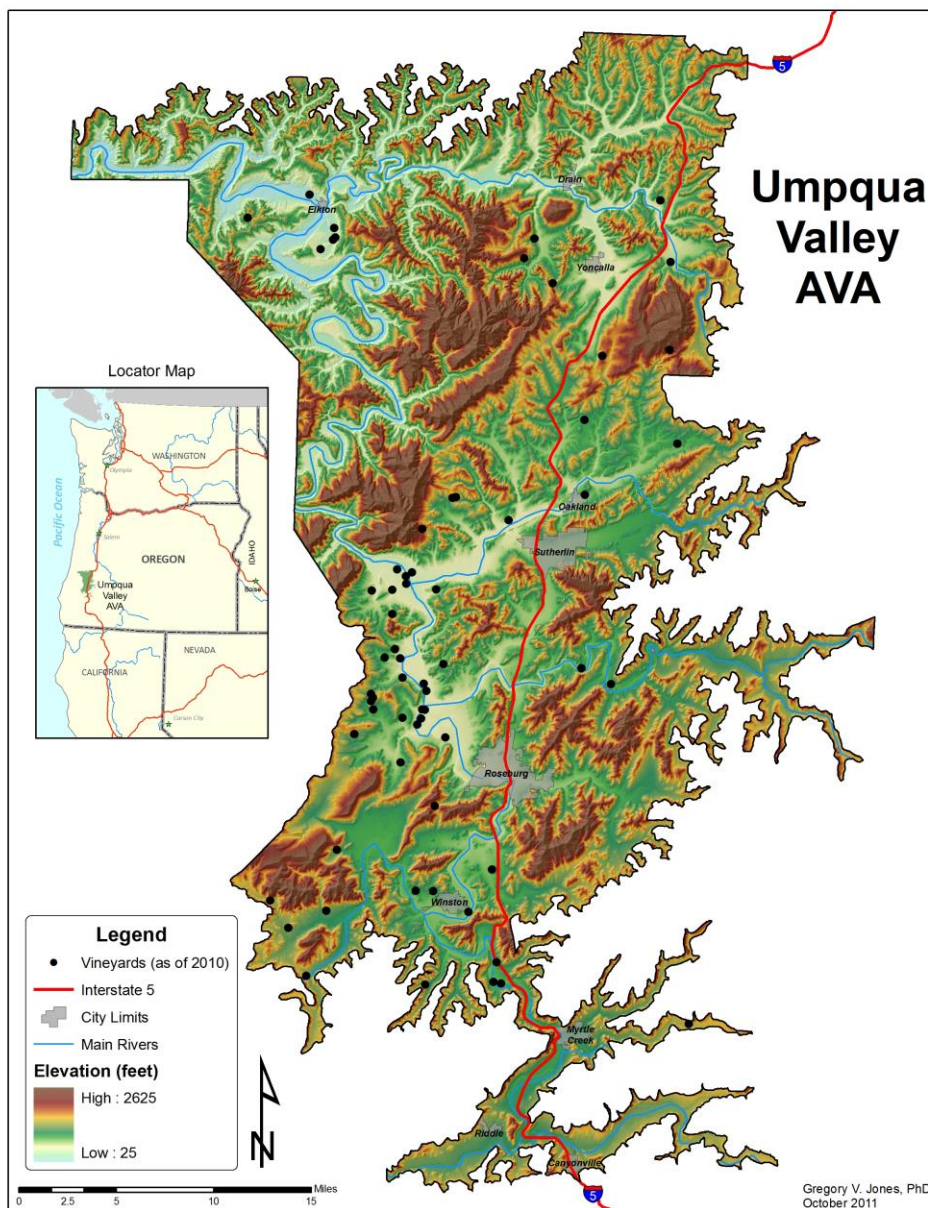


Vintage 2021

Umpqua Valley Reference Vineyard Report



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Summary:

