Production, Maturity, and Wine Composition of Winegrape Varieties in Western Oregon

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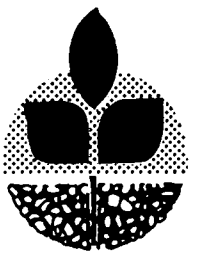

Agricultural Experiment Station
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PRODUCTION, MATURITY, AND WINE COMPOSITION OF WINEGRAPE VARIETIES IN WESTERN OREGON

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ABSTRACT

Yield, maturity, and wine composition were monitored for 22 winegrape cultivars in three locations, Willamette Valley terrace and floor sites and Rogue Valley floor site, for one to seven years (1976-1982). Yield and cluster size of Gewurztraminer, Muscat Ottonel, Chardonnay, Pinot noir, Gamay Beaujolais, Merlot, and Malbec depended on fruit set in the cooler Willamette Valley sites. High crop loads were deleterious to maturity of Muller-Thurgau, Sylvaner, White Riesling, and Pinot noir in areas under 2500 degree days (°F) and also to maturity of Chenin blanc, French Colombard, and Zinfandel at 2500-2900 degree day locations. Harvest data were collected from late September through October. The average fruit composition for most varieties ranged from 19 to 22° Brix, 7 to 12 g/L titratable acidity, and 3.0 to 3.4 pH. Varietal performance varied by season and vineyard location. Maturation was earlier at warmer sites but many cultivars developed varietal character at relatively low levels of soluble solids. Pinot noir developed more color and tannin in areas of 2070-2500 degree days if crop level was below 5.5 T/A. Muller-Thurgau and Gewurztraminer were prone to low acids. Premium quality table wines noted

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from trial locations in western Oregon included Pinot noir, Gamay Beaujolais, Pinot Meunier, Chardonnay, Sauvignon blanc, White Riesling, Gewurztraminer, Muller-Thurgau, Semillon, Cabernet Sauvignon, and Merlot.

A summary of varietal performance, recommended production levels, and regions by degree days, and a qualitative assessment of varietal character obtained in western Oregon is presented.

INTRODUCTION

The growth of the contemporary V. vinifera industry in Oregon began in 1961 with the planting of 20 acres of winegrapes in the Umpqua Valley, followed in the mid-1960s by plantings in the upper Willamette Valley. By 1973, there were 30 Oregon winegrowers with 460 planted acres, 60 of which were bearing (9). By 1976, there were 9 wineries producing vinifera table wines, and by 1985, the number had grown to 50 wineries and the acreage had expanded to more than 4,000 acres of which one-third was bearing. The new vineyard acreage is primarily because of expansion in the McMinnville, Forest Grove, Elkton, and the Hermiston-Boardman areas (7).

Today the Willamette Valley vineyards comprise 59% of the total acreage in the state, the largest concentration in Yamhill, Washington, and Polk counties, with smaller acreages in Lane, Marion, Benton, and Linn counties (7). Morrow county in eastern Oregon has another 22% of the acreage. Many of the Oregon vineyards are small with 75% being 20 acres or less. Only a few are larger than 30 acres.

The vineyard acreage in Oregon by 1984 (7) consisted of premium European vinifera varieties, including: Pinot noir (26.4%), Chardonnay (23.6%), White Riesling (19.9%), Gewurztraminer (7.8%), Cabernet Sauvignon (5.7%), Sauvignon blanc (4.0%), Muller-Thurgau (2.6%), Pinot gris (2.0%),

and Merlot (2.0%). There are also smaller acreages of Sylvaner, Muscat Ottonel, Early Muscat, and Chenin blanc.

Site location to optimize grape maturity has been an important concern. Various indices were examined to evaluate the adaptation of vinifera grapes to the environment in Oregon (2). Aney found that the April-October PE_T (Thornthwaite's potential evapotranspiration index) was the best indicator of summer insolation in terms of wine quality based on European wine regions; degree day accumulation (April-October degree days above 50°F) was the next best indicator. He suggested that the April-October PE_T value of 21.0 should be the critical minimum value below which ripening of wine grapes would be doubtful while 23.0 would be optimum for early varieties and 25.0 to 27.0 would be maximum values. The April-October PE_T values of the interior valleys of western Oregon ranged from 21 to 25. Aney noted that degree days in the same valleys ranged from 1800°F to 2500°F at elevations of 165 to 1,500 feet. Traditional wine regions of Europe in Germany and France were 1634°F for the Mosel, 2025°F for Dijon and 2400°F for Beaune in Burgundy, and 2817°F for the Bordeaux region. Low winter temperatures below 0°F which can limit vinifera production were seldom recorded in western Oregon (one in 50 years). Rainfall occurs predominantly from October through May usually leaving the summer months dry and warm. Relative humidity during summer usually reaches daily minimums of 15%.

Vineyards of western Oregon are planted principally on 3 soil orders: Mollisols, Alfisols, and Ultisols. Predominate planting has been on the terraced and upland areas of these valleys. Surface soil textures vary from silt loam to clay loam and are moderately acid in the north and less acid in the south. Reddish strongly leached Ultisols occur on older terraces in the Willamette Valley. Some vineyards are also on the

floodplain or lower terraces which are characterized by soils predominantly deep, silty, moderately dark, somewhat acid and commonly poorly drained. Soils on the valley floor of southwest Oregon are less silty, more variable in depth and lighter colored. Moisture holding capacity of these soils is 9 to 20 inches or enough to supply evapotranspiration requirement during the season without irrigation.

