CULTURAL CONTROL OF PHYLLOXERA IN EXISTING VINEYARDS BY ROOT SYSTEM CONVERSION

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Project Title: Cultural Control of Phylloxera in Existing Vineyards by Root System Conversion Methods

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Objectives and Timetable:

The objectives of this study were:

1. To determine the feasibility of selected methods of root system conversion in existing vineyards. A bench grafted treatment will be in included for purposes of comparison (interplanting between existing vines).
2. To determine the suitability of phylloxera-resistant rootstocks for root system conversion.
3. To determine the influence of root system conversion methods on growth, productivity and fruit composition of grapevines.
4. To develop a detailed cost analysis of selected root system conversion methods.

The time table of this study was:

February-March 1992	Establish new plots and regraft as needed in existing plots
February-March 1992	Collect data for economic analysis
April-August 1992	Monitor plots (% take and observation of practicality of methods)
May 1992	Collect petiole samples
June 1992	Petiole sample analysis
September-October 1992	Collection of yield and fruit composition data

November-December 1992	Data analysis and interpretation
January 1993	Collection of pruning weight data
January-February 1993	Continued data analysis and writing of AVF report

SUMMARY:

Root system conversion methods were evaluated in small research blocks at the White Hills Vineyard near Santa Maria, CA and the Meridian Vineyard near Paso Robles, CA during the 1992 season. Larger scale commercial blocks were evaluated at the previously mentioned vineyards as well as the Douglas Vineyard near Santa Ynez, CA, the Cat Canyon Vineyard near Los Alamos, CA, and the Sierra Madre Vineyard near Santa Maria, CA.

Varieties used in these experiments were Gewurztraminer (White Hills), Chardonnay (Cat Canyon, Douglas, Sierra Madre, and White Hills), Cabernet Sauvignon (Meridian), and Syrah (Meridian). Root system conversion treatments included inverted side grafting using cuttings, approach grafting using a rooting, interplanting between existing vines using a benchgraft, and an ungrafted control.

In certain experiments, the suitability of selected rootstocks for root system conversion was tested using inverted side grafting (cutting). Freedom, Harmony, Teleki 5C, Teleki 5A, Kober 5BB, and Couderc 1613 rootstocks were used in these experiments.

Grafting was done in February 1992 by Ken Coates, Coates Grafting, East Wenatchee, WA. Periodic inspections of the plots were made during the growing season. The extent of graft union formation was subjectively assessed during these inspections. Data on the cost of grafting and after-grafting care in commercial scale blocks were collected by Hampton Farming Company personnel.

Yield data for Gewurztraminer was collected when vines were harvested on September 9, 1992. Syrah vines were harvested and yield data collected on September 11, 1992. Harvest of Chardonnay vines occurred on September 25, 1992. Berry samples were collected at harvest and fruit composition determined. Percentage take was measured on December 2-4, 1992. Chardonnay and Gewurztraminer vines were pruned during February 1993.

Approach grafting produced the highest % take. The percentage take obtained for inverted side grafting using cuttings was extremely low as in 1991. This method of root system conversion is not recommended for further testing. Root system conversion method and rootstock had little effect on vine performance. Economic analysis of approach grafting indicated that it would cost approximately $5,210 / acre to achieve 100% conversion during a 5 year period with a 76% initial take. This is a conservative and high estimate. Factors influencing the estimated cost of root system conversion by approach grafting were vineyard density (830 vines/A), the initial % take, and the cost of grafting which was relatively high at $3.00/vine.

RESEARCH ACCOMPLISHMENTS:

Evaluation of root system conversion methods continued during the 1992 season. Approach grafting was more successful than inverted side grafting (Tables 1 and 10). Good quality rootstock wood is essential for successful approach grafting. Minimum diameter for canes on rootings used for approach grafting is 5/16". Canes should be this diameter at the graft union. When good rootstock wood is used, take should be in the range of 80-90%. Approach grafting at the Meridian Vineyard was a total failure because poor quality wood was used (Table 1). Most wood used in this plot had small diameter canes (3/16"). Conversely, better quality wood was used for approach grafting at the White Hills Vineyard and the % take was much higher. Almost all failures were due to use of poor quality wood rather than poor grafting technique or after-grafting care. Consequently, it is critical to work closely with the grapevine nurseries to insure that you have a supply of acceptable quality wood.

Selected vine performance data is given in Tables 2-5, 7-9, and 11-13. In general, root system conversion method or rootstock used for root system conversion did not have a consistent effect on vine performance.

