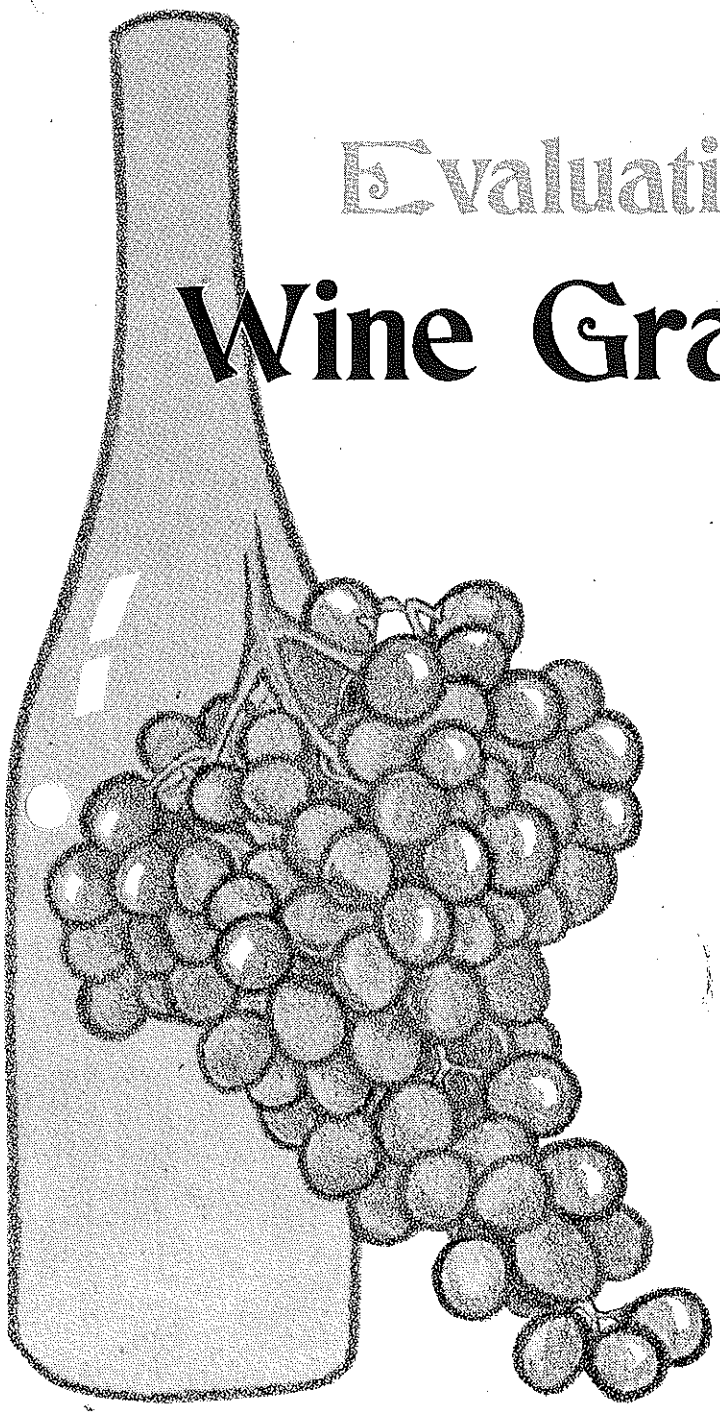
Evaluations of
Wine Grape Varieties
for Lodi



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A long-term study was conducted to determine the suitability of certain grape varieties for table wine production in the Lodi area. To obtain this objective, an experimental test plot was established in the area in 1960, and wines from each of the 22 varieties grown there were made and evaluated. This bulletin describes:

- The experimental test plot
- Wine-making methods used for small lots of wine
- Climate and soil determinations
- Must and wine analyses
- Viticultural descriptions and observations
- Wine quality comments and evaluations