Several varietal trial plots were established in commercial vineyards and research farms in western Oregon in the late 1960s and early 1970s to evaluate the adaptability and the phenology of wine grapes. The data collected from seven of the trial plots are used for characterizing the production and wine composition of 22 cultivars grown on these non-irrigated vineyards of western Oregon.

MATERIALS AND METHODS

Grape Production

Six phenology sites were chosen in both commercial and research vineyards to represent the range of grape production in western Oregon. The site descriptions are summarized in Table 1. The two sites on the valley floor, Corvallis and Medford, were vineyards in the research stations of Oregon State University; the other sites were part of commercial vineyards on terraces with western, southern, or eastern exposure. The two extremes in degree day accumulations are represented by the Corvallis site at 1,966 degree days and by Medford at 2,781 degree days. All phenology vineyards were non-irrigated after the vines were of bearing age.

Plots consisted of 20 vines of each variety in Corvallis and Medford; other Willamette Valley sites contained four each. Vines were planted from 1969 to 1974 and all vineyards except two were trained to a three-

wire vertical trellis maintaining upright shoots during the growing season. The vineyards in Dundee and Medford were trained on a three-wire cross arm trellis with the shoots supported on the cross arms. Vine spacing was variable, spacing in the two research vineyards was 8 X 12 feet while spacing in the Elmira vineyard was 6 X 10 feet; in the Dundee vineyard 7 X 10 feet; and in the Sheridan vineyard 8 X 10 feet. Cane pruning was used in all plots, and dormant pruning was maintained at 30 to 50 buds per vine.

Each variety was monitored for maturity at each site at one- to two-week intervals during the harvest season. Random berry samples and cluster samples were taken from 4 to 20 vines consisting of 50 to 200 berries or 10 to 20 clusters, respectively. The samples were crushed and the juice pressed through cheesecloth and analyzed for Brix, titratable acidity, and pH (1).

Wine Production and Analysis

At harvest, 50 to 300 pounds of each variety were crushed, destemmed, and 30 to 50 milligrams/l of sulfur dioxide was added. White varieties were pressed with a horizontal basket press to an average yield of 145 gallons per ton. The white juice was settled at 4°C for 24 hours, racked, and inoculated with yeast (one gram of rehydrated yeast per gallon, Red Star Pasteur Champagne strain, UCD #595, Universal Foods, Milwaukee, WI) and fermented at 15°C. Red varieties were inoculated similarly and fermented on the skins for 5 to 7 days. Temperatures ranged from 18 to 26°C during fermentation and the caps submerged four times daily by punching down. The red wines were pressed from the skins at approximately 0° Brix, settled for one week, racked, and inoculated 0.5% by volume with ML-34 malolactic bacteria in grape juice media (6).

White wines were fined with bentonite (Volclay) to remove heat unstable protein. The amount of bentonite required was determined using a heat-cold test (80°C for 6 hours followed by 4°C for 12 hours) recommended by Pockock and Rankine (8).

After malolactic fermentation (red wines) and protein stabilization (white wines), the wines were cold stabilized for two weeks at 0°C, filtered through cellulose pads (Scott SG), and bottled. The new wines were analyzed for percent alcohol by ebulliometer, titratable acidity, volatile acidity, pH, residual sugar, and total phenolics (1). Anthocyanin content in the red wines was determined spectrophotometrically at pH = 1 using an extinction coefficient of $E^{1\%}_{1\ cm} = 380$ (10). Protein content in white wines was determined using a dye binding procedure, the Bradford Technique from Bio-Rad Laboratories, Richmond, CA (4). Qualitative assessment of varietal character was determined several months after bottling by OSU enologists and winegrape industry members.

RESULTS AND DISCUSSION

Grape Production

The summary of the vine performance by cultivar and sites is given in Table 2. Vine yields varied by cultivar, year, and site. Generally, yields in the Willamette Valley were higher in 1979 and 1982 than 1980 and 1981. No cluster weights were taken in 1979, 1980, and 1981 from the Willamette Valley sites, but field observations of the clusters indicated that there were larger clusters in 1979 and 1982 while they were smaller in 1980 and 1981. Since fruit set is temperature dependent (11), we compared mean temperatures during the last 15 days of June when bloom generally occurred in the Willamette Valley as 60.8°, 62.1°, 60.1°, and 66.9°F consecutively for the four years. The influence of weather as

expressed as mean temperature related poorly with cluster size during the four years. However, when temperature was based on daily duration above 69°F during the bloom period (5), a consistent relationship occurred with cluster size: 1979 and 1982, 8.6 and 6.1 hours; 1981 and 1982, 3.8 and 1.5 hours, respectively. Although there was no consistent pruning levels, crop load, and vine vigor necessary to properly evaluate the cause of yield variation, the cool wet weather during bloom is believed to be a chief reason for yield variability in western Oregon.

The highest yields for Gewurztraminer, Muller-Thurgau, Chardonnay, Pinot noir, Cabernet Sauvignon, and Merlot were noted at the warmer Willamette terrace sites and Rogue Valley floor vineyards. The coolest site on the Willamette Valley floor had vine yields comparable to the warmer sites for only Semillon and White Riesling. Cluster size of Merlot increased with increasing insolation from the Willamette Valley to the Rogue Valley. The cluster size of Chardonnay from the Willamette Valley terrace sites was much smaller than the other sites probably because of clonal differences (Table 2).