Winter 2020-21 was mild and relatively dry and was followed by a moderately dry growing season continuing the ongoing drought concerns for Oregon and much of the western US. The spring was relatively cool in the Umpqua Valley with mild frosts into mid-April, then followed by wide swings between early season heat then cool, wet conditions toward the tail end of flowering and start of fruit set. Fruit set was more consistent than experienced in 2020, but many reported smaller berries and clusters across the region. Heat stress came early in 2021, with early and late June the most prominent. Over three days in late June all-time temperature records were broken across the region. Growing degree-day totals for the Umpqua Valley in 2021 ended up the highest since the very warm 2015 vintage. Across sites and varieties in the region the phenological timing averaged April 15th for bud break, June 4th for bloom, August 9th for véraison, and September 30th for harvest. Growers reported generally low disease pressure, relatively high pest pressure (mites and especially leafhoppers), little to no bird pressure until later in the picking window, and a moderately long harvest period that presented very good quality fruit at average to slightly lower yields due to bloom to fruit set weather conditions and the ongoing drought conditions.

Project Overview:

This work is a continuation of the 2004-2010 reference vineyard project which established a suite of reference vineyards in the Umpqua Valley AVA with a purpose of providing an in depth look at spatial variations in important characteristics of temperature, phenology, composition, and yields in the region. Starting with the 2011 vintage, the project has been scaled back to cover only temperature, phenology, and harvest composition from eight sites (no fruit sampling as in prior years). At each of the eight sites temperature devices record at 15-minute intervals during both the dormant season (Nov 1-Mar 31) and the growing season (Apr 1-Oct 31). The observations are then aggregated to hourly and daily average, maximum, and minimum values and summarized over the entire region. Additional summaries are done for the Roseburg NWS station and the Roseburg Agri-Met station. For phenological observations, the sites submit dates for the four main events of bud break, bloom, véraison, and harvest for a range of varieties planted at each site. The phenological data are then summarized by average dates and intervals between dates for the entire region. Finally, harvest composition values for °Brix, titratable acidity, and pH, along with yields are submitted by the sites and are then summarized for the region.

Please note that this is the final year of the project, see the last section of this report for more information.

Climate:***Dormant Season***

The PNW experienced a relatively warm winter during 2020-2021, with temperatures in the region 1.7°F above the 1901-2000 period¹. In Oregon, the winter averaged 1.5°F warmer than normal, with maximum temperatures slightly lower than minimum temperatures compared to averages. Spatially the winter ranged from 0.7°F above along the coastal climate division and southwestern valleys to 2.4°F above in the north central climate division. The Roseburg weather station had a November 2020 through March of 2021 that was 0.6°F above the 1991-2020 normals. The first three months of the winter were very mild with November slightly below average, but December-January 2.1°F above average. The

¹ Some comparisons are made with a 100-year average from 1901-2000 while others are made with climate normals, which are 30-year periods used by the global weather and climate services community for summarizing numerous weather variables. All references to 'normal' and 'average' for the Medford weather station in this report are with the 1981-2010 period, which will be replaced by the 1991-2020 period sometime during 2021.

remainder of the winter was cool with temperatures in February and March 1.1°F and 0.7°F below average, respectively. The second week of November, the last week of December, and the third week of January saw the coldest temperatures of the winter with an absolute minimum of 26.0°F observed on November 9th at the Roseburg weather station, which was a record cold temperature for that date. The dormant period had five record warm temperatures of 73°F occurring on November 3rd, 77°F on November 5th, 68°F on November 17th, 63°F on January 12th, and 62°F on January 13th.

