American Vineyard Foundation
Viticulture Consortium
California Rootstock Commission
North Coast Viticulture Research Group

Final Report – March 2002

Project Title: Rootstock Interactions with Cultural Practices
Principal Investigator: James Wolpert

Summary

(In the interest of maintaining the summary at one page, not all objectives are summarized, however, all are summarized in the text.)

Objective: Interaction of Pruning Formula and Rootstock
Cordon trained spur-pruned Cabernet Sauvignon vines on six rootstocks (420A, SO4, 101-14, 3309C, 110R, and 1103P) were pruned to four balanced pruning formulae (4, 8, 12, and 16 buds per lb. of prunings) to test the independence of vegetative capacity and pruning formula.

Choice of rootstock affected total vegetative growth and higher pruning formulae resulted in reduced shoot vigor on all rootstocks. Total leaf area per vine averaged 28.1, 16.7, 14.6, 11.0, 9.6, and 4.2 m^2 on 1103P, 110R, 3309C, S04, 101-14, and 420A respectively. Shoot lengths averaged 150, 120, 98, and 84 cm at the 4, 8, 12, and 16 bud formulae. Under the extreme pruning formulae and rootstock capacities used in this study, rootstock/pruning interactions were noted for all aspects of vegetative growth except final pruning weight. At low pruning formulae, higher capacity rootstocks produced larger shoots (176cm on 1103P and 110R compared to 118 cm on 420A). Differences in vigor diminished at higher pruning formulae. Total vegetative growth responded curvilinearly to pruning. Leaf area per vine was reduced by 40% at the lowest pruning formula on all rootstocks except 110R. For all rootstocks, it reached a maximum between the 8 and 12 bud/lb formulae and declined slightly thereafter. Rootstock affected yields both through effects on initial vine size and through effects on bud fruitfulness. Yields averaged 13.7, 9.0, 7.2, 4.4, 5.5, and 1.9 per vine for 1103P, 110R, 3309c, SO4, 101-14, and 420A respectively. Larger vines also produced larger clusters with more and larger berries. Cluster weights averaged 105, 101, 93, 88, 94, and 72 gm for 1103P, 110R, 3309c, SO4, 101-14, and 420A, respectively. The number of clusters per shoot varied by rootstock but was less dependent on vine size, averaging 1.79, 1.86, 1.68, 1.68, 1.86, and 1.60 clusters per shoot for 110R, 101-14, 1103P, 3309C, SO4, and 420A. Significant pruning/rootstock interactions existed due to very low fruitfulness on lowest capacity rootstock at the lowest pruning formula. Rootstock and pruning formula affected crop to pruning weight ratio without significant interaction. Crop to prunings ratios were lower on SO4 and 420A than on other rootstocks (3.5, 3.6, 4.8, 5.1, 5.4, and 5.5 on SO4, 420A, 3309C, 101.14, 110R, and 1103P). Crop to pruning weight ratios increased from 2.5 at the 4bud/lb pruning treatment to 6.3 at 16 bud/lb. Significant effects of rootstock, pruning formula, and their interaction were noted for rate of maturation. °Brix on 1103P was delayed at all pruning levels. Fruit from vines on 420A and SO4 was riper than that of vines on 110R, 309C or 101-14. Rootstock, pruning, and their interaction affected maturity solely through differences in crop and vegetative growth.

The independence of rootstock and pruning on vigor was found to break down at extreme capacities and pruning formulae. Further, the response of total vegetative growth to pruning was found to be curvilinear across the broader range of pruning formulae.

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Project Title: **Rootstock Interactions with Cultural Practices**

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Objectives of the Research:
To test the interaction of rootstock with potassium application in Merlot.
To further test the interaction of rootstock and pruning level on crop load and vegetative growth

Interaction of rootstock and pruning level.

OBJECTIVE: Establish pruning criteria for rootstocks 110R, 101-14, and 5-C.

This portion of the project examines the response of cordon trained Cabernet Sauvignon on 110R, 101-14, and 5-C rootstocks to a wide range of pruning levels using established vineyards at the Oakville Experimental Vineyard. The purpose is to generate information on appropriate treatment levels in a second trial (planted in 1999) which ultimately will examine the interaction of rootstock, vine space, and pruning formula. Foreknowledge of an appropriate range of pruning treatments for each of the three rootstocks will avoid training errors and allow gathering useful information a year earlier in the second trial.

SUMMARY:

Total vegetative growth was dependent on pruning level and vine spacing. Pruning weights declined slightly from 0.9 kg/vine at 3 and 6 bud/m^2 to 0.7 kg/vine at 9 bud/m^2. Pruning weights increased from 0.65 kg/vine on 1M spacing to 1.2 kg/vine at 2.2m. Vigor was dependent on rootstock, pruning level and vine space. In all cases shoot growth fell to inadequate levels (below 30 gm/shoot) at the highest pruning level of 9 bud/m^2. Yields were dependent on rootstock, pruning level, and vine space. With fewer clusters per shoot and setting fewer berries per cluster, 101-14 was less fruitful than 110R. Yields averaged 4.3 and 5.4 kg/vine on 101-14 and 110R respectively. Yields on 5-C were comparable to those of 110R. Yields were dependent on vine space and pruning level through number of shoots retained but reached a maximum at the 6 bud/m^2 pruning level due to reductions in clusters per shoot and berry weight. At pruning levels of 3, 6, and 9 bud/m, yields were 1.5, 3.5, and 3.4 kg/vine on 1M vine spacing and 4.6, 7.5, and 7.4 kg/vine on 2m spacing. The balance of crop to vegetative growth depended solely on pruning level. Crop to pruning weight ratios were 3.9, 6.6, and 9.2 for the 3, 6, and 9 bud/m^2 treatments. Rootstock and vine spacing had no effect on fruit composition at harvest. Maturities depended on pruning level without significant interaction. Soluble solids were adequate up to pruning levels of 6 buds per square meters but fell below 23 °Brix at higher bud numbers.

RESULTS

The response of Cabernet Sauvignon (Clone UCD #8) grapevines on 110R, 101-14, and 5-C rootstocks to a range of pruning levels was evaluated at the Oakville Experimental Vineyard. Vines utilized were from two separate plots, each containing 110R and one of the remaining two rootstocks. Vines used in the comparison of 5-C and 110R were planted on 2.4x1m and 2.4x2.2m while those used to compare 101-14 and 110R were on 2.4x1.8m. Pruning levels were chosen to give 3, 6, and 9 buds per square meter of land area for each rootstock-spacing combination (7, 15, 22 bud per vine on 1m spacing, 13, 26, 40 bud per vine on 1.8m spacing, and 16, 32, and 48 bud per vine on 2.2m spacing). Because actual bud number varied according to the spacing, it was handled as a continuous variable for purposes of statistical analysis.

Data is given for total vegetative growth, vigor, yield, balance, and maturity in Table 1 for the comparison of 5-C and 110R and in Table 2 for the comparison of 101-14 and 110R.

In both plantings, the effect of rootstock on total vegetative growth as measured by weight of dormant prunings was not significant to 5%. Pruning weights did decline slightly at the highest pruning level. Averaged over all stocks and planting densities, pruning weights were 0.91, 0.90, and 0.71kg/vine at 3, 6, and 9 bud/m^2. In the comparison of 5-C and 110R, pruning weight was additionally affected by vine spacing and averaged 0.65 and 1.20 kg/vine at 1 and 2.2m spacings.

Vigor, expressed as weight per shoot was dependent on rootstock and pruning level without interaction in the comparison of 101-14 and 110R. Shoot weight ranged from a high of 62 gm at the lowest pruning level on 110R to a low of 11 gm at the highest pruning level on the weaker rootstock. In the comparison of 5-C and 110R, vigor decreased on wider spacing and at higher pruning levels, both of which interacted with rootstock. In all cases, however, shoot growth fell to inadequate levels (below 30 gm/shoot) at the highest pruning level of 9 bud/m^2. The decrease in vigor at the wider spacing is important in that it occurred in spite of pruning to buds per square meter of land area. This suggests that in this location none of the three rootstocks will fully utilize the capacity of the widest (3M) spacing being allotted in the new planting.

Yields were dependent on rootstock and pruning level in the comparison of 101-14 and 110R. 101-14 was less fruitful with fewer clusters per shoot and setting fewer berries per cluster. Yields averaged 4.3 and 5.4 kg/vine on 101-14 and 110R respectively. Higher pruning levels decreased clusters per shoot and berry weight but increased the number of cluster per vine via the number of shoots retained. Yields reached a maximum at the 6 bud/m^2 pruning level. Yields averaged 3.2, 5.8, and 5.8 kg/vine at 3,6, and 9 bud/m^2. In the comparison of 5-C and 110R yields were dependent on vine space and pruning level through number of shoots retained but again reached a maximum at the 6 bud/m^2 pruning level. At pruning levels of 3, 6, and 9 bud/m, yields were 1.5, 3.5, and 3.4 kg/vine on 1M vine spacing and 4.6, 7.5, and 7.4 kg/vine on 2m spacing.

The balance of crop to vegetative growth depended solely on pruning level. Averaged over all rootstock and spacings, crop to pruning weight ratios were 3.9, 6.6, and 9.2 for the 3, 6, and 9 bud/m^2 treatments.

As with vine balance, neither rootstock nor spacing affected fruit maturity in either trial. Maturities depended on pruning level without significant interaction. In all cases, soluble solids were adequate up to pruning levels of 6 bud/m^2 but fell below 23 °Brix at greater bud numbers. Soluble solids content averaged 24.2, 23.4, and 22.8 °Brix at 3, 6, and 9 buds/m^2.

In summary, pruning levels above 6 buds per square meter of land area resulted in decreased total vegetative growth, inadequate shoot vigor, and delays in maturation without additional crop yield. Treatment differences were readily distinguishable between 3 and 6 buds per meter of land area. With respect to imposing treatments on the future trial, pruning levels of 3.28, 4.92, and 6.56 buds per square meter would correspond to easily imposed treatments of 8, 12, and 16 bud/vine at 1M in-row spacing, 16, 24, and 32 bud/vine at 2M, and 24, 36 and 48 bud/vine at 3M.

TABLE 1: Effect of vine spacing and pruning level on vegetative growth, vigor, yield, balance and maturity of Cabernet Sauvignon grown on 5-C and 110R rootstocks at the Oakville Experimental Vineyard, 2001 data.

Rootstock	Vine Spacing	Pruning Level (bud/m^2)	Pruning Level (bud/vine)	Pruning Weight (kg/vine)	Shoot Weight (kg/vine)	Yield (kg/vine)	Yield:Pruning Ratio	°Brix
5-C	2.4m x 1.0m	3	7	0.57	86	1.6	2.6	24.2
5-C	2.4m x 1.0m	6	15	0.71	50	3.8	5.4	23.8
5-C	2.4m x 1.0m	9	22	0.51	25	3.4	6.8	22.8
5-C	2.4m x 2.2m	3	16	1.30	53	4.5	3.6	23.9
5-C	2.4m x 2.2m	6	32	0.86	28	6.8	8.1	23.0
5-C	2.4m x 2.2m	9	48	0.97	26	7.7	8.0	22.8
110R	2.4m x 1.0m	3	7	0.80	112	1.4	1.9	24.7
110R	2.4m x 1.0m	6	15	0.74	52	3.2	4.6	24.5
110R	2.4m x 1.0m	9	22	0.58	28	3.4	6.1	23.7
110R	2.4m x 2.2m	3	16	1.45	88	4.8	3.5	24.4
110R	2.4m x 2.2m	6	32	1.45	49	8.2	6.0	22.8
110R	2.4m x 2.2m	9	48	1.17	28	7.0	6.4	22.7
Signif. Levels								
Rootstock				NS	NS	NS	NS	NS
Vine Space				0.01	0.0007	0.002	NS	NS
Rootstock * Vine Space				NS	NS	NS	NS	NS
Pruning Level				0.002	0.0001	0.0001	0.0001	0.0001
Pruning * Rootstock				NS	0.004	NS	NS	NS
Pruning * Space				NS	0.004	NS	NS	NS
Pruning * Stock * Space				NS	NS	NS	NS	NS

TABLE 2: Effect of vine spacing and pruning level on vegetative growth, vigor, yield, balance and maturity of Cabernet Sauvignon grown on 101-14 and 110R rootstocks at the Oakville Experimental Vineyard, 2001 data.

Rootstock	Vine Spacing	Pruning Level (bud/m^2)	Pruning Level (bud/vine)	Pruning Weight (kg/vine)	Shoot Weight (kg/vine)	Yield (kg/vine)	Yield:Pruning Ratio	°Brix
101-14	2.4m x 1.8m	3	13	0.58	43	3.1	5.5	24.0
101-14	2.4m x 1.8m	6	26	0.70	32	5.3	7.7	23.4
101-14	2.4m x 1.8m	9	40	0.38	11	4.6	12.2	22.2
110R	2.4m x 1.8m	3	13	0.76	62	3.3	4.3	24.5
110R	2.4m x 1.8m	6	26	0.93	36	6.3	6.8	23.5
110R	2.4m x 1.8m	9	40	0.61	16	6.7	11.0	23.0
Signif. Levels								
Rootstock				0.06	0.03	0.03	NS	NS
Pruning Level				0.0001	0.0001	0.001	0.0001	0.0001
Pruning * Rootstock				NS	NS	NS	NS	NS

Figure 1: Influence of pruning level and vine spacing on vegetative growth and vigor of Cabernet Sauvignon grown on 5-C, 110R, and 101-14 rootstocks at the Oakville Experimental Vineyard, 2001 data.

