American Vineyard Foundation
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Final Report
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Project Title: **Evaluation of Winegrape Clones**

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Objective of the Proposal:

1. To evaluate 20 Pinot noir and 13 Chardonnay clones (Table 1) for their viticultural and enological attributes in production of base wines for sparkling wine production.

2. To evaluate five Merlot (Table 2) and three Malbec clones (Table 6) for their viticultural and enological attributes for production of red wine.

Experiments Underway or Completed to Accomplish Objective(s):

1. Separate replicated plots of Pinot noir and Chardonnay clones have been established at Gloria Ferrer in Sonoma.

2. Separate replicated plots of Merlot and Malbec are underway at the Department's Oakville Experimental Vineyard.

Significant Results and Accomplishments to Date:

Pinot noir and Chardonnay

Table 1. **Clones of Pinot noir and Chardonnay clones used in this trial:**

Pinot noir clones or selections	Chardonnay clones or selections
Standards	**Standards**
UCD 2A	UCD 4 (Olmo 66)
UCD 4	Wente (formerly UCD 2A)
UCD 13	Esp 352
UCD 17	CTPS 75 Dijon
UCD 22	CTPS 76 Dijon
UCD 31	CTPS 78 Dijon
UCD 32	CTPS 96 Dijon
UCD 33	
	New Champagne Clones
New Champagne Clones	CTPS 118
CTPS 389	CTPS 121
CTPS 521	CTPS 124
CTPS 665	CTPS 130
CTPS 666	CTPS 131
CTPS 668	CTPS 132
CTPS 743	
CTPS 779	
CTPS 780	
CTPS 870	
CTPS 871	
CTPS 872	
CTPS 927	

Chardonnay Clones

All clones were harvested on a Brix basis with consideration of acid levels. The mean harvest Brix was 21.6 in 2000 and did not vary by more than 0.6 °Brix from the mean with the exception of the Wente clone that was harvested 1.2 °Brix above the mean. This compares with the three-year average that shows a mean harvest Brix of 20.8 and no clone being more than 0.3 °Brix from the mean with the exception again being the Wente clone that was 0.7 °Brix above the mean. While this data suggests that overall we were successful in harvesting the clones at a similar sugar level it also suggests that we have a sampling problem with the Wente clone. The Wente clone has both very large and very small berries, “hens and chickens”. We speculate that our sampling did not do a good job of collecting the proper ratio of these different berry sizes.

Clones were whole-cluster pressed by Gloria Ferrer, according to their pressing protocol. Juice was settled overnight, racked into 60 L stainless steel containers, shipped to Davis and divided into three replicate lots for fermentation. The triplicate fermentations will be bench tasted and those found to have defects discarded. The remaining lots will be combined and bottled for industry tasting.

Data from the Chardonnay trial are presented as 2000 data (Tables 2a-b) as well as 1998-00 three-year averages (Tables 3c-d). In 2000 all clones were harvested within 5 days with the exception of clone 4 that was harvested 13 days after the first clone. Similar data is seen in the three-year data. The three-year data show all clones harvested within 4 days except clone 4 that was harvested 9 days after the first clone.

Yield in 2000 (Table 2a) was consistent with the three-year averages (Table 3c). Clone 4 and the Wente clone had the highest and lowest yields respectively. The Wente clone has had the lowest yield in each year of the trial (Fig. 2). In both 2000 and the three-year data the only significant difference was between the Wente clone and all the others. The yield range was approximately 2x for the three-year data and in 2000. In 2000 clone 4 had a yield of 8.2 kg $vine^{-1}$ and the Wente clone yield was 4.0 kg $vine^{-1}$. Differences in yield were driven by cluster weight through both berries per cluster and berry weight. Clone 4 had heavier clusters due to significantly more berries per cluster. The Wente clone had both the fewest berries per cluster and the lightest clusters.

For the majority of clones harvest date was correlated to vine yield (Fig. 1). Two notable exceptions stand out. While clone 4 has the largest crop and latest harvest date, the harvest date appears to be delayed more than the yield would warrant when compared to the other clones. In 2000 clone 96 had a yield only 0.1 kg $vine^{-1}$ less than clone 4 and yet was harvested 11 days earlier. Likewise the Wente clone with the lowest yield also has a much later harvest date than we would predict. These observations hold for both the 2000 and three-year data.

Pruning weight data are not yet taken for the 2000 season. The 1998-99 data (Table 3a) show a tight clustering of shoot number with only 3 shoots $vine^{-1}$ (22 to 25) difference between the high and the low. Pruning weight was greatest for the low yielding Wente clone at 2.08 kg $vine^{-1}$. Other than this observation pruning weight did not seem to be related to yield with an r^2 of only 0.13.

Figure 1. Relationship of crop load to harvest date.

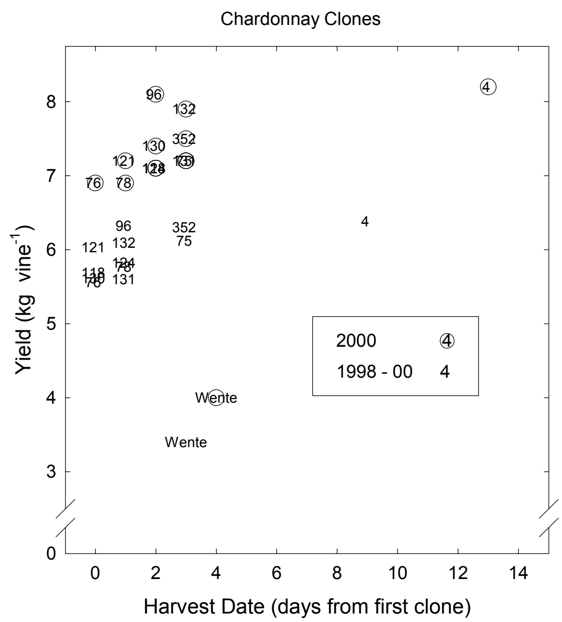


Figure 2. Yield of Chardonnay clones over time.

