhouse studies of phylloxera resistance.

Funding History

This project was supported by the Wine Advisory Board ($15,348) and the PNW Center for Small Fruits Research ($9,890) in 1992-93. We also received funding of $17,000 from the Center for Applied Agricultural Research in January 1992.

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Table 1. Temperatures For Three Vineyard Sites Infested with Phylloxera, 1992[z]

Site	Date	Mean Range Soil Temperature (15-30 cm)	Mean Soil Temperature	Mean Air Temperature (4 ft. in canopy)
Yamhill I	4/22-5/10	12.2-21.4	16.1	14.6
	5/14-6/1	19.1-24.0	21.2	16.4
	6/4-6/21	19.9-24.5	21.8	16.0
	6/24-7/5	21.1-27.2	23.7	22.6
	7/7-7/19	21.2-26.5	23.6	20.1
	7/22-8/2	22.2-26.5	24.5	19.7
	8/5-8/19	21.4-25.9	24.2	20.0
	8/21-8/30	21.9-24.0	20.7	19.0
Yamhill II	4/22-5/10	12.9-21.3	17.0	17.3
	5/15-6/1	18.9-23.9	21.2	17.0
	6/4-6/20	20.0-24.0	22.3	18.3
	7/7-7/19	21.7-27.6	24.3	*
	7/22-8/2	22.9-27.7	25.4	*
	8/5-8/18	21.7-26.6	25.1	*
	8/21-8/30	22.3-25.2	24.1	*
Marion**	7/7-7/19	18.7-23.3	19.2	17.8
	7/22-8/2	20.0-23.5	19.8	18.9
	8/26-8/31	20.9-21.8	21.4	19.0

[z]Temperatures taken every 30 minutes on a Datapod 212 and summarized for mean temperatures.

*Data errors on air temperature channel.

**Datapod replaced after early season failure.

Figure 1. Phylloxera Populations at Three Vineyard Sites in Oregon