Buerken (3) indicated that economic yields of 3 to 4 T/A are necessary for small vineyards in Oregon. All cultivars tested averaged yields in this range or greater except for Gewurztraminer, Sylvaner, Cabernet Sauvignon, Merlot, and Malbec at the coolest site in the Willamette Valley. It was difficult to judge the suitability of the Willamette Valley terrace sites for economic yields of several varieties since yields were taken only during 1982. Observations have noted, however, that Gewurztraminer and Merlot do not give consistent yields in the Willamette Valley sites.

Maturity and Wine Composition

The average maturity and wine composition for the various cultivars are given in Table 3 and Table 4. The number of years monitored and the number of samples are listed for each site. The average harvest date and the average fruit analysis is given with the ranges observed in °Brix, titratable acidity, and pH. The average wine composition is given, including percent alcohol, titratable acidity, pH, phenolic content, anthocyanin content, and bentonite demand.

Average harvest dates were from late September to late October. Generally, the rate of maturation for most varieties was slow to moderate. For example, in 1982 (an average year in which heat accumulations from 1890 to 2520°F at the Willamette Valley sites) the rate of increase in soluble solids for Gewurztraminer, Chardonnay, and Pinot noir from mid-September to harvest averaged 1° Brix every 6-7 days at cooler sites and every 3 days at warmer sites (5).

Most varieties at the Willamette Valley floor site matured several days later than the warmer Willamette Valley terrace sites with lower soluble solids, higher acidity, and lower pH. Although little maturity data were obtained for the Umpqua Valley region, this area has vineyard sites where varietal performance is similar to Willamette Valley terrace sites as well as others which are more similar to the Rogue Valley floor sites.

Early maturing varieties ripened in late September and early October in the Rogue Valley and by mid-October in the Willamette Valley. These included Gewurztraminer, Chasselas Dore, Muller-Thurgau, Pinot noir, Gamay Beaujolais, and Pinot Meunier. Chardonnay, Pinot blanc, Sauvignon blanc, White Riesling, and Cabernet Sauvignon ripened by mid-October in the Rogue Valley and mid to late October in the Willamette Valley. The differences

in ripening between the Rogue Valley sites and the Willamette Valley sites were more pronounced for the early maturing varieties than for the mid to late season varieties. For example, Gewurztraminer and Pinot noir were harvested on the average of 17 and 19 days earlier at the Rogue Valley sites; Chardonnay and White Riesling were harvested on the average of 5 and 8 days earlier, respectively. Varieties which matured at the Rogue Valley sites but poorly at Willamette Valley sites included Semillon, Flora, Muscat blanc, Chenin blanc, French Colombard, Merlot, Malbec, and Zinfandel. Cabernet Sauvignon at the Willamette Valley terrace sites matured only during warmer growing seasons only.

Composition of the white wines averaged 9.5 to 12.9% alcohol, 5.8 to 10.7 g/l titratable acidity, 3.0 to 3.6 pH, with 180 to 363 mg/l of total phenolics. Bentonite required to protein stabilize the wines ranged from 12.0 to 69.6 g/hl, corresponding to approximately 1 to 6 pounds per 1,000 gallons. Less bentonite was generally required to stabilize wines produced from the cooler Willamette Valley floor site than the other warmer sites, with the exception of Gewurztraminer. White Riesling and Chardonnay from the Willamette Valley floor site required the least bentonite; Gewurztraminer and Sauvignon Blanc from the Rogue Valley floor required the most.

Composition of the red wines averaged 10.9 to 12.3% alcohol, 5.0 to 6.3 g/l titratable acidity, 3.42 to 3.84 pH, with 860 to 1,499 mg/l of total phenolics, and 145 to 424 mg/l of anthocyanin pigments. Pinot noir from Willamette Valley terrace sites contained on the average higher concentrations of anthocyanins and phenolics than those from the cooler Willamette Valley floor site and the warmer Rogue Valley floor sites. Lower average maturity at the cooler site and higher crop levels at the

warmer sites may have contributed to this. Gamay Beaujolais and Pinot Meunier produced wines with anthocyanin content similar to Pinot noir but with lower phenolics. Merlot produced wines with less color and tannin than Cabernet Sauvignon while Malbec had similar levels.

SUMMARY AND CONCLUSIONS

Varieties which developed good varietal character in western Oregon and which matured on the average with moderate soluble solids (20°Brix or higher), included: Gewurztraminer, Chardonnay, Sauvignon blanc, Flora (warmer sites), Pinot noir, Gamay Beaujolais, Pinot Meunier, Cabernet Sauvignon (warmer sites), and Merlot (warmer sites). Varieties which developed good varietal character and which matured on the average with low soluble solids (less than 20°Brix), included: White Riesling, Muller-Thurgau, Sylvaner, Muscat Ottonel, and Semillon. Several varieties grown at cooler sites produced fruit with good potential for sparkling wine production with low to moderate soluble solids, moderate to high acidity, and low pH, including: Chardonnay, Pinot noir, Pinot Meunier, Gamay Beaujolias, and White Riesling.

Other promising varieties and clones are being evaluated and include Pinot Gris, Auxerrois, Gamay noir, Pinot blanc, as well as several clones of already established varieties, including Gewurztraminer, Pinot noir, Chardonnay, and White Riesling.

Table 5 summarizes the performances of the varieties studied and recommends production levels (T/A), regions by degree days, and gives a qualitative assessment of the varietal character in western Oregon.

