AMERICAN VINEYARD FOUNDATION

Research Report

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Project Title: Clonal Testing of Wine grapes in the San Joaquin Valley

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Summary:

This is an ongoing study to evaluate promising, virus disease-free FPMS clonal material for the San Joaquin Valley. Data collection continued (third fruiting year in 2001) with the Chardonnay, Cabernet Sauvignon, Merlot, and Zinfandel/Primitivo trials. These trials were planted with 6 clones each in 1997 in order to evaluate clonal differences in a warm climate region. A new Barbera trial was planted in 2000 and trained in 2001.

Chardonnay. Clone 4 was high yielding in 2001, as in 1999; its cluster numbers and yields were lower in 2000, suggesting an alternate bearing response. Clone yield differences in 2001could be largely attributed to differences in berries per cluster and cluster weight. While Clone 4 had the fewest clusters, they were the heaviest due to high berry numbers per cluster; its fruit composition was again among the best -- high soluble solids and TA, and low pH. Clone 20 also tends to be high yielding, but with heavier berries of lower soluble solids. Clone 15 had the fewest berries per cluster and the lowest bunch rot incidence in 2001; it was also lowest yielding.

Cabernet Sauvignon. Clone 2 again had the fewest clusters and smallest berries. Clone 24 was also more similar to Clone 2 than the others. The others were similar to one another except for the heavier berries and higher fruit pH of Clone 22. While the overall differences were not great, the trend toward smaller berries with Clones 2 and 24 and the larger berries of Clone 22 may be of importance to San Joaquin Valley growers. However, the smaller berry characteristics are accompanied with some sacrifice in yield, unless pruning practice can compensate for the lower cluster numbers in Clones 2 and 24.

Merlot. The Merlot clones showed significant differences in all of the measured parameters. Clone 11 produced the heaviest berries with the highest bunch rot. It also produced the highest fruit pH in 1999 and

2000, all of which are undesirable characteristics for warm districts. Clone 14 again produced fewer clusters with smaller berries than some of the others, with corresponding lower vine yields and higher ^{o}Brix. Clone 10 was the most fruitful and had the highest fruit TA. It has also performed well in all yield and fruit composition parameters in previous years. Thus, Clone 10 has consistently shown good characteristics, while Clone 11 shows some unfavorable characteristics for warm climates. While Clone 14 has small berries, its lower yield is a disadvantage, unless this can be improved with higher pruning levels.

Zinfandel/Primitivo. Clonal differences were again not as distinct as they were in 1999 when the Primitivo clones had smaller berries, fewer berries/cluster and clusters of lower mass and earlier ripening and less rot as compared to the Zinfandel clones. However, the Primitivo clones continue to show some advantages over the Zinfandel clones in terms of higher cluster numbers, higher fruit % soluble solids, smaller berry weights, and much less bunch rot in one clone, Primitivo 6. Primitivo 3 is again showing the highest yield potential of all of the selections, and with good fruit composition. Overall, clonal differences within the Zinfandel and Primitivo clone groups were small; they were greater between the two groups.

The clonal variations in response over time point to the importance of multiple year data collection in excess of 2 years of full production. At least 4 years of full production data are needed to determine longer term vine response.

Objectives:

1. To establish wine grape clone testing needs and objectives in the San Joaquin Valley relative to cultivar priorities, availability of suitable plant material, and desirable vine, fruit and wine characteristics.

2. To develop comparative information on clone performance of important and promising cultivars for the warmer viticulture districts.

3. To provide information on clone performance in a warm district for grower and winery planting decisions and to facilitate their availability to industry.

Major Research Accomplishments

Four trials comparing six clones each of Chardonnay, Cabernet Sauvignon, Merlot, and Zinfandel/Primitivo were planted in 1997. All of the trials were designed as single-vine plots, replicated 10 times in randomized complete blocks. Vine and row spacing is 7.5 x 10 feet. The vines were trained to bilateral cordons at a 53" height in 1998. The vertical trellis system has a single foliar catch wire at 64", a standard or common practice in the San Joaquin Valley. The site is too vigorous for a VSP system in this warm region. The vines first fruited in 1999; 2001 was the second year of mature vine production and data collection.