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EVALUATIONS OF WINE GRAPE VARIETIES FOR LODI

INTRODUCTION

In the past, most California wine grape variety evaluations were made with the idea of applying recommendations based on them to large areas of the state. This approach had disadvantages—for example, a variety recommended for Region IV might not be well suited to all parts of that region, which includes delta areas of moderate climate as well as Sierra Nevada foothills having much greater climatic ranges. And, obviously, sandy soils of the Modesto area are not comparable to the rich, loamy soils around Lodi. Clearly, what was needed for a specific area was a body of recommendations based on a study of wine grape varieties grown in an area of similar climate and soils. Previous evaluations (Amerine and Winkler, 1944, 1963), although often corresponding to find ings in this bulletin, did not have that advantage.

A further complication was present in the Lodi district, however. For many years, principal viticultural and winemaking operations there had been the production of table grapes and dessert wines. But in recent years, consumers' tastes have changed—there has been decreasing demand for table grapes and dessert wines, and an ever-increasing demand for table wines. Any study of wine grape varieties suitable for the Lodi area should, therefore, concentrate on table wine varieties.

With these objectives in mind, a Lodi Variety Trial Plot was established in 1960. The varieties to be studied were grown there, and wines made from them were produced and tested under precisely controlled conditions. Data from these tests, plus data gathered from field observations in the area, form the basis for viticultural performance and wine quality evaluations presented here.

EXPERIMENTAL METHODS

The Lodi Variety Trial plot was located approximately 3 miles east of Lodi in the northernmost grape-producing district of the San Joaquin Valley. It is the coolest area in the San Joaquin Valley: late afternoon temperatures are influenced by ocean breezes coming through the Carquinez Straits, and maximum temperatures are normally of a relative short duration. Maximum temperatures are usually reached between 4:00 and 5:00 p.m. and then begin to decline. Table 1 gives the average hours per day of temperatures above 80°, 90°, and 100° F by month for two typical years. Table 2 gives the degree-days by month for 1965 through 1971.

San Joaquin County soils map (Weir, 1952) classified the soil on which the grape varieties were grown as Hanford Sandy Loam. However, mechanical analysis of the soil found the texture to be a loam. Table 3 gives soil analyses for the site. The varieties tested were on resistant rootstocks commercially used in this district. The plot was designed with 10 vines each on St. George, 1613, Dog Ridge, and Salt Creek (Ramsey). There were 40 vines for each variety, which was adequate for extensive wine evaluations. The vines, which were spaced 8 × 12 feet, were bilateral-cordon trained on a standard 2-wire trellis. The wire supporting the cordon was 36 inches above the vineyard floor. The foliage wire was 12 to 16 inches above the cordon wire, depending on the vigor of a variety.

Fruit quality determinations were made by collecting 100-berry samples and analyzing the expressed juices for degree Brix, total acids, and pH.

The field berry-sampling technique consisted of taking 10 berries from each vine at various positions on the clusters and throughout the vines as described by Amerine and Roessler (1958). All 10 vines from each variety-rootstock combination were sampled, thus giving a 100-berry sample. Sampling began when maturity approached 17 degrees Brix and was repeated weekly until harvest. Samples were taken to the laboratory and run within 3 hours of picking. The unwashed berries were crushed gently with a large mortar and pestle so as not to break the seeds, and the juice was then filtered and squeezed through 4 thicknesses of cheesecloth. Degree Brix was determined with a calibrated and temperature-corrected hand refractometer. Total acids (expressed as grams tartaric per 100 ml) were determined by titrating with 0.133N Na OH to an end point of pH 8.2 with a glass-electrode pH meter (Amerine, 1965). The pH of the expressed juice was measured by means of a Corning pH meter, Model 7.