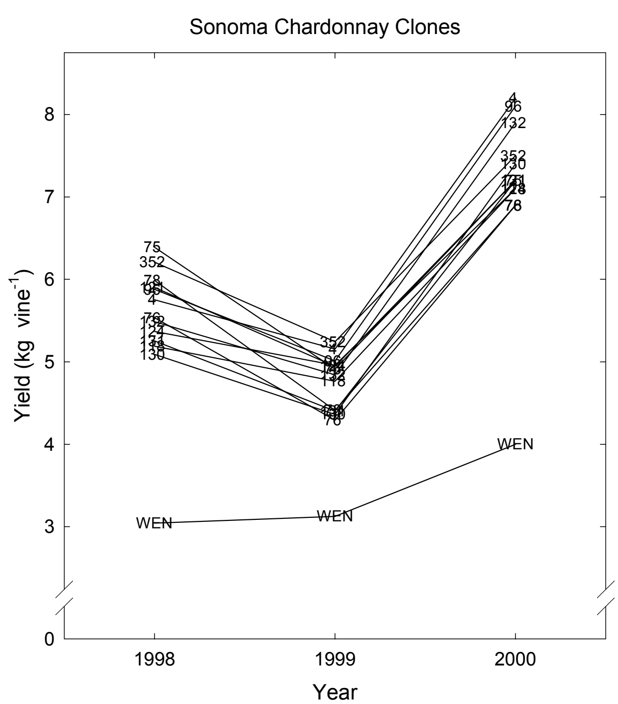


Table 2a. Sonoma County - Gloria Ferrer Chardonnay - (2000)

Chardonnay Clone	Yield (kg · vine^{-1})	Pruning Weight (kg · vine^{-1})	Shoots per Vine	Yield: Pruning Weight
4	8.2 a			
75	7.2 a			
76	6.9 a			
78	6.9 a			
96	8.1 a			
118	7.1 a			
121	7.2 a			
124	7.1 a			
130	7.4 a			
131	7.2 a			
132	7.9 a			
352	7.5 a			
Wente	4.0 b			
Signific. Level	***			

Chardonnay Clone	Clusters per Vine	Cluster Weight (g)	Berries per Cluster	Berry Weight (g)
4	47 b	174 a	na	na
75	53 ab	136 c	97 ab	1.40 d
76	51 ab	135 c	98 b	1.52 abcd
78	54 ab	127 c	88 b	1.44 bcd
96	49 ab	165 ab	107 a	1.54 ab
118	50 ab	142 c	91 b	1.56 ab
121	50 ab	145 bc	93 b	1.56 a
124	53 ab	133 c	93 ab	1.43 cd
130	53 ab	139 c	92 b	1.50 abcd
131	51 ab	140 c	89 b	1.57 a
132	54 ab	147 bc	98 ab	1.50 abcd
352	54 ab	140 c	90 b	1.56 a
Wente	55 a	74 d	67 c	1.10 e
Signific. Level	**	***	***	***

Table 2b. Sonoma County - Gloria Ferrer Chardonnay - (2000)

Chardonnay Clone	Shoot Weight (g)	Clusters per Shoot
4		
75		
76		
78		
96		
118		
121		
124		
130		
131		
132		
352		
Wente		
Signific. Level		

Chardonnay Clone	Harvest Date (days after earliest clone)	°Brix at Harvest Date	TA ($g \cdot l^{-1}$)	pH
4	13	21.5 bc	11.5 a	3.17 e
75	3	21.6 bc	10.7 abc	3.20 de
76	0	21.0 c	10.8 ab	3.23 cde
78	1	21.3 bc	10.6 abcd	3.24 bcd
96	2	21.2 bc	10.6 abcd	3.28 abc
118	2	21.5 bc	9.9 bcd	3.25 abcd
121	1	21.3 bc	10.2 bcd	3.25 abcd
124	2	21.8 bc	10.1 bcd	3.27 abc
130	2	21.7 bc	9.7 cd	3.30 a
131	3	22.1 ab	10.0 bcd	3.30 a
132	3	21.9 abc	9.7 d	3.30 ab
352	3	21.5 bc	10.6 abcd	3.25 abcd
Wente	4	22.8 a	11.4 a	3.30 a
Signific. Level		***	***	***

Missing measurements have not been collected for 2000.
*, **, *** , ns represent p≤ 0.05, p≤ 0.01, p≤ 0.001, not significant, respectively.
Mean separation with Tukey's Studentized Range Test..

Table 3a. Sonoma County- Gloria Ferrer Chardonnay - (1998-2000)

Chardonnay Clone	Yield (kg · vine^{-1})	*Pruning Weight (kg · vine^{-1})*	*Shoots per Vine*	*Yield: Pruning Weight*
4	6.38 a	*1.73 abcd*	*22 b*	*3.19 abc*
75	6.12 a	*1.59 cd*	*23 ab*	*3.53 a*
76	5.56 a	*2.01 abc*	*24 ab*	*2.50 c*
78	5.77 a	*2.10 a*	*25 a*	*2.48 c*
96	6.32 a	*2.04 ab*	*24 ab*	*2.70 bc*
118	5.69 a	*1.49 d*	*23 ab*	*3.53 a*
121	6.03 a	*1.73 abcd*	*24 ab*	*3.16 abc*
124	5.82 a	*1.62 bcd*	*24 ab*	*3.29 ab*
130	5.61 a	*1.59 cd*	*23 ab*	*3.06 abc*
131	5.60 a	*1.67 bcd*	*24 ab*	*2.95 abc*
132	6.09 a	*1.62 bcd*	*23 ab*	*3.29 ab*
352	6.30 a	*1.79 abcd*	*23 ab*	*3.26 abc*
Wente	3.40 b	*2.08 a*	*23 ab*	*1.58 d*
Signific. Level	***	***	*	***

Chardonnay Clone	Clusters per Vine	Cluster Weight (g)	Berries per Cluster	Berry Weight (g)
4	38 d	168 a	116 a	1.43 abcd
75	44 abc	138 cd	102 bc	1.35 d
76	43 abc	128 cd	90 de	1.42 bcd
78	46 ab	125 d	91 d	1.37 d
96	41 cd	153 ab	106 b	1.46 abc
118	42 bc	133 cd	91 de	1.47 abc
121	43 bc	140 bc	95 cd	1.48 ab
124	44 abc	131 cd	95 cd	1.39 de
130	43 abc	129 cd	89 de	1.45 abc
131	42 bc	132 cd	89 de	1.50 a
132	44 abc	138 cd	95 cd	1.47 abc
352	47 a	134 cd	93 cd	1.46 abc
Wente	45 abc	76 e	81 e	0.96 e
Signific. Level	***	***	***	***

Table 3b. Sonoma County- Gloria Ferrer Chardonnay - (1998-2000)

Chardonnay Clone	*Shoot Weight* *(g)*	*Clusters per Shoot*
4	*79 ab*	*1.51 b*
75	*70 ab*	*1.71 ab*
76	*86 ab*	*1.67 ab*
78	*86 ab*	*1.71 ab*
96	*84 ab*	*1.52 b*
118	*65 b*	*1.70 ab*
121	*74 ab*	*1.68 ab*
124	*69 ab*	*1.71 ab*
130	*71 ab*	*1.69 ab*
131	*71 ab*	*1.61 ab*
132	*71 ab*	*1.68 ab*
352	*78 ab*	*1.86 a*
Wente	*90 a*	*1.71 ab*
Signific. Level	***	***