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Table 1. Phenology site description in western Oregon (7-year average)

Location (nearest city)	Soil Type	Altitude (ft)	Exposure (slope)	Degree Days[1] (°F) (range)	Seasonal Ln[1] (29°F) (days)	Ann Precip[1] (in)	EP_T (Apr-Oct)
Willamette Valley							
Corvallis	clay loam	200	v. floor 3°N	1970 (1,825-2,167)	271	37.2	23.1
Elmira	loam	551	terrace 5°SW	2,000 est	266	40.6	22.8
Dundee	clay loam	620	terrace 5°E	2378 (2,282-2,534)	226	42.6	23.2
Sheridan	clay loam	700	terrace 10°S	2153 (1,928-2,383)	226	42.6	23.2
Rogue Valley							
Medford	sandy loam	1,390	v. floor 1°N	2783 (2,477-2,893)	219	18.2	25.0
Ruch	loam	1,500	terrace 5°W	2599	208	24.1	24.2

[1]Data taken from closest weather station; degree days were calculated from the daily mean temperature minus 10°C accumulated from April 1 to October 30.

Table 2. Vine performance of 22 wine grape cultivars in several sites in western Oregon, 1976-82

Cultivar (clone) Sites	No. of Sites	No. of Years	Yield/Vine (kg) Range	Yield/Vine (kg) Ave.	Yield/A T/A	Cluster Weight (g)
White Wines						
Chasselas Dore (UCD E2V8 H98)[1]						
Willamette Valley floor	1	2	5.4-10.8	8.1	4.1	100
Rogue Valley floor	1	5	6.4-26.6	15.0	7.6	154
Gewurztraminer (UCD FV6 3V1-8)						
Willamette Valley floor	1	4	1.7-7.3	3.5	1.7	82
Willamette Valley terraces	3	1	1.5-8.9	4.1	3.3	68
Rogue Valley floor	1	6	3.8-8.1	5.6	2.9	86
Muller-Thurgau (UCD H10V9)						
Willamette Valley floor	1	3	5.0-11.4	8.8	4.5	118
Willamette Valley terraces	3	1	1.2-12.7	7.1	5.6	127
Rogue Valley floor	1	7	8.6-19.1	15.5	7.8	140
Sylvaner (UCD F4V9-16)						
Willamette Valley floor	1	4	3.6-9.4	5.4	2.8	113
Rogue Valley floor	1	7	2.6-14.2	11.1	5.6	104
White Riesling (UCD D5V16)						
Willamette Valley floor	1	4	3.7-14.4	9.7	4.9	127
Willamette Valley terraces	3	1	5.3-14.2	9.4	6.5	113
Rogue Valley floor	1	7	4.2-14.7	9.6	4.9	95
Chardonnay (UCD 9V7 H90) *(UCD L1V2)						
Willamette Valley floor	1	4	2.2-11.7	6.9	3.5	208
Willamette Valley terraces*	3	1	6.8-14.6	10.7	7.3	113
Rogue Valley floor	1	7	6.2-16.1	10.6	5.4	154
Pinot blanc (Melon) (UCD F10V12 H66) *(UCD D4V9-16)						
Willamette Valley floor*	1	2	8.6-11.8	10.2	5.2	154
Rogue Valley floor	1	7	6.2-13.2	8.4	4.4	107
Pinot gris (UCD D1V13, Colmar 146 and 152)						
Willamette Valley floor	1	2	4.4-11.3	8.7	4.4	104

Table 2. Vine performance of 22 wine grape cultivars in several sites in western Oregon, 1976-82 (continued)

Cultivar (clone) Sites	No. of Sites	No. of Years	Yield/Vine (kg) Range	Yield/Vine (kg) Ave.	Yield/A T/A	Cluster Weight (g)
White Wines (continued)						
Sauvignon blanc (UCD F4V6-8)						
Willamette Valley floor	1	3	4.1-8.6	6.0	3.0	127
Willamette Valley terraces	3	1	7.1-11.6	9.3	7.0	118
Rogue Valley floor	1	7	3.2-8.2	5.8	3.0	122
Semillon (UCD F2V2 H151) *(UCD D10V2-4)						
Willamette Valley floor	1	2	8.2-16.4	12.3	6.2	195
Rogue Valley floor*	1	7	6.8-17.9	12.1	6.1	177
Flora (UCD D10V1-5)						
Willamette Valley floor	1	1	---	13.6	6.9	168
Rogue Valley floor	1	7	6.8-17.7	11.2	5.7	136
Muscat Ottonel (UCD G8V9, Colmar 492)						
Willamette Valley floor	1	2	6.7-9.1	7.8	4.0	79
Muscat blanc (UCD F3V13-14)						
Rogue Valley floor	1	7	2.6-10.6	7.8	4.0	157
Chenin blanc (UCD C4V1-16)						
Rogue Valley floor	1	6	6.0-15.6	11.5	5.8	118
French Colombard (UCD F13V8 H91)						
Rogue Valley floor	1	6	12.0-28.3	18.6	9.5	163
Red Wines						
Pinot noir (UCD F7V12-1)						
Willamette Valley floor	1	4	3.8-10.5	6.7	3.5	118
Willamette Valley terraces	3	1	0.9-11.4	5.0	3.5	72
Rogue Valley floor	1	7	7.4-14.9	10.4	5.3	95
Gamay Beaujolais (UCD H7V15 H141)						
Willamette Valley floor	1	4	2.5-9.6	5.7	2.9	127
Rogue Valley floor	1	2	6.0-6.8	6.4	3.3	82

Table 2. Vine performance of 22 wine grape cultivars in several sites in western Oregon, 1976-82 (continued)