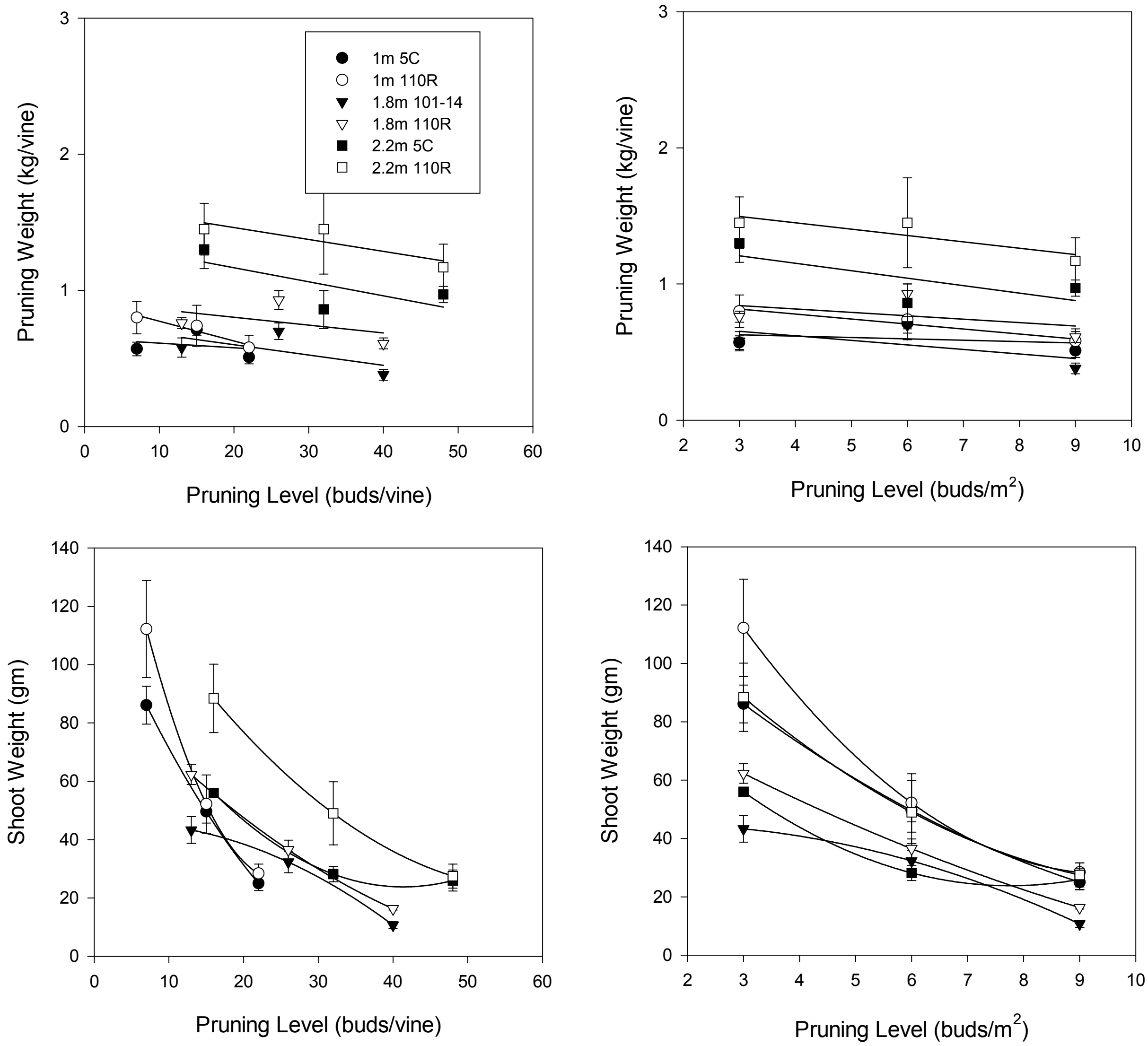
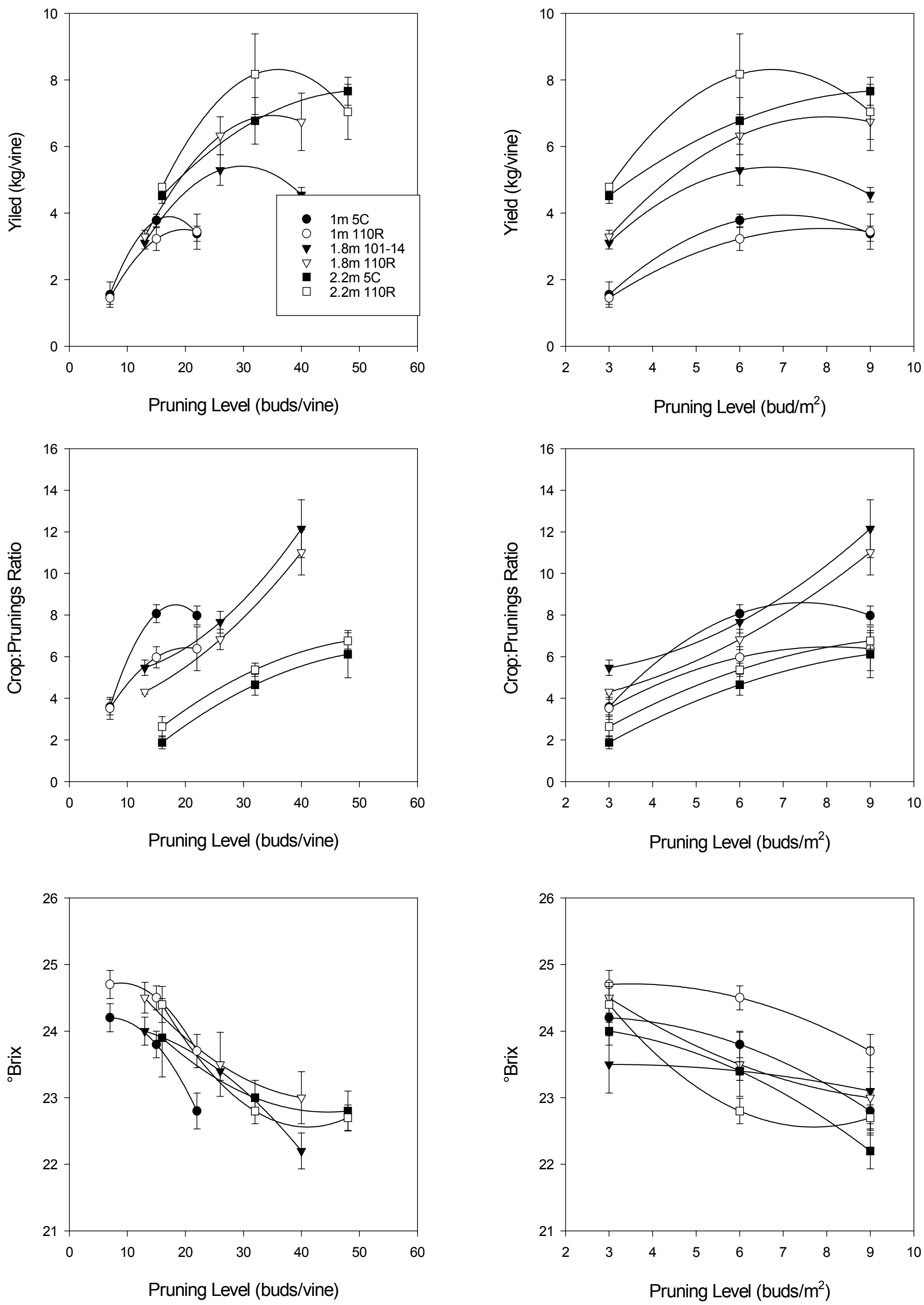


Figure 2: Influence of pruning level and vine spacing on yield, vine balance and fruit maturity of Cabernet Sauvignon grown on 5-C, 110R, and 101-14 rootstocks at the Oakville Experimental Vineyard, 2001 data.



Expansion of capacity model

This portion of the project expands on a four-year AFV-funded project completed in 1999 which indicated total vegetative growth of cane pruned vines on four rootstocks was unaffected by pruning formula across a wide range of site capacities. That independence suggested total vegetative growth could therefore be a tool for predicting vine size and balance for pre-plant decisions. To further refine a predictive model, this study examines whether the previously observed independence holds true for cordon trained spur-pruned vines and tests the limits of that independence through extremes of pruning formula and rootstock capacity.

OBJECTIVES:

1) Examine whether the previously observed independence holds true for cordon trained spur-pruned vines and find the limits of that independence through extremes of pruning formula and rootstock capacity.
2) Rank of a broader range or rootstocks for their effect on vegetative capacity and cropping characteristics.

OBJECTIVE 1: Interaction of Pruning Formula and Rootstock
Cordon trained spur-pruned Cabernet Sauvignon vines on six rootstocks (420A, SO4, 101-14, 3309C, 110R, and 1103P) were pruned to four balanced pruning formulae (4, 8, 12, and 16 buds per lb. of prunings) to test the independence of vegetative capacity and pruning formula.

Choice of rootstock affected total vegetative growth while higher pruning formulae resulted in reduced shoot vigor on all rootstocks. Under the extreme pruning formulae and rootstock capacities used in this study, rootstock/pruning interactions were noted for all aspects of vegetative growth except final pruning weight. At low pruning formulae vigor was no longer independent of rootstock: higher capacity rootstocks produced larger shoots. Differences in vigor diminished at higher pruning formulae. Total vegetative growth responded curvilinearly to pruning. Leaf area per vine was reduced by 40% at the lowest pruning formula on all rootstocks except 110R. For all rootstocks it reached a maximum between the 8 and 12 bud/lb formulae and declined slightly thereafter. Rootstock affected yields both through effects of initial vine size on bud number retained and through effects on bud fruitfulness. Larger vines also produced larger clusters with more and larger berries. The number of clusters per shoot varied by rootstock but was less dependent on vine size. Significant pruning/rootstock interactions existed due to very low fruitfulness on 420A at the lowest pruning formula. Rootstock and pruning formula affected crop to pruning weight ratio without significant interaction. Significant effects of rootstock, pruning formula, and their interaction were noted for rate of maturation. °Brix on 1103P was delayed at all pruning levels. Fruit from vines on 420A and SO4 was riper than that of vines on 110R, 309C or 101-14. Rootstock, pruning, and their interaction affected maturity solely through differences in crop and vegetative growth.

The independence of rootstock and pruning on vigor was found to break down at extreme capacities and pruning formulae. Further, the response of total vegetative growth to pruning was found to be curvilinear across the broader range of pruning formula.

OBJECTIVE 2: Ranking of Additional Rootstocks for Vegetative Capacity.

Cabernet Sauvignon vines on 20 rootstocks were balanced pruned to 8 buds per lb of prunings and ranked according to their vegetative capacities and cropping characteristics. The stocks include 5 *berlandieri x rupestris* crosses (775P, 1103P, 1447P, 99R, 110R, and 140Rug), 2 *rupestris x riperia* crosses (3309C and 101-14), 10 *berlandieri x riperia* crosses (Cosmo 2, Cosmo 10, 225Rug, 5BB, 125AA, SO4, 5A, 5C, 8B, and 420A), 1616C with *solonis x riparia* parentage, and Freedom (1613C x c*hampinii*).

Total weight of dormant prunings ranged from a low of 0.62 kg per vine on 420A to a high of 2.97 kg on 1103P. With the exception of SO4 and Freedom, the change in total vegetative growth from pre-treatment values to those of 2001-2002 was proportional between rootstocks. The change in rank for those two stocks suggests it may not be possible to rank vegetative capacity of rootstocks to within 10% of their pruning weights. Vigor varied with rootstock capacity even though vines were pruned to the same formula. Shoots of the three highest capacity rootstocks were significantly longer than those of the lowest capacity rootstocks: 146, 138, and 135 cm on 775P, 1103P, and 225Ru compared to 103 cm on 1616C and 420A.
Rootstock affected crop yield through effects on vine size and components affecting cluster size. Yields ranged from a high of 14.4 kg per vine for 1103P to lows of 2.1 and 2.3 kg for 8B and 420. Overall yields were lower than predicted by the vegetative growth for SO4, 5C, 775P and 1447P. Vines on 101-14 and Freedom produced more than predicted. Berries were smaller than predicted by vegetative capacity for vines on S04, 110R, and 1447P and larger than expected on Teleki 5A, Freedom, Cosmo 2, and Cosmo 10. The number of berries per cluster was low on 8B and high on 101-14 and 5BB. Rootstocks varied in their ability to ripen resultant crop loads. Maturity of fruit on 5A, Freedom, 1447P, 5C, and 99R were significantly below the value predicted by regression against yield per vine. Maturities on SO4, 125AA, Cosmo 2 and 5BB were above predicted values.

The observed inter-dependence of vigor and total vegetative growth at extreme capacities limits predictive modeling. Accuracy will diminish for very high and very low capacity rootstocks.

RESULTS

OBJECTIVE 1: Interaction of Pruning Formula and Rootstock

Cordon trained spur-pruned Cabernet Sauvignon on six rootstocks (420A, SO4, 101-14, 3309C, 110R, and 1103P) were pruned to four balanced pruning formulae (4, 8, 12, and 16 buds per lb. of prunings) to test the independence of vegetative capacity and pruning formula. These six rootstocks were chosen for their extreme range in vegetative capacity. The vines were trellised to a quadrilateral GDC which further maximized differences in the expression of vegetative capacity. The site is a well drained gravely bale clay loam. Eight single vine replications were utilized. Treatments were first imposed in the winter of 1999-2000.

In agreement with the earlier more restricted study, rootstock affected total vegetative growth and higher pruning formulae resulted in reduce shoot vigor on all rootstocks. Total leaf area per vine averaged 28.1, 16.7, 14.6, 11.0, 9.6, and 4.2 m^2 on 1103P, 110R, 3309C, S04, 101-14, and 420A respectively. Shoot lengths averaged 150, 120, 98, and 84 cm at the 4, 8, 12, and 16 bud formulae (Table 1).

However, unlike the previous study where pruning formula and rootstock effects were largely independent, under the extremes used in this study, rootstock interacted with pruning formula for all aspects of vegetative growth except final pruning weight (Table1). At low pruning formulae, higher capacity rootstocks produced larger shoots. Using shoot length at veraison as a measure of vigor, rootstock dependent differences were distinguishable below pruning formulae of 8 buds per pound of prunings and diminished thereafter (Figure 1). At the lowest pruning formula (four bud/pound), shoot lengths ranged from a high of 176cm on 1103P and 110R to a low of 118 on 420A. At twelve buds per pound, differences in shoot length had diminished to 103 cm on 1103P vs 91 cm on 420A. Using dormant shoot weight as a measure of vigor, only the two weakest stock s(420A and 101-14) were distinguishable and only at the lowest pruning formula. Shoot weights averaged 41, 43, 40, 52, 43, and 37 for 1103P, 110R, 3309C, S04, 101-14, and 420A respectively.

Within the range of pruning formulae rootstock capacities used in the earlier study (5 to 12.5 bud/lb), vigor in this study was also essentially linear and independent of rootstock. In the extremes, however, vigor did depend on capacity.

Total leaf area per vine, which in the previous study was linearly dependent on rootstock and site but independent of pruning formula, was found here to depend on a significant pruning/rootstock interaction (Table 1). Leaf area per vine responded curvilinearly to pruning. It was reduced by 40% at the lowest pruning formula on all rootstocks except 110R. For all rootstocks it reached a maximum between the 8 and 12 bud/lb formulae and declined slightly thereafter (Figure 2). The curvilinear response to pruning was most pronounced for the highest capacity rootstock (1103P), which also declined by 28% from its maximum of 34 m2 at the eight bud/lb formula. Total weight of dormant prunings, a second measure of vegetative capacity, also responded curvilinearly to pruning. The rootstock/pruning interaction was not significant in 2001. In the first year of this study (2000), both the non-linear response and rootstock/pruning interaction were more pronounced for both leaf area per vine and pruning weight. The fact that they diminished in 2001 indicates the vines are still equilibrating. It is likely the non-linear response will persist but the interaction will not, thus complicating but not preventing modeling of vine vegetative growth under extreme conditions of capacity.

Rootstock affected yields both through effects on initial vine size and through effects on bud fruitfulness (clusters per shoot) (Table 2, Figure 3). The rootstock effects through vine size were dominant; overall yields depended on initial pruning weights and subsequent number of buds retained. Yields averaged 13.7, 9.0, 7.2, 4.4, 5.5, and 1.9 per vine for 1103P, 110R, 3309c, SO4, 101-14, and 420A respectively. In general, larger vines also produced larger clusters with more and larger berries. 420A was the lowest in each of these parameters. Cluster weight averaged 105, 101, 93, 88, 94, and 72 gm for 1103P, 110R, 3309c, SO4, 101-14, and 420A. The number of clusters per shoot varied by rootstock but was less dependent on vine size, averaging 1.79, 1.86, 1.68, 1.68, 1.86, and 1.60 clusters per shoot for 110R, 101-14, 1103P, 3309C, SO4, and 420A.

In agreement with the early work, increasing pruning formula increased overall yield through the number of clusters. Unlike the earlier study, however, interactions between rootstock and pruning formula were noted for all yield components except clusters per shoot. For all but the lowest capacity rootstock, increasing yields were accompanied by expected compensating reductions in set and bud fruitfulness across pruning treatments. Set and bud fruitfulness on 420A, however, was very low at the 4 bud per pound formula, peaked at 8 buds per pound and declined appropriately thereafter. About half of the difference in bud fruitfulness can be explained as an artifact of unintentional differences in suckering at extremely low bud numbers. At 4 bud per pound, 420A averaged only 6.3 count buds per vine but was allowed to retain an average of 2 additional non-count shoots with low fruitfulness: 1.26 shoots/count bud compared to 1.00 for the other rootstocks at the same pruning formula. Differences in berry set and cluster weight should not have been affected.

Rootstock and pruning formula affected crop to pruning weight ratio without significant interaction (Table 3, Figure 4). At all pruning formulae crop to prunings ratios were lower on SO4 and 420A than on other rootstocks (3.5, 3.6, 4.8, 5.1, 5.4, and 5.5 on SO4, 420A, 3309C, 101.14, 110R, and 1103P). Averaged by pruning formula, crop to pruning weight ratios increased from 2.5 at the 4bud/lb treatment to 6.3 at 16 bud/lb. Significant interactions occurred for the second measure of vine balance: leaf area per gram crop. 420A at the lowest pruning formula had inordinately high leaf areas per gram crop due in part to the inordinately low crops and in part to the retention of unfruitful non-count shoots that contributed to total leaf area per vine and hence leaf area per gram crop.

Significant effects of rootstock, pruning formula, and their interaction were noted for rate of maturation (Table 3, Figure 5). °Brix on 1103P was again delayed at all pruning levels. Unlike the preceding season, however, vines on that stock pruned to 8 or more buds per lb ultimately attained 24 °Brix with additional hang time. Fruit from vines on 420A and SO4 was riper than that of vines on 110R, 309C or 101-14. °Brix on 9/5/01 averaged 22.9, 24.2, 24.2, 24.9, 24.2, and 24.8 for 1103P, 110R, 3309C, SO4, 101-14, and 420A respectively (Figure 4). Rootstock and pruning formula effects on maturation could be fully accounted for by their effects crop load and vegetative growth. Regression against yield accounted for 59% of the variance in °Brix and pruning weight accounted for an additional 5% (°Brix = 25.04 - 0.225*yield + 0.502*pruning weight Rsq= 0.64). ANOVA on the residual indicates neither rootstock, pruning, nor their interaction had additional effects.

OBJECTIVE 2: Ranking of Additional Rootstocks for Vegetative Capacity.

Cabernet Sauvignon vines on 20 rootstocks were balanced pruned to 8 buds per lb of prunings and ranked according to their vegetative capacities and cropping characteristics. The stocks include 5 *berlandieri x rupestris* crosses (775P, 1103P, 1447P, 99R, 110R, and 140Rug), 2 *rupestris x riperia* crosses (3309C and 101-14), 10 *berlandieri x riperia* crosses (Cosmo 2, Cosmo 10, 225Rug, 5BB, 125AA, SO4, 5A, 5C, 8B, and 420A), 1616C with *solonis x riparia* parentage, and Freedom (1613C x c*hampinii*).

Total weight of dormant prunings was lower in 2001 than in 2000 for all rootstocks. Weights ranged from a low of 0.62 kg per vine on 420A to a high of 2.97 kg on 1103P (Table 4, Figure 6a). In general, the change in total vegetative growth from pre-treatment values to those of 2001-2002 was fairly proportional between rootstocks. However, even subtle differences caused changes in the ranking established using pre-treatment values. Specifically the reduction in total vegetative growth of Freedom was slightly more pronounced, and of SO4 less pronounced, relative to other rootstocks: resulting in a change in rank (Figure 6b). This variability within a single vineyard suggests limits on the method used to compare vineyards reported in 2000. It may not be possible to rank vegetative capacity of rootstocks to within 10% of their pruning weights.