Costs were monitored for each vineyard block that was grafted. Costs include labor and materials necessary for grafting and after-grafting care (repainting, suckering, etc.). These cost data were compiled by Neil Roberts, Hampton Farming Co. Using the information provided and the % take for each block, a cost projection was developed to determine the total cost and time for complete conversion using selected methods of root system conversion. An example showing approach grafting is given in Table 14.

Cost projections for a range of initial % take's are presented in Table 15. For root system conversion to be economically feasible, the most important factor appears to be a high initial % take. When initial % take is below 70%, costs and time required to achieve full conversion increase dramatically.

Table 1. Evaluation[z] of percentage take[y] in commercial scale blocks during 1992.

Vineyard location	Root System conversion method	Scion	Rootstock	Acres grafted	Take (%)
Cat Canyon	Inverted side graft	Chardonnay	Freedom	2.5	19
Douglas	Inverted side graft	Chardonnay	Freedom	0.35	32
Meridian	Inverted side graft	Cabernet Sauvignon	5c	2.0	24
Meridian	Approach graft	Cabernet Sauvignon	5c	1.5	7
Sierra Madre	Inverted side graft	Chardonnay	Freedom	5.0	11
White Hills	Inverted side graft	Chardonnay	Freedom	5.0	18
White Hills	Approach graft	Chardonnay	Freedom	2.5	76

[z] Graft unions were evaluated on 2-4 December 1992.

[y] Rated using the scale listed below:

Category	Description
1	No callus
2	Some callus
3	Good callus
4	Very good callus

Evaluation of Rootstocks and Root System Conversion Methods for a Syrah Vineyard

Table 2. Effect of root system conversion method on yield[z] of Syrah grapevines. 1992. Meridian Home Vineyard, Paso Robles, CA.

Treatment[y]	Yield (kg/vine)	Yield (t/ha)	Clusters /vine	Cluster Weight (g)	Berry Weight (g)	Berries/ Cluster
Control	5.1	9.2	63	82.1	1.3	65
Inverted Side Graft I	4.4	7.8	55	79.6	1.3	63
Interplanting	4.3	7.6	57	75.5	1.3	59
Approach Graft (5BB)	4.5	8.1	58	78.7	1.3	60
Inverted Side Graft II	4.7	8.4	61	77.2	1.2	65
	n.s.[x]	n.s.	n.s.	n.s.	n.s.	n.s.

[z] Harvested on September 11, 1992.

[y] Freedom rootstock used for all treatments except approach grafting.

[x] n.s.= Not significant at the 0.05 level.

Table 3. Effect of root system conversion method on fruit composition[z] of Syrah grapevines. 1992. Meridian Home Vineyard, Paso Robles, CA.

Treatment[y]	Soluble Solids (%)	pH	Titratable Acidity (g/100 ml)
Control	22.7ab[x]	3.41	0.52
Inverted Side Graft I	23.4a	3.38	0.52
Interplanting	24.0a	3.39	0.51
Approach Graft (5BB)	24.1a	3.44	0.55
Inverted Side Graft II	21.3b	3.40	0.54
		n.s.	n.s.

[z] Sampled on September 10, 1992.

[y] Freedom rootstock used for all treatments except approach grafting.

[x] Means followed by the same letter do not differ significantly at the 0.05 level; n.s.= Not significant. Mean separation by Duncan's Multiple Range test.

Table 4. Effect of rootstock on yield[z] of Syrah grapevines. 1992. Meridian Home Vineyard, Paso Robles, CA.

Treatment[y]	Yield (kg/vine)	Yield (t/ha)	Clusters /vine	Cluster Weight (g)	Berry Weight (g)	Berries/ Cluster
Control	3.6b[x]	6.5b	50bc	72.2	1.2	60
5C	3.7b	6.6b	52abc	70.5	1.2	57
5A I	3.2b	5.7b	44c	72.6	1.2	62
5BB	4.7a	8.5a	63a	74.5	1.2	60
Harmony	3.4b	6.1b	46bc	72.2	1.2	60
1613	4.2ab	7.5ab	58ab	72.1	1.3	57
5A II	3.3b	5.9b	44c	75.9	1.2	61
				n.s.	n.s.	n.s.

[z] Harvested on September 11, 1992.

[y] Root system conversion method used was inverted side graft (cuttings) except for 5BB which was approach grafting (rooting).

[x] Means followed by the same letter do not differ significantly at the 0.05 level; n.s.= Not significant. Mean separation by Duncan's Multiple Range test.

Table 5. Effect of rootstock on fruit composition[z] of Syrah grapevines. 1992. Meridian Home Vineyard, Paso Robles, CA.