Cultivar (clone) Sites	No. of Sites	No. of Years	Yield/Vine (kg) Range	Yield/Vine (kg) Ave.	Yield/A T/A	Cluster Weight (g)
Red Wines (continued)						
Pinot Meunier (UCD H10V5 H105)						
Willamette Valley floor	1	1	---	5.9	3.0	86
Rogue Valley floor	1	6	5.2-9.2	7.8	4.0	108
Cabernet Sauvignon (UCD G9V3 H62)						
Willamette Valley floor	1	2	1.9-7.5	4.7	2.4	100
Willamette Valley terraces	3	1	3.3-8.7	7.0	5.4	127
Rogue Valley floor	1	7	5.6-13.5	9.4	4.8	91
Merlot (UCD D3V5 H81)						
Willamette Valley floor	1	2	1.3-5.5	3.4	1.7	72
Willamette Valley terraces	3	1	3.4-13.1	6.5	4.9	82
Rogue Valley floor	1	7	5.4-13.5	10.2	5.2	113
Malbec (UCD C6V11 H63)						
Willamette Valley floor	1	1	4.2	4.2	2.1	68
Rogue Valley floor	1	6	1.2-6.6	4.1	2.0	57
Zinfandel (UCD F10V6-7)						
Rogue Valley floor	1	6	6.4-15.5	11.1	5.6	213

[1]Indicates clonal source.

Table 3. White table wine varieties, average composition of musts and wines from western Oregon, 1976-1982

Site	Average Must Composition						Average Wine Composition					
	No. Years	No. Samples	Ave. Harvest Date	°Brix (Range)	TA[1] g/100 mL (Range)	pH (Range)	No. Samples	Alcohol % Vol.	TA g/L	pH	Phenols[2] mg/L GAE	Bentonite[3] Demand - g/hL (No. Samples)
GEWURZTRAMINER												
Willamette Valley Floor	7	7	10/16	20.8 (19.7-21.4)	0.85 (0.65-0.99)	3.30 (3.05-3.44)	5	12.5	7.3	3.26	231	56.4 (5)
Willamette Valley Terrace	7	14	10/13	22.3 (19.8-24.3)	0.80 (0.52-1.01)	3.44 (3.30-3.77)	5	12.5	5.8	3.50	212	
Rogue Valley Floor	7	10	9/24	22.3 (21.3-25.0)	0.72 (0.52-0.93)	3.43 (3.27-3.64)	6	12.3	6.2	3.36	208	58.8 (5)
MULLER-THURGAU												
Willamette Valley Floor	6	6	10/19	17.3 (15.3-18.5)	0.71 (0.44-0.87)	3.07 (2.90-3.20)	1	9.5	7.5	3.10	180	
Willamette Valley Terrace	7	19	10/19	18.8 (16.6-22.9)	0.71 (0.45-0.92)	3.31 (3.01-3.75)	8	10.7	6.2	3.34	203	21.6 (5)
Rogue Valley Floor	7	10	10/7	19.6 (17.7-22.2)	0.69 (0.49-0.90)	3.30 (3.10-3.45)	6	11.0	5.9	3.30	192	39.6 (4)
SYLVANER												
Willamette Valley Floor	7	7	10/25	18.2 (17.1-19.5)	1.08 (0.86-1.30)	3.18 (2.95-3.30)	5	10.0	9.4	3.11	265	32.4 (3)
Willamette Valley Terrace	6	12	10/24	19.5 (16.2-23.8)	0.95 (0.75-1.20)	3.26 (3.11-3.40)	6	11.2	7.7	3.29	218	39.6 (4)
Rogue Valley Floor	6	9	10/10	21.6 (17.8-23.8)	0.87 (0.66-1.22)	3.28 (3.10-3.47)	6	12.1	7.4	3.32	255	49.2 (4)
WHITE RIESLING												
Willamette Valley Floor	7	7	10/27	18.2 (16.5-20.5)	1.21 (0.99-1.42)	2.92 (2.80-3.00)	4	10.0	10.4	2.93	363	12.0 (2)
Willamette Valley Terrace	6	17	10/24	19.9 (17.6-22.8)	1.12 (0.88-1.29)	3.06 (2.87-3.27)	12	11.2	9.7	3.09	273	31.2 (5)
Rogue Valley Floor	7	10	10/16	19.8 (18.3-20.8)	1.08 (0.89-1.23)	3.03 (2.95-3.14)	4	10.9	9.6	3.01	267	44.4 (3)

Table 3. White table wine varieties, average composition of musts and wines from western Oregon, 1976-1982 (continued)