Contrary to the more restricted study completed in 1999 where vigor was controlled solely by pruning formula and independent of rootstock, shoot length and shoot weight differed significantly across this broader range of rootstocks (Table 4, Figure 7a). Even though vines were pruned to the same formula of 8 buds per lb of prunings, shoots of the three highest capacity rootstocks were significantly longer than those of the lowest capacity rootstocks; shoot length correlated with final pruning weight. Specifically, shoot lengths were 146, 138, and 135 cm on 775P, 1103P, and 225Ru compared to 103 cm on 1616C and 420A. High capacity rootstocks were more vigorous. Average shoot weight also differed significantly between rootstocks but correlated less with total weight of dormant prunings (Figure 7b). Shoot growth on vines with high bud numbers was less uniform and, while very weak shoots still contributed to shoot length and leaf area, they contributed almost nothing to total pruning weight. The lack of correlation limits the use of average dormant shoot weight as an indicator of vigor at extremely high bud numbers.

While differences in vigor or total vegetative growth were not observable for vines within the range of capacities used in the original study, their inter-dependence at the extremes used here complicates predictive modeling. Accuracy of prediction will diminish for very high and very low capacity rootstocks.

As noted under objective 1 above, the dominant factor in determining total yield was number of shoots retained, a function of rootstock capacity through initial pruning weight; i.e. yield was expected to correlate with initial vine size. Yields ranged from a high of 14.4 kg per vine for 1103P to lows of 2.1 and 2.3 kg for 8B and 420A (Table 5, Figure 8). Also as noted above, all components of yield except clusters per shoot correlated with initial vine size: larger vines having larger clusters with more berries. Beyond this correlation, individual rootstocks additionally affected specific components (Figure 8). The most pronounced were differences in berry size and clusters per shoot. Berries were smaller than expected for vines on S04, 110R, and 1447P and larger than expected on Teleki 5A, Freedom, Cosmo 2, and Cosmo 10. The number of berries per cluster was low on 8B and high on 101-14 and 5BB. Cluster size remained small on 8b, 1447 and 775P.

In 2001 yields were significantly lower than predicted by the vegetative growth for SO4, 5C, 775P and 1447P. Vines on 101-14 and Freedom produced more than predicted (Figure 8). The inclusion of 5C in the group with lower than predicted yields is in contrary to the results of the earlier study and last year's results in this trial. Cabernet Sauvignon on that rootstock has consistently been highly fruitful in the past. Such seasonal variation dictates the use of long term averages in generating predictive models.

Rootstocks varied in their ability to ripen resultant crop loads (Table 6, Figure 9). Differences in crop yield accounted for 33% of the variation in maturation (°Brix=25.00-0.114*yield, Rsq=0.33). Maturity of fruit on 5A, Freedom, 1447P, 5C, and 99R were significantly below the value predicted by regression against yield per vine (Figure 9c). Maturities on SO4, 125AA, Cosmo 2 and 5BB were above predicted values. Of these rootstocks, 1447P and 99R were also below, and Cosmo 2 above, average predicted maturity in 1999. No measure of vegetative growth or vine balance accounted for additional variation.

Table 1. Influence of rootstock and pruning formula on vegetative growth, 2001 data.

Rootstock	Pruning Weight (kg/vine)	Shoots Per Vine	Shoot Weight (gm)	Shoot Length (cm)	Total Leaf Area Per Vine (m^2)
1103 Paulsen	2.54	76	42	126	28.1
110R	1.71	49	43	118	16.7
3309C	1.50	47	40	108	14.6
SO4	1.28	31	51	120	11.0
101-14	1.09	31	43	108	9.6
420A	0.51	16	34	98	4.3
R-Sq. Vine Size	85%	46%	<1%	12%	75%
Sig. of Vine Size	0.0001	0.0001	NS	0.0001	0.0001
Residual Rootstock	NS	0.0009	0.0009	NS	NS

Pruning Formula	Pruning Weight (kg/vine)	Shoots Per Vine	Shoot Weight (gm)	Shoot Length (cm)	Total Leaf Area Per Vine (m^2)
4 buds/lb	1.46	19	76	150	10.7
8 buds/lb	1.65	39	44	120	16.0
12 buds/lb	1.46	54	28	98	16.5
16 buds/lb	1.28	60	22	84	14.2
Sig. Levels					
Pruning Formula	0.001	0.0001	0.0001	0.0001	0.0001
Pruning*Stock	NS	0.0001	0.0001	0.0001	0.03

Table 2. Influence of rootstock and pruning formula on components of yield, 2001 data.

Rootstock	Shoots Per Vine	Clusters Per Shoot	Clusters Per Vine	Berry Weight (g)	Berries Per Cluster	Cluster Weight (g)	Yield (kg/vine)
1103 Paulsen	76	1.79	135	1.04	101	105	13.7
110R	49	1.86	91	0.94	106	101	9.0
3309C	47	1.68	78	0.96	97	93	7.2
SO4	31	1.69	51	0.90	98	88	4.5
101-14	31	1.86	57	0.95	99	94	5.5
420A	16	1.60	26	0.88	82	72	1.9
R-Sq. Vine Size	46%	9%	49%	43%	21%	36%	59%
Sig. of Vine Size	0.0001	0.007	0.0001	0.0001	0.0001	0.0001	0.0001
Residual Rootstock	0.0009	0.008	0.005	NS	NS	NS	NS

Pruning Formula	Shoots Per Vine	Clusters Per Shoot	Clusters Per Vine	Berry Weight (g)	Berries Per Cluster	Cluster Weight (g)	Yield (kg/vine)
4 buds/lb	19	1.78	34	0.94	105	100	3.8
8 buds/lb	38	1.82	70	0.95	102	97	7.3
12 buds/lb	54	1.74	96	0.95	98	93	9.3
16 buds/lb	60	1.65	101	0.95	84	80	8.5
Sig. Level							
Pruning Formula	0.0001	0.002	0.0001	NS	0.0001	0.0001	0.0001
Pruning*Stock	0.0001	NS	0.0006	0.05	0.01	0.01	0.05

Table 3. Influence of rootstock and pruning formula on vine balance and fruit maturity, 2001 data.

Rootstock	Pruning Weight (kg/vine)	Yield (kg/vine)	Crop to Prunings Ratio	Leaf Area per Gram Fruit (cm/gm)	°Brix
1103 Paulsen	2.54	13.7	5.51	22	22.9
110R	1.71	9.0	5.37	21	24.2
3309C	1.50	7.2	4.82	22	24.2
SO4	1.28	4.5	3.39	27	24.9
101-14	1.09	5.5	5.14	20	24.2
420A	0.51	1.9	3.64	27	24.8
R-Sq. Vine Size	85%	59%	13%	8%	25%
Sig. of Vine Size	0.0001	0.0001	0.001	0.02	0.0001
Residual Rootstock	NS	NS	0.05	NS	NS

Pruning Formula	Pruning Weight (kg/vine)	Yield (kg/vine)	Crop to Prunings Ratio	Leaf Area per Gram Fruit (cm/gm)	°Brix
4 buds/lb	1.46	3.8	2.49	34	24.9
8 buds/lb	1.65	7.3	4.18	23	24.3
12 buds/lb	1.46	9.3	5.92	19	23.6
16 buds/lb	1.28	8.5	6.28	19	23.8
Sig. Levels					
Pruning Formula	0.001	0.0001	0.0001	0.0001	0.0001
Pruning*Stock	NS	0.05	NS	0.01	0.006

Table 4. Influence of rootstock on total vegetative growth and vigor of Cabernet Sauvignon grown at the Oakville Experimental Vineyard. Vines were balanced pruned to 8 buds / lb of prunings, 2001 data.

		Pre-Treatment		Final					
Rootstock	Parentage	1999 Pruning Weight	1999 Rank	2001 Pruning Weight	2001 Rank	Shoots Per Vine	Shoot Weight (gm)	Shoot Length (cm)	Leaf Area Per Vine (M^2)
1103P	*ber X rup*	3.95	1	2.97	1	73	41	138	35.7
775P	*ber X rup*	3.33	2	2.92	2	60	50	146	30.0
225 Ru	*ber X Rip*	3.34	3	2.69	3	59	46	135	27.3
5BB	*ber X rip*	2.94	4	2.35	4	48	49	126	20.4
99R	*ber X rup*	2.89	5	2.24	6	52	44	125	21.5
Cosmo 2	*ber X rip*	2.61	6	2.31	5	50	46	125	20.9
110R	*ber X rup*	2.57	7	1.88	7	44	43	117	16.6
1447P	*ber X rup*	2.38	8	1.89	9	41	46	123	16.9
5C	*ber X rip*	2.38	9	1.91	8	39	49	124	16.1
Cosmo10	*ber X rip*	2.27	10	1.83	10	41	45	121	16.0
140 Ru	*ber X rup*	2.24	11	1.60	11	40	40	113	14.3
Freedom	*ber X rip*	1.92	12	1.34	15	34	40	120	13.4
3309C	*rup X rip*	1.76	13	1.51	12	34	48	123	14.0
125AA	*ber X rip*	1.68	14	1.44	14	31	47	129	13.3
SO4	*ber X rip*	1.66	15	1.45	13	29	50	128	12.6
101-14	*rup X rip*	1.60	16	1.14	17	28	40	109	10.2
5A	*ber X rip*	1.38	17	1.17	16	23	52	123	9.3
1616C	*ber X rip*	1.22	18	0.83	18	22	44	103	6.8
8B	*ber X rip*	1.20	19	0.81	19	19	41	112	6.7
420A	*ber X rip*	0.94	20	0.62	20	16	41	103	5.0
Sig. Level		0.0001		0.0001		0.0001	0.02	0.0001	0.0001

Table 5. Components of yield for Cabernet Sauvignon grown on twenty rootstocks at the Oakville Experimental Vineyard. Vines were balanced pruned to 8 buds / lb of prunings, 2001 data.

Rootstock	Parentage	Clusters per Shoot	Clusters per Vine	Berry Weight (g)	Berries per Cluster	Cluster Weight (g)	Yield (kg/vine)
1103P	*ber X rup*	1.71	129	1.10	100	114	14.4
775 P	*ber X rup*	1.78	107	1.04	99	103	11.2
240 Ru	*ber X rip*	1.81	106	1.16	112	130	13.7
5BB	*ber X rip*	1.80	85	1.10	122	135	11.9
99R	*ber X rup*	1.80	93	1.07	112	119	11.2
Cosmo 2	*ber X rip*	1.92	96	1.15	106	122	11.7
110R	*ber X rup*	1.97	87	0.95	112	107	9.9
1447P	*ber X rup*	1.85	77	0.96	91	87	6.7
5C	*ber X rip*	1.80	69	1.08	102	109	7.6
Cosmo10	*ber X rip*	1.84	75	1.10	106	116	8.8
140 Ru	*ber X rup*	1.81	73	0.98	95	93	6.9
Freedom	*ber X rip*	1.74	59	1.05	108	113	6.8
3309C	*rup X rip*	1.79	62	0.95	94	89	5.7
125AA	*ber X rip*	1.77	54	1.04	94	98	5.3
SO4	*rup X rip*	1.84	53	0.88	99	87	4.7
101-14	*ber X rip*	1.89	53	0.93	111	103	5.8
5A	*ber X rip*	1.83	41	1.08	90	98	4.2
1616C	*ber X rip*	1.68	37	0.93	81	75	2.9
8B	*ber X rip*	1.72	33	0.94	66	62	2.1
420A	*ber X rip*	1.67	26	0.88	96	84	2.3
Sig. Level		NS	0.0001	0.0001	0.0001	0.0001	0.0001

Table 6. Vine balance and fruit maturity of Cabernet Sauvignon grown on twenty rootstocks at the Oakville Experimental Vineyard. Vines were balanced pruned to 8 buds / lb of prunings, 2001 data.

Rootstock	Parentage	Final Pruning Weight	Yield (kg/vine)	Crop to Prunings Ratio	Leaf Area per Gram of Fruit	°Brix
1103P	*ber X rup*	2.97	14.4	4.90	26	22.9
775 P	*ber X rup*	2.92	11.2	3.78	28	23.6
240 Ru	*ber X rip*	2.69	13.7	5.10	20	23.6
5BB	*ber X rip*	2.35	11.9	4.88	18	24.4
99R	*ber X rup*	2.24	11.2	4.96	20	23.0
Cosmo 2	*ber X rip*	2.31	11.7	5.04	18	24.3
110R	*ber X rup*	1.88	9.9	4.99	19	24.2
1447P	*ber X rup*	1.89	6.7	3.51	26	23.4
5C	*ber X rip*	1.91	7.6	4.04	22	23.5
Cosmo10	*ber X rip*	1.83	8.8	4.79	19	24.2
140 Ru	*ber X rup*	1.60	6.9	4.27	22	24.6
Freedom	*ber X rip*	1.34	6.8	5.19	20	23.7
3309C	*rup X rip*	1.51	5.7	3.52	26	24.5
125AA	*ber X rip*	1.44	5.3	3.65	25	24.9
SO4	*rup X rip*	1.45	4.7	3.07	28	25.3
101-14	*ber X rip*	1.14	5.8	4.86	18	24.2
5A	*ber X rip*	1.17	4.2	3.47	25	23.7
1616C	*ber X rip*	0.83	2.9	3.44	26	25.1
8B	*ber X rip*	0.81	2.1	2.52	35	24.8
420A	*ber X rip*	0.62	2.3	3.44	23	24.9
Sig. Level		0.0001	0.0001	0.0001	0.0001	0.0001

Figure 1. Influence of rootstock and pruning formula on vigor. Increasing pruning formula from 4 to 16 buds per lb of prunings decreased individual shoot weight and length for each rootstock. A significant interaction occurred in which high capacity rootstocks had higher vigor at the lowest pruning formula.

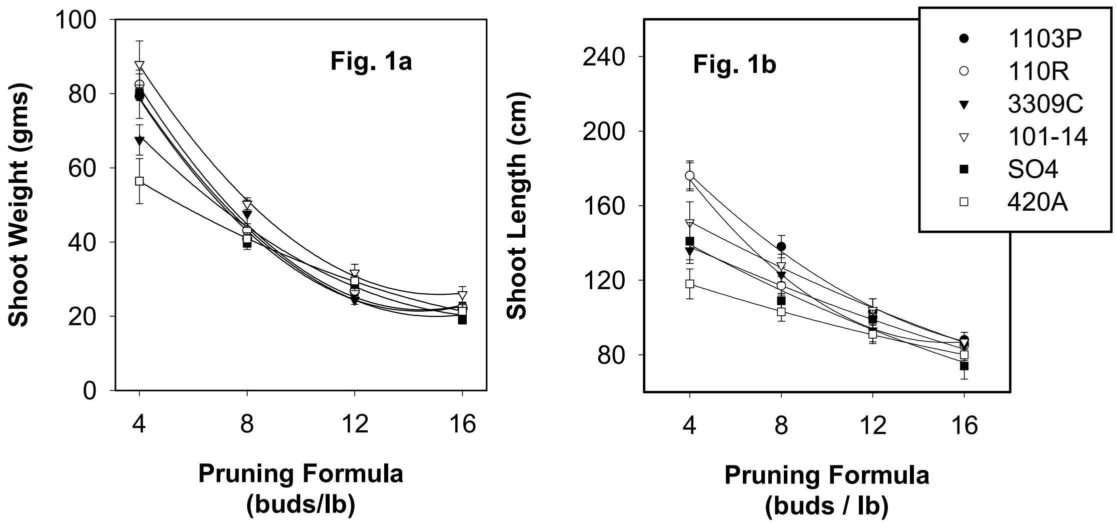


Figure 2. Influence of rootstock and pruning formula on total vegetative growth of Cabernet Sauvignon grown at the Oakville Experimental Vineyard. Vines on 1103P responded curvilinearly to pruning formula. They produced a maximum leaf area and weight of dormant prunings at 8 to 12 buds per pound of prunings.