Chardonnay Clone	Harvest Date (days after earliest clone)	°Brix at Harvest Date	pH	TA $(g \cdot l^{-1})$
4	10	20.9 b	3.10 d	12.5 a
75	4	20.9 b	3.09 d	11.1 bc
76	1	20.6 b	3.13 bcd	11.1 bc
78	2	20.9 b	3.12 cd	11.1 bc
96	2	20.5 b	3.16 abc	11.0 cd
118	1	20.5 b	3.13 abcd	9.9 e
121	1	20.5 b	3.17 ab	10.6 cde
124	2	21.0 ab	3.16 abc	10.8 cde
130	1	20.8 b	3.17 ab	10.5 cde
131	2	21.0 ab	3.18 a	10.5 cde
132	2	20.9 b	3.14 abcd	10.0 de
352	4	20.6 b	3.12 cd	10.9 cde
Wente	4	21.5 a	3.16 abc	12.1 ab
Signific. Level		***	***	***

Italicized measurements have not been collected for 2000.
*, **, ***, ns represent $p \leq 0.05$, $p \leq 0.01$, $p \leq 0.001$ and not significant, respectively.
Mean separation with Tukey's Studentized Range Test

Pinot noir

Data for Pinot noir are presented for the 2000 (Table 4a-d) season and the two-year average data from 1999–00 (Table 5a-d). As with the Chardonnay clones harvest was determined on a Brix basis with consideration of acid levels. Harvest was completed over a 21-day period in 2000 and the two-year data shows a 19-day span. In both data sets clone 4 was the first harvested and clone 780 was the last. Mean harvest °Brix for 2000 was 19.9 and the range was from high to low was 2.3 °Brix. Harvest was a frustrating experience as shown by the range of sugar levels at harvest. Half the clones were harvested more than 0.5 °Brix from the mean. The range of sugar levels is far from our goal and we will make every effort to correct this in the coming year.

Wines were made from the Pinot noir fruit using the procedure described for the Chardonnay clones.

While the data for 1999- 00 is presented most of the discussion will be confined to the 2000 data. Two-year data can be skewed by a data anomaly in one year and conclusions we make from it can be faulty.

Date of harvest was largely determined by crop load (Fig. 3). It is however, difficult to draw any conclusions here due to the range of °Brix that at which they were harvested. Yield ranged from 5.7 (clone 870) to 9.4 (clone 666) kg $vine^{-1}$ in 2000. We saw significant differences in berries per cluster and berry weight. This combination of these parameters created differences in cluster weight. Of note is clone 743 that had 17% more berries than the closest other clone resulting in 16% heavier clusters. It must also be noted that clone 743 also had the fewest clusters per vine. While no one yield parameter (Fig. 4) can be shown to be the driving force of yield differences we take note of differences in cluster number. Cluster number ranged from 43 (clone 743) to 68 (clone 927). The source of these differences, whether shoots per vine or clusters per shoot, will have to await shoot counting at pruning. Every attempt was made to balance these vines at an equal number of buds and to thin shoots. We will count shoots at pruning time and see if the difference in cluster number was due to the number of shoots or clusters per shoot. Data taken in 1999, reported in the multi-year table, shows a difference of only 4 shoots per vine between the high and low. This data also shows a range of from 1.2 to 2.1 clusters per shoot. It would therefore, appear that cluster number may largely be a function of clusters per shoot in this trial. We look forward to more years of data to help sort out the yield parameters in this trial.

Table 4a. Sonoma County - Gloria Ferrer Pinot Noir - (2000)

Pinot Noir Clone	Yield (kg · vine^{-1})	Pruning Weight (kg · vine^{-1})	Shoots per Vine	Yield: Pruning Weight
2A	7.90 abcd			
4	5.79 cd			
13	5.99 cd			
17	7.91 abcd			
22	6.14 cd			
31	6.75 bcd			
32	8.35 abc			
33	9.20 ab			
389	8.26 abcd			
521	7.43 abcd			
665	7.51 abcd			
666	9.41 a			
668	7.12 abcd			
743	7.15 abcd			
779	8.91 ab			
780	6.70 bcd			
870	5.68 d			
871	8.37 abc			
872	6.61 bcd			
927	6.78 bcd			
Signific. Level	***			

Table 4b. Sonoma County - Gloria Ferrer Pinot Noir - (2000)

Pinot Noir Clone	Clusters per Vine	Cluster Weight (g)	Berries per Cluster	Berry Weight (g)
2A	63 abcd	124 bcdef	95 bcd	1.32 bcde
4	60 abcde	95 f	79 d	1.21 e
13	55 cde	108 cdef	85 bcd	1.26 cde
17	57 abcde	138 abc	90 bcd	1.53 a
22	53 def	117 bcdef	83 bcd	1.41 abcd
31	51 ef	131 bcde	96 bcd	1.35 abcde
32	59 abcde	141 ab	96 bcd	1.47 ab
33	67 ab	137 abc	100 abc	1.36 abcde
389	66 abc	125 bcde	91 bcd	1.36 abcde
521	60 abcde	123 bcdef	89 bcd	1.39 abcde
665	57 abcde	131 bcde	97 bcd	1.36 abcde
666	66 abc	142 ab	101 ab	1.41 abcd
668	54 def	132 bcde	97 bcd	1.35 abcde
743	43 f	166 a	120 a	1.39 abcde
779	62 abcde	143 ab	102 ab	1.40 abcd
780	56 Bcde	120 bcdef	94 bcd	1.28 cde
870	55 de	103 def	79 d	1.31 bcde
871	63 abcd	133 abcd	93 bcd	1.42 bac
872	51 ef	129 bcde	101 ab	1.28 cde
927	68 a	99 ef	80 cd	1.24 de
Signific. Level	***	***	***	***

Table 4c. Sonoma County - Gloria Ferrer Pinot Noir - (2000)

Pinot Noir Clone	Shoot Weight (g)	Clusters per Shoot
2A		
4		
13		
17		
22		
31		
32		
33		
389		
521		
665		
666		
668		
743		
779		
780		
870		
871		
872		
927		
Signific. Level		

Table 4d. Sonoma County - Gloria Ferrer Pinot Noir - (2000)

Pinot Noir Clone	Harvest Date (days after first clone)	°Brix at Harvest Date	pH	TA ($g \cdot l^{-1}$)
2A	11	19.1 e	3.25 ab	9.3 ab
4	0	19.5 cde	3.22 ab	9.6 ab
13	5	19.6 bcde	3.28 ab	9.7 ab
17	19	21.2 ab	3.25 ab	9.5 ab
22	9	20.2 abcde	3.26 ab	9.6 ab
31	11	19.9 abcde	3.30 b	8.9 ab
32	10	19.3 cde	3.28 b	9.1 ab
33	11	19.3 de	3.31 ab	8.4 b
389	18	20.3 abcde	3.22 b	8.6 b
521	9	19.6 bcde	3.27 ab	9.3 ab
665	10	19.2 de	3.21 ab	8.5 b