Chardonnay

Procedure: All of the bilateral cordon vines were pruned to eighteen 2-node spurs. The number of flower clusters per vine was counted after bud break in April, 2001. Harvest was performed on August 15, 2001 for total fruit yield per vine. Berry samples (100 per vine) were taken at harvest for mean berry weight, soluble solids (degree Brix), titratable acidity, and pH analyses. The number of clusters with rot was recorded, as well as their total weight. Clusters were scored as "with rot" when 4 or more adjoining berries showed decay. Mean cluster weight per plot was calculated from total per vine yield and cluster numbers; number of berries per cluster were calculated from cluster weight and berry weight means per plot.

Results (Table 1): Yield differences could be largely attributed to differences in clusters/vine and/or cluster

weight. While Clone 4 had the fewest clusters, they were the heaviest due to high berry numbers per cluster. This resulted in high yields for Clone 4, although not significantly different from Clones 6, 18 and 37. In contrast, the lower yield of Clone 15 was attributed to smaller clusters due to fewer berries per cluster. Clone 15 also had a significantly lower bunch rot incidence than the others. Otherwise, clonal differences were relatively minor. Clone 20 had the heaviest berries while Clone 6 berries were smallest. Clone 4 had the highest fruit soluble solids, although not statistically different than Clones 6, 18 and 37. Clone 20 was lowest in soluble solids, although not statistically different from Clone 15. Clone 4 had the lowest fruit pH of all of the selections. Titratable acidity was significantly higher in Clones 4 and 15 as compared to Clones 18 and 37.

Some year to year clonal differences should be noted. Clone 4 was high yielding in 1999, of comparatively low yield in 2000, and high yielding again in 2001, a sign of alternate bearing. This was due to a noticeable drop in cluster numbers in 2000. However, Clone 4 has always produced the heaviest clusters of good fruit composition, ie. high soluble solids, high TA and low pH. Clone 20 also tends to be high yielding, but with heavier berries of lower soluble solids. Clone 6 had the fewest berries per cluster for the first two years, but only Clone 15 showed this characteristic in 2001. The result was a very low bunch rot incidence in Clone 15, an important characteristic for a warm region. These variations in response over time point to the importance of multiple year data collection in excess of 2 years of full production. It would appear that at least 4 years of full production data collection is needed to determine longer term vine response. Even still, the more consistent cluster and berry weight responses of Clones 4 and 20 suggest that some clonal characteristics may be fairly consistent over time.

Cabernet Sauvignon

Procedure: Vine management and data collection were similar to the Chardonnay trial. Harvest and fruit data collection were performed on August 31, 2001.

Results (Table 2): Harvest yields were similar for all of the clones, except Clone 2, which was of significantly lower yield than Clones 8, 21 and 22. This lower yield can be attributed to a combination of fruit effects -- fewer clusters of smaller berries than most of the other clones. All of the other clones had similar cluster numbers per vine, although Clone 21 and Clone 24 cluster numbers were not significantly different than those of Clone 2. Berry weights were heaviest in Clone 22 and smallest in Clone 2; the others were intermediate and similar in berry weight. There were no significant differences in cluster characteristics, ie cluster weight, berry number per cluster and % clusters with rot. Fruit soluble solids were highest in Clone 21 and lowest in Clone 2; the others were intermediate and similar in soluble solids concentration. Fruit titratable acidity concentrations were all similar. PH values were also similar except for Clone 22, of higher pH than Clones 8, 10, 21, and 24.

As in the past, Clone 2 had the fewest clusters and smallest berries. The others were similar to one another except for the heavier berries and higher fruit pH of Clone 22. Clone 24 was again most similar to Clone 2. While the overall clone differences were not great, the trend toward smaller berries with Clones 2 and 24 and larger berries of Clone 22 may be of importance to San Joaquin Valley growers. However, the smaller berry characteristics may be accompanied with some sacrifice in yield, unless pruning practice can compensate for the lower cluster numbers in Clones 2 and 24. Both clones are California vineyard selections (Clone 2 = Concannon, heat-treated 168 days and Clone 24 = Laurel Glen vineyard, no heat treatment) while the others represent California vineyard and foreign imported selections.