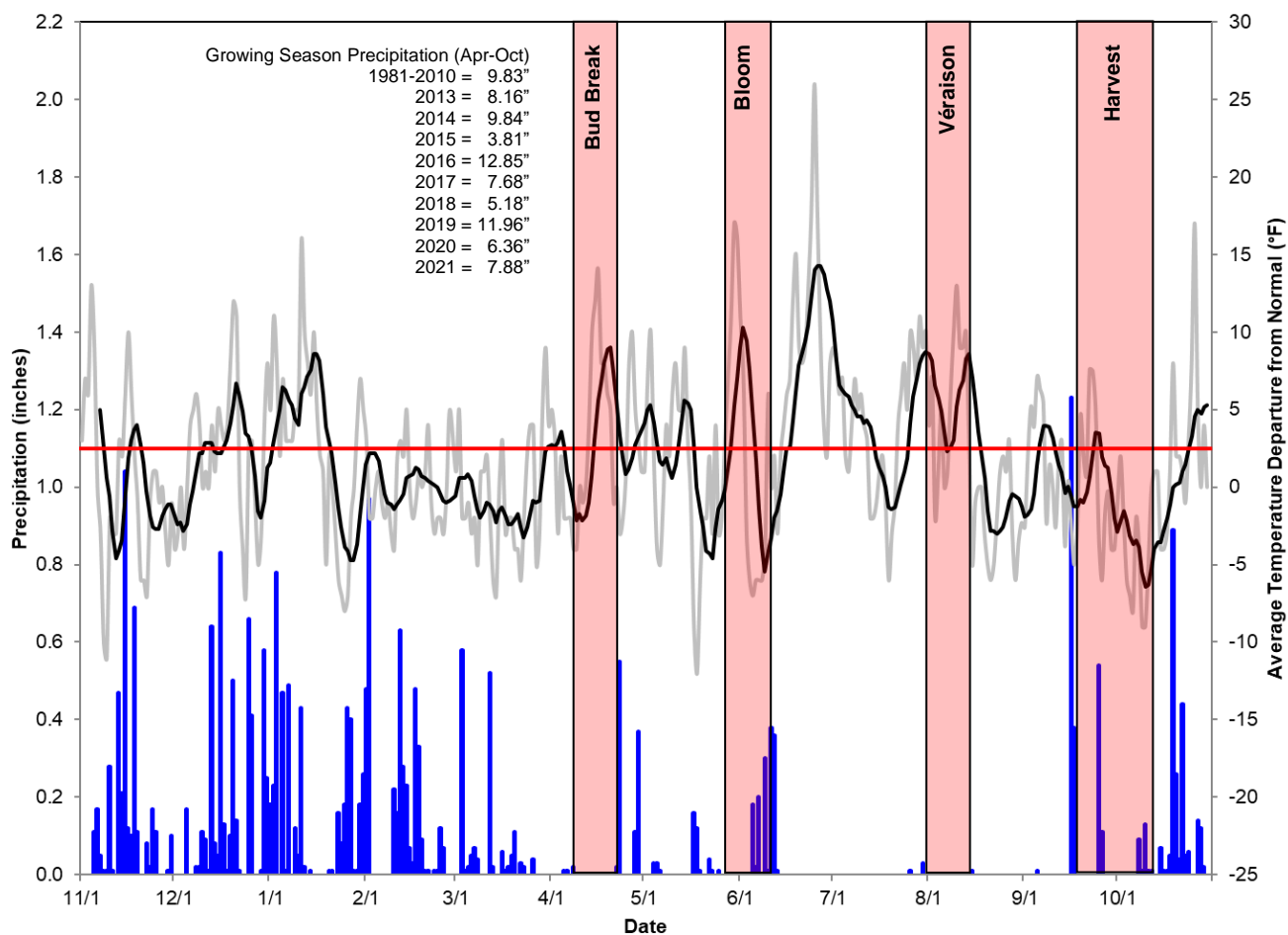


Figure 1 – Daily average temperature departures from normal and precipitation for November 1, 2020 to October 31, 2021 from the Roseburg weather station. The gray line is the day-to-day temperature departures from normal, the black line is the weekly average departures, and the blue bars are daily precipitation. The long-term average is derived from the 1981-2010 climate normals. The vertical red bars represent the variation in region-wide average phenology (see text for more details).

