Evaluation of 35 Wine Grape Cultivars and 'Chardonnay' on 4 Rootstocks Grown in Western Colorado

R. A. Hamman, Jr.[1] and I. E. Dami[2]

Introduction

Wine grape performance is influenced by climatic conditions during each growing season. Evaluating the performance by measuring growth and fruit composition parameters of cultivars grown in western Colorado is extremely helpful to Colorado wine grape growers when deciding what cultivar to plant.

Interest in western Colorado's potential to commercially produce wine grapes continues to increase. Production has grown from less than 20 acres in 1980 to over 350 acres in 1997. Vineyards are being planted at a rate of approximately 25-30 acres per year. These vineyards are being planted in various locations throughout western Colorado often where commercial grape production has never occurred. The topography of these locations varies enough to dramatically influence microclimates and thus fruit quality and production. The following report is intended to provide growers with 1997 performance characteristics of 35 cultivars and one cultivar Chardonnay clone104 grafted to four rootstocks grown at the Orchard Mesa Research Center in Grand Junction, CO.

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[1]Viticulturist. To whom in queries should be addressed. Viticulture Laboratory, Colorado State University Orchard Mesa Research Center, Grand Junction, CO 81503.

[2]Research Assistant. Formerly with the viticulture laboratory, Colorado State University Orchard Mesa Research Center.

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Materials and Methods

Vineyard and weather data were recorded at the Orchard Mesa Research Center (OMRC) in Grand Junction, Colorado at the elevation of 4,596 feet. Two test vineyards (vineyard A is furrow irrigated and vineyard B is drip irrigated) were used. The soils in both vineyards are Mesa clay loams. Each cultivar of vineyard B consists of 16 vines (4 replications with 4 vines per replication) in a randomized complete block design. The rootstock trial was planted in 1992 and consists of 4 rootstocks, with 10 vines per rootstock, in a randomized block design. Chardonnay clone 104 was grafted to the following four rootstocks: 5C, 101-14, 420-A and 3309. All of the grapevines evaluated were between 5 - 13 years old, were spur-pruned and trained to bilateral cordons on a 6-wire vertically shoot positioned trellis system. Vineyard A has 2 vine spacings, 605 vines per acre (7 ft. between vines and 12 ft. between rows) and 726 vines per acre (6 ft. x 10 ft.). Vineyard B and the rootstock trial have a vine spacing of 871 vines per acre (5 ft. x 10 ft.).

Vineyard A was furrow irrigated 6 times the entire season, beginning May 15 and ending July 25, approximately every three weeks. Each irrigation was 6 hours. Vineyard B was drip irrigated 2 times per week beginning May 8 and ending August 29 totaling 25 gallons per vine per week for a season total of 316 gallons per vine. Rainfall recorded at OMRC for the 1997 April - October period was 12.51 inches, a near record for this site. Standard fall irrigations were not applied to either vineyard based on neutron probe soil moisture readings and the 2.7 inches of extra rainfall, well above the 30-year average precipitation level for September and October.

Standard cultural management practices were implemented including spur pruning in March, mechanical weed control (5 separate hydraulic hoe cultivations), pest and disease management control and bird control (plastic netting was applied on August 15). Powdery mildew was controlled with 7 spray applications including 4 wettable sulfur sprays and 3 spray applications of the demethylase inhibitor fungicide Nova. The powdery mildew control program began May 27 and finished August 8. Crop load and vine balance adjustments were made to all cultivars by shoot thinning the first week of June. Overcrowded and weak shoots (<10" growth)