The mature grapes were hand harvested and placed in 50-pound picking boxes. A total of 3 boxes of each

TABLE 1.
AVERAGE HOURS PER DAY ABOVE 80, 90, 100° F, BY MONTH, LODI VARIETY TRIAL PLOT*

Month	Average hours by month, 1965, 1967					
	Above 80	Above 90	Above 100	Above 80	Above 90	Above 100
		1965			*1967*	
April	1.4	nil+	0.0	0.0	0.0	0.0
May	3.6	0.6	0.0	3.8	1.6	0.0
June	3.4	0.7	0.0	5.2	1.9	0.2
July	8.0	2.8	nil+	9.7	4.8	0.3
August	7.6	2.4	0.0	9.6	5.0	0.4
September	3.9	0.3	0.0	6.8	1.6	0.0
October	3.5	0.2	0.0	1.3	0.0	0.0

* Temperature data were recorded at the site of the variety trial by a Hydrothermograph Recorder.
+ More than 0.0 but less than 0.1.

variety was picked. The grapes were transported to the University of California, Davis, where they were crushed and stemmed the same day they were picked or the following day. Free-run juice samples were obtained from crushed grapes for the must analysis. The samples were analyzed within a few hours for degree Brix, total acidity, and pH. A sample of the must was fermented in a Kjeldahl flask and total nitrogen determined when the sample was dry. These analyses were made as described by Amerine (1965).

White varieties were pressed immediately, with essentially no skin-contact time. The juice would be equivalent to commercial free run with a very low solids content. Red varieties were left in contact with the skins for about 3 days. The degree Brix was usually between 5° and 12° at time of press. Again, the press was relatively light.

White juices were fermented in 12-gallon glass containers. The red musts were fermented in 20-gallon earthenware crocks or polyethylene barrel liners of appropriate size. Sulfur dioxide (75 mg/per l) was added and then the yeast culture (1 per cent of the total volume). The standard yeast used was *Saccharomyces cerevisiae* Montrachet strain (Department of Viticulture and Enology culture No. 522). Degrees Brix were determined daily or every few days until fermentations were complete. White wines were fermented at 70° F for the first 3 years of this 6-year study and at 60° F for the last 3 years. Red wines were all fermented at 70° F. Once the wines were dry, they were racked and held in full containers at 53° F. A rigorous schedule of racking and treatment was then maintained to reduce cellar oxidation and possible spoilage. The final step was to filter and bottle the wines. All samples were kept in glass containers.

The finished wines were tasted by the expert panel at the University of California, Davis, in the spring of the year following production, using the methodology described by Ough and Baker (1961). Tastings were also held each year with the cooperating winery to apprise them of the wine quality and to maintain grower interest. These tastings were in substantial agreement with the panel results at Davis. The wines were also analyzed for certain chemical attributes using methods described by Amerine (1965).

TABLE 2.
DEGREE-DAYS BY MONTH, 1965 THROUGH 1971, LODI VARIETY TRIAL PLOT*

Month	Degree-days by year						
	1965	1966	1967	1968	1969	1970	1971
April	258.5	375.5	0.0	288.5	204.5	120.0	176.0
May	412.5	493.5	447.0	422.0	504.0	465.0	308.0
June	481.5	589.0	545.5	653.0	528.0	594.0	498.0
July	693.0	617.0	781.5	743.5	741.5	728.5	724.0
August	711.5	747.0	810.5	660.0	752.0	679.0	730.5
September	453.0	591.5	669.0	605.0	643.5	558.0	551.0
October	421.5	354.0	386.0	349.0	261.5	291.5	236.0
TOTAL	3431.5	3767.5	3639.5	3721.0	3635.0	3486.0	3223.5

* Degree-days per month is calculated by the following formula:

$$\text{Degree-days per month} = \left(\frac{\text{Max. °F temp.} + \text{min. °F temp.}}{2} - 50\right) \times \text{number of days per month.}$$

Temperature data were recorded at the site of the variety trial by Hydrothermograph Recorder.