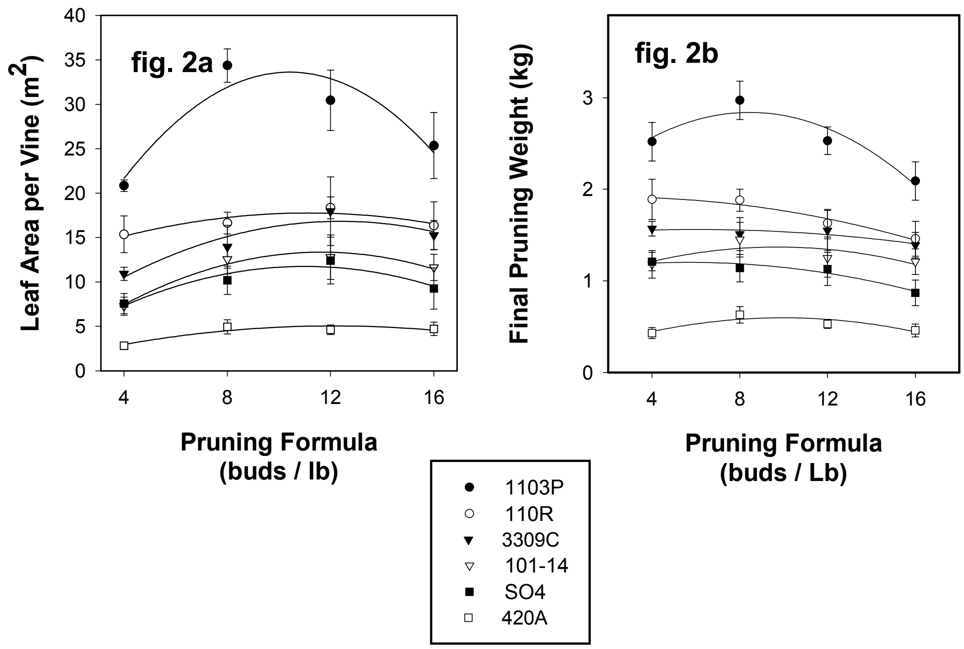


Figure 3. Effect of rootstock and pruning formula on crop yield at harvest, 10/4/2001. Interactions were noted for all components of yield. 1103P berry weight declined above 8 buds/pound. 420A produced fewer clusters per shoot with fewer berries per cluster and therefore smaller clusters at the lowest pruning formula. Overall yield depended primarily on clusters per vine stemming from the retention of more shoots at the higher pruning formulae.

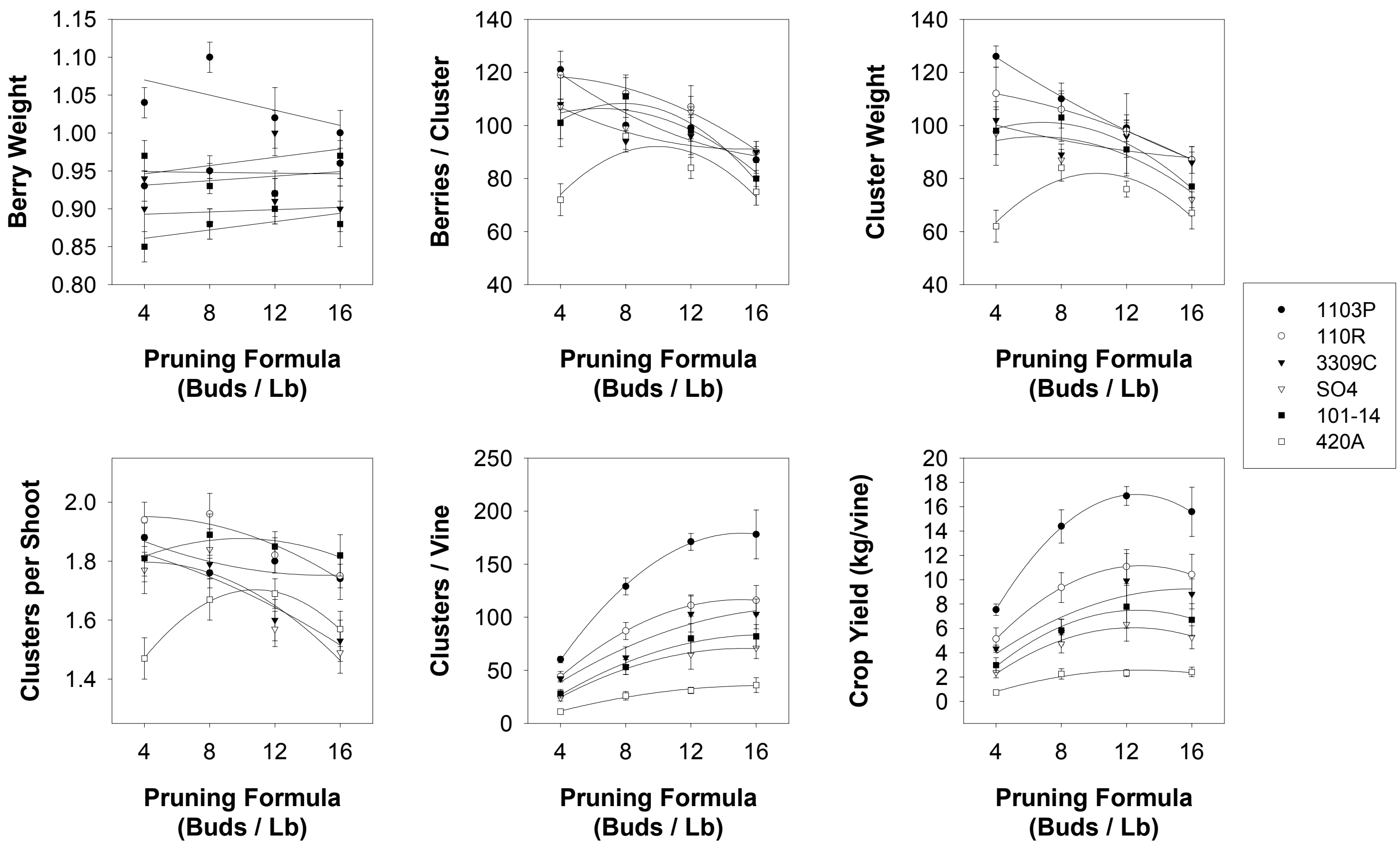


Figure 4. Effect of rootstock and pruning formula on crop to pruning weight ratio and leaf area per gram of fruit. Crop to pruning weight ratios rose with increasing crop per vine on higher capacity rootstocks and at higher pruning formulas. Significant interaction was noted for rootstock/pruning effects on leaf area per vine due to inordinately low crops on 420A at the 4 bud per pound formula.

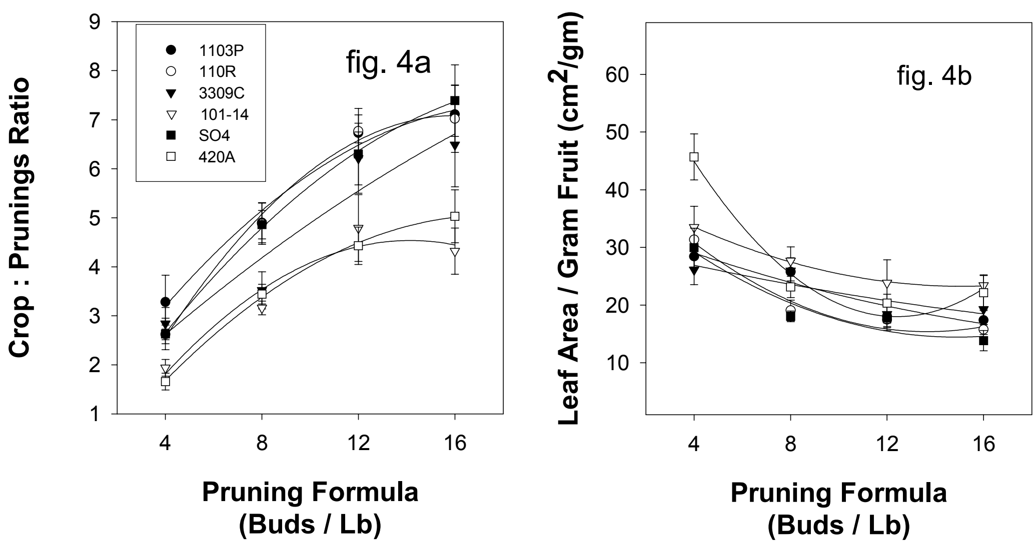


Figure 5. Effect of rootstock and pruning formula on fruit maturity on 9/05/01. Soluble solids was reduced by increased crops from higher pruning formulae and from higher bud numbers retained on high capacity rootstocks. Yield and pruning weight accounted for 64% of the variance. Neither rootstock nor pruning were significant beyond their effects on crop load.

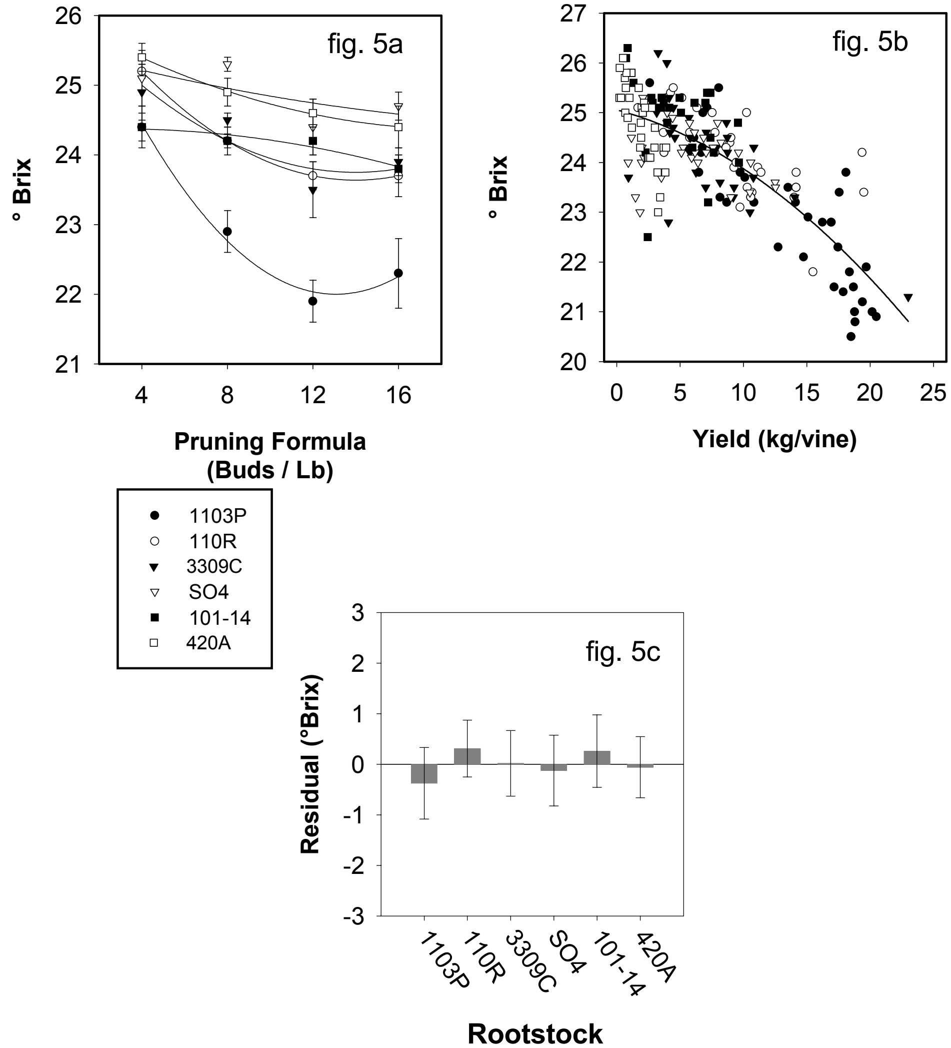


Figure 6. Ranking of 20 rootstocks for vegetative growth of Cabernet Sauvignon grown at the Oakville Experimental Vineyard. 2001 pruning weights were lower than those of 1999 for all rootstocks (fig 6a). Small differential changes resulted in a change in significant change in rank SO4 and Freedom (fig 6b).

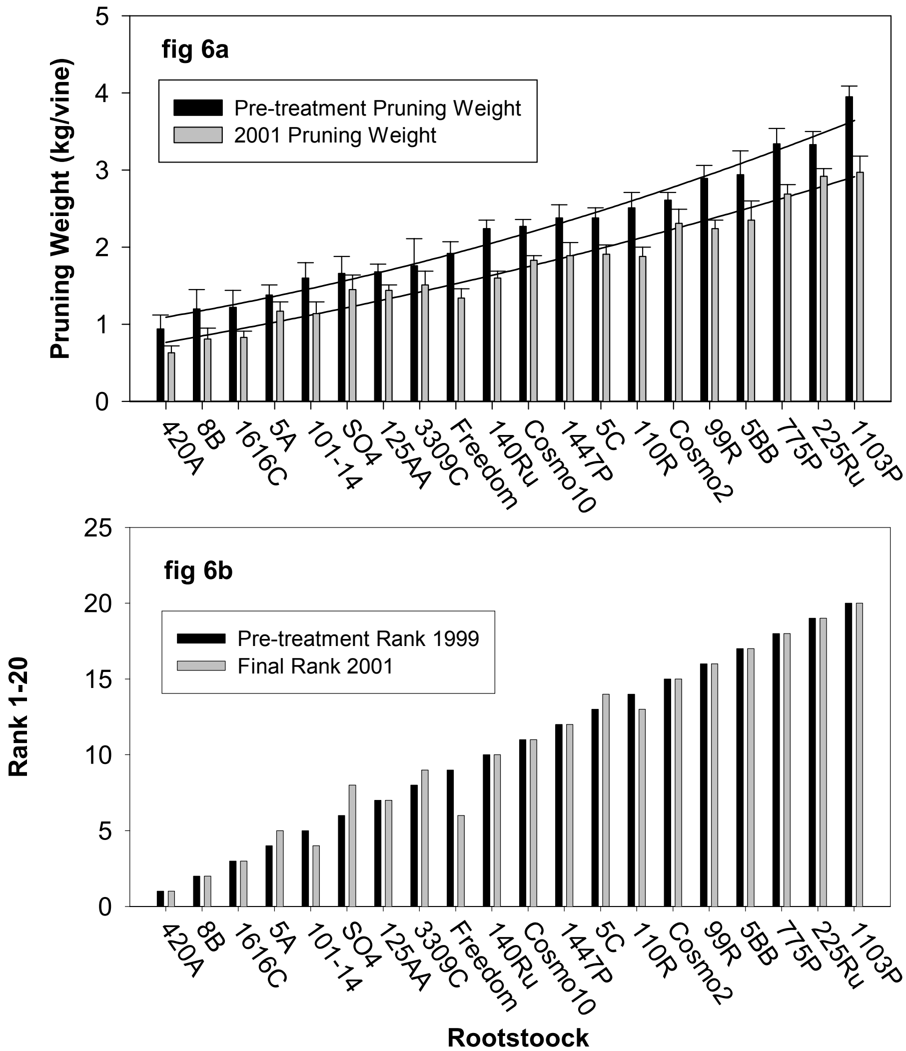


Figure 7. Shoot vigor of Cabernet Sauvignon on 20 rootstocks pruned to 8 bud per pound of prunings. Even though pruned to the same formula, very high capacity vines were more vigorous than very low capacity vines: shoot length correlated with pruning weight.

1=420A	6=Freedom	11=Cosmo 10	16=Cosmo 2
2=Teleki 8B	7=Kobler 125AA	12=1447P	17=5BB
3=1616C	8=SO4	13=5C	18=225Ru
4=101-14	9=3309C	14=110R	19=775P
5=Teleik 5A	10=140Ru	15=99R	20=1103P

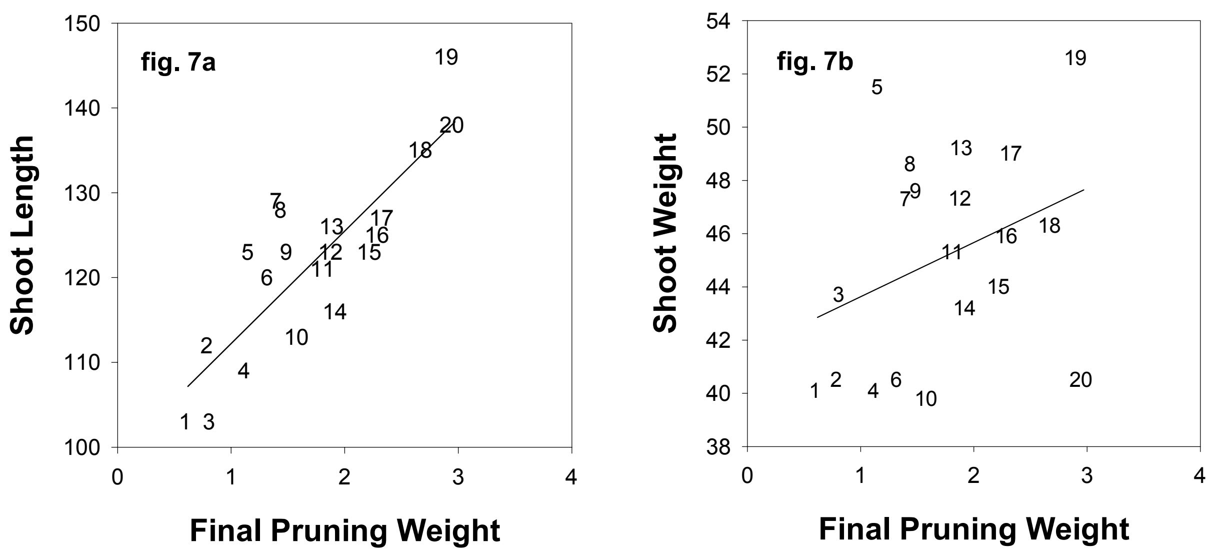


Figure 8. Components of yield for Cabernet Sauvignon grown on 20 rootstocks at Oakville Experimental Vineyard 10/05/01. Rootstocks are arranged in descending order of final vegetative capacity. Reference line is the regression against vegetative rank. All components but clusters per shoot correlated with total vegetative growth, larger vines being more fruitful. Individual stocks additionally affected specific components: primarily berry weight.