666	18	20.6	abcde	3.21	9 . 7	a b	9.4	ab
668	11	19.5	bcde	3.23	8 9	a b	8.9	ab
743	11	19.4	cde	3.30	9 . 0	a b	9.7	ab
779	20	21.0	abc	3.28	9 8	a b	8.9	ab
780	20	20.8	abcd	3.28	9 . 3	a b	9.0	ab
870	4	19.2	de	3.26	9 . 3	a b	9.8	ab
871	19	20.0	abcde	3.25	1 0 . 0	a	9.3	ab
872	17	21.4	a	3.30	a		9.3	ab
927	4	19.8	bcde	3.20	a		10.0	a
Signific. Level		***		ns				

Missing measurements have not been collected for 2000.
*, **, ***, ns represent p≤ 0.05, p≤ 0.01, p≤ 0.001and not significant, respectively.
Mean separation with Tukey's Studentized Range Test

Table 5a. Sonoma County - Gloria Ferrer Pinot Noir - (1999-2000)

Pinot Noir Clone	Yield (kg · vine^{-1})		*Pruning Weight (kg · vine^{-1})*		*Shoots per Vine*		*Yield: Pruning Weight*	
2A	7.43	abcd	*0.88*	*abcd*	*26*	*ab*	*8.0*	*abcd*
4	5.15	ef	*0.99*	*abcd*	*28*	*a*	*5.0*	*def*
13	4.91	f	*1.35*	*abcd*	*27*	*ab*	*3.0*	*f*
17	6.81	abcdef	*1.14*	*abcd*	*24*	*ab*	*5.7*	*bcdef*
22	5.58	def	*1.21*	*abcd*	*27*	*a*	*4.3*	*def*
31	7.20	abcd	*0.77*	*bcd*	*26*	*ab*	*10.7*	*a*
32	7.47	abcd	*1.42*	*ab*	*27*	*ab*	*5.3*	*cdef*

33	8.10 ab	*1.04 abcd*	*26 ab*	*7.9 abcde*
389	7.80 abc	*0.96 abcd*	*25 ab*	*8.2 abcd*
521	6.39 bcdef	*1.52 a*	*26 ab*	*4.1 def*
665	7.26 abcd	*0.70 d*	*23 b*	*11.4 a*
666	8.52 a	*1.15 abcd*	*26 ab*	*7.2 abcdef*
668	7.65 abc	*0.90 abcd*	*26 ab*	*9.6 abc*
743	6.97 abcde	*1.10 abcd*	*25 ab*	*6.2 bcdef*
779	7.92 abc	*1.13 abcd*	*24 ab*	*6.3 bcdef*
780	6.81 abcdef	*0.75 cd*	*25 ab*	*10.1 ab*
870	5.20 ef	*1.37 abc*	*26 ab*	*3.8 ef*
871	7.55 abc	*0.88 abcd*	*24 ab*	*8.3 abcd*
872	6.16 cdef	*1.10 abcd*	*24 ab*	*5.8 bcdef*
927	6.15 cdef	*1.04 abcd*	*24 ab*	*6.0 bcdef*
Signific. Level	***	***	***	***

Table 5b. Sonoma County - Gloria Ferrer Pinot Noir - (1999-2000)

Pinot Noir Clone	Clusters per Vine	Cluster Weight (g)	Berries per Cluster	Berry Weight (g)
2A	59 a	127 bcdef	98 cde	1.29 de
4	52 abcd	100 g	77 g	1.31 cde
13	44 def	112 efg	79 fg	1.42 abcd
17	49 bcde	140 bc	93 cdefg	1.52 a
22	43 def	134 bcdef	93 cdefg	1.43 abc

31	48 bcde	149 bc	102 bcd	1.45 ab
32	53 abc	142 bc	99 bcde	1.45 ab
33	56 ab	146 bc	104 bcd	1.40 abcd
389	57 a	139 bcd	96 cdef	1.45 ab
521	51 abcd	124 cdefg	88 defg	1.42 abc
665	51 abcde	145 bc	101 bcd	1.44 ab
666	59 a	145 bc	102 bcd	1.42 abc
668	53 abc	144 bc	100 bcd	1.43 abc
743	37 f	191 a	132 a	1.44 ab
779	53 abc	151 b	108 bc	1.40 abcd
780	51 abcd	134 bcde	97 cdef	1.38 bcde
870	46 cde	115 defg	81 efg	1.41 abcd
871	54 abc	141 bc	99 bcde	1.42 abc
872	43 ef	148 bc	116 ab	1.27 e
927	58 a	108 fg	80 gf	1.35 bcde
Signific. Level	***	***	***	***

Table 5c. Sonoma County - Gloria Ferrer Pinot Noir - (1999-2000)

Pinot Noir Clone	*Shoot Weight* *(g)*	*Clusters per Shoot*
2A	*34 bc*	*2.1 a*
4	*35 bc*	*1.5 cde*

13		*50 abc*	*1.2 e*
17		*47 abc*	*1.7 bcd*
22		*44 abc*	*1.3 e*
31		*30 c*	*1.8 abc*
32		*53 ab*	*1.7 bcd*
33		*40 abc*	*1.8 abc*
389		*39 abc*	*1.9 ab*
521		*59 a*	*1.7 bcd*
665		*30 bc*	*1.9 ab*
666		*45 abc*	*2.0 ab*
668		*34 bc*	*2.0 ab*
743		*45 abc*	*1.3 e*
779		*47 abc*	*1.8 abc*
780		*30 c*	*1.9 abc*
870		*52 abc*	*1.4 de*
871		*36 bc*	*1.9 abc*
872		*46 abc*	*1.4 de*
927		*44 abc*	*2.0 ab*
Signific. Level		***	***

Table 5d. Sonoma County - Gloria Ferrer Pinot Noir - (1999-2000)

Pinot Noir Clone	Harvest Date (days after earliest clone)	°Brix at Harvest Date	pH	TA (g · l^{-1})
2A	12.0	19.7 c	3.19 abc	10.6 abcd
4	0.0	19.8 bc	3.19 abc	10.9 abc
13	4.0	19.9 bc	3.18 abc	11.1 abc
17	15.0	20.5 abc	3.17 abc	11.4 a
22	6.5	20.4 abc	3.17 abc	10.2 abcd
31	13.5	20.1 abc	3.24 a	10.1 bcd
32	9.0	19.6 c	3.18 abc	10.7 abcd
33	9.5	20.0 abc	3.22 ab	9.6 d
389	17.0	20.1 abc	3.20 abc	10.6 abcd
521	6.0	19.6 c	3.19 abc	10.1 bcd
665	9.0	19.7 c	3.16 abc	10.1 bcd
666	17.5	20.2 abc	3.14 bc	10.0 bcd
668	14.0	19.9 bc	3.16 abc	10.7 abcd
743	12.5	19.9 bc	3.19 abc	11.1 ab
779	16.5	20.5 abc	3.18 abc	9.8 cd
780	18.5	20.0 abc	3.22 ab	10.8 abc
870	3.5	19.9 bc	3.19 abc	10.5 abcd
871	17.5	20.8 ab	3.19 abc	10.9 abc
872	17.0	21.0 a	3.17 abc	11.1 ab
927	2.0	20.1 abc	3.13 c	11.1 ab
Signific. Level		***	***	***

Italicized measurements have not been collected for 2000.
*, **, ***, ns indicate $p \leq 0.05$, $p \leq 0.01$, $p \leq 0.001$ and not significant, respectively.
Mean separation with Tukey's Studentized Range Test.