Merlot

Procedure: Vine management and data collection were similar to the Cabernet Sauvignon trial. Harvest and fruit data collection were performed on August 24. 2001.

Results (Table 2): Clone 10 produced the most clusters per vine in 2001. Clones 1 and 14 were lower in cluster numbers than Clones 10 and 11; Clones 3, 9 and 11 were intermediate and similar in cluster numbers. Berry weight was heaviest in Clones 3 and 11 and lightest in Clones 1, 10 and 14; Clone 9 was intermediate in berry weight. Cluster weights were heaviest in Clones 1, 3, 9 and 11 and lightest in Clones 10 and 14. Berries per cluster were highest in Clones 1, 3, and 9 and lowest in Clones 10 and 11; Clone 14 was intermediate in berries per cluster. Bunch rot was particularly high in Clone 11 as compared to the others. This may be attributed to the heavy berries. Yield was lowest with Clone 14 although not significantly different than Clone 1. The others were of similar yield. Fruit soluble solids was also highest in lower yielding Clone 11; the others were all similar. Titratable acidity was higher in Clone 10 as compared to Clones 1, 3 and 9, although the differences were minor. PH was lower in Clone 10 as compared to the others.

Overall, the Merlot clones showed significant differences in all of the measured parameters. Several characteristics are worth noting at this point. Clone 11 produced the heaviest berries with the highest bunch rot in 2001. In 1999 and 2000, it also produced the highest fruit pH, all of which are undesirable characteristics for the San Joaquin Valley. Clone 14 again produced fewer clusters with smaller berries than some of the others, which corresponded with lower vine yields and higher % soluble solids. Clone 10 was the most fruitful and had the highest fruit TA. It has also performed well in all yield and fruit composition parameters in past years. Thus, Clone 10 has consistently shown good characteristics, while Clone 11 shows several unfavorable characteristics for warm climate conditions. While Clone 14 has the desirable small berries, its lower yield is a distraction, unless this can be improved with higher pruning levels.

Zinfandel/Primitivo

Procedure: Vine management and data collection were similar to the Cabernet Sauvignon trial. Harvest and fruit data collection was performed on August 28, 2001.

Results (Table 3): The early harvest of lower fruit soluble solids was performed to interrupt the rapid development of sour rot in the clusters. Bunch rot incidence was high and with no significant differences among the Zinfandel and Primitivo clones except for the lower rot in Clone P6. Berry weights were highest in the Zinfandel clones -- 1A, 2 and 3. Cluster number per vine was higher in Clone P3 than Clones 1A and 3; cluster weights and berries/cluster were not different among the clones. Vine yields were highest in Clone P3, although not significantly different than Clone 3. The others were all similar in yield except that Clone 1A was lower than Clones 3 and P3. Soluble solids was highest in the Primitivo clones except Clone 1A which was similar to P3 and P5; Clones 2 and 3 were lowest. No clone differences were shown in TA; differences in pH were minor.

Overall, the Primitivo clones are again showing some advantages over the Zinfandel clones in terms of vine fruitfulness, fruit soluble solids, smaller berry weights, and less bunch rot (Primitivo 6). Primitivo 3 is again showing the highest yield potential of all of the selections, and with good fruit composition.

The method of assessing bunch rot was to count all of the clusters that have 4 or more adjoining berries

showing decay. The percent clusters with rot is then calculated from the total cluster count. While this method determines 'incidence' or 'presence/absence' of rot in the cluster population, it does not address the overall severity or total percent of berries showing decay. Thus, overall severity of bunch rot will be included in the 2002 by scoring the percent rot in each cluster.