The eight reference vineyards in the Umpqua Valley averaged 43.8°F during the winter of 2020-2021 (Table 1). Average minimum temperatures ranged from 35.5 to 38.6°F over the eight sites with an absolute minimum of 22.3°F observed on November 9th and lows down to the mid to high 20’s during late December, late January, and the third week of March. On average, the sites observed a total of 28 days below freezing during the winter with a range from 15 days (Elkton area site) to 40 days (central AVA site).

Precipitation during the winter of 2020-2021 was below normal over the majority of the PNW, with the driest areas being southern and eastern Oregon, eastern Washington, and southern Idaho (50-80% of normal). Only portions of western Washington and Oregon and the northern Cascades experienced

normal winter precipitation (100-130% of normal). While precipitation is not observed at the reference vineyards, values from the main climate stations in the Southern Oregon region indicate that November through March ranged from slightly to significantly below average. The Roseburg weather station experienced a winter with 15.36", which was 8.51" below the 1981-2010 climate normals (36% below) with February the only month with above normal precipitation (Figure 1). The greatest one-day precipitation amount at the Roseburg weather station occurred on November 15th with 1.04" and there were no daily precipitation records during the winter for the station.

Table 1 – Umpqua Valley reference vineyard dormant season (November 1-March 31, 2020-21) and growing season (April 1-October 31, 2021) climate characteristics. Note that the dormant season minimum temperature value is the average absolute low temperature observed. Growing degree-days are calculated from Apr-Oct 2021 (base of 50°F with no upper cut-off).

Dormant Season (Nov 1 – Mar 31)	Average	Standard Deviation	Maximum	Minimum	Range
Average Temperature (°F)	43.8	0.5	44.7	43.1	1.6
Absolute Minimum Temperature (°F)	24.4	1.8	28.1	22.3	5.8
# of Days < 32°F	28	8.1	40	15	25
Growing Season (Apr 1 – Oct 31)	Average	Standard Deviation	Maximum	Minimum	Range
Growing Degree-Days	2859	317	3236	2258	978
Growing Season Average Temperature (°F)	63.2	1.5	65.0	60.2	4.8
Average Maximum Temperature (°F)	80.3	2.7	84.1	75.5	8.5
# of Days > 95°F	28	14	51	7	44
Average Minimum Temperature (°F)	48.0	1.3	50.0	46.2	3.8
# of Days < 32°F	5	3.6	10	0	10
Median Last Spring Frost (date or days)	Apr 12	5 days	Apr 15	Mar 30	16 days
Median First Fall Frost (date or days)	Nov 7	12 days	Nov 7	Oct 12	26
Median Frost-Free Period (days)	209	19 days	222	180	42 days

Growing Season

The 2021 growing season from April through October across the PNW was relatively warm, ending up 3.0°F above the long-term average from 1901-2000 and the 2nd warmest on record. Oregon was slightly higher than the PNW average at 3.3°F above average with the regions ranging from the Willamette Valley +2.7°F, the Columbia Gorge and Columbia Valley +3.3°F, and Southern Oregon +3.4°F. Maximum temperatures were the warmest on record (3.9°F above average) while minimum temperatures were the 3rd warmest on record (2.6°F above average). Overall, the growing season average daily temperatures observed at the Roseburg weather station were 2.7°F warmer than the 1991-2020 climate normals (Figure 1). The station experienced warmer than average temperatures every month from April through September, with June (5.6°F) and July (3.5°F) the greatest above average. October was the only month below average for the vintage (-0.9°F). The warmest day at the Roseburg station during the growing season was 114.0°F on June 27th, during a three-day intense heat wave that broke records throughout the PNW. Roseburg experienced 50 days above 90°F, 21 days above 95°F, and 5 days above 100°F, significantly higher numbers compared to the long-term average. The growing season had six temperature extreme records set in 2021, 99°F on June 1st, 94°F on June 2nd, 93°F on June 20th, 97°F on June 21st, 105°F on June 26th, and 114°F on June 27th, an all-time highest temperature record.