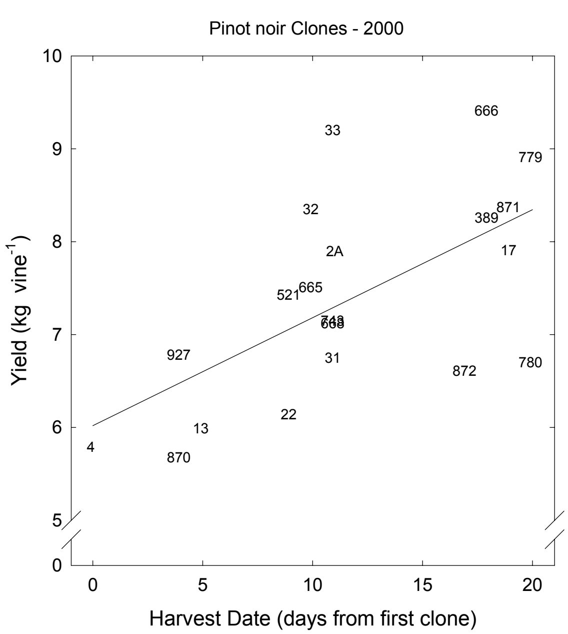
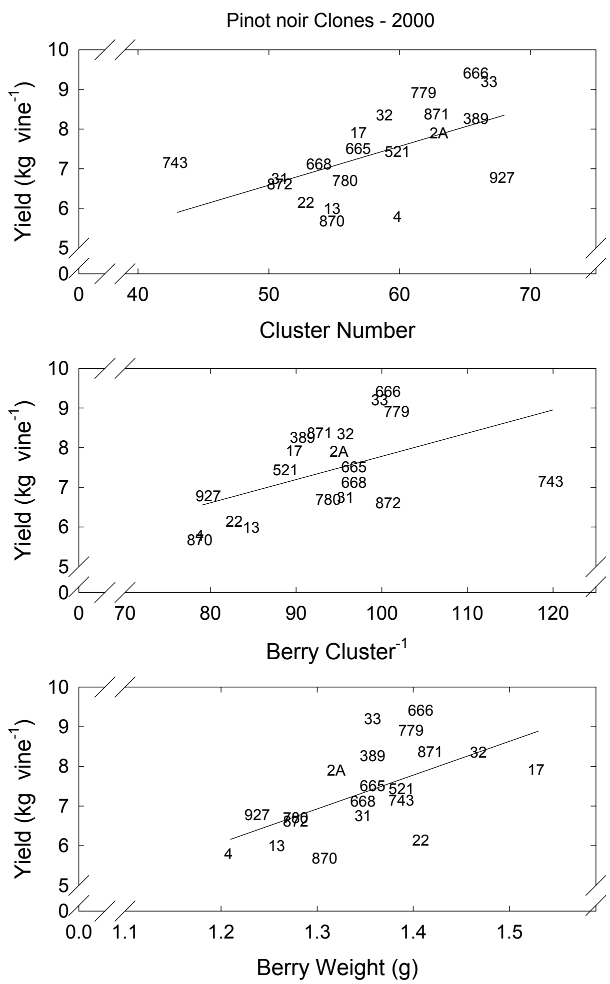


Figure 3. Relationship of crop load to harvest date.

Figure 4. Effect of several yield parameters on total yield.



Merlot Results:

Table 6. Merlot clones at the Oakville Experimental Vineyard

Clone #	Source
FPMS 01	Inglenook 12V2
FPMS 03	Inglenook 6V9
FPMS 06	Monte Rosso 8V19
FPMS 08	Argentina
FPMS 09	Rauscedo 3 (Italy)

Again in 2000, Duckhorn Vineyards has made the Merlot clones. The lot will be will be large enough to split at the time of malo-lactic fermentation to permit part of the wine to be moved to Davis in stainless steel, without oak treatment, while the remainder of the wine will be aged in oak, either neutral oak or new barrels, at the election of the Duckhorn winemakers

As in preceding years, clone FPMS 8 yielded less crop (6.3 tons/acre) in the 2000 growing season than did the other clones (9.2 to 10.3 tons/acre) (Table 7). As in previous years, the primary responsible component was the number of berries per cluster (103 for clone FPMS 8 versus 151 to 164 for clones 1, 3, 6, 9). In 2000 clone FPMS 8 also produced the smallest berries and second lowest bud fruitfulness, i.e. the number of clusters per shoot. Averaged over six years, clone FPMS 8 has produced approximately two thirds the tonnage of the other four clones due to smaller clusters caused by reductions in both number of berries per cluster and berry size (Table 8). Significant interactions between year and clone were observed for all components of yield except the number of shoots retained (an imposed value) and berry weight (Table 8, Figure 5). Relative to the other clones, clone FPMS 8 exhibited substantially reduced bud fruitfulness in 1996. In that year, it compensated for the reduced number of clusters per shoot with a relative increase in number of berries per cluster. For two of the five years studied (1996, 1998), clone FPMS 9 exhibited slight reductions in total yield caused by reduced berry set. Averaged over six years, clones FPMS 1, 3, 6, 8, and 9 have produced 9.1, 9.4, 9.3, 6.2, and 8.8 tons/acre on a 8ft x 6 ft planting density.

Fruit composition varied by clone in 2000 (Table 9). Clone FPMS 8 continued to produce fruit with the highest pH (3.48 compared to 3.36 to 3.39 for the other clones) and highest potassium concentration (2020 ppm vs 1800 to 1870 ppm). This trend has been consistent in each of the six years studied (Figure 6). Soluble solids did not differ significantly in 2000. Averaged over five years however, the soluble solids content of FPMS 1 was slightly lower, and that of FPMS 9 was slightly higher than those of the other clones. Average maturities were 24.2, 24.3, 24.3, 24.4, and 24.7 °Brix for clones FPMS 1, 3, 6, 8, 9 respectively (Table 10). Seasonal interactions were observed in which maturities were delayed by large crops for clones FPMS 1, 3, and 6 in 1996 (Figure 6).