Treatment[y]	Soluble Solids (%)	pH	Titratable Acidity (g/100 ml)
Control	24.0a[x]	3.45	0.50
5C	23.2ab	3.45	0.50
5A I	24.2a	3.50	0.47
5BB	23.3ab	3.40	0.55
Harmony	24.1a	3.48	0.47
1613	22.3b	3.44	0.51
5A II	23.4ab	3.45	0.51
		n.s.	n.s.

[z] Sampled on September 10, 1992.

[y] Root system conversion method used was inverted side graft (cuttings) except for 5BB which was approach grafting (rooting).

[x] Means followed by the same letter do not differ significantly at the 0.05 level; n.s.= Not significant. Mean separation by Duncan's Multiple Range test.

Evaluation of Rootstocks for Root System Conversion in a Chardonnay Vineyard

Table 6. Influence of rootstock on % take in 1992[w]. Chardonnay. White Hills Vineyard, Santa Maria, CA.

Treatment	Presence of roots on cuttings (%)	Successful[x] graft union formation (%)	Rootstock stem[y] caliper (mm)	Successful[z] conversion (%)
Control (own rooted)	---	---	---	---
Teleki 5A I	93	15	9.16	28
Freedom	79	14	9.19	27
Harmony	92	27	10.24	61
Teleki 5C	89	15	10.07	29
Teleki 5A II	92	15	7.50	42
Teleki 5BB	88	12	9.31	28
1613	88	3	10.90	49

w Root system conversion method used in this experiment was inverted side graft.

x Categories 3 and 4 were considered to have successful graft union formation. Rated using a scale of 1-4 on December 3, 1992.

Category	Description
1	No callus
2	Some callus
3	Good callus
4	Very good callus

y Vines with successful graft union formation only.

z % conversion = 1991 and 1992 grafts.

Table 7. Effect of rootstock on yield[z] of Chardonnay grapevines. 1992. White Hills Vineyard, Santa Maria, CA.

Treatment[y]	Yield (kg/vine)	Yield (t/ha)	Clusters /vine	Cluster Weight (g)	Berry Weight (g)	Berries/ cluster
Control	3.0	6.0	33	90.7	27.2	57
Teleki 5C	3.3	6.7	32	104.3	27.2	61
Freedom	3.4	7.0	33	104.3	27.2	59
1613	3.2	6.7	33	99.8	27.2	59
Teleki 5A I	3.1	6.2	32	95.2	27.2	56
Harmony	3.6	7.4	35	104.3	27.2	60
Teleki 5AII	3.3	6.9	33	99.8	27.2	60
Teleki 5BB	3.3	6.7	32	104.3	27.2	61
	n.s.[x]	n.s.	n.s.	n.s.	n.s.	n.s.

[z] Harvested on September 25, 1992.

[y] Root system conversion method used was inverted side graft (cuttings).

[x] Means followed by the same letter do not differ significantly at the 0.05 level; n.s. = Not significant. Mean separation by Duncan's Multiple Range test.

Table 8. Effect of rootstocks on fruit composition[z] of Chardonnay grapevines. 1992. White Hills Vineyard, Santa Maria, CA.

Treatment[y]	Soluble Solids (%)	pH	Titratable Acidity (g/100ml)
Control	23.3 a[x]	3.31	0.85 b
Teleki 5C	22.5 bc	3.30	0.91 a
Freedom	22.1 c	3.28	0.91 a
1613	22.9 ab	3.28	0.92 a
Teleki 5A I	22.5 bc	3.30	0.91 a
Harmony	22.7 b	3.29	0.92 a
Teleki 5A II	22.6 bc	3.29	0.90 a
Teleki 5BB	22.8 ab	3.30	0.90 a
		n.s.	

[z] Sampled on September 24, 1992.

[y] Root system conversion method used was inverted side graft (cuttings).

[x] Means followed by the same letter do not differ significantly at the 0.05 level; n.s. = Not significant. Mean separation by Duncan's Multiple Range test.

Evaluation of Root System Conversion Methods for Gewurztraminer Grapevines

Table 10. Influence of root system conversion methods on the % take in 1992. Gewurztraminer White Hills Vineyard. Santa Maria, CA.

Treatment[x]	Presence of roots on cuttings (%)	Successful graft union formation[z] (%)	Successful conversion[y] (%)
Control (own rooted)	---	---	---
Inverted side graft (cutting)	82%	17%	28%
Approach graft	0	69%	74%

x Freedom rootstock used in this experiment.

y % conversion = 1991 and 1992 grafts

z Categories 3 and 4 were considered to have successful graft union formation. Rated using a scale of 1-4 on december 3, 1992.