were removed and the remaining shoots were spaced to approximately 4 - 5 shoots per foot of canopy. Crop load was also adjusted by removing excess clusters July 22. Secondary cluster development and clusters on shoots with less than 15 inches of growth were removed. All vines were manually hedged 10" above the top trellis wire by late July. This provides a canopy height of at least 40 inches. Fruit maturity parameters and harvest date were determined by sampling 50 - 100 berries per cultivar and testing for sugar (soluble solids)concentration, total acidity and pH. At harvest, a must sample was taken to determine sugar concentration (EBrix, using Milton Roy Laboratory Refractometer), pH (Orion 720A pH meter) and titratable acidity (titration with 0.100 N sodium hydroxide to end point pH of 8.2). All samples were centrifuged for two minutes at 7,000 rpm using a table top International clinical centrifuge. At harvest, average cluster, fruit, and vine weights and yield (tons per acre) were measured for each cultivar. Clusters per vine, and shoots per vine were counted in August and pruning weights were measured in February and March 1998. The fruit weight to pruning weight ratios also called crop load levels were calculated by dividing the average fruit weight by the average pruning weight. This ratio is a good indicator of vine balance. Chardonnay for example had a ratio of 7.6:1 which indicated that for every 7.6 pounds fruit there is 1 pound of pruned wood, a well balanced vine. Years of research and practical experience have proven that optimum ratios of fruit to wood should be between 5:1 to 10:1 for a wide range of wine grape varieties. Very low ratios of 1:1, 2:1 or 3:1 indicate excessive vegetative growth, whereas high ratios well above 10:1 indicate overcropped vines. Pruning weight per foot of trellised canopy was determined by dividing pruning weight from each plot by spacing between vines.

Climate Summary

Average monthly mid-winter low temperatures recorded at OMRC were 2EF to 7EF warmer during 1997 than the 30-year average. A potentially devastating spring frost (17EF) occurred April 12, 1997. No bud or cane injury or crop reduction from this unusual spring frost were observed. The date of bud break (stage 5 using the Eichorn Lorenz method) was normal for all cultivars presented in Table 3. Bud break began April 25 with Andover and ended May 10 with Sangiovese. Rainfall was abnormally high for this area with 12.9 inches compared to the

normal 6.2 inches for May - October. The total cumulative growing degree days (April 1 - October 31, 50EF base) for 1997 was slightly warmer (3451) than the 30-year average (3328). Harvest began with Aurora, August 21 and ended with Sangiovese October 16. All cultivars were harvested later than the previous 2 years. Chardonnay was harvested October 9 which was 23 days later than 1996 and 14 days later than 1995. One explanation for the late harvest could be from unusually high rainfall and cool weather during the final ripening stage (August - October). During this period, 5.92 inches of moisture was recorded which was 3.42 inches above the 30 year average. The first fall frost of 1997 occurred the morning of October 13 (26EF) and was 2 weeks earlier than normal.

Results and Discussion

Cultivar Trial:

The vines in the cultivar trial are just now becoming mature for data collection. The data presented in tables 1 and 2 are preliminary observations and should not be considered as recommendations. A minimum of 5 years of collected cultivar data are needed before recommendations can be made. The highest yielding cultivar was Flora at 9.7 tons per acre followed by Semillon at 8.3 tons per acre. The lowest yielding cultivar was Norton at 1.6 tons per acre followed by Andover at 2.3 tons per acre. Cluster weights were highest with Semillon at 12.5 ounces per cluster followed closely by Muscat Blanc which averaged 11.1 ounces per cluster (Table 1). Pruning weights per vine were quite variable between cultivars and indicate genetic vigor differences. Malbec, Shiraz and Carmine averaged over 2 pounds of pruning wood per vine, or about 0.5 lbs/ft of canopy and were the most vigorous in this trial. Seigerebe, Pinot Gris, Dolcetto, Andover and Aurora were the least vigorous cultivars with average pruning weights of 0.6 - 0.7 pounds per vine, or 0.1 lbs/ft of canopy. Optimum pruning weights are about 0.3 lbs/ft of canopy.