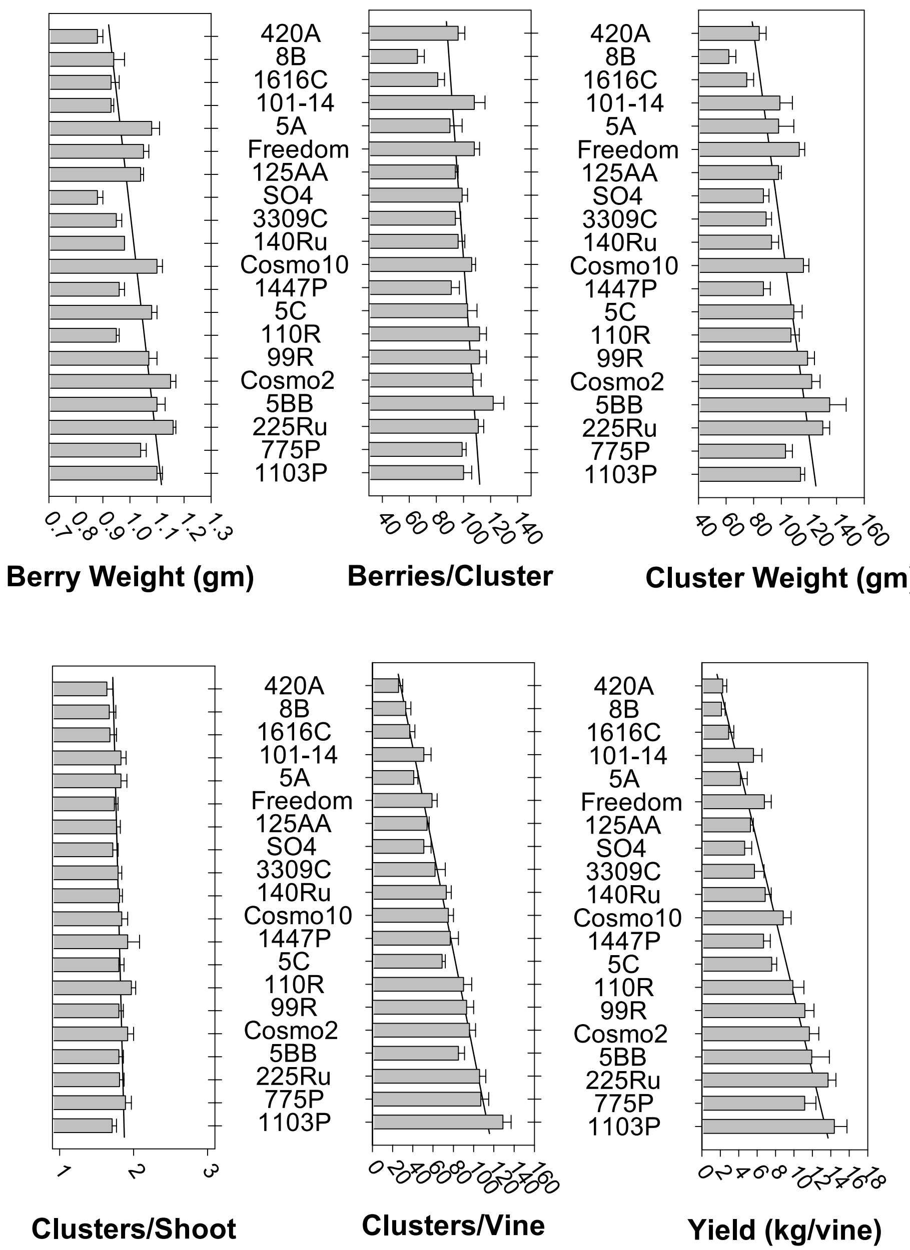
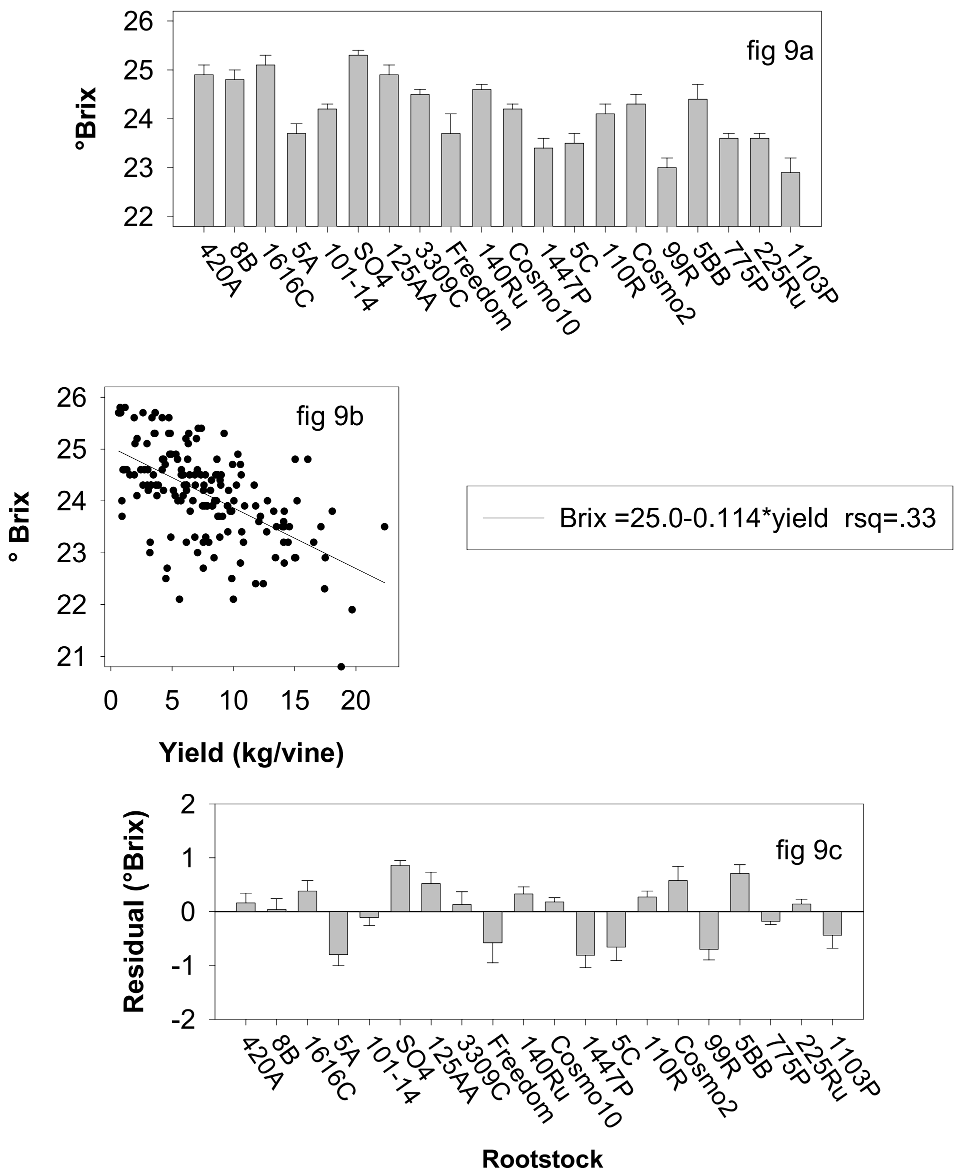


Figure 9. Effect of rootstock on maturation of Cabernet Sauvignon balanced pruned to 8 bud/lb of prunings. °Brix on Freedom, 1447P, 775P, and 99R were significantly below the value predicted by regression against yield per vine. Maturities on Cosmo 2 and 225Ru were above predicted values.



Objective 3. To Test the Interaction of Rootstock with Potassium Application in Merlot

Sonoma County Rootstock Trial

Scion: Merlot

Years conducted: 1996-2001

Years reported: 1997-2001

Rootstocks:

5C
5BB
420A
110 R
1103 P
140 Ru
101-14 Mgt
3309 C
44-53 Mgt

Data has been collected at this trial since 1997. In 2001 the vines received an additional treatment application of potassium fertilizer; prior applications were made in 1994 and 1997. The fertilizer application consisted of 8 lbs K_2SO_4 placed under the drip emitter in the spring.

Rootstock had a large effect on yield regardless of potassium treatment. The yield range for the mean data (1997 – 2001), from high to low, was 2.3x for fertilized vines and 3.0x for unfertilized vines. 110R was the highest yielding rootstock for both the unfertilized (9.8 kg vine^{-1}) and fertilized (10.9 kg vine^{-1}) treatments. In contrast 44-53 was the lowest yielding rootstock for both the unfertilized (4.2 kg vine^{-1}) and fertilized (3.6 kg vine^{-1}) treatments. Across all rootstocks differences in yield were largely the result of cluster weight and cluster number, correlation coefficients of 0.96 and 0.94 respectively.

110R however, achieved its high yield without the benefit of the highest cluster number; that distinction went to 3309. 110R achieved the highest cluster weight with the highest number of berries per cluster of all rootstocks in the trial. Despite having the highest number of clusters 3309 was not the highest yielding rootstock due to relatively low berry number and berry weight. With the exception of berry weight, 44-53 had the lowest values of all rootstocks in all yield components.

For the mean data (1997 – 2001) potassium fertilization had a positive effect on yield for 7 of the 9 rootstocks. Only the yields of 3309 and 44-53 did not benefit from the potassium fertilization. 5BB showed the greatest yield gains (2.4 kg vine^{-1}) with potassium fertilization. Of the rootstocks showing yield increases due to potassium fertilization all had also had an increase in cluster number and, with the exception of 1103P, an increase in shoot number.

The vines were not pruned to a set number of shoots, rather bud number was set at the discretion of the pruner. The vine size and therefore the shoot number was a function of the pruners perception of the vines ability to produce and ripen a crop. It could be argued that by allowing different shoot numbers we may have improperly influenced the yield. It can be expected that vines that are restricted in crop level will respond with an increase in pruning weight. We do not see this. All rootstocks showing increased yield and shoot number with potassium fertilization also showed increased pruning weight. The interpretation may be that since the unfertilized treatments, despite having lower crop levels, had lower pruning weight that they may actually have too many shoots.

For the 2001 data the yield picture was somewhat different than the 1997-2001 mean data. As for the mean data 44-53 had the lowest yields. In fact, the yields of 44-53 were so low (2.0 and 1.7 kg vine^{-1} for unfertilized and fertilized vines respectively) that it appeared to failing at this site. The mean data high yielder 110R however, was not the yield leader in 2001. 5C and 5BB were the highest yielding rootstocks in 2001. 5C had the largest yield among unfertilized vines 10.1 kg vine^{-1} with 5BB second and 5BB had the highest yield among fertilized vines 11.9 kg vine^{-1} with 5C next. The distinguishing yield component was cluster weight where 5C and 5BB had the heaviest cluster weights in the trial.

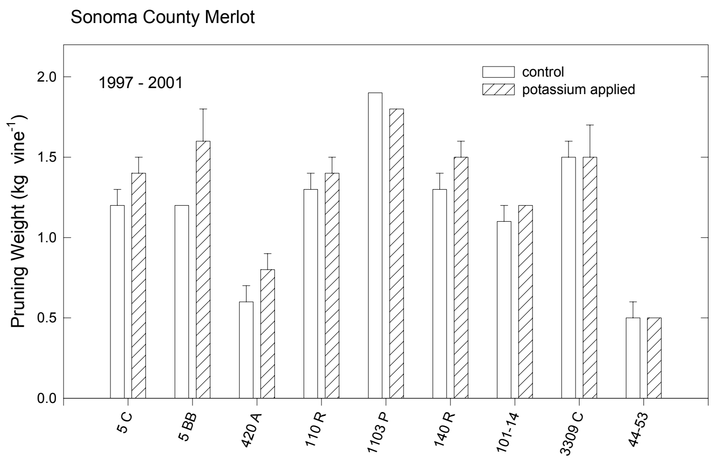
The spread of pruning weight across rootstocks for the mean data (1997 – 2001) was even greater than for yield. The range, high to low, was 3.8x for unfertilized vines and 3.6x for fertilized vines. 1103P had the largest pruning weight and 44-53 the lowest. These two rootstocks also had the highest and lowest shoot numbers. Despite having the largest number of shoots the yield of 1103 was reduced by having among the fewest number of berries per cluster. The 2001 pruning weight data was similar to the 1997-2001 mean data and once again 1103P had the highest pruning weight and 44-53 the lowest.

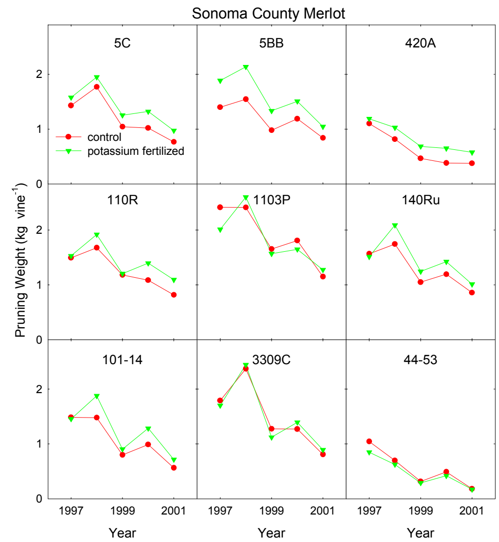
The values of yield to pruning weight seen in this trial exceed what are often considered desirable values. This implies that the vineyard may be, to some extent, over cropped. Data for 2001 show values that may be considered alarmingly high and are larger than those shown in the 1997-2001 mean data for every rootstock.

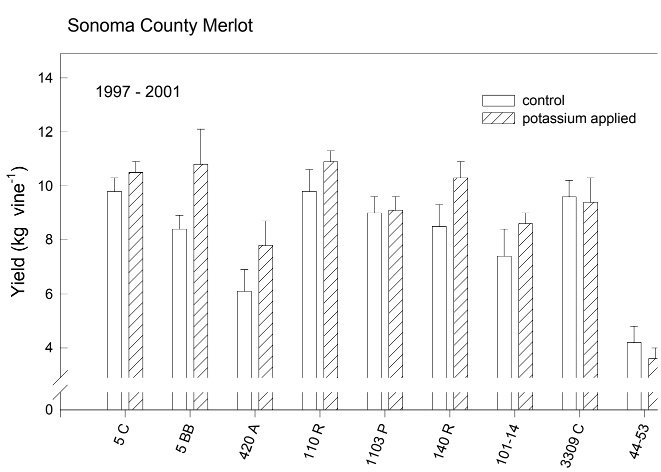
Analysis of juice samples showed little differences in brix or TA. TA values did however, continue to be slightly lower for potassium fertilized vines. There was a large effect on juice pH. Juice pH of potassium fertilized vines was higher for all rootstocks. The increase in pH was more pronounced in 2001 than in the 1997-2001 mean data. Juice pH was highest for 44-53 and 1103P for both the mean and 2001 data and for both fertilized and unfertilized treatments. Juice potassium and pH were highly correlated (correlation coefficient 0.92) and the higher values seen in 2001 may be attributable to the reapplication of potassium fertilizer in 2001.

Table 1. Correlation coefficients from mean data -1997-2001.