Pruning weights from the 2000 growing season will be collected in February 2001 (Table 11). Averaged over the five years 1995-1999, pruning weights were 2.17, 2.40, 2.53, 2.78, and 2.30

kg per vine for clones 1, 3, 6, 8, and 9 respectively (Table 12). Differences in the average crop to pruning weight ratios were primarily caused by the low crops of FPMS 8 rather than differences in vegetative growth (Table 12, Figure 7).

Table 7:Components of yield for five Merlot clones. Oakville, CA. 2000.

Clone	Shoots per Vine	Clusters per Shoot	Clusters Per Vine	Berries Per Cluster	Berry Weight (gm)	Cluster Weight (gm)	Crop Yield Kg/ Vine	Crop Yield Ton/Ac
FPMS 01	23.8	1.79	43	151	1.44	217	9.2	9.2
FPMS 03	23.8	1.89	45	155	1.44	222	9.9	9.9
FPMS 06	24.5	1.84	45	158	1.45	229	10.3	10.3
FPMS 08	24.6	1.82	45	103	1.34	138	6.3	6.3
FPMS 09	24.8	1.89	47	164	1.35	219	10.3	10.3
Signif. Level	NS	0.04	0.05	0.0001	0.006	0.0001	0.0001	0.0001

Table 8:Components of yield for five Merlot clones grown at the Oakville Experimental Vineyard, Oakville, CA. Data are the mean of six years (1995-2000)

Clone	Shoots per Vine	Clusters per Shoot	Clusters Per Vine	Berries Per Cluster	Berry Weight (gm)	Cluster Weight (gm)	Crop Yield Kg/ Vine	Crop Yield Ton/Ac
FPMS 01	21.7	1.74	38	134	1.48	203	9.1	9.1
FPMS 03	21.7	1.76	38	135	1.46	203	9.4	9.4
FPMS 06	21.8	1.74	38	132	1.48	202	9.3	9.3
FPMS 08	21.9	1.70	37	98	1.41	141	6.2	6.2
FPMS 09	22.1	1.76	39	126	1.42	189	8.8	8.8
Signif. Levels								
Clone	NS	NS	NS	0.0001	0.001	0.0001	0.0001	0.0001
Year*Clone	NS	0.0001	0.0002	0.04	NS	0.0003	0.0001	0.0001

Table 9: Fruit composition at harvest of five Merlot clones. Oakville Experimental Vineyard, Oakville. CA. 2000.

Clone	Soluble Solids (°Brix)	pH	Titratable Acidity (gm/L)	Potassium (ppm)
FPMS 01	25.1	3.36	6.11	1860
FPMS 03	25.2	3.39	6.10	1800
FPMS 06	25.1	3.39	6.15	1840
FPMS 08	25.4	3.48	5.75	2020
FPMS 09	25.6	3.38	6.04	1870
Signif. Level	NS	0.0001	NS	0.0001

Table 10: Fruit composition at harvest of five Merlot clones grown at the Oakville Experimental Vineyard, Oakville, CA. Data are the mean of six years (1995-2000).

Clone	Soluble Solids (°Brix)	pH	Titratable Acidity (gm/L)	Potassium (ppm)
FPMS 01	24.2	3.41	5.83	1730
FPMS 03	24.3	3.41	5.94	1750
FPMS 06	24.3	3.43	5.94	1740
FPMS 08	24.4	3.51	5.76	1870
FPMS 09	24.7	3.44	5.83	1760
Signif. Levels				
Clone	0.0008	0.0001	NS	0.0001
Year*Clone	0.0001	0.01	NS	0.006

Table 11: Influence of clone on pruning weight and average weight of dormant canes of Merlot. Oakville Experimental Vineyard, Oakville. CA. 2000.

Clone	Shoots Per Vine	Shoot Weight (gm)	Pruning Weight (kg/vine)	Yield : Pruning Ratio
FPMS 01	23.8			
FPMS 03	23.8			
FPMS 06	24.5			
FPMS 08	24.6			
FPMS 09	24.8			
Signif. Level	NS			

Table 12: Influence of clone on pruning weight and average weight of dormant canes of Merlot grown at the Oakville Experimental Vineyard, Oakville, CA. Data are the mean of five years (1995-1999).

Clone	Shoots Per Vine	Shoot Weight (gm)	Pruning Weight (kg/vine)	Yield : Pruning Ratio
FPMS 01	21.7	109	2.17	4.91
FPMS 03	21.7	119	2.40	4.79
FPMS 06	21.8	126	2.53	4.49
FPMS 08	21.9	138	2.78	2.87
FPMS 09	22.1	112	2.30	4.49
Signif. Levels				
Clone	NS	0.0004	0.0003	0.0001
Year*Clone	NS	0.03	NS	0.0001

Figure 5: Seasonal interaction of five Merlot clones for components of yield. Clone FPMS 08 exhibited reduced bud fruitfulness in 1996. It compensated for the reduced number of clusters per shoot with a relative increase in number of berries per cluster during that year. Even given that interaction, clone FPMS 08 has consistently produced the smallest clusters. For two of the five years studied (1996 and 1998), clone FPMS 09 exhibited reductions in total yield caused by reduced berry set.

Figure 6: Seasonal interaction of five Merlot clones for fruit composition. Maturities were delayed by large crops for clones FPMS 01, 03, and 06 in 1996. Clone 08 has consistently produced fruit with the highest pH and potassium concentration.

Figure 7: Distribution of average yield and pruning weights for five clones of Merlot. Data is the average of five years 1995-1999. Differences in yield to pruning weight ratios were primarily due to lower than average crops for FPMS 08.

Malbec

Table 13. Malbec clones at the Oakville Experimental Vineyard

Clone #	Source
FPMS 04	Bordeaux 808-1
FPMS 06	Viticulture K129V1
FPMS 08	PI 312798, WA K2V58

Cardinale will make the Malbec wines in 2000. In 1997, 1999, and 2000, a thinning treatment was overlaid on clone FPMS 08 unless indicated all data presented is from unthinned vines.

At 4.9 tons/acre, the 2000 crop yields for Malbec from the Oakville Experimental Station were 40% above the average of the preceding 4 years (3.5 tons/acre). Clonal differences were evident in all components of yield except berry weight (Table 14). In 2000, clone FPMS 08 was again the most fruitful in all components and produced 9.7 tons per acre compared to 4.1 and 2.2 tons per acre for FPMS 04 and 06. In each of the last four years, FPMS 08 has consistently produced the greatest crop and FPMS 06 has produced the least. Averaged over five years, yields were 3.0, 2.2, and 6.2 tons per acre for FPMS 04, 06, and 08 respectively (Table 15, Figure 7).