Site	Average Must Composition						Average Wine Composition					
	No. Years	No. Samples	Ave. Harvest Date	°Brix (Range)	TA[1] g/100 mL (Range)	pH (Range)	No. Samples	Alcohol % Vol.	TA g/L	pH	Phenols[2] mg/L GAE	Bentonite[3] Demand - g/hL (No. Samples)
CHARDONNAY												
Willamette Valley Floor	7	7	10/26	19.5 (17.1-21.2)	1.20 (0.94-1.43)	3.11 (2.96-3.24)	3	10.9	9.6	3.06	242	12.0 (2)
Willamette Valley Terrace	7	20	10/21	20.7 (18.0-23.1)	1.09 (0.85-1.44)	3.15 (2.99-3.40)	10	11.9	9.5	3.26	275	27.6 (3)
Rogue Valley Floor	7	10	10/16	21.7 (20.7-23.8)	1.01 (0.56-1.30)	3.27 (3.10-3.56)	6	11.8	8.0	3.32	268	42.0 (5)
PINOT BLANC												
Willamette Valley Floor	7	7	10/26	17.9 (16.7-19.4)	1.01 (0.71-1.27)	3.21 (3.00-3.30)	5	9.8	8.2	3.08	344	
Willamette Valley Terrace	6	11	10/22	19.0 (17.2-21.8)	0.95 (0.68-1.30)	3.21 (2.84-3.54)	5	10.8	7.2	3.35	251	
Rogue Valley Floor	6	9	10/15	19.1 (18.3-20.2)	0.86 (0.68-1.04)	3.24 (3.00-3.46)	7	10.7	7.1	3.30	290	
PINOT GRIS												
Willamette Valley Floor	6	6	10/15	20.8 (19.3-22.6)	0.96 (0.87-1.08)	3.16 (2.90-3.30)	3	11.6	8.4	3.20	295	
SAUVIGNON BLANC												
Willamette Valley Floor	7	7	10/26	20.0 (17.8-21.9)	1.28 (1.03-1.48)	3.05 (2.85-3.21)	4	11.3	9.8	3.08	242	32.4 (3)
Willamette Valley Terrace	5	8	10/23	22.1 (18.0-24.6)	1.02 (0.70-1.11)	3.18 (3.05-3.33)	2	12.9	8.3	3.60	191	
Rogue Valley Floor	7	10	10/15	21.9 (20.4-25.5)	1.02 (0.72-1.28)	3.21 (3.10-3.41)	7	12.2	8.0	3.34	234	69.6 (5)

Table 3. White table wine varieties, average composition of musts and wines from weatern Oregon, 1976-1982 (continued)

Site	Average Must Composition						Average Wine Composition					
	No. Years	No. Samples	Ave. Harveat Date	°Brix (Range)	TA[1] g/100 mL (Range)	pH (Range)	No. Samples	Alcohol % Vol.	TA g/L	pH	Phenols[2] mg/L GAE	Bentonite[3] Demand - g/hL (No. Samples)
SEMILLON												
Willamette Valley Floor	7	7	10/25	16.7 (14.6-19.0)	1.25 (0.92-1.51)	3.01 (2.75-3.35)	2	9.8	9.9	2.94	179	24.0 (1)
Willamette Valley Terrace	6	12	10/26	18.4 (15.8-22.9)	1.20 (0.67-1.78)	3.10 (2.90-3.30)	9	10.9	8.5	3.21	211	26.4 (3)
Rogue Valley Floor	6	9	10/15	19.8 (18.1-22.2)	0.83 (0.59-1.33)	3.20 (3.10-3.42)	8	10.9	7.2	3.22	188	33.6 (4)
FLORA												
Willamette Valley Floor	7	7	10/26	18.8 (17.0-21.5)	1.02 (0.82-1.31)	3.08 (2.80-3.30)	4	10.7	8.5	3.01	207	21.6 (2)
Rogue Valley Floor	6	6	10/19	22.3 (20.1-24.5)	0.82 (0.67-1.03)	3.20 (3.10-3.40)	6	12.4	7.7	3.25	254	30.0 (3)
MUSCAT OTTONEL												
Willamette Valley Floor	6	6	10/16	18.4 (17.5-19.9)	0.62 (0.47-0.78)	3.25 (3.05-3.39)						
MUSCAT BLANC												
Willamettel Valley Floor	6	6	10/21	18.3 (16.2-21.4)	1.07 (0.83-1.33)	3.10 (2.99-3.17)						
Rogue Valley Floor	6	6	10/15	20.7 (18.8-22.4)	0.94 (0.78-1.12)	3.18 (3.00-3.30)	3	11.7	7.9	3.20	266	30.0 (2)
CHASSELAS DORE												
Willamette Valley Floor	7	7	10/19	16.4 (16.1-17.5)	0.78 (0.61-0.87)	3.26 (2.95-3.52)						
Rogue Valley Floor	3	3	10/6	17.2 (16.3-18.0)	0.74 (0.68-0.80)	3.30						

Table 3. White table wine varieties, average composition of musts and wines from western Oregon, 1976-1982 (continued)

Site	Average Must Composition						Average Wine Composition					
	No. Years	No. Samples	Ave. Harvest Date	°Brix (Range)	TA[1] g/100 mL (Range)	pH (Range)	No. Samples	Alcohol % Vol.	TA g/L	pH	Phenols[2] mg/L GAE	Bentonite[3] Demand - g/hL (No. Samples)
CHENIN BLANC												
Willamette Valley Floor	6	6	10/25	15.1 (11.8-17.4)	1.63 (1.27-2.20)	3.12 (2.75-3.12)						
Rogue Valley Floor	6	6	10/21	20.1 (18.4-21.5)	1.15 (0.89-1.39)	3.14 (3.00-3.30)	6	11.3	9.5	3.19	221	36.0 (2)
FRENCH COLOMBARD												
Willamette Valley Floor	6	6	10/25	16.4 (15.0-17.6)	1.46 (1.29-1.62)	2.98 (2.55-3.20)						
Willamette Valley Terrace	5	11	10/30	19.9 (17.4-22.3)	1.25 (0.93-1.64)	3.02 (2.73-3.20)	7	11.7	10.7	3.02	218	
Rogue Valley Floor	5	8	10/18	20.9 (17.9-23.4)	1.11 (0.82-1.54)	3.08 (3.00-3.22)	5	11.5	9.2	3.04	206	

[1]TA: Titratable acidity expressed as tartrate.

[2]GAE: Gallic acid equivalents.

[3]Bentonite required to remove unstable protein. 12 g/hL equals 1 lb/1000 gallons.