Category	Description
1	No callus
2	Some callus
3	Good callus
4	Very good callus

Table 11. Effect of root system conversion method on yield[z] of Gewurztraminer grapevines. 1992. White Hills Vineyard, Santa Maria, CA.

Treatment[y]	Yield (kg/vine)	Yield (t/ha)	Clusters/ vine	Cluster Weight (g)	Berry Weight (g)	Berries/ cluster
Control	10.6	21.7	134	77.1	1.4	51
Inverted Side Graft	10.7	22.0	140	77.1	1.4	49
Approach Graft	11.9	24.4	150	77.1	1.4	51
	n.s.[x]	n.s.	n.s.	n.s.	n.s.	n.s.

[z] Harvested on September 9, 1992.

[y] All rootstocks were Freedom.

[x] n.s. = Not significant at the 0.05 level.

Table 12. Effect of root system conversion method on fruit composition[z] of Gewurztraminer grapevines. 1992. White Hills Vineyard, Santa Maria, CA.

Treatment[y]	Soluble Solids (%)	pH	Titratable Acidity (g/100ml)
Control	22.1	3.23	0.72
Inverted Side Graft	21.6	3.20	0.72
Approach Graft	21.6	3.19	0.75
	n.s.[x]	n.s.	n.s.

[z] Sampled at harvest on September 9, 1992.

[y] All rootstocks used were Freedom.

[x] n.s.= Not significant at the 0.05 level.

Table 13. Effect of root system conversion methods on pruning weight of Gewurztraminer grapevines. 1992. White Hills Vineyard. Santa Maria, CA.

Treatment[y]	Pruning weight (kg/vine)	Nodes retained
Control	0.7	122
Inverted side graft	0.8	122
Approach graft	0.8	119
	n.s.[z]	n.s.

[y] Freedom rootstock used in this experiment.

[z] n.s. = Not significant at the 0.05 level.

Table 14. Estimated cost of root system conversion - Approach Graft.

White Hills Vineyard (Chardonnay, Freedom Rooting, Approach Graft - 2.5 acre block)

Initial Take - 76%

	Year 1	Year 2	Year 3	Year 4	Year 5
Grafting costs	3,645	901	229	60	16
After grafting care costs	270	67	17	4	1
Total costs/A	3915	968	246	64	17

TOTAL COST - 100% CONVERSION AFTER 5 YEARS (PER ACRE) $5,210

Table 15. Effect of initial percentage take on root system conversion costs - Approach graft using rootings.

Time and cost calculations for full conversion under different take %'s.

Assumptions:

Rootings - $1.35 ea	830 vines/acre (5.25x10 spacing)
Grafting - $3.00/vine	Uses 3% as inflation factor
Supplies - $0.03/vine	1 rooting/vine
After grafting care - $305/acre	

70 % Take

	Year 1	Year 2	Year 3	Year 4
Grafting costs	3,645	1,126	358	117
After grafting care costs	305	94	30	10
Total costs per acre	3,950	1,221	388	127

TOTAL COST - 100% CONVERSION AFTER 4 YEARS (PER ACRE) $5,686

80 % Take

	Year 1	Year 2	Year 3
Grafting costs	3,645	751	159
After grafting care costs	305	63	13
Total costs per acre	3,950	814	173

TOTAL COST - 100% CONVERSION AFTER 3 YEARS (PER ACRE) $4,936

90 % Take

	Year 1	Year 2
Grafting costs	3,645	375
After grafting care costs	305	31
Total costs per acre	3,950	407

TOTAL COST - 99% CONVERSION AFTER 2 YEARS (PER ACRE) $4,357

Outside Presentations of Research:

Oral Presentations:

1. Striegler, R.K. Review of Root System Conversion Research. Sonoma County Grape Growers Association Rootstock Conversion Seminar. Santa Rosa, CA. April 14, 1993.

2. Striegler, R.K. Rootstock Conversion Update. Wine Grape Day. Sacramento, CA. February 27, 1993.

3. Striegler, R.K. Viticultural Research Involving Disease and Pest Control. WRCC-24 Meeting. Santa Rosa, CA. September 13, 1992.

4. Striegler, R.K. and D.R. Wineman. Root System Conversion Research. Monterey County Grape Growers Association Meeting. Soledad, CA. July 21, 1992.

5. Striegler, R.K. Introduction of Rootstock Conversion. Sonoma County Grape Growers Association and Santa Rosa Junior College Viticulture Program Seminar. Santa Rosa, CA. July 15, 1992.

Grafting Demonstrations:

1. April 16-17, 1993. Santa Rosa Junior College Farm Vineyard. Santa Rosa, CA. Field demonstration portion of Rootstock Conversion Seminar.