Fruit weight to pruning weight ratios were acceptable (5:1 to 10:1) for all cultivars except Seigerebe, Semillon, Seyval blanc, Pinot blanc, Dolcetto and Aligote. These cultivars were over

balanced and had fruit to wood ratios that ranged between 11.2 to 19.8. Ratios above 10:1 represent vines with too much fruit and very little foliage. The fruit of an over balanced vine often never adequately matures and this may partially explain the poor sugar development of Seigerebe which had a fruit to wood ratio of 19.8.

At harvest juice composition (Table 2) for all cultivars except Andover was within acceptable range for wine-making purposes. The total acid (TA) for Andover was extremely high at 17.2 g/l. Seigerebe matured with the lowest sugar of 17.8E Brix. Vignoles; had the highest sugar development, 30.2EBrix. The fruit of Vignoles was purposely left to ripen longer and allowed to dessicate to develop a higher sugar concentration for a sweet style reserve wine. No bunch rot was observed from this extra hang time. Vignoles retained desirable high acid (9.8 g/l) and normal pH (3.23) even at 30.2EBrix. pH measurements for all cultivars were recorded between 3.0 - 3.7. Late maturing cultivars such as Rkatsitelli, Riesling, Norton and Sangiovese all achieved desirable juice compositions in spite of the forced harvest immediately following the early frost of October 13.

Rootstock Trial:

The vines in the rootstock trial are just now becoming mature for data collection. The data presented in tables 3 and 4 are preliminary observations and should not be considered as recommendations. A minimum of 5 years of collected rootstock data are needed before recommendations can be made. The observations we made provide some preliminary indications of the performance of 5C, 420A, 3309 and 101-14 rootstocks grafted to Chardonnay 104 in western Colorado. Bud break of vines on rootstock 5C occurred May 2 (Table 5) which was earlier than the self-rooted Chardonnay and all the other rootstocks. Vines of rootstock 3309 were the last to develop with it's bud break occurring on May 6. The date of harvest for all four rootstocks was October 8. Cluster weight, fruit weight per vine and yield (tons per acre) were observed to be greater with 420-A than any other rootstock but similar to self-rooted Chardonnay (Table 3). The rootstocks 3309 and 101-14 had the lowest yields (4.7 tons per acre and 4.6 tons per acre respectively), cluster weights and fruit weights per vine.

The most surprising observation of all four rootstocks in 1997 was the early stunted shoot growth of vines on rootstock 3309. On June 4 we measured shoot length at 4 - 5 inches of vines on 3309 rootstock. Shoot length of vines on 5C rootstocks planted next to and within the same row as of vines on 3309 rootstock measured 24 inches. This stunted growth was not observed with vines on 5C, 420A or 101-14 rootstocks. All rootstocks were irrigated equally at a rate of 25 gallons per vine per week. . One explanation for the stunted growth of vines grafted to 3309 rootstock may be it's low tolerance to saline soils. Studies in France and Australia indicate that vines grafted to 3309 rootstocks do not tolerate saline soils (American Society for Enology and Viticulture rootstock seminar, 1992). However, further study in Colorado is needed to explain this unusual stunted growth of vines on 3309 rootstock.

Juice compositions for all 4 rootstocks (Table 4) were similar but did not show any large differences from self-rooted vines.

Conclusions

The cultural management (i.e. pruning, irrigation, weed control, disease control, shoot thinning, and cluster thinning) and design of this trial allowed us to make growth and fruit composition measurements of 35 cultivars and 4 rootstocks for the 1997 season. Based on this 1997 data, wine grape performance for 33 cultivars and Chardonnay grafted to 4 rootstocks was excellent.. Fruit quality measurements (sugar, acid and pH) were good and can be described as having excellent wine potential. Wine grape performance for Andover and French Columbard was poor. The 1997 harvest was approximately two weeks later than normal, however, fruit quality was not compromised. The rootstock trial needs further study and conclusions are premature, however, the growth performance and fruit quality of vines on 5C and 420-A rootstocks for the 1997 season was good and very similar to the performance of self-rooted vines.

Table 1. 1997 Growth Characteristics for 35 cultivars grown at Orchard Mesa Research Center.