Table 4. Red table wine varieties, average composition of musts and wines from western Oregon, 1976-1982

Site	Average Must Composition						Average Wine Composition					
	No. Years	No. Samples	Ave. Harvest Date	°Brix (Range)	TA g/100 mL (Range)	pH (Range)	No. Samples	Alcohol % Vol.	TA[1] g/L	pH	Phenols mg/L	Anthocyanins[2] mg/L
PINOT NOIR												
Willamette Valley Floor	7	7	10/21	20.1 (18.9-20.8)	1.09 (1.00-1.21)	3.14 (3.00-3.25)	5	11.0	6.0	3.57	864	172
Willamette Valley Terrace	7	21	10/21	22.1 (18.4-25.9)	0.99 (0.57-1.32)	3.29 (3.07-3.70)	13	12.3	5.0	3.84	1,300	212
Rogue Valley Floor	7	10	10/4	21.9 (21.0-23.0)	0.94 (0.72-1.11)	3.31 (3.15-3.43)	7	11.3	5.6	3.53	1,112	145
GAMAY BEAUJOLAIS												
Willamette Valley Floor	7	7	10/21	20.8 (19.2-22.8)	1.18 (1.00-1.33)	3.04 (2.90-3.22)	3	11.5	5.3	3.49	890	166
Willamette Valley Terrace	6	12	10/22	21.6 (19.8-25.3)	1.03 (0.78-1.16)	3.23 (3.05-3.54)	6	11.9	5.0	3.78	919	182
Rogue Valley Floor	5	8	10/8	21.6 (20.0-23.0)	0.84 (0.56-1.01)	3.23 (3.18-3.23)						
PINOT MEUNIER												
Willsmette Valley Floor	6	6	10/18	20.3 (17.5-22.0)	1.14 (0.92-1.24)	3.12 (2.90-3.26)						
Willamette Valley Terrace	6	12	10/23	20.6 (17.4-24.9)	1.05 (0.69-1.24)	3.23 (3.05-3.57)	6	11.8	5.2	3.67	947	174
Rogue Vslley Floor	6	8	10/9	22.0 (20.0-23.8)	0.97 (0.78-1.37)	3.39 (3.30-3.56)	6	12.1	7.3*	3.48*	846	147
CABERNET SAUVIGNON												
Willamette Valley Floor	4	4	10/21	18.7 (17.8-20.3)	1.21 (1.02-1.45)	3.07 (2.90-3.18)						
Willamette Valley Terrace	5	11	10/21	20.4 (17.9-23.8)	1.00 (0.70-1.40)	3.23 (3.07-3.50)	6	10.9	5.9	3.70	1,448	407
Rogue Valley Terrace	7	10	10/18	21.3 (19.6-24.4)	1.08 (0.81-1.28)	3.26 (3.10-3.50)	7	11.6	5.6	3.70	1,336	388

Table 4. Red table wine varieties, average composition of musts and wines from western Oregon, 1976-1982 (continued)

Site	Average Must Composition						Average Wine Composition					
	No. Years	No. Samples	Ave. Harvest Date	°Brix (Range)	TA g/100 mL (Range)	pH (Range)	No. Samples	Alcohol % Vol.	TA[1] g/L	pH	Phenols mg/L	Anthocyanins[2] mg/L
MERLOT												
Willamette Valley Floor	3	3	10/25	19.4 (18.6-20.6)	1.08 (0.88-1.22)	3.17 (2.97-3.31)						
Rogue Valley Floor	7	8	10/10	22.3 (21.2-24.5)	0.85 (0.70-0.96)	3.33 (3.15-3.60)	5	12.3	5.7	3.42	1,047	192
MALBEC												
Willamette Valley Floor	5	5	10/20	19.1 (17.1-20.2)	1.18 (0.71-1.75)	3.38 (3.00-3.62)						
Rogue Valley Floor	5	8	10/12	22.0 (20.2-24.8)	0.81 (0.60-1.35)	3.32 (3.10-3.62)	4	11.4	5.1	3.82	1,499	424
ZINFANDEL												
Willamette Valley Terrace	5	10	10/28	17.3 (14.3-20.8)	1.40 (1.13-1.83)	3.01 (2.75-3.20)						
Rogue Valley Floor	4	6	10/19	20.4 (18.1-23.6)	1.26 (0.82-1.54)	3.24 (3.05-3.40)	5	10.9	6.3	3.49	1,012	200

[1] Malolactic fermentations complete.

[2] $E^{1\%}_{1\ cm}$ = 380, 520 nm, pH 1.

*No malolactic fermentation.

Table 5. Wine grape cultivars and wine production in western Oregon

Cultivar	Suggested regions by degree day (°F)	Recommended crop levels (T/A)	Wine production considerations
White Wines			
Gewurztraminer	1,890-2,520[1]	3-5	Inconsistent cropping caused by low fruit set in regions below 2160°, damaged below 0°F, excessive vigor on heavy soils; prounounced spicy aroma and flavor, moderate to high Brix with moderate acidity and pH; several clones presently being evaluated
Muller-Thurgau	1,890-2,160 2,160-2,520 2,520-2,880	3-4 4-6 6-8	Adjust crop to site, loose clusters; floral character similar to Riesling but less distinct, low to moderate Brix with moderate acidity and low pH
Sylvaner	2,070-2,520 2,520-3,015	4-5 5-7	Adjust crop to site, tight clusters, susceptible to bunch rot; less character than White Riesling, low to moderate Brix with moderate to high acidity and low pH
White Riesling	2,070-2,160 2,160-3,015	4-5 5-7	Adjust crop to site, susceptible to bunch rot and berry dilution from heavy rains, hardy to -8°F; distinct floral aroma and flavor, low to moderate Brix with high acidity and low pH; several clones presently being evaluated
Chardonnay	2,070-2,790	3-6	High variability among several clones in cluster size, yield, and susceptibility to poor fruit set, hardy to -8°F; distinct varietal character, moderate Brix with moderate to high acidity and low pH; several clones being evaluated