Yields on Malbec have been extremely susceptible to rainy weather at time of bloom. Such rains occurred in two of the four years studied (1996 and 1998) resulting in significant year*clone interactions for several yield components, but ultimately stemming from differential alteration of fruit set (Figures 8 & 9, Table 15).

Choice of rootstock also affected crop yields in 2000. As in the preceding three years, vines on 110R rootstock produced more crop than did vines on 5-C (30% in 2000). The yield component primarily responsible was the number of clusters per shoot: vines on 110R had 2.19 clusters per shoot while those on 5-C had only 1.91 (Table 14). Rootstock effects on clusters per shoot and overall yield have been consistent for the last four years of study (Table 15, Figures 10 & 11) with vines on 110R averaging 4.1 tons/acre compared to 3.4 tons/acre on 5-C. Rootstock effects on fruit set and berry weight have varied from year to year but generally resulted in larger clusters for vines on 110R. In the 2000 growing season vines on 110R averaged 137 gm per cluster while those on 5-C averaged 119 gm. In 2000, rootstock*clone interactions were not statistically discernable for individual yield components. However, there was a significant rootstock*clone interaction for total yield. Clone FPMS 06 produced disproportionately low crops on 5-C in 2000. Yields for FPMS 06 on 5-C were 14% below the average of the preceding 4 years while yields on all other clone/rootstock combinations were above.

Significant interactions of year and rootstock for components of yield arose as vines on 110R became more fruitful than vines on 5-C in the last three seasons (Figures 10 & 11). The increase in fruitfulness was evident in all components.

By allowing an additional 10 days to ripen clone FPMS 08, fruit at harvest did not vary in soluble solids by clone in 2000 (Table 16). Fruit from FPMS 04, was lowest in pH while fruit from FPMS 08 was lowest in titratable acidity and potassium concentration. Rootstock did not affect maturity in 2000, nor were there significant rootstock*clone interactions.

Seasonal interactions have been observed for treatment effects on rate of ripening due to heavy crops in 1997 and 2000 (Table 17 and Figure 12). In 1997, 1999, and 2000, a thinning treatment was overlaid on clone FPMS 08. A portion of the vines in each replicate was thinned. Lowering crops from 11.6 to 8.8 tons per acre in 1997 and from 9.7 to 7.7 tons per acre in 2000 increased the rate of ripening to levels comparable with that of the other clones. Thinning FPMS 08 form 6.7 to 5.7 tons per acre in 1999 had no effect on maturity (Figure 12).

There were no significant interactions between rootstock and clone on fruit composition in 2000 (Table 16). Averaged over the four years of study, however, clone FPMS 08 experienced greater delays in maturation on 110R due to the larger crops on that rootstock (Table 17, Figure 13).

Pruning weights from the 2000 growing season will be collected in February 2001. Averaged over the four years 1996-1999, pruning weights were 3.16, 3.58, and 2.38 kg per vine for clones 04, 06, and 08 respectively (Table 18). Differences in the average crop to pruning weight ratios were caused both the higher crops and lower pruning weight of FPMS 08.

Table 14: Effect of rootstock and clone on yield components of Malbec grown at Oakville, CA. Except where indicated data are from unthinned vines and represent the normal cropping patterns of the clones. Data are from the 2000 growing season.

Rootstock	Clusters Per Shoot	Clusters per Vine	Berry Weight (gm)	Berries Per Cluster	Cluster Weight (gm)	Crop Yield Kg/ Vine	Crop Yield Ton/ac
5C	1.91	48	1.92	66	119	5.9	4.3
110R	2.19	54	1.90	79	137	7.7	5.6
Signif. Levels	0.01	0.02	NS	0.02	0.03	0.0008	0.0008

Clone	Cluster Per Shoot	Clusters per Vine	Berry Weight (gm)	Berries Per Cluster	Cluster Weight (gm)	Crop Yield Kg/ Vine	Crop Yield ton/ac
FPMS 04	2.13	54	1.90	56	105	5.6	4.1
FPMS 06	1.76	42	1.95	39	74	3.0	2.2
FPMS 08	2.33	58	1.88	123	230	13.4	9.7
Signif. Levels	0.0001	0.0001	NS	0.0001	0.0001	0.0001	0.0001

Rootstock * Clone Interaction		Cluster Per Shoot	Clusters per Vine	Berry Weight (gm)	Berries Per Cluster	Cluster Weight (gm)	Crop Yield Kg/ Vine	Crop Yield Ton/ac
5C	FPMS 04	1.94	50	1.90	54	106	5.1	3.7
5C	FPMS 06	1.65	40	1.97	36	67	2.5	1.8
5C	FPMS 08	2.20	55	1.89	110	207	11.5	8.3
110R	FPMS 04	2.31	59	1.90	57	105	6.1	4.5
110R	FPMS 06	1.87	45	1.94	43	81	3.5	2.5
110R	FPMS 08	2.45	62	1.86	136	253	15.4	11.2
Signif. Levels		NS	NS	NS	NS	NS	0.01	0.01

Table 15: Effect of rootstock and clone on yield components of Malbec grown at Oakville, CA. Except where indicated data are from unthinned vines and represent the normal cropping patterns of the clones. Data are the mean of 4 years: 1996-2000.

Rootstock	Clusters Per Shoot	Cluster s Per Vine	Berry Weight (gm)	Berries Per Cluster	Cluster Weight (gm)	Crop Yield Kg/ Vine	Crop Yield ton/ac
5C	1.84	40	1.86	52	97	4.7	3.4
110R	2.08	45	1.89	55	104	5.6	4.1
Signif. Levels							
Rootstock	0.0001	0.0006	NS	0.02	0.02	0.0005	0.0005
Year * Rootstock	NS	0.02	0.02	0.001	0.0007	0.02	0.02

Clone	Cluster Per Shoot	Clusters Per Vine	Berry Weight (gm)	Berries Per Cluster	Cluster Weight (gm)	Crop Yield Kg/ Vine	Crop Yield ton/ac
FPMS 04	1.93	42	1.88	43	82	4.1	3.0
FPMS 06	1.74	38	1.82	36	66	3.1	2.2
FPMS 08	2.23	48	1.92	81	156	8.5	6.2
Signif. Levels							
Clone	0.0001	0.0001	0.004	0.0001	0.0001	0.0001	0.0001
Year * Clone	0.001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Rootstock * Clone Interaction		Cluster Per Shoot	Clusters Per Vine	Berry Weight (gm)	Berries Per Cluster	Cluster Weight (gm)	Crop Yield Kg/ Vine	Crop Yield ton/ac
5C	FPMS 04	1.81	40	1.85	42	80	3.9	2.8
5C	FPMS 06	1.63	36	1.84	36	66	2.9	2.1
5C	FPMS 08	2.10	46	1.91	78	148	7.6	5.5
110R	FPMS 04	2.06	44	1.91	44	85	4.4	3.2
110R	FPMS 06	1.85	40	1.81	36	66	3.3	2.4
110R	FPMS 08	2.36	50	1.91	85	164	9.4	6.9
Signif. Levels								
Stock * Clone		NS	0.02	0.02	0.001	0.0007	0.02	0.02
Year * Stock * Clone		NS	NS	NS	MS	NS	NS	NS

Table 16: Effect of rootstock and clone on fruit composition of Malbec at harvest. Oakville, CA. 2000.