Heat accumulation in the PNW started off near average to slightly above average in eastern and northern Oregon and eastern Washington, while moderately above average for southern Oregon. For most of the vintage, growing degree-days (GDD) tracked close to 2015, one of the warmest vintages to date, until falling off in August and especially in October (Figure 2). In the end, the 2021 vintage GDD amounts over most of California, Oregon, and Washington ended up 17-28% above the 1981-2010

normals, 7-12% above the last fifteen vintages, and up to 10% greater than the 2020 vintage. Isolated areas in eastern Washington, eastern Oregon, and Idaho were closer to normal.

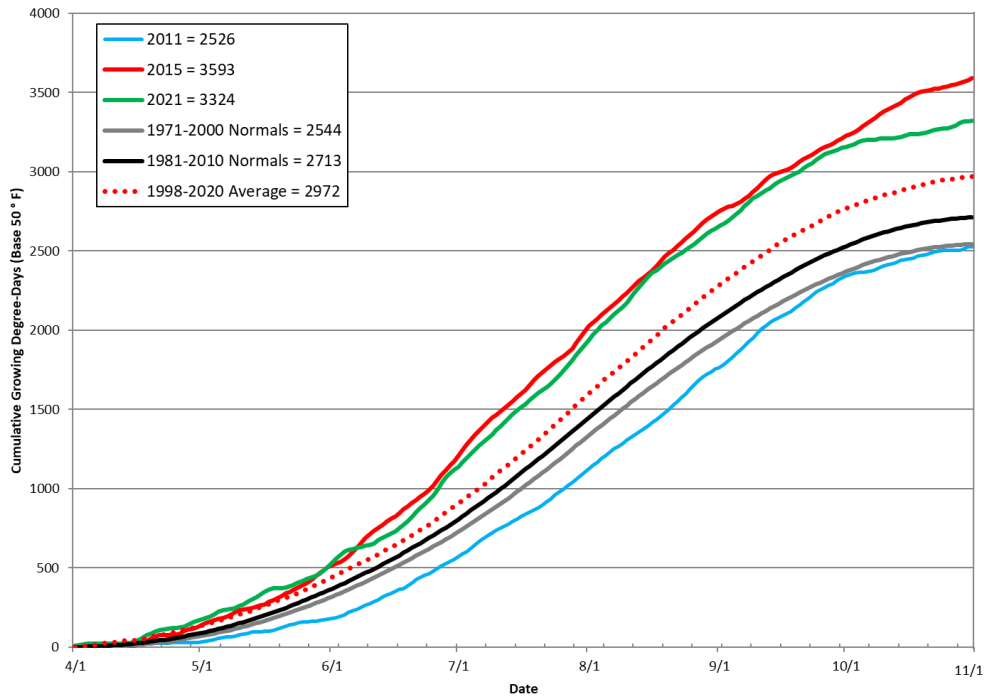


Figure 2 – Growing degree-day accumulation during April-October 2021 from the Roseburg weather station (green line). The long-term averages shown are for the 1971-2000 climate normals (gray line), 1981-2010 climate normals (black line), the 1998-2020 period average (red dotted line), 2015 the warmest year since 1998 (red line), and 2011 the coolest year since 1998 (blue line). Data calculated from daily Tmax and Tmin observations for April 1st through October 31st using a base of 50°F with no upper cut-off.

Figure 3 shows the same degree-day data but, instead of cumulative as in Figure 2, it gives the daily accumulation relative to the 1981-2010 and 1998-2020 averages. As is common in most springs, 2021 saw wide swings in heat accumulation during April through June. Greater accumulation than average occurred during the warm early May, followed by a cool period later in May, then an early season heat wave in the first week of June, followed by a cool/wet period, then the major heat wave in late June (Figure 3). The rest of the growing season saw some week-to-week fluctuations but mostly near average daily accumulation until the significant drop off in late September and early October (Figure 3).