Table 5. Wine grape cultivars and wine production in western Oregon (continued)

Cultivar	Suggested regions by degree day (°F)	Recommended crop levels (T/A)	Wine production considerations
Red Wines (continued)			
Merlot	2,430-3,015	3-6	Very susceptible to poor fruit set in regions under 2,430° days, hardy to -8°F; similar to but less herbaceous aroma and character than Cabernet Sauvignon, lighter in color and tannin with moderate Brix, moderate acidity, and low pH
Malbec	2,520-3,015	3-5	Very susceptible to poor fruit set in regions below 2,520° days, unproductive; less aromatic than Merlot with more color and tannin, moderate to high Brix, moderate acidity and pH
Zinfandel	2,520-3,015	5-6	Susceptible to bunch rot, adjust crop to site and season, susceptible to damage below 0°F; uneven ripening with low Brix, high acidity, low pH and low color

[1]Heat Unit Classes	Regions and Sites
1,890-2,160°F	Willamette Valley slopes, western, or hilltop exposures Willamette Valley slopes between 800-1,200 altitude Willamette Valley valley floor
2,070-2,400°F	Willamette Valley slopes, southern, or eastern exposures below 800 feet Mid-Columbia Valley-Mosier slopes below 800 feet
2,300-2,430°F	Umpqua Valley slopes, eastern or hilltop exposures Umpqua Valley slopes between 800-1,100 feet altitude Umpqua Valley floor (outside the fog belt)
2,430-2,520°F	Umpqua Valley slopes, southern exposures below 800 feet Rogue and Illinois Valley slopes 1,500-1,800 feet altitude
2,520-2,750°F	Rogue and Illinois Valley slopes below 1,500 feet altitude Rogue and Illinois Valley floor
2,600-2,880°F	The Dalles slopes below 1,000 feet altitude The Dalles valley floor
2,750-3,015°F	Umatilla-Boardman irrigated lands

Table 5. Wine grape cultivars and wine production in western Oregon (continued)

Cultivar	Suggested regions by degree day (°F)	Recommended crop levels (T/A)	Wine production considerations
White Wines (continued)			
Muscat blanc	2,520-2,880	3-4	Susceptible to poor fruit set, low yields; distinct Muscat character with moderate Brix, acidity, and pH
Chasselas dore	2,070-2,520	4-6	Very consistent yields but low Brix and acid, susceptible to bunch rot; low varietal character
Chenin blanc	2,070-2,880	4-6	Adjust crop to site and season; fair character with low Brix, high acidity, and low pH
French Colombard	2,520-2,880	4-7	Adjust crop to site and season, tolerant to bunch rot and harvest rains; moderate character with moderate Brix, high acidity, and low pH
Red Wines			
Pinot noir	2,070-2,200 2,200-2,520	3-4 4-6	Adjust crop to site and season, susceptible to poor fruit set, berry split from fall rains, and bunch rot, hardy to -8°F; excellent varietal character with moderate to high Brix, moderate acidity, and low pH
Gamay Beaujolais	2,070-2,200 2,200-2,520	3-4 4-6	Upright clone of Pinot noir, less susceptible to bunch rot, susceptible to poor fruit set; similar but less intense character than Pinot noir
Pinot Meunier	2,070-2,520	3-6	Loose cluster; similar to Pinot noir but less intense in character
Cabernet Sauvignon	2,430-3,015	3-6	Tolerant to harvest rains and bunch rot, hardy to -8°F; pronounced herbaceous aroma and flavor, with moderate Brix, moderate acidity, and low pH

Table 5. Wine grape cultivars and wine production in western Oregon (continued)

Cultivar	Suggested regions by degree day (°F)	Recommended crop levels (T/A)	Wine production considerations
White Wines (continued)			
Pinot blanc	2,070-2,610	3-5	Melon has been planted as Pinot blanc in many vineyards; moderate varietal character with low Brix, high acidity and low pH; several European clones of Pinot blanc are being evaluated which are susceptible to poor fruit set but have better Brix-acid balance, and more pronounced varietal character and earlier maturity
Pinot gris	1,890-2,610	4-6	Matures similar to Pinot noir, susceptible to poor fruit set; moderate Brix, moderate acidity, and low pH; several clones being evaluated from Colmar; matures with light pink-grey pigmentation
Sauvignon blanc	2,070-2,880	3-5	Vines too vigorous, essential to control vigor for yield and quality; distinct herbaceous character in regions less than 2,520° days with moderate Brix, moderate to high acidity and low pH
Semillon	2,520-2,880	5-6	Difficult to mature in regions below 2,520° days, adjust crop to site, susceptible to bunch rot; similar but less intense character than Sauvignon blanc, low to moderate brix, moderate acidity and low pH
Flora	2,070-2,880	5-7	Matures later than Gewurztraminer but less susceptible to poor fruit set, hardy to -8°F; ripens with dark pink color, moderate to high Brix, moderate acidity, and low pH
Muscat Ottonel	2,070-2,520	3-4	Susceptible to poor fruit set, low yields, loose clusters; distinct Muscat character with low to moderate Brix, low acidity and moderate pH