Rootstock	° Brix	pH	Titratable Acid (gm/L)	Potassium (ppm)
5C	25.0	3.62	5.8	1880
110R	25.0	3.60	5.9	1780
Signif. Levels	NS	NS	NS	NS

Clone	° Brix	pH	Titratable Acid (gm/L)	Potassium (ppm)
FPMS 04	24.9	3.57	6.2	1920
FPMS 06	25.3	3.64	6.0	1940
FPMS 08	24.8	3.61	5.3	1630
Signif. Levels	NS	0.002	0.0001	0.0001

Rootstock * Clone Interaction		° Brix	pH	Titratable Acid (gm/L)	Potassium (ppm)
5C	FPMS 04	25.0	3.57	6.1	1960
5C	FPMS 06	25.1	3.65	6.0	1940
5C	FPMS 08	24.8	3.63	5.4	1740
110R	FPMS 04	24.8	3.57	6.3	1890
110R	FPMS 06	25.4	3.63	5.9	1930
110R	FPMS 08	24.9	3.59	5.3	1520
Signif. Levels		NS	NS	NS	NS

Table 17: Effect of rootstock and clone on fruit composition of Malbec at harvest. Oakville, CA. Data are the mean of four years: 1997- 2000.

Rootstock	Berry Weight (gm)	° Brix	pH	Titratable Acid (gm/L)	Potassium (ppm)
5C	1.86	23.5	3.51	6.2	1808
110R	1.89	23.6	3.49	6.5	1786
Signif. Levels					
Rootstock	NS	NS	0.004	NS	NS
Year * Rootstock	0.02	0.04	NS	NS	0.005

Clone	Berry Weight (gm)	° Brix	pH	Titratable Acid (gm/L)	Potassium (ppm)
FPMS 04	1.8	23.8	3.51	6.3	1884
FPMS 06	1.82	23.8	3.51	6.9	1907
FPMS 08	1.92	23.1	3.47	8.8	1602
Signif. Levels					
Clone	0.004	0.0001	0.004	0.0001	0.0001
Year * Clone	0.0001	0.0001	0.0001	0.0001	0.0001

Rootstock * Clone Interaction		Berry Weight (gm)	° Brix	pH	Titratable Acid (gm/L)	Potassium (ppm)
5C	FPMS 04	1.85	23.7	3.52	6.2	1890
5C	FPMS 06	1.84	23.6	3.52	6.9	1900
5C	FPMS 08	1.91	23.3	3.49	5.7	1640
110R	FPMS 04	1.91	23.9	3.50	6.5	1880
110R	FPMS 06	1.81	23.9	3.51	6.9	1920
110R	FPMS 08	1.94	23.0	3.45	6.0	1560
Signif. Levels						
Stock * Clone		NS	0.02	NS	NS	NS
Year * Stock * Clone		NS	NS	0.05	NS	0.0006

Table 18: Effect of rootstock on pruning weights for three clones of Malbec. Oakville, CA. 1996-1999.

Rootstock	Shoots Per Vine	Weight Per Shoot	Pruning Weight (kg/vine)	Yield:Pruning Ratio
5C	26.0	133	3.09	1.51
110R	25.9	131	3.20	1.71
Signif. Level				
Rootstock	NS	NS	NS	NS
Year * Rootstock	NS	0.006	0.0001	0.02

Clone	Shoots Per Vine	Weight Per Shoot	Pruning Weight (kg/vine)	Yield:Pruning Ratio
FPMS 04	26.1	147	3.16	0.95
FPMS 06	26.1	147	3.58	0.78
FPMS 08	25.6	102	2.38	3.14
Signif. Levels				
Clone	NS	0.0001	0.0001	0.0001
Year * Clone	0.007	0.0003	0.0001	0.0001

Rootstock * Clone Interaction		Shoots Per Vine	Weight Per Shoot	Pruning Weight (kg/vine)	Yield:Pruning Ratio
5C	FPMS 04	26.2	141	3.24	0.93
5C	FPMS 06	26.1	158	3.73	0.66
5C	FPMS 08	25.8	100	2.29	2.99
110R	FPMS 04	26.0	153	3.67	0.97
110R	FPMS 06	26.2	137	3.42	0.91
110R	FPMS 08	25.5	103	2.47	3.30
Signif. Levels					
Stock * Clone		NS	0.02	0.03	NS
Year * Stock * Clone		NS	NS	NS	NS

Figure 8. Effect clone for five years on components of yield of Malbec grown at the Oakville Experimental Vineyards. 1996-2000.

Figure 9. Interaction of year and clone on components of yield of Malbec grown at the Oakville Experimental Vineyards. 1996-2000. Interactions arose both from a lack of clonal differences in the extremely low crop year of 1996 compared to the other years, and from season to season variation in ranking of individual components by clone. Clone FPMS 08 had fewer clusters per shoot in 1997 than its normal ranking would predict while clone FPMS 04 had fewer in 1999.

Figure 10. Effect rootstock for five years on components of yield of Malbec grown at the Oakville Experimental Vineyards. 1996-2000.

Figure 11. Interaction of year and rootstock for components of yield of Malbec grown at the Oakville Experimental Vineyards. 1996-2000. Significant interactions arose as vines on 110R became more fruitful than vines on 5-C in the last three seasons. The increase in fruitfulness was evident in all components.

Figure 12: Effect of clone on rate of ripening for Malbec grown at the Oakville Experimental Vineyard. 1997-2000. Sampled each year on a single date, data indicates crops larger than 9 kg/vine delayed maturity of clone FPMS 08. Thinning clone 8 in the heaviest cropped years (1997 and 2000) improved rate of ripening.

Figure 13: Effect of clone on fruit composition at harvest of Malbec grown at the Oakville Experimental Vineyard. 1997-2000. Clone 8 was harvested 8 days later than the other clones in 1997 and 10 days later in 2000. The additional hang time was sufficient to ripen clone 8 at 9.7 tons per acre in 2000 but not at 11.6 tons per acre in 1997.