Cultivar	Vine Age	Vineyard Spacing	Tons/ Acre	Cluster Wt. (oz.)	Clusters/ Vine	Fruit Wt./Vine (lbs)	Pruning wt/ft of canopy (lbs)	Pruning Wt.	Fruit Wt/Pruning Wt. (ratio)
Aligote *	13	7'x12'	4.1	5.8	66.5	13.5	0.14	1.00	13.5
Andover *	8	6'x10'	2.3	3.5	36.7	6.3	0.10	0.60	9.8
Aurora *	8	6'x10'	2.6	3.5	44.0	7.2	0.11	0.70	10
Cabernet Franc *	6	6'x10'	4.0	5.1	51.8	11.0	0.20	1.20	8.8
Carmine *	13	7'x12'	7.6	5.6	81.0	25.1	0.44	3.10	7.9
Cabernet Sauvignon*	5	6'x10'	5.1	5.6	53.4	14.0	0.23	1.40	9.9
Cayuga White	6	5'x10'	5.0	7.8	33.5	11.5	0.22	1.10	9.9
Chardonel	6	5'x10'	5.9	7.4	32.0	13.5	0.32	1.60	8.2
Chardonnay	6	5'x10'	5.7	4.5	45.1	13.0	0.34	1.70	7.6
Dolcetto	5	5'x10'	3.6	6.6	23.7	8.3	0.12	0.60	12.7
Flora	13	7'x12'	9.7	6.9	**V**	**V**	**V**	**V**	**V**
French Columbard*	13	7'x12'	7.6	11.0	**V**	25.1	**V**	**V**	**V**
Gamay Beaujolais*	13	7'x12'	4.1	5.5	53.0	13.5	**V**	**V**	**V**
Gewurztraminer*	6	5'x10'	7.3	6.5	45.3	16.8	0.34	1.70	9.4
La Crosse*	8	6'x10'	4.5	4.6	**V**	12.3	**V**	**V**	**V**
Malbec*	13	7'x12'	7.4	8.6	70.0	24.4	0.54	3.80	6.3
Merlot	6	5'x10'	6.8	8.7	34.5	15.6	0.30	1.50	10.0
Müller thurgau	6	5'x10'	4.7	7.2	28.7	10.8	0.20	1.00	10.2
Muscat Blanc *	13	7'x12'	6.2	11.1	41.8	14.2	0.24	1.70	8.3
Norton	6	5'x10'	1.6	3.9	26.8	3.7	0.20	1.00	10.2
Pinot Blanc #159	6	5'x10'	5.0	8.5	30.0	11.5	0.16	0.80	13.8
Pinot Gris	6	5'x10'	2.9	4.8	28.0	6.6	0.14	0.70	9.1
Pinot Noir #347	6	5'x10'	4.6	5.6	35.2	10.5	0.20	1.00	9.9
Pinot Noir-Dijon	6	5'x10'	3.0	4.9	25.8	6.8	0.16	0.80	7.9
Riesling	6	5'x10'	4.8	5.8	37.9	11.02	0.40	2.00	5.4
Rkatsitelli *	8	6'x10'	5.3	6.9	29.1	12.2	0.15	0.90	13.1
Sangiovese	6	5'x10'	6.1	8.0	23.8	14.0	0.26	1.30	10.5
Seigerebe *	8	6'x10'	4.4	4.5	41.3	12.1	0.10	0.60	19.8
Semillon *	13	7'x12'	8.3	12.5	65.2	27.4	0.34	2.40	11.20
Seyval Blanc	6	5'x10'	5.9	5.9	36.3	13.5	0.22	1.10	11.5
Shiraz	6	5'x10'	6.9	7.2	42.3	15.8	0.48	2.40	6.4
St. Pepin *	8	6'x10'	6.4	6.1	**V**	17.6	**V**	**V**	**V**
Sylvaner *	13	7'x12'	6.4	5.8	74.0	17.6	**V**	**V**	**V**
Vignoles	6	5'x10'	3.0	4.2	34.2	6.9	0.22	1.10	5.8
Viognier	6	5'x10'	5.7	4.9	32.5	13.0	0.30	1.50	8.6

* Furrow irrigated, 2 - 19 vines per cultivar, planting not randomized. (**V**= no data available)

Table 2. 1997 at harvest juice compositions for 35 cultivars grown at Orchard Mesa Research Center.