	Pruning wt	Shoot number	Shoot weight	Yield	Cluster number	Cluster weight	Yield : Prn wt	Berry per cluster	Berry weight	BRIX	TA	PH	Juice Potassium (PPM)
Pruning wt		0.94	0.98	0.82	0.83	0.76	-0.86	0.61	0.75	0.39	0.04	-0.01	-0.20
Shoot number	0.94		0.87	0.92	0.96	0.84	-0.70	0.79	0.65	0.27	0.29	-0.25	-0.42
Shoot weight	0.98	0.87		0.76	0.73	0.73	-0.89	0.55	0.78	0.41	-0.06	0.06	-0.14
Yield	0.82	0.92	0.76		0.94	0.96	-0.49	0.91	0.70	0.18	0.35	-0.31	-0.42
Cluster number	0.83	0.96	0.73	0.94		0.82	-0.53	0.84	0.54	0.18	0.35	-0.31	-0.44
Cluster weight	0.76	0.84	0.73	0.96	0.82		-0.43	0.92	0.75	0.17	0.36	-0.33	-0.44
Yield : Prn wt	-0.86	-0.70	-0.89	-0.49	-0.53	-0.43		-0.21	-0.69	-0.49	0.29	-0.29	-0.08
Berry per cluster	0.61	0.79	0.55	0.91	0.84	0.92	-0.21		0.44	-0.02	0.60	-0.58	-0.68
Berry weight	0.75	0.65	0.78	0.70	0.54	0.75	-0.69	0.44		0.37	-0.23	0.25	0.17
BRIX	0.39	0.27	0.41	0.18	0.18	0.17	-0.49	-0.02	0.37		-0.38	0.41	0.12
TA	0.04	0.29	-0.06	0.35	0.35	0.36	0.29	0.60	-0.23	-0.38		-0.95	-0.88
PH	-0.01	-0.25	0.06	-0.31	-0.31	-0.33	-0.29	-0.58	0.25	0.41	-0.95		0.92
Juice Potassium (ppm)	-0.20	-0.42	-0.14	-0.42	-0.44	-0.44	-0.08	-0.68	0.17	0.12	-0.88	0.92	


Sonoma County Merlot
1997 - 2001
control
potassium applied
Pruning Weight (kg vine-1)
2.0
1.5
1.0
0.5
0.0
5 C
5 BB
420 A
110 R
1103 P
140 R
101-14
3309 C
44-53


Sonoma County Merlot
5C
5BB
420A
110R
1103P
140Ru
101-14
3309C
44-53
control
potassium fertilized
Pruning Weight (kg vine-1)
Year
1997
1999
2001


Sonoma County Merlot
1997 - 2001
control
potassium applied
Yield (kg vine-1)
14
12
10
8
6
4
0
5 C
5 BB
420 A
110 R
1103 P
140 R
101-14
3309 C
44-53

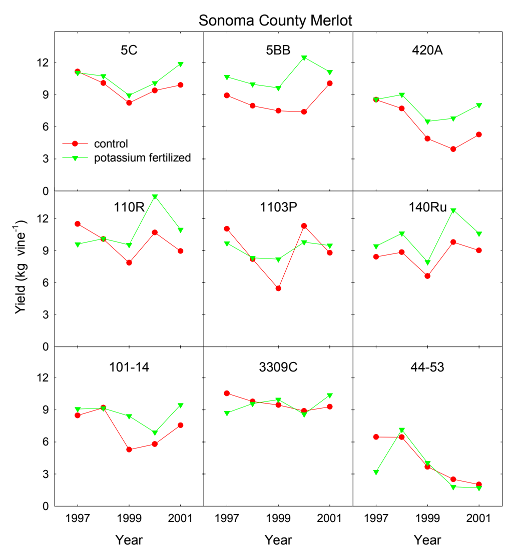

Sonoma County Merlot
5C
5BB
420A
110R
1103P
140Ru
101-14
3309C
44-53
control
potassium fertilized
Yield (kg vine-1)
Year
1997
1999
2001

Table - 1997 - 2001
Sonoma County – Merlot / Rootstock Trial

Rootstock	Yield (kg vine^{-1})		Pruning Weight (kg vine^{-1})		Shoot Number		Yield : Pruning Weight	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	9.8 ± 0.5	10.5 ± 0.4	1.2 ± 0.1	1.4 ± 0.1	35 ± 1	36 ± 1	9.0 ± 0.6	8.1 ± 0.3
5BB	8.4 ± 0.5	10.8 ± 1.3	1.2 ± 0.0	1.6 ± 0.2	31 ± 2	36 ± 1	7.6 ± 0.4	7.4 ± 0.2
420A	6.1 ± 0.8	7.8 ± 0.9	0.6 ± 0.1	0.8 ± 0.1	25 ± 2	29 ± 2	11.8 ± 1.1	10.2 ± 0.3
110R	9.8 ± 0.8	10.9 ± 0.4	1.3 ± 0.1	1.4 ± 0.1	33 ± 2	35 ± 1	8.3 ± 0.3	8.0 ± 0.3
1103 P	9.0 ± 0.6	9.1 ± 0.5	1.9 ± 0.0	1.8 ± 0.0	38 ± 1	37 ± 1	5.1 ± 0.3	5.3 ± 0.2
140Ru	8.5 ± 0.8	10.3 ± 0.6	1.3 ± 0.1	1.5 ± 0.1	34 ± 2	36 ± 1	7.4 ± 0.4	7.6 ± 0.1
101-14	7.4 ± 1.0	8.6 ± 0.4	1.1 ± 0.1	1.2 ± 0.0	32 ± 2	35 ± 1	7.8 ± 0.4	7.9 ± 0.4
3309	9.6 ± 0.6	9.4 ± 0.9	1.5 ± 0.1	1.5 ± 0.2	37 ± 1	35 ± 2	7.5 ± 0.7	7.2 ± 0.2
44-53	4.2 ± 0.6	3.6 ± 0.4	0.5 ± 0.1	0.5 ± 0.0	21 ± 2	19 ± 1	9.9 ± 0.8	8.9 ± 0.2
all rootstocks	8.1 ± 0.6	9.0 ± 0.8	1.2 ± 0.1	1.3 ± 0.1	32 ± 2	33 ± 2	8.3 ± 0.6	7.8 ± 0.4

Rootstock	Shoot Weight (g)		Cluster Number		Cluster Weight (g)		Berries per Cluster	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	31 ± 4	34 ± 2	67 ± 2	71 ± 2	150 ± 8	151 ± 7	129 ± 6	127 ± 2
5BB	35 ± 3	38 ± 3	60 ± 4	68 ± 3	142 ± 7	158 ± 13	124 ± 5	128 ± 7
420A	22 ± 2	26 ± 2	53 ± 4	60 ± 3	110 ± 9	131 ± 9	113 ± 6	123 ± 5
110R	34 ± 2	36 ± 2	64 ± 3	67 ± 2	157 ± 7	164 ± 6	130 ± 4	133 ± 2
1103 P	45 ± 1	43 ± 1	64 ± 2	66 ± 2	141 ± 5	140 ± 5	114 ± 4	116 ± 3
140Ru	34 ± 3	36 ± 1	63 ± 4	69 ± 2	137 ± 10	151 ± 6	117 ± 6	125 ± 3
101-14	29 ± 3	31 ± 2	62 ± 4	67 ± 2	117 ± 9	130 ± 4	116 ± 6	118 ± 3
3309	35 ± 3	36 ± 2	72 ± 3	71 ± 3	134 ± 6	134 ± 9	122 ± 4	120 ± 4
44-53	22 ± 2	22 ± 1	43 ± 4	44 ± 4	97 ± 11	82 ± 4	89 ± 9	76 ± 3
all rootstocks	32 ± 2	34 ± 2	61 ± 3	65 ± 3	132 ± 7	138 ± 8	117 ± 4	118 ± 6

Table - 1997 - 2001
Sonoma County – Merlot / Rootstock Trial

Rootstock	Berry Weight (g berry^{-1})		Brix		TA (g l^{-1})		pH	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	1.2 ± 0.0	1.2 ± 0.0	22.1 ± 0.2	22.4 ± 0.2	7.9 ± 0.1	7.4 ± 0.1	3.33 ± 0.01	3.40 ± 0.01
5BB	1.2 ± 0.0	1.3 ± 0.0	22.0 ± 0.1	22.1 ± 0.1	7.1 ± 0.1	7.3 ± 0.3	3.37 ± 0.01	3.41 ± 0.01
420A	1.0 ± 0.0	1.1 ± 0.0	22.1 ± 0.1	22.4 ± 0.1	7.6 ± 0.2	7.3 ± 0.2	3.34 ± 0.01	3.39 ± 0.02
110R	1.2 ± 0.0	1.2 ± 0.0	22.6 ± 0.1	22.6 ± 0.1	7.4 ± 0.2	7.2 ± 0.2	3.37 ± 0.02	3.43 ± 0.01
1103 P	1.2 ± 0.0	1.2 ± 0.0	22.8 ± 0.1	22.5 ± 0.1	7.0 ± 0.2	6.6 ± 0.1	3.44 ± 0.02	3.55 ± 0.01
140Ru	1.2 ± 0.0	1.2 ± 0.0	22.6 ± 0.2	22.6 ± 0.1	7.4 ± 0.3	6.9 ± 0.2	3.37 ± 0.02	3.44 ± 0.01
101-14	1.0 ± 0.0	1.2 ± 0.0	22.3 ± 0.1	22.2 ± 0.2	7.7 ± 0.2	7.1 ± 0.2	3.33 ± 0.01	3.41 ± 0.01
3309	1.1 ± 0.0	1.2 ± 0.0	22.4 ± 0.1	22.5 ± 0.1	7.5 ± 0.2	6.9 ± 0.2	3.34 ± 0.01	3.46 ± 0.03
44-53	1.1 ± 0.0	1.1 ± 0.0	22.2 ± 0.2	22.5 ± 0.2	7.1 ± 0.3	6.0 ± 0.1	3.42 ± 0.02	3.63 ± 0.02
all rootstocks	1.1 ± 0.0	1.2 ± 0.0	22.3 ± 0.1	22.4 ± 0.1	7.4 ± 0.1	7.0 ± 0.1	3.37 ± 0.01	3.46 ± 0.03

Rootstock	Juice Potassium (ppm)	
	-K	+K
5C	1733 ± 37	1815 ± 21
5BB	1754 ± 23	1823 ± 21
420A	1725 ± 21	1731 ± 13
110R	1704 ± 24	1773 ± 29
1103 P	1773 ± 26	1893 ± 40
140Ru	1714 ± 45	1801 ± 32
101-14	1651 ± 27	1795 ± 32
3309	1704 ± 55	1823 ± 67
44-53	1851 ± 90	2088 ± 102
all rootstocks	1734 ± 19	1838 ± 34

Table - 1997
Sonoma County – Merlot / Rootstock Trial

Rootstock	Yield (kg vine^{-1})		Pruning Weight (kg vine^{-1})		Shoot Number		Yield : Pruning Weight	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	11.2 ± 1.0	11.1 ± 0.7	1.4 ± 0.3	1.6 ± 0.2	32 ± 2	34 ± 1	8.8 ± 1.2	7.7 ± 1.3
5BB	8.9 ± 1.4	10.7 ± 1.0	1.4 ± 0.2	1.9 ± 0.1	26 ± 5	35 ± 1	6.3 ± 0.3	5.6 ± 0.3
420A	8.5 ± 0.4	8.6 ± 1.3	1.1 ± 0.2	1.2 ± 0.2	26 ± 2	25 ± 2	8.3 ± 0.9	7.8 ± 1.4
110R	11.5 ± 1.1	9.6 ± 0.6	1.5 ± 0.2	1.5 ± 0.1	31 ± 3	32 ± 1	7.8 ± 0.6	6.3 ± 0.3
1103 P	11.0 ± 1.0	9.7 ± 0.6	2.4 ± 0.1	2.0 ± 0.1	37 ± 2	35 ± 2	4.6 ± 0.5	4.8 ± 0.2
140Ru	8.4 ± 1.5	9.4 ± 1.1	1.6 ± 0.3	1.5 ± 0.1	30 ± 2	32 ± 3	6.1 ± 1.6	6.4 ± 1.0
101-14	8.5 ± 1.5	9.1 ± 0.8	1.5 ± 0.2	1.5 ± 0.1	33 ± 3	34 ± 2	5.9 ± 0.8	6.4 ± 0.6
3309	10.5 ± 1.1	8.7 ± 0.7	1.8 ± 0.3	1.7 ± 0.2	35 ± 2	35 ± 2	6.8 ± 1.8	5.3 ± 0.6
44-53	6.5 ± 0.7	3.2 ± 0.3	1.0 ± 0.2	0.9 ± 0.1	23 ± 2	18 ± 1	6.4 ± 0.8	4.1 ± 0.9
all rootstocks	9.5 ± 0.6	8.9 ± 0.8	1.5 ± 0.1	1.5 ± 0.1	30 ± 2	31 ± 2	6.8 ± 0.4	6.0 ± 0.4

Rootstock	Shoot Weight (g)		Cluster Number		Cluster Weight (g)		Berries per Cluster	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	44 ± 9	47 ± 7	65 ± 3	67 ± 3	171 ± 13	165 ± 10	156 ± 17	138 ± 5
5BB	59 ± 7	54 ± 4	56 ± 6	65 ± 3	155 ± 12	160 ± 13	145 ± 11	133 ± 7
420A	44 ± 9	51 ± 10	54 ± 3	56 ± 4	155 ± 4	146 ± 16	151 ± 4	139 ± 8
110R	48 ± 3	49 ± 4	62 ± 4	61 ± 4	179 ± 12	155 ± 4	151 ± 5	134 ± 4
1103 P	66 ± 3	58 ± 3	74 ± 3	67 ± 5	150 ± 11	139 ± 5	132 ± 8	121 ± 5
140Ru	54 ± 10	49 ± 7	56 ± 5	60 ± 5	144 ± 17	156 ± 12	127 ± 13	131 ± 9
101-14	46 ± 9	43 ± 4	61 ± 6	66 ± 4	131 ± 13	136 ± 5	127 ± 10	123 ± 5
3309	53 ± 10	49 ± 4	73 ± 4	68 ± 3	143 ± 8	127 ± 8	133 ± 9	103 ± 7
44-53	45 ± 4	46 ± 4	45 ± 3	35 ± 2	142 ± 18	89 ± 11	118 ± 16	72 ± 11
all rootstocks	51 ± 3	50 ± 1	60 ± 3	61 ± 3	152 ± 5	141 ± 8	138 ± 4	122 ± 7

Table - 1997
Sonoma County – Merlot / Rootstock Trial

Rootstock	Berry Weight (g berry^{-1})		Brix		TA (g l^{-1})		pH	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	1.1 ± 0.1	1.2 ± 0.0	23.1 ± 0.4	23.0 ± 0.1	6.9 ± 0.2	5.9 ± 0.2	3.34 ± 0.02	3.45 ± 0.01
5BB	1.1 ± 0.0	1.2 ± 0.0	23.3 ± 0.4	23.3 ± 0.2	6.2 ± 0.2	5.8 ± 0.4	3.41 ± 0.02	3.51 ± 0.03
420A	1.0 ± 0.0	1.1 ± 0.1	23.0 ± 0.1	23.0 ± 0.1	6.6 ± 0.2	6.1 ± 0.2	3.32 ± 0.00	3.37 ± 0.02
110R	1.2 ± 0.1	1.2 ± 0.0	23.7 ± 0.3	24.1 ± 0.0	6.8 ± 0.1	6.3 ± 0.1	3.31 ± 0.01	3.38 ± 0.02
1103 P	1.1 ± 0.0	1.2 ± 0.0	23.5 ± 0.3	23.3 ± 0.2	6.6 ± 0.1	6.2 ± 0.1	3.40 ± 0.02	3.52 ± 0.03
140Ru	1.1 ± 0.0	1.2 ± 0.0	23.8 ± 0.2	23.8 ± 0.3	7.4 ± 0.4	6.2 ± 0.2	3.34 ± 0.01	3.47 ± 0.02
101-14	1.0 ± 0.0	1.1 ± 0.1	22.6 ± 0.2	22.9 ± 0.3	7.0 ± 0.3	6.1 ± 0.4	3.32 ± 0.02	3.46 ± 0.02
3309	1.1 ± 0.0	1.2 ± 0.0	23.7 ± 0.2	23.9 ± 0.4	6.9 ± 0.1	6.2 ± 0.3	3.37 ± 0.01	3.50 ± 0.02
44-53	1.2 ± 0.0	1.3 ± 0.1	22.9 ± 0.1	21.8 ± 0.5	6.8 ± 0.2	5.8 ± 0.3	3.33 ± 0.02	3.50 ± 0.01
all rootstocks	1.1 ± 0.0	1.2 ± 0.0	23.3 ± 0.1	23.2 ± 0.2	6.8 ± 0.1	6.1 ± 0.1	3.35 ± 0.01	3.46 ± 0.02

Rootstock	Juice Potassium (ppm)	
	-K	+K
5C	1709 ± 84	1804 ± 68
5BB	1934 ± 167	1968 ± 80
420A	1878 ± 110	1767 ± 73
110R	1572 ± 42	1579 ± 36
1103 P	1711 ± 49	1834 ± 94
140Ru	1642 ± 59	1831 ± 50
101-14	1613 ± 44	1761 ± 43
3309	1801 ± 200	1900 ± 94
44-53	1503 ± 34	1675 ± 51
all rootstocks	1707 ± 47	1791 ± 38

Table - 1998
Sonoma County – Merlot / Rootstock Trial

Rootstock	Yield (kg vine^{-1})		Pruning Weight (kg vine^{-1})		Shoot Number		Yield : Pruning Weight	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	10.1 ± 1.2	10.7 ± 0.4	1.8 ± 0.1	1.9 ± 0.1	34 ± 2	37 ± 1	5.7 ± 0.5	5.6 ± 0.3
5BB	8.0 ± 0.9	10.0 ± 1.0	1.5 ± 0.1	2.1 ± 0.2	29 ± 3	34 ± 2	5.1 ± 0.3	4.8 ± 0.4
420A	7.7 ± 0.8	9.0 ± 1.1	0.8 ± 0.1	1.0 ± 0.2	24 ± 2	28 ± 3	9.8 ± 1.3	9.2 ± 0.8
110R	10.1 ± 1.2	10.1 ± 0.5	1.7 ± 0.2	1.9 ± 0.1	32 ± 2	31 ± 2	6.0 ± 0.3	5.3 ± 0.2
1103 P	8.2 ± 1.0	8.3 ± 0.6	2.4 ± 0.1	2.6 ± 0.1	37 ± 1	36 ± 2	3.4 ± 0.3	3.2 ± 0.3
140Ru	8.9 ± 1.3	10.6 ± 0.6	1.7 ± 0.3	2.1 ± 0.1	29 ± 4	33 ± 3	5.3 ± 0.6	5.1 ± 0.3
101-14	9.2 ± 1.2	9.2 ± 0.7	1.5 ± 0.2	1.9 ± 0.1	30 ± 2	34 ± 2	6.3 ± 0.6	4.9 ± 0.3
3309	9.8 ± 0.9	9.6 ± 0.8	2.4 ± 0.3	2.4 ± 0.3	37 ± 2	35 ± 2	4.3 ± 0.5	4.0 ± 0.2
44-53	6.5 ± 1.3	7.2 ± 0.9	0.7 ± 0.2	0.6 ± 0.1	20 ± 2	17 ± 2	9.5 ± 0.5	11.8 ± 1.1
all rootstocks	8.7 ± 0.4	9.4 ± 0.4	1.6 ± 0.2	1.9 ± 0.2	30 ± 2	32 ± 2	6.2 ± 0.7	6.0 ± 0.9