TABLE 3
SOIL ANALYSES OF LODI VARIETY TRIAL PLOT, 1968

Depth sampled for analyses	Textures	pH	ECe	$Ca^{++} + Mg^{++}$	Na^{+}	Sodium adsorption ratio	Organic matter	NO_3–N
ft.			*millimhos*	*me/l*	*me/l*		*per cent*	*ppm*
0–1	Loam	6.2	0.25	1.5	1.0	1	1.7	3.6
1–2	Loam	6.4	0.30	1.7	1.3	1	0.8	4.2
2–3	Loam	6.6	0.37	2.0	1.7	2	0.5	4.2
3–4	Loam	6.7	0.31	1.5	1.6	2	0.3	2.1
4–5	Loam	7.0	0.30	0.9	2.1	5	0.6	2.3

EVALUATION AND DISCUSSION

A summary of viticultural descriptions, some wine quality comments, and a general evaluation of each variety are on pages 7 to 9.[1] Tokay, Carignane, Grenache, and Ruby Cabernet were not included in the Lodi Variety Trial plot because these varieties are planted extensively in this district. Evaluations given for these varieties are based on commercial winery experiences, experimental lots taken from other Lodi vineyards, and observational data.

In general, the white varieties evaluated as "good" if not overcropped make standard-to-excellent table wines, with the exception of Tokay (which is best suited for sherry materials, brandy, or perhaps bulk champagne blending material). Of the white varieties, only Sauvignon blanc has a recognizable varietal character. French Colombard has a distinct, odd flavor if left overly long on the vine. Muscat blanc and Orange Muscat can be made into dry or nearly-dry table wines and do not have the bitterness associated with some muscat varieties. Gray Riesling can be an excellent or a poor wine, with quality being dependent on the viticulturist; its time of harvest is important, and crop-level maintenance requires expert attention. Emerald Riesling is a good blending wine for acidity, but it is a difficult variety to handle in the winery at full maturity because of browning problems.

Barbera, Petite Sirah, and Ruby Cabernet make distinctive wines. Barbera is fruity, and Petite Sirah makes a rich highly-colored wine of good-to-excellent quality. Ruby Cabernet makes a wine of distinctive varietal character but must be properly aged for best results. In experimental samples, Cabernet Sauvignon had a distinctive varietal aroma and flavor, thus indicating its potential as a premium wine for this district. (The need for further testing limits this qualification.) Carignane is the grape most commonly used for standard, slightly sweet table wines. Zinfandel, like Gray Riesling, requires that vines not be overcropped and that fruit be harvested at the proper level of maturity—if these varieties are properly handled, wines of distinctive varietal aroma can be made. (Overcropping results in unbalanced wines of low color.) Low taste-panel scores for Zinfandel do not properly reflect its potential. Samples made from other Lodi vineyards over a number of years have verified its worth if properly handled. St. Macaire is an excellent blending wine, having high tannin and color for this area. It has a good flavor and aroma but is not distinctive and should not be confused with Valdepeñas. Gros Mansenc makes an interesting wine. It is unusual in that the color is high and the tannin low, and this results in unbalanced wines having an "empty" taste. Its higher-than-average color led to good taste-panel scores, but viticultural problems of this variety resulted in its being evaluated as poor. Refosco has high color and tannin but usually matures late and produces a thin wine. Pinot St. George wines have exceptionally high amounts of soluble solids when dry; they are highly buffered by the large amount of nitrogen compounds present, usually resulting in off-flavored, easily-spoiled wines.

Tables 4 and 5 summarize the analytical data on musts and wines from grapes grown in the experimental plot. There were not a large number of samples for each variety, but our close supervision of the plot made the data meaningful. For white varieties, the lower maturity of Chenin blanc and Gray Riesling resulted in wines of lower alcohol and color than those of Aligoté and French Colombard. The acidity of French Colombard is notably good at the higher maturity. The red varieties had a greater range of maturity: harvest dates were about 15 days later on the average than for the white varieties. With the exception of Barbera, St. Macaire, and Zinfandel, the alcohol content was lower than desired. The high acidity of Barbera at full maturity is notable, as is its high sensory score. The high pH of Petite Sirah is of some concern, but most of the wine had a balanced taste. The exceptionally high total nitrogen and the high pH and low sensory scores of Pinot St. George make it an inferior wine. St. Macaire's high tannin, color, and alcohol, as compared to that of Refosco, make it the better of the two for blending. The unusual tannin-color combination for Gros Mansenc was consistent from year to year, thus making it a poor wine for blending.