Cultivar	EBrix	TA (gms./l)	pH
Aligote *	24.2	6.4	3.23
Andover *	22.4	17.2	3.42
Aurora *	21.0	6.8	3.40
Cabernet Franc *	23.8	5.5	3.37
Cabernet Sauvignon*	23.0	5.8	3.28
Carmine *	23.6	5.2	3.36
Cayuga White	23.0	6.2	3.36
Chardonel	23.2	10.7	3.30
Chardonnay	24.4	6.8	3.47
Dolcetto	24.0	6.4	3.36
Flora	23.6	6.5	3.37
French Columbard*	20.0	14.5	3.00
Gamay Beaujolais*	23.4	5.5	3.34
Gewurztraminer #457	23.0	6.0	3.32
La Crosse*	24.0	7.8	3.48
Malbec*	23.2	7.9	3.35
Merlot	23.2	4.3	3.45
Müller thurgau	22.8	5.6	3.45
Muscat Blanc *	22.2	5.6	3.22
Norton	25.2	6.1	3.36
Pinot Blanc #159	22.0	5.5	3.31
Pinot Gris	23.2	7.6	3.30
Pinot Noir #347	23.0	6.9	3.44
Pinot Noir-Dijon	22.8	5.1	3.43
Riesling	23.6	8.6	3.02
Rkatsitelli *	23.6	6.4	3.03
Sangiovese	21.4	7.65	3.14
Seigerebe *	17.8	4.4	3.51
Semillon *	24.0	5.0	3.26
Seyval Blanc	21.6	6.7	3.51
Shiraz	23.5	5.8	3.44
St. Pepin *	23.2	7.0	3.68
Sylvaner *	25.0	6.0	3.43
Vignoles	30.2	9.8	3.23
Viognier	24.4	6.6	3.28

* Furrow irrigated, 2 -19 vines per cultivar, planting not randomized.