Rootstock	Shoot Weight (g)		Cluster Number		Cluster Weight (g)		Berries per Cluster	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	26 ± 3	27 ± 1	62 ± 7	72 ± 1	165 ± 9	150 ± 6	142 ± 5	131 ± 9
5BB	27 ± 1	31 ± 2	52 ± 5	60 ± 2	152 ± 8	165 ± 12	142 ± 7	137 ± 8
420A	17 ± 2	18 ± 2	59 ± 5	58 ± 6	131 ± 7	157 ± 8	151 ± 5	161 ± 10
110R	26 ± 2	31 ± 1	60 ± 5	57 ± 2	168 ± 11	177 ± 9	145 ± 10	152 ± 7
1103 P	33 ± 2	36 ± 0	60 ± 6	61 ± 5	135 ± 5	137 ± 9	113 ± 8	119 ± 8
140Ru	30 ± 2	32 ± 2	58 ± 6	65 ± 4	153 ± 15	163 ± 8	142 ± 12	145 ± 8
101-14	25 ± 3	28 ± 2	63 ± 5	57 ± 2	145 ± 11	161 ± 13	153 ± 13	147 ± 11
3309	32 ± 2	35 ± 2	71 ± 6	66 ± 5	140 ± 9	146 ± 4	132 ± 9	136 ± 5
44-53	17 ± 2	18 ± 1	49 ± 4	52 ± 6	131 ± 23	137 ± 5	137 ± 14	148 ± 8
all rootstocks	26 ± 2	28 ± 2	59 ± 2	61 ± 2	147 ± 5	155 ± 4	140 ± 4	142 ± 4

Table - 1998
Sonoma County – Merlot / Rootstock Trial

Rootstock	Berry Weight (g berry^{-1})		Brix		TA (g l^{-1})		pH	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	1.2 ± 0.0	1.2 ± 0.1	20.4 ± 0.3	21.4 ± 0.2	7.5 ± 0.2	6.8 ± 0.2	3.21 ± 0.01	3.26 ± 0.01
5BB	1.1 ± 0.0	1.2 ± 0.0	20.7 ± 0.3	21.4 ± 0.1	6.8 ± 0.2	6.8 ± 0.2	3.23 ± 0.01	3.27 ± 0.02
420A	0.9 ± 0.0	1.0 ± 0.0	20.4 ± 0.6	21.8 ± 0.2	6.8 ± 0.3	6.1 ± 0.3	3.25 ± 0.02	3.28 ± 0.03
110R	1.2 ± 0.0	1.2 ± 0.0	22.0 ± 0.1	21.7 ± 0.2	6.7 ± 0.3	6.3 ± 0.4	3.28 ± 0.02	3.32 ± 0.03
1103 P	1.2 ± 0.1	1.2 ± 0.0	21.8 ± 0.1	21.6 ± 0.2	6.4 ± 0.1	6.0 ± 0.1	3.29 ± 0.01	3.35 ± 0.02
140Ru	1.1 ± 0.1	1.1 ± 0.0	21.2 ± 0.2	21.3 ± 0.1	6.2 ± 0.2	5.8 ± 0.1	3.26 ± 0.02	3.31 ± 0.01
101-14	1.0 ± 0.0	1.1 ± 0.0	21.8 ± 0.1	22.0 ± 0.3	6.6 ± 0.2	6.2 ± 0.2	3.24 ± 0.02	3.28 ± 0.01
3309	1.1 ± 0.0	1.1 ± 0.0	21.6 ± 0.1	21.4 ± 0.3	6.3 ± 0.2	6.1 ± 0.3	3.25 ± 0.03	3.34 ± 0.03
44-53	0.9 ± 0.1	0.9 ± 0.1	19.6 ± 0.7	20.6 ± 0.3	7.0 ± 0.3	5.9 ± 0.1	3.19 ± 0.02	3.31 ± 0.02
all rootstocks	1.1 ± 0.0	1.1 ± 0.0	21.0 ± 0.3	21.5 ± 0.1	6.7 ± 0.1	6.2 ± 0.1	3.24 ± 0.01	3.30 ± 0.01

Rootstock	Juice Potassium (ppm)	
	-K	+K
5C	1609 ± 44	1702 ± 122
5BB	1514 ± 99	1722 ± 42
420A	1552 ± 131	1516 ± 53
110R	1503 ± 126	1540 ± 42
1103 P	1545 ± 99	1586 ± 84
140Ru	1543 ± 138	1623 ± 100
101-14	1475 ± 109	1741 ± 77
3309	1405 ± 36	1573 ± 91
44-53	1658 ± 123	1595 ± 89
all rootstocks	1534 ± 25	1622 ± 27

Table - 1999
Sonoma County – Merlot / Rootstock Trial

Rootstock	Yield (kg vine^{-1})		Pruning Weight (kg vine^{-1})		Shoot Number		Yield : Pruning Weight	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	8.2 ± 0.6	9.0 ± 0.4	1.0 ± 0.1	1.3 ± 0.1	36 ± 1	38 ± 1	8.0 ± 0.4	7.2 ± 0.2
5BB	7.5 ± 0.6	9.6 ± 1.5	1.0 ± 0.1	1.3 ± 0.2	32 ± 2	36 ± 2	7.9 ± 0.8	7.4 ± 0.4
420A	4.9 ± 0.9	6.5 ± 1.1	0.5 ± 0.1	0.7 ± 0.1	20 ± 4	28 ± 3	10.8 ± 1.2	9.8 ± 1.0
110R	7.9 ± 0.5	9.5 ± 1.1	1.2 ± 0.1	1.2 ± 0.1	33 ± 2	36 ± 1	6.7 ± 0.2	8.0 ± 0.9
1103 P	5.5 ± 0.6	8.2 ± 0.4	1.7 ± 0.1	1.6 ± 0.1	39 ± 1	40 ± 1	3.3 ± 0.4	5.3 ± 0.3
140Ru	6.6 ± 1.2	7.9 ± 0.5	1.0 ± 0.1	1.2 ± 0.1	35 ± 2	37 ± 2	6.3 ± 0.7	6.4 ± 0.2
101-14	5.3 ± 1.3	8.4 ± 0.4	0.8 ± 0.1	0.9 ± 0.0	30 ± 3	33 ± 1	6.5 ± 0.8	9.4 ± 0.6
3309	9.5 ± 0.9	10.0 ± 1.1	1.3 ± 0.2	1.1 ± 0.2	37 ± 3	35 ± 3	8.0 ± 1.2	9.2 ± 0.6
44-53	3.7 ± 1.0	4.0 ± 0.4	0.3 ± 0.1	0.3 ± 0.0	15 ± 3	15 ± 2	15.6 ± 4.5	14.1 ± 0.5
all rootstocks	6.6 ± 0.6	8.1 ± 0.6	1.0 ± 0.1	1.1 ± 0.1	31 ± 3	33 ± 2	8.1 ± 1.1	8.5 ± 0.9

Rootstock	Shoot Weight (g)		Cluster Number		Cluster Weight (g)		Berries per Cluster	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	29 3	33 ± 2	69 ± 2	76 ± 3	120 ± 10	119 ± 7	104 ± 9	99 ± 3
5BB	31 4	36 ± 5	67 ± 5	71 ± 5	115 ± 13	134 ± 14	97 ± 8	109 ± 9
420A	24 2	24 ± 1	57 ± 4	58 ± 4	83 ± 11	110 ± 11	84 ± 9	98 ± 8
110R	36 2	34 ± 2	65 ± 3	71 ± 3	122 ± 10	134 ± 12	106 ± 8	113 ± 8
1103 P	43 3	39 ± 2	51 ± 1	70 ± 2	107 ± 11	117 ± 8	89 ± 7	101 ± 7
140Ru	30 4	33 ± 2	62 ± 7	67 ± 2	106 ± 13	118 ± 7	95 ± 13	106 ± 7
101-14	27 3	27 ± 2	57 ± 8	72 ± 3	89 ± 9	118 ± 3	91 ± 9	105 ± 2
3309	34 3	31 ± 3	77 ± 6	78 ± 5	124 ± 9	129 ± 13	117 ± 9	123 ± 10
44-53	20 4	19 ± 2	49 ± 9	58 ± 3	71 ± 12	69 ± 5	67 ± 10	63 ± 6
all rootstocks	30 2	31 ± 2	61 ± 3	69 ± 2	104 ± 6	116 ± 7	94 ± 5	102 ± 6

Table - 1999
Sonoma County – Merlot / Rootstock Trial

Rootstock	Berry Weight (g berry^{-1})		Brix		TA (g l^{-1})		pH	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	1.2 ± 0.0	1.2 ± 0.1	22.5 ± 0.3	22.9 ± 0.2	8.9 ± 0.2	8.9 ± 0.5	3.29 ± 0.01	3.40 ± 0.01
5BB	1.2 ± 0.0	1.2 ± 0.1	22.1 ± 0.1	22.1 ± 0.2	8.0 ± 0.1	9.1 ± 0.4	3.35 ± 0.02	3.40 ± 0.03
420A	1.0 ± 0.1	1.1 ± 0.0	22.0 ± 0.4	22.5 ± 0.3	8.7 ± 0.3	8.8 ± 0.3	3.27 ± 0.02	3.39 ± 0.05
110R	1.2 ± 0.0	1.2 ± 0.0	22.5 ± 0.1	22.6 ± 0.3	8.5 ± 0.5	9.3 ± 0.4	3.33 ± 0.03	3.43 ± 0.03
1103 P	1.2 ± 0.0	1.2 ± 0.0	23.2 ± 0.1	23.2 ± 0.1	8.5 ± 0.5	8.7 ± 0.2	3.46 ± 0.03	3.63 ± 0.03
140Ru	1.1 ± 0.0	1.1 ± 0.1	23.2 ± 0.3	23.1 ± 0.2	8.8 ± 0.4	8.8 ± 0.5	3.32 ± 0.03	3.43 ± 0.04
101-14	1.0 ± 0.0	1.1 ± 0.0	22.7 ± 0.2	22.7 ± 0.2	8.4 ± 0.2	8.2 ± 0.3	3.34 ± 0.03	3.39 ± 0.03
3309	1.1 ± 0.0	1.0 ± 0.0	22.2 ± 0.3	22.6 ± 0.2	9.0 ± 0.3	8.9 ± 0.3	3.28 ± 0.02	3.42 ± 0.05
44-53	1.1 ± 0.1	1.1 ± 0.1	22.3 ± 0.3	23.3 ± 0.4	8.3 ± 0.5	7.6 ± 0.2	3.31 ± 0.04	3.57 ± 0.04
all rootstocks	1.1 ± 0.0	1.1 ± 0.0	22.5 ± 0.1	22.8 ± 0.1	8.6 ± 0.1	8.7 ± 0.2	3.33 ± 0.02	3.45 ± 0.03

Rootstock	Juice Potassium (ppm)	
	-K	+K
5C	1690 ± 13	1698 ± 57
5BB	1641 ± 65	1601 ± 80
420A	1558 ± 35	1696 ± 45
110R	1740 ± 35	1885 ± 179
1103 P	1629 ± 38	1797 ± 92
140Ru	1798 ± 147	1884 ± 141
101-14	1650 ± 44	1709 ± 45
3309	1601 ± 35	1623 ± 96
44-53	1544 ± 30	1776 ± 96
all rootstocks	1650 ± 27	1741 ± 34

Table - 2000
Sonoma County – Merlot / Rootstock Trial

Rootstock	Yield (kg vine^{-1})		Pruning Weight (kg vine^{-1})		Shoot Number		Yield : Pruning Weight	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	9.4 ± 0.5	10.1 ± 1.0	1.0 ± 0.1	1.3 ± 0.1	30 ± 1	31 ± 1	9.3 ± 0.4	7.6 ± 0.4
5BB	7.4 ± 1.3	12.5 ± 3.1	1.2 ± 0.1	1.5 ± 0.2	30 ± 2	34 ± 3	6.3 ± 0.7	7.9 ± 1.0
420A	3.9 ± 0.9	6.8 ± 1.1	0.4 ± 0.1	0.6 ± 0.1	23 ± 2	29 ± 1	11.1 ± 1.4	10.2 ± 0.9
110R	10.7 ± 1.7	14.1 ± 1.4	1.1 ± 0.1	1.4 ± 0.1	29 ± 3	33 ± 2	9.6 ± 0.9	10.2 ± 0.9
1103 P	11.3 ± 1.5	9.8 ± 1.6	1.8 ± 0.1	1.6 ± 0.1	33 ± 3	30 ± 2	6.2 ± 0.7	5.9 ± 0.9
140Ru	9.8 ± 1.3	12.8 ± 1.3	1.2 ± 0.1	1.4 ± 0.1	32 ± 3	36 ± 1	8.1 ± 0.9	9.1 ± 0.9
101-14	6.3 ± 1.2	6.9 ± 0.5	1.0 ± 0.1	1.3 ± 0.1	30 ± 2	33 ± 1	6.3 ± 0.9	5.5 ± 0.5
3309	8.9 ± 1.6	8.6 ± 1.7	1.3 ± 0.1	1.4 ± 0.1	33 ± 3	32 ± 2	7.0 ± 1.2	5.8 ± 0.9
44-53	2.5 ± 0.7	1.8 ± 0.3	0.5 ± 0.1	0.4 ± 0.0	24 ± 2	25 ± 1	5.4 ± 1.3	4.1 ± 0.6
all rootstocks	7.8 ± 1.0	9.3 ± 1.3	1.0 ± 0.1	1.2 ± 0.1	29 ± 1	31 ± 1	7.7 ± 0.6	7.4 ± 0.7

Rootstock	Shoot Weight (g)		Cluster Number		Cluster Weight (g)		Berries per Cluster	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	34 ± 3	43 ± 2	54 ± 2	56 ± 3	175 ± 11	181 ± 13	110 ± 5	109 ± 7
5BB	39 ± 3	44 ± 2	43 ± 4	59 ± 7	170 ± 18	200 ± 23	103 ± 14	116 ± 16
420A	16 ± 4	23 ± 2	35 ± 4	47 ± 6	105 ± 15	140 ± 10	78 ± 9	92 ± 9
110R	38 ± 2	43 ± 4	50 ± 5	62 ± 5	208 ± 16	226 ± 11	130 ± 15	138 ± 4
1103 P	56 ± 4	55 ± 3	54 ± 5	50 ± 4	204 ± 11	191 ± 16	120 ± 6	111 ± 10
140Ru	37 ± 2	40 ± 3	56 ± 4	64 ± 3	175 ± 18	200 ± 17	104 ± 8	118 ± 8
101-14	32 ± 2	39 ± 4	46 ± 5	56 ± 2	133 ± 15	124 ± 7	89 ± 6	76 ± 5
3309	39 ± 3	43 ± 2	56 ± 4	55 ± 7	155 ± 17	149 ± 19	94 ± 10	92 ± 10
44-53	20 ± 4	17 ± 2	23 ± 2	22 ± 4	101 ± 21	80 ± 3	63 ± 12	53 ± 5
all rootstocks	35 ± 4	39 ± 4	46 ± 4	52 ± 4	158 ± 13	166 ± 15	99 ± 7	101 ± 8