Research Success Statement

This research has already provided the grape industry with clone performance information and recommendations for important warm climate cultivars -- French Colombard, Chenin blanc, Barbera, Muscat of Alexandria, Muscat blanc, Grenache, and Sangiovese. The trials are the first and only to be conducted on these cultivars in California with the exception of Sangiovese. The data have assisted nurseries, growers and vintners in selecting the best performing clones and to avoid clones with inferior or undesirable characteristics. Examples include the recommendation to use Chenin blanc Clone 4 or Clone 1 and to avoid Clone 5, which produces very tight clusters with a 75% higher bunch rot level than the others. Future Muscat blanc plantings should use Clone 4 from Milan and avoid the widely planted Clone 1 with its lower fruitfulness of heavy, rot-prone, and larger-berried clusters. Grenache growers can choose between Clone 1A with high cluster numbers, smaller berries, and less rot potential or Clone 3 for higher yield, although with heavier clusters and berries, some delayed fruit maturation and a greater rot potential. Sangiovese Clone 4 should be avoided in warm districts due to poor fruit composition (low TA and high pH), high bunch rot incidence and lower anthocyanin content in the wine; Clone 2 is more fruitful and of smaller berry size than Clone 3. Other cultivar clonal preferences from this research include Muscat of Alexandria Clone 2A, French Colombard Clone 2 and Barbera Clone 6.

The results from these studies have been presented at the ASEV Annual Meeting Technical Sessions, regional Cooperative Extension grower meetings, UC Kearney Agricultural Center field days, UNEX Recent Advances in Viticulture and Enology, UNEX Clonal Short Course, CSU-Fresno Advanced Viticulture Course, and International Symposium on Clonal Selection, Portland, OR. Articles have also been published in *California Grape Grower* and *American Vineyard.*

The data from the Chardonnay, Cabernet Sauvignon, Merlot and Zinfandel/Primitivo are showing significant differences among many of the clones after 2 years of full production. The information will be of long-term importance to growers and wineries interested in growing these cultivars in warm regions. The continuation of clonal evaluation of the new Barbera clones from Torino and the reintroduction of FPMS Barbera Clone 6 (previously Clone 1) will be important to future plantings of this cultivar. The only registered Barbera in previous years was Clone 2, shown in our trials to have heavy berries and clusters of lower anthocyanin content and a high bunch rot potential.

Funds Status

As of December 17, 2001 all of the 2001 funding had been spent as outlined in the 2001 Proposal.

Table 1.
WINEGRAPE CLONAL SELECTIONS 2001
U.C. KEARNEY AG CENTER
CLONAL MEANS
CHARDONNAY

Clone #	Harvest Date	Weight / Berry (gms)	Soluble Solids (brix)	pH	Titratable Acidity (g/100ml)	Number of Clusters/ Vine	Total Yield/Vine (lbs.)	% Clusters with Rot	Cluster Wt. (lbs.)	Berries/ Cluster
4	15-Aug	1.48 ab	22.2 a	3.41 b	0.65 a	92 c	39.93 a	18.38 a	0.44 a	135 a
6	15-Aug	1.46 b	22.0 ab	3.47 a	0.63 ab	116 ab	35.90 abc	12.49 a	0.31 b	96 b
15	15-Aug	1.49 ab	21.6 bc	3.46 a	0.66 a	121 ab	31.26 c	2.23 b	0.26 c	79 c
18	15-Aug	1.50 ab	22.0 ab	3.47 a	0.60 b	110 ab	36.96 ab	13.72 a	0.34 b	104 b
20	15-Aug	1.54 a	21.3 c	3.46 a	0.63 ab	107 b	34.07 bc	12.77 a	0.32 b	93 b
37	15-Aug	1.50 ab	22.0 ab	3.49 a	0.61 b	124 a	38.16 ab	18.82 a	0.31 b	94 b
Pr > F		0.1691	0.0086	0.0002	0.0092	0.0004	0.0097	0.0004	<.0001	<.0001