GDD accumulation for 2021 ended up 3324 for the Roseburg weather station compared to 2935 at the Roseburg Agri-Met station and 3068 at the Medford Agri-Met station at SOREC. The 3324 GDD is nearly the same as the 2020 vintage (3335), slightly lower than the warmest vintages of 2014 (3547) and 2015 (3593), 23% higher than the 1981-2010 normals (2970) and 10% higher compared to the 2001-2020 average (3013) (Figure 2). The year ended up being near the average of the last six vintages. Compared to other locations statewide, Roseburg ended up with the 3rd highest heat accumulation compared to state’s four main wine producing region’s weather stations (McMinnville 2633, Milton-Freewater 3521, and Medford 3802).

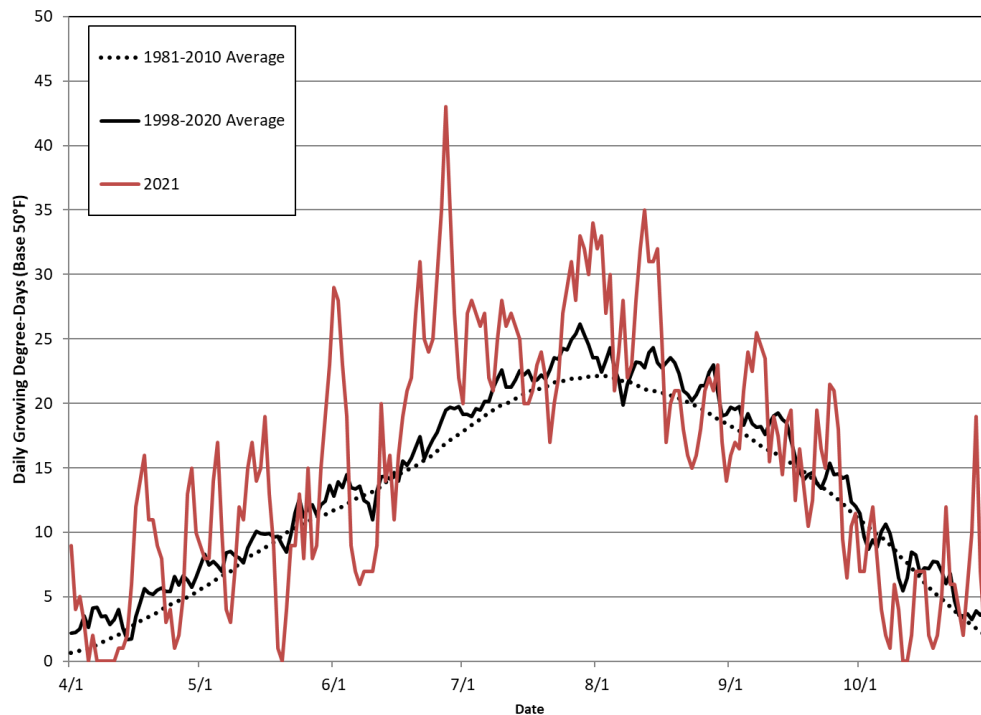


Figure 3 – Same data as in Figure 2 but shown as daily growing degree-day values during April-October 2021 from the Roseburg weather station (base 50°F). The long-term averages are derived from the 1981-2010 climate normals and the average from the 1998-2020 period of record.

For the 2021 vintage, site temperature data from the eight reference vineyards showed that the average GDD accumulation was 2859 with a standard deviation of 317 units (Table 1). Maximum accumulation was 3236 GDD (southern AVA site) while the minimum was 2258 GDD (Elkton area site). In terms of heat extremes there were 28 days on average with temperatures over 95°F across the region, ranging from a low of 7 