[1] Detailed viticultural descriptions of most of these varieties can be found in "Wine Grape Varieties in the San Joaquin Valley" (Kasimatis, et al., 1972). Copies of this are obtainable by sending $2.50 to: Publications, 1422 South 10th Street, Richmond, California 94804.

VARIETY EVALUATION

Variety	Origin	Vigor	Pruning practice	Cluster size	Cluster density	Rot potential	Production, tons per acre*	Remarks: Viticulture	Remarks: Wine quality	Evaluation†
White										
Aligoté	France	Medium	Spur	Medium to large	Well-filled	Low	6– 8	No problems	Good; fruity; non-varietal aroma	Good
Burger	France	Medium	Spur	Large	Compact	Low	10–14	Excessive yields; low sugar	Poor quality	Poor
Chenin blanc	France	High	Spur	Medium to large	Compact	High	8–10	Very fruitful; may require cluster thinning; susceptible to *Botrytis* rot	Fruity; above average quality	Good
Emerald Riesling	UC Davis	High	Spur	Large	Well-filled	Low	8–10	Quick delivery after harvest necessary	Wines tend to brown; tart; fruity; high acidity	Qualified
French Colombard	France	High	Spur	Medium to large	Well-filled	Low	9–12	Susceptible to shoot breakage	Good; fruity; rich in flavor; high in acid	Good
Gewürztraminer	Germany	Low to medium	Cane	Small	Compact	High	3– 5	Excessive rot; poor production; hard to pick	Flat and coarse	Poor
Gray Riesling	France	High	Long spur	Small to medium	Well-filled	High	5– 7	Susceptible to *Botrytis* rot and thrips	Good if cropped normally and picked at proper maturity	Qualified

(Continued)

Variety	Origin	Vigor	Pruning practice	Cluster size	Cluster density	Rot potential	Production, tons per acre°	Remarks: Viticulture	Remarks: Wine quality	Evaluation†
Grillo	Sicily	Medium	Spur	Medium to large	Well-filled	Low	8–10	No problem	Makes coarse table wine; very good dessert wine	Qualified
Helena	UC Davis	Medium to high	Spur	Medium	Well-filled	Moderate	7– 9	No problem	Poor and unbalanced	Poor
Muscat blanc	Italy	Low to medium	Spur	Medium	Well-filled	Low	4– 6	Low production; tendency to sunburn and shrivel	Used for semi-sweet muscat flavored table wine	Good
Orange Muscat	Italy	Medium	Spur	Medium	Well-filled	Low	6– 8	No problem	Used for semi-sweet muscat flavored table wine	Good
Peverella	Austria	High	Spur	Large	Compact	Moderate	7–11	Not a consistent bearer; subject to rot	Ordinary wine; tart; high acid	Poor
Sauvignon blanc	France	High	Cane	Small	Compact	Moderate	5– 7	Hard to hand harvest; small clusters	Fruity; distinct flavor	Good
Tokay	Algeria	High	Spur	Large	Well-filled	Moderate	9–12	No problem	For sherry; not for table wines	Good
White Riesling	Germany	Low to medium	Cane	Small	Compact	Moderate	3– 5	Susceptible to rot	Recognizable varietal characteristics but thin-bodied wine	Poor
Red										
Barbera	Italy	Medium	Spur	Medium	Well-filled	Low	7– 9	Spindly growth; many second clusters	Good to excellent; fruity	Good
Cabernet Sauvignon	France	High	Cane	Small	Loose	Low	4– 6	Buds out late; no rot problem following rains	Good varietal character	Qualified
Carignane	Spain	High	Spur	Large	Well-filled	Low	8–12	Susceptible to mildew	Standard; used for blending	Good
Grenache	Spain	High	Spur	Large	Compact	Moderate	9–14	Erratic production; poor wood maturity	Below standard blending wine; poor color	Poor
Gros Manseng	France	Medium	Spur	Medium	Loose to well-filled	Low	5– 7	Susceptible to spider mites	High color; low tannins; poor character	Poor
Petite Sirah	France	Medium	Spur	Medium	Compact	Moderate	6– 8	No problem	Good color; soft wine	Good
Pinot St. George	Unknown	Medium	Spur	Medium	Compact	High	3– 5	Thin-skinned; berries tend to rot	Undesirable flavors; high nitrogen	Poor
Refosco	Italy	Medium	Spur	Small to Medium	Well-filled	Low	5– 8	No problem	Thin wines; high tannins	Poor
Ruby Cabernet	UC Davis	High	Spur	Medium	Loose to well-filled	Low	6– 8	Hard to hand harvest	Distinct varietal character	Good
St. Macaire	France	Medium	Spur	Medium	Loose to well-filled	Low	6– 9	No problem	Very good for blending; high color; high acid	Good
Zinfandel	Unknown	Medium	Spur	Medium-large	Well-filled to very compact	High	5– 9	Susceptible to rot and spider mites	Good quality if handled properly; if overcropped low color, low acid, poor quality	Good