Table 2.
U.C. KEARNEY AG CENTER
CLONAL MEANS
CABERNET SAUVIGNON

Clone #	Harvest Date	Weight / Berry (gms)	Soluble Solids (brix)	pH	Titratable Acidity (g/100ml)	Number of Clusters/ Vine	Total Yield/Vine (lbs.)	% Clusters with Rot	Cluster Wt. (lbs.)	Berries/ Cluster
2	31-Aug	1.28 c	22.2 c	3.65 ab	0.52 a	59 b	28.46 b	0.00 a	0.49 a	171 a
8	31-Aug	1.38 ab	22.5 abc	3.64 b	0.52 a	71 a	37.29 a	0.78 a	0.53 a	177 a
10	31-Aug	1.33 bc	22.8 ab	3.62 b	0.51 a	74 a	34.91 ab	0.00 a	0.51 a	172 a
21	31-Aug	1.39 ab	23.4 a	3.64 b	0.51 a	70 ab	39.53 a	0.00 a	0.60 a	194 a
22	31-Aug	1.44 a	22.9 ab	3.67 a	0.50 a	74 a	41.60 a	0.52 a	0.57 a	179 a
24	31-Aug	1.32 bc	22.6 abc	3.63 b	0.52 a	63 ab	33.89 ab	0.00 a	0.56 a	193 a
Pr > F		0.0040	0.0307	0.0118	0.4868	0.0509	0.0215	0.2276	0.627	0.8348

Table 3.
WINEGRAPE CLONAL SELECTIONS 2001
U.C. KEARNEY AG CENTER
CLONAL MEANS
MERLOT

Clone #	Harvest Date	Weight / Berry (gms)	Soluble Solids (brix)	pH	Titratable Acidity (g/100ml)	Number of Clusters/ Vine	Total Yield/Vine (lbs.)	% Clusters with Rot	Cluster Wt. (lbs.)	Berries/ Cluster
1	24-Aug	1.43 cd	24.0 b	3.83 a	0.38 b	74 c	32.85 ab	2.49 b	0.44 ab	140 a
3	24-Aug	1.51 ab	23.8 b	3.83 a	0.38 b	78 bc	35.99 a	4.01 b	0.46 a	140 a
9	24-Aug	1.48 bcd	24.2 b	3.85 a	0.38 b	78 bc	35.69 a	3.90 b	0.46 a	141 a
10	24-Aug	1.45 cd	24.2 b	3.77 b	0.40 a	92 a	35.07 a	1.71 b	0.38 c	121 b
11	24-Aug	1.56 a	24.2 b	3.85 a	0.39 ab	84 b	35.63 a	7.50 a	0.43 ab	125 b
14	24-Aug	1.39 d	25.0 a	3.85 a	0.39 ab	72 c	29.45 b	2.52 b	0.41 bc	132 ab
Pr > F		<.0001	0.0107	0.0002	0.0431	0.0003	0.0251	0.007	0.0014	0.0049

Table 4.
WINEGRAPE CLONAL SELECTIONS 2001
U.C. KEARNEY AG CENTER
CLONAL MEANS
ZINFANDEL / PRIMITIVO

Clone #	Harvest Date	Weight / Berry (gms)	Soluble Solids (brix)	pH	Titratable Acidity (g/100ml)	Number of Clusters/ Vine	Total Yield/Vine (lbs.)	% Clusters with Rot	Cluster Wt. (lbs.)	Berries/ Cluster
1A	28-Aug	2.75 a	22.70 b	3.60 ab	0.49 a	67 b	36.68 c	35.49 a	0.57 a	95 a
2	28-Aug	2.72 a	21.80 c	3.54 c	0.51 a	83 ab	44.20 bc	34.66 a	0.55 a	93 a
3	28-Aug	2.68 ab	21.81 c	3.61 a	0.49 a	70 b	45.83 ab	29.82 a	0.68 a	115 a
P3	28-Aug	2.49 c	23.16 ab	3.56 abc	0.50 a	90 a	53.49 a	28.10 a	0.61 a	111 a
P5	28-Aug	2.48 c	23.10 ab	3.59 abc	0.51 a	74 ab	42.38 bc	28.00 a	0.58 a	105 a
P6	28-Aug	2.52 bc	23.52 a	3.61 a	0.50 a	76 ab	41.51 bc	15.64 b	0.57 a	101 a
Pr > F		0.0010	<.0001	0.0376	0.8784	0.0331	0.0063	0.0001	0.3230	0.2457