Table - 2000
Sonoma County – Merlot / Rootstock Trial

Rootstock	Berry Weight (g berry^{-1})		Brix		TA (g l^{-1})		pH	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	1.6 ± 0.1	1.7 ± 0.0	21.0 ± 0.3	20.8 ± 0.4	6.8 ± 0.1	6.6 ± 0.2	3.47 ± 0.01	3.49 ± 0.01
5BB	1.7 ± 0.1	1.8 ± 0.1	20.0 ± 0.4	19.8 ± 0.1	7.2 ± 0.2	7.2 ± 0.2	3.40 ± 0.03	3.41 ± 0.02
420A	1.3 ± 0.0	1.6 ± 0.1	21.2 ± 0.4	20.8 ± 0.3	7.1 ± 0.2	7.5 ± 0.1	3.44 ± 0.02	3.46 ± 0.01
110R	1.6 ± 0.1	1.6 ± 0.0	21.0 ± 0.2	20.6 ± 0.3	6.9 ± 0.2	6.6 ± 0.1	3.48 ± 0.02	3.47 ± 0.03
1103 P	1.7 ± 0.0	1.7 ± 0.0	20.8 ± 0.1	20.1 ± 0.3	6.4 ± 0.1	6.3 ± 0.1	3.55 ± 0.02	3.54 ± 0.02
140Ru	1.7 ± 0.1	1.7 ± 0.0	20.8 ± 0.3	20.6 ± 0.3	6.4 ± 0.1	6.2 ± 0.1	3.51 ± 0.02	3.49 ± 0.02
101-14	1.5 ± 0.1	1.6 ± 0.0	20.4 ± 0.2	19.4 ± 0.2	8.0 ± 0.3	7.9 ± 0.2	3.39 ± 0.03	3.36 ± 0.03
3309	1.6 ± 0.0	1.6 ± 0.1	20.1 ± 0.3	19.6 ± 0.1	7.2 ± 0.1	6.6 ± 0.0	3.43 ± 0.03	3.44 ± 0.02
44-53	1.6 ± 0.1	1.5 ± 0.1	21.5 ± 0.1	21.5 ± 0.1	6.5 ± 0.1	5.7 ± 0.1	3.58 ± 0.06	3.70 ± 0.07
all rootstocks	1.6 ± 0.0	1.6 ± 0.0	20.8 ± 0.2	20.4 ± 0.2	7.0 ± 0.2	6.7 ± 0.2	3.47 ± 0.02	3.48 ± 0.03

Rootstock	Juice Potassium (ppm)	
	-K	+K
5C	1976 ± 49	2103 ± 55
5BB	1976 ± 48	2069 ± 22
420A	1980 ± 18	1943 ± 46
110R	1987 ± 72	2016 ± 50
1103 P	2161 ± 51	2201 ± 66
140Ru	1900 ± 39	1945 ± 39
101-14	1920 ± 32	1952 ± 73
3309	2151 ± 87	2153 ± 82
44-53	2265 ± 107	2489 ± 223
all rootstocks	2035 ± 42	2097 ± 58

Table - 2001

Sonoma County – Merlot / Rootstock Trial

Rootstock	Yield (kg vine^{-1})		Pruning Weight (kg vine^{-1})		Shoot Number		Yield : Pruning Weight	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	9.9 ± 0.6	11.9 ± 0.7	0.8 ± 0.1	1.0 ± 0.1	40 ± 2	42 ± 1	13.3 ± 1.0	12.3 ± 0.8
5BB	10.1 ± 1.0	11.1 ± 0.7	0.8 ± 0.1	1.0 ± 0.2	40 ± 3	41 ± 1	12.2 ± 1.2	11.1 ± 0.9
420A	5.3 ± 1.5	8.0 ± 0.9	0.4 ± 0.1	0.6 ± 0.1	32 ± 3	36 ± 1	19.1 ± 5.1	13.9 ± 0.4
110R	9.0 ± 0.5	11.0 ± 0.7	0.8 ± 0.1	1.1 ± 0.1	42 ± 2	42 ± 1	11.5 ± 1.1	10.2 ± 0.6
1103 P	8.8 ± 0.4	9.5 ± 0.4	1.1 ± 0.0	1.3 ± 0.0	44 ± 1	43 ± 1	7.7 ± 0.5	7.4 ± 0.2
140Ru	9.0 ± 1.0	10.6 ± 0.7	0.9 ± 0.1	1.0 ± 0.1	42 ± 3	44 ± 2	11.0 ± 1.8	10.8 ± 0.9
101-14	7.6 ± 0.9	9.5 ± 0.2	0.6 ± 0.1	0.7 ± 0.0	38 ± 2	41 ± 2	13.8 ± 1.2	13.3 ± 0.5
3309	9.3 ± 0.8	10.4 ± 1.0	0.8 ± 0.1	0.9 ± 0.1	41 ± 2	40 ± 2	11.5 ± 0.6	11.9 ± 0.6
44-53	2.0 ± 0.4	1.7 ± 0.3	0.2 ± 0.0	0.2 ± 0.0	21 ± 1	20 ± 3	12.4 ± 2.4	10.5 ± 1.2
all rootstocks	7.9 ± 0.9	9.3 ± 1.0	0.7 ± 0.1	0.9 ± 0.1	38 ± 2	39 ± 2	12.5 ± 1.0	11.3 ± 0.6

Rootstock	Shoot Weight (g)		Cluster Number		Cluster Weight (g)		Berries per Cluster	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	19 ± 2	23 ± 1	84 ± 3	87 ± 6	119 ± 7	139 ± 7	133 ± 5	159 ± 6
5BB	21 ± 2	25 ± 3	85 ± 6	85 ± 2	119 ± 9	132 ± 7	136 ± 5	143 ± 5
420A	11 ± 3	16 ± 1	62 ± 11	80 ± 4	77 ± 14	99 ± 9	99 ± 15	125 ± 8
110R	20 ± 3	26 ± 3	84 ± 4	85 ± 2	108 ± 10	129 ± 7	115 ± 8	128 ± 5
1103 P	26 ± 1	30 ± 1	81 ± 1	82 ± 3	108 ± 4	115 ± 5	115 ± 5	126 ± 8
140Ru	21 ± 2	23 ± 2	85 ± 6	89 ± 3	106 ± 8	119 ± 5	118 ± 6	122 ± 6
101-14	15 ± 1	18 ± 1	84 ± 4	85 ± 5	89 ± 9	112 ± 6	120 ± 9	137 ± 7
3309	20 ± 1	22 ± 2	85 ± 5	87 ± 1	109 ± 6	120 ± 11	135 ± 9	144 ± 10
44-53	9 ± 2	9 ± 1	50 ± 6	51 ± 6	42 ± 10	33 ± 4	60 ± 12	43 ± 5
all rootstocks	18 ± 2	21 ± 2	78 ± 4	81 ± 4	98 ± 8	111 ± 10	115 ± 8	125 ± 11

Table - 2001
Sonoma County – Merlot / Rootstock Trial

Rootstock	Berry Weight (g berry^{-1})		Brix		TA (g l^{-1})		pH	
	-K	+K	-K	+K	-K	+K	-K	+K
5C	0.9 ± 0.0	0.9 ± 0.0	23.5 ± 0.3	23.8 ± 0.2	9.4 ± 0.3	9.0 ± 0.4	3.35 ± 0.03	3.41 ± 0.02
5BB	0.9 ± 0.0	0.9 ± 0.0	23.9 ± 0.2	23.9 ± 0.2	7.4 ± 0.6	7.5 ± 0.6	3.44 ± 0.04	3.46 ± 0.03
420A	0.8 ± 0.0	0.8 ± 0.0	23.7 ± 0.2	23.8 ± 0.1	8.8 ± 0.3	8.1 ± 0.2	3.40 ± 0.01	3.46 ± 0.03
110R	0.9 ± 0.0	1.0 ± 0.0	23.8 ± 0.2	24.1 ± 0.2	8.2 ± 0.5	7.4 ± 0.4	3.44 ± 0.05	3.57 ± 0.04
1103 P	0.9 ± 0.0	0.9 ± 0.0	24.5 ± 0.2	24.6 ± 0.2	7.3 ± 0.5	6.0 ± 0.1	3.51 ± 0.03	3.70 ± 0.04
140Ru	0.9 ± 0.0	1.0 ± 0.0	24.0 ± 0.3	24.1 ± 0.1	8.2 ± 0.6	7.5 ± 0.3	3.42 ± 0.05	3.52 ± 0.03
101-14	0.7 ± 0.0	0.8 ± 0.0	24.1 ± 0.1	24.3 ± 0.1	8.6 ± 0.2	7.4 ± 0.4	3.38 ± 0.03	3.56 ± 0.03
3309	0.8 ± 0.0	0.8 ± 0.1	24.4 ± 0.1	24.8 ± 0.3	8.2 ± 0.4	6.9 ± 0.4	3.38 ± 0.02	3.61 ± 0.07
44-53	0.7 ± 0.0	0.8 ± 0.0	25.0 ± 0.4	25.2 ± 0.3	6.9 ± 0.5	5.2 ± 0.2	3.69 ± 0.06	4.08 ± 0.07
all rootstocks	0.8 ± 0.0	0.9 ± 0.0	24.1 ± 0.2	24.3 ± 0.2	8.1 ± 0.3	7.2 ± 0.4	3.45 ± 0.03	3.60 ± 0.07

Rootstock	Juice Potassium (ppm)	
	-K	+K
5C	1681 ± 53	1767 ± 55
5BB	1704 ± 26	1758 ± 18
420A	1659 ± 37	1732 ± 46
110R	1718 ± 109	1846 ± 67
1103 P	1820 ± 38	2045 ± 63
140Ru	1686 ± 54	1722 ± 36
101-14	1596 ± 47	1811 ± 63
3309	1560 ± 22	1867 ± 80
44-53	2283 ± 391	2904 ± 316
all rootstocks	1745 ± 72	1939 ± 125

Table 1: Effect of rootstock on components of yield for dry farmed Cabernet Sauvignon. Oakville, CA. Data is the mean of five years 1997-2001.

Rootstock	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
5-C	19.0	1.84	35	118	1.17	138	4.9	3.7
110R	19.3	1.85	36	118	1.13	134	4.9	3.7
140 Ru	19.3	1.88	37	118	1.14	134	5.0	3.8
1103P	19.2	1.89	37	121	1.11	134	5.1	3.8
Signif. Level	NS	NS	0.04	NS	0.03	NS	NS	NS

Table 2: Effect of in-row spacing on components of yield for dry farmed Cabernet Sauvignon. Oakville, Ca. Data is the mean of five years 1997-2001.

In-row Spacing	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
1.0 M	11.9	1.77	21	112	1.10	124	2.6	3.2
1.6 M	19.6	1.90	37	121	1.15	140	5.2	4.0
2.2 M	26.1	1.93	50	123	1.15	141	7.2	4.0
Signif. Levels	0.0001	0.05	0.0001	0.002	0.01	0.0006	0.0001	0.001

Table 3: Interaction of rootstock and in-row spacing on components of yield for dry farmed cabernet sauvignon. Oakville, Ca. Data is the mean of five years 1997-2001

Stock	Space	Shoots per Vine	Cluster per Shoot	Cluster Per Vine	Berries Per Cluster	Berry Weight (gm)	Cluster Weight (gm)	Crop Yield Kg/ vine	Ton/Ac
5-C	1.0M	11.7	1.80	21	112	1.16	131	2.8	3.4
5-C	1.6M	19.3	1.86	36	123	1.16	143	5.2	4.0
5-C	2.2M	25.8	1.86	48	118	1.18	140	6.8	3.8
110R	1.0M	12.0	1.79	21	113	1.09	124	2.7	3.3
110R	1.6M	19.4	1.85	36	118	1.15	136	4.9	3.8
110R	2.2M	26.5	1.92	51	122	1.16	141	7.2	4.0
140 Ru	1.0M	11.8	1.78	21	110	1.10	121	2.6	3.1
140 Ru	1.6M	20.0	1.90	38	120	1.16	140	5.3	4.1
140 Ru	2.2M	26.0	1.97	51	123	1.15	141	7.3	4.1
1103P	1.0M	11.9	1.70	20	112	1.07	120	2.4	3.0
1103P	1.6M	19.7	2.00	40	123	1.13	139	5.6	4.3
1103P	2.2M	25.9	1.97	51	128	1.12	143	7.4	4.1
Signif. Level		NS	NS(.07)	NS(.06)	NS	NS(.08)	0.01	0.05	0.02

Table 4: Significance of treatment interactions with year on components of yield for dry farmed cabernet sauvignon. Oakville, Ca. Data is the mean of five years 1997-2001

	Shoots per Vine	Clusters per Shoot	Clusters Per Vine	Berries Per Cluster	Berry Weight (gm)	Cluster Weight (gm)	Crop Yield	
							Kg/ Vine	Ton/Ac
Year	NS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Year*Stock	NS	NS	0.02	0.004	NS	0.001	0.0005	0.0008
Year*Space	0.0002	0.002	0.003	NS	NS	NS	0.0001	0.006
Year*Stock*Space	NS	NS	NS	NS	NS	NS	0.006	0.05

Table 5: Effect of Rootstock on fruit composition at harvest of dry farmed Cabernet Sauvignon. Oakville, Ca. Data is the mean of five years 1997-2001

Rootstock	Soluble Solids (°Brix)	pH	Titratable Acidity (gm/L)	Potassium (ppm)
5-C	24.3	3.32	6.9	1490
110R	25.0	3.32	7.2	1570
140 Ru	25.2	3.36	7.2	1540
1103P	24.9	3.38	7.4	1690
Signif. Level	0.006	0.0001	0.04	0.01

Table 6: Effect of in-row spacing on fruit composition of at harvest of dry farmed Cabernet Sauvignon. Oakville, Ca. Data is the mean of five years 1997-2001

In-Row Spacing	Soluble Solids (°Brix)	PH	Titratable Acidity (gm/L)	Potassium (ppm)
1.0 M	25.2	3.36	7.1	1630
1.6 M	24.7	3.36	7.2	1580
2.2 M	24.6	3.32	7.3	1510
Signif. Levels	0.006	0.04	0.03	0.04

Table 7: Interaction of rootstock and in-row spacing on fruit composition at harvest of dry farmed Cabernet Sauvignon. Oakville, Ca. 1997-2001

Stock	Spacing	Soluble Solids (°Brix)	PH	Titratable Acid (gm/L)	Potassium (ppm)
5-C	1.0M	24.5	3.34	6.9	1510
5-C	1.6M	24.4	3.33	6.8	1510
5-C	2.2M	24.1	3.29	7.0	1440
110R	1.0M	25.4	3.32	7.1	1600
110R	1.6M	24.9	3.34	7.2	1600
110R	2.2M	24.8	3.30	7.3	1510
140 Ru	1.0M	25.7	3.39	7.1	1620
140 Ru	1.6M	25.1	3.36	7.2	1510
140 Ru	2.2M	24.8	3.33	7.2	1500
1103P	1.0M	25.4	3.40	7.3	1790
1103P	1.6M	24.5	3.39	7.4	1690
1103P	2.2M	24.9	3.36	7.5	1580
Signif. Level		NS	NS	NS	NS

Table 8: Significance of treatment interactions with year on fruit composition at harvest of dry farmed Cabernet Sauvignon. Oakville, Ca. 1997-2001

	Soluble Solids (°Brix)	PH	Titratable Acidity (gm/L)	Potassium (ppm)
Year	0.0001	0.05	0.0001	NS
Year*Stock	0.0001	NS	0.006	NS
Year*Space	NS	NS	NS	NS
Year*Stock*Space	NS	NS	NS	NS

Table 9: Influence of rootstock on pruning weight and average weight of dormant canes of dry farmed Cabernet Sauvignon at Oakville, Ca. Data is the mean of five years 1997-2001.

Rootstock	Shoots Per Vine	Shoot Weight (gm)	Pruning Weight (kg/vine)	Yield : Pruning Ratio
5-C	19.0	62	1.15	4.4
110R	19.3	76	1.45	3.5
140 Ru	19.3	88	1.66	3.2
1103P	19.2	104	1.95	2.6
Signif. Level	NS	0.001	0.001	0.0002

Table 10: Influence of in-row spacing on pruning weight and average weight of dormant canes of dry farmed Cabernet Sauvignon at Oakville, Ca. Data is the mean of five years 1997-2001

In-row Spacing	Shoots Per Vine	Shoot Weight (gm)	Pruning Weight (kg/vine)	Yield : Pruning Ratio
1.0 M	11.9	89	1.06	2.8
1.6 M	19.6	83	1.62	3.5
2.2 M	26.1	77	2.01	3.9
Signif. Level	0.0001	0.008	0.0001	0.0002

Table 11: Interaction of rootstock and in-row spacing on vegetative growth for dry farmed cabernet sauvignon at Oakville, Ca. 1997-2001

Stock	Spacing	Shoots Per Vine	Shoot Weight (gm)	Pruning Weight (kg/vine)	Yield : Pruning Ratio
5-C	1.0M	11.7	68	0.81	3.7
5-C	1.6M	19.3	61	1.16	4.5
5-C	2.2M	25.8	56	1.47	5.0
110R	1.0M	12.0	77	0.92	3.0
110R	1.6M	19.4	79	1.54	3.5
110R	2.2M	26.5	71	1.88	4.0
140 Ru	1.0M	11.8	96	1.13	2.5
140 Ru	1.6M	20.0	85	1.69	3.4
140 Ru	2.2M	26.0	83	2.15	3.7
1103P	1.0M	11.9	114	1.35	1.9
1103P	1.6M	19.7	104	2.04	2.8
1103P	2.2M	25.9	96	2.48	3.1
Signif. Level		NS	NS	NS	NS

Table 12: Significance of treatment interactions with year on vegetative growth for dry farmed cabernet sauvignon at Oakville, Ca. 1997-2001

	Shoots Per Vine	Shoot Weight (gm)	Pruning Weight (kg/vine)	Yield : Pruning Ratio
Year	0.0001	0.0001	0.0001	0.0001
Year*Stock	0.01	0.0001	0.0001	0.0003
Year*Space	0.0001	NS	0.0003	0.003
Year*Stock*Space	NS	NS	NS	NS