° Production figures given are considered ideal crop-levels using good cultural practices.
† Good. Varieties which proved to be viticulturally sound and produced wines of acceptable quality.
Qualified. Variety may make quality wine but for lack of sufficient information, or because of problems of growing or winemaking, it may be of questionable value.
Poor. For reason of viticultural or enological problems, or of sensory quality of the product, the variety is considered inadequate.

TABLE 4.
TEST RESULTS OF WHITE VARIETIES

Variety	Number of years tested	Number of samples	Average date of harvest	Must analysis: Degrees Brix	Must analysis: Total acid (g H₂ta/100 ml)	Must analysis: pH	Must analysis: Total N (mg/l)	Wine analysis: Total acid (g H₂ta/100 ml)	Wine analysis: pH	Wine analysis: Extract (g/100 g)	Wine analysis: Ethanol (v/v%)	Wine analysis: Total phenol (mg/l)	Wine analysis: Color*	Wine analysis: Sensory score 0–20
Aligoté	5	5	15 Sept.	21.0	0.78	3.53	1250	0.69	3.42	2.5	12.1	229	12.8	13.6
Chenin blanc	4	11	13 Sept.	19.9	0.83	3.36	848	0.79	3.32	2.1	11.5	180	5.7	12.8
French Colombard	4	7	30 Sept.	22.2	0.96	3.53	1489	0.79	3.44	2.5	12.4	208	10.2	13.8
Gray Riesling	5	14	1 Sept.	20.5	0.82	3.50	1468	0.78	3.40	2.3	11.7	236	8.6	12.2
Grillo*	2	2	12 Sept.	21.2	0.84	3.40	1365	0.54	3.63	12.2	20.1	185	7.0	14.2
Peverella	4	5	14 Sept.	21.0	1.02	3.37	1113	0.94	3.24	2.5	11.8	290	11.7	12.3

* Wine made as a dessert-fortified type.
+ By Duboscqcolor comparator with a standard dye mixture. Increase in values indicates increase in color.