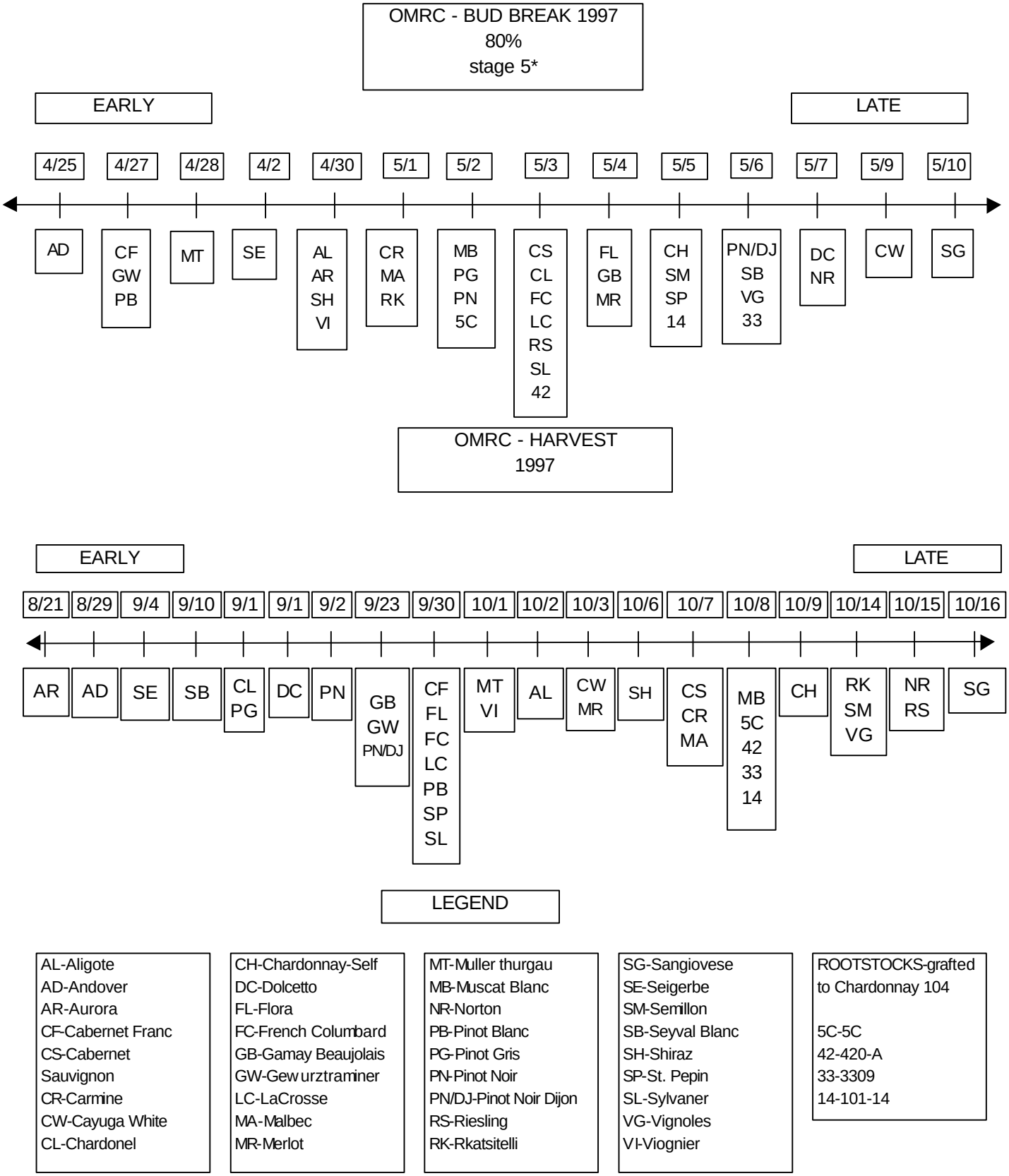
Table 3. 1997 growth characteristics of Vitis *vinifera* 'Chardonnay' clone 104 grafted to four rootstocks.

Growth Characteristics								
Rootstock	Vine Age	Cluster Wt. (oz.)	Fruit Wt/Vine (lbs.)	Tons/ Acre	Clusters/ Vine	Pruning Wt. (lbs/vine)	Pruning wt/ft of canopy (lbs)	Fruit Wt./Pruning Wt. Ratio
3309	5	5.0	10.8	4.7	29.7	2.07	0.41	5.2
420-A	5	5.7	13.3	5.8	37.1	2.10	0.42	6.3
101-14	5	5.1	10.6	4.6	35.9	2.47	0.49	4.3
5C	5	5.4	11.7	5.1	32.5	2.40	0.48	4.8
Self-rooted	6	4.5	13.0	5.7	45.0	1.74	0.34	7.5

Table 4. 1997 juice compositions of Vitis *vinifera* 'Chardonnay' clone 104 grafted to four rootstocks.

Juice Composition			
Rootstock	EBrix	TA	pH
3309	22.8	7.2	3.32
420-A	22.6	6.8	3.28
101-14	23.5	6.6	3.35
5C	23.3	5.8	3.36
Self-rooted	22.3	5.7	3.45

Table 5. 1997 Bud Break and Harvest dates for 35 cultivars and Chardonnay clone 104 on 4 rootstocks.



*Note that the actual bud break "stage" of development was determined by using the Eichorn-Lorenz 1977 method. Stage 5 is when the emerging green shoot is first clearly visible. The actual date of bud break is when 80% of the vine reaches stage 5.