TABLE 5.
TEST RESULTS OF RED VARIETIES

Variety	Number of years tested	Number of Samples	Average date of harvest	Days on skins	Must analysis: Degrees Brix	Must analysis: Total acid (g H₂ta/100 ml)	Must analysis: pH	Must analysis: Total N (mg/l)	Wine analysis: Total acid (g H₂ta/100 ml)	Wine analysis: pH	Wine analysis: Extract (g/100 g)	Wine analysis: Ethanol (v/v%)	Wine analysis: Total phenol (mg/l)	Wine analysis: Color*	Wine analysis: Sensory score 0–20
Barbera	4	5	3 Oct.	3	22.3	1.04	3.47	1405	0.84	3.61	3.1	12.1	913	153	13.5
Cabernet Sauvignon	3	3	1 Oct.	3	20.4	0.83	3.44	1033	0.70	3.48	–	10.6	1197	143	13.4
Gros Manseno	4	4	5 Oct.	3	20.8	0.98	3.41	1743	0.82	3.51	2.8	10.9	964	264	13.0
Petite Sirah	5	11	1 Oct.	2.6	19.9	0.68	3.64	1351	0.60	3.84	2.9	10.5	1729	284	12.8
Pinot St. George	3	3	21 Sept.	2.3	21.6	0.86	3.78	2155	0.74	4.15	3.7	10.6	1131	94	9.8
Refosco	3	3	4 Oct.	3	19.5	0.65	3.52	1007	0.71	3.43	2.5	9.7	1600	154	12.8
St. Macaire	6	6	6 Oct.	2.8	21.6	0.99	3.59	1652	0.72	3.63	3.1	11.4	1790	1170	12.8
Zinfandel	4	4	1 Oct.	3.3	21.2	0.86	3.55	1210	0.72	3.60	2.5	11.5	1180	49	12.1

* By Duboscqcolor comparator with a standard dye mixture. Increase in values indicates increase in color.

ENOLOGICAL PROBLEMS

Some of the special problems of concern in making white table wine in warm areas are: (a) prevention of oxidation, (b) high temperatures of fermentation and storage, and (c) removal of solids from the juice prior to fermentation. Good cellar general practices are described by Amerine *et al.* (1967), and Ough and Amerine (1966) discuss desirable temperature control. Prevention of oxidation can be accomplished by prompt crushing, juice separation, and fermentation. Once wines are fermented, prevention of contact with oxygen is essential. Cooling, settling, and racking of the juice help prevent hydrogen sulfide formation by removing residual dusting sulfur—centrifugation of the juice also accomplishes this. These treatments also lower the non-soluble solids and tend to increase wine quality.

Red table wines should be fermented at warmer temperatures not exceeding 80° F, and maintaining good skin-juice contact during this period expedites color extraction. Skin-juice contact should not be continued after about 5 degrees Brix. For the most desirable character development for red varietal wines, they should be aged in oak cooperage. For standard wines, the oak aging may not be desirable. Certain high tannin varieties should be gelatin fined.

In general, the same rules apply for making quality wines in all locations. Grapes from warmer areas are generally harvested at a lower degree Brix. Wines made from these lower-degree-Brix grapes usually mature fast and are generally fruity. A major problem is malo-lactic fermentation, which should be prevented if possible. This can be accomplished to some degree by careful attendance to fining and racking, use of sulfur dioxide, and use of fumaric acid and filtration. Most wines from the Lodi area which undergo malo-lactic acid fermentation do not easily recover, and some never recover their original quality.

ROOTSTOCK EVALUATION

Selection of the proper rootstocks for soil type, root pest, and variety is highly important. In the Lodi trial plot, the rootstock Dog Ridge caused an excess vigor problem with most of the high-vigor varieties. Varieties with excessive growth, poor set, and reduced yields on Dog Ridge were French Colombard, Tokay, Helena, Sauvignon blanc, Grenache, and Cabernet Sauvignon.

Salt Creek is a vigorous rootstock, but varieties grafted onto this stock were not as vigorous as were the same

varieties on Dog Ridge. Varieties that were difficult to manage because of excess vigor were French Colombard, Tokay, and Grenache.

St. George rootstock was a poor stock for the variety Pinot St. George. Yields were drastically reduced because both stock and scion had high levels of nitrate-nitrogen, growth was excessive, and fruit set was poor.

The rootstock 1613 produced weak vines when grafted to low- or medium-vigor varieties. These weak vines resulted in fruit sunburn damage, berry shrivel, excess browning, and low yields. Vigorous varieties on 1613 produced a normal crop of good-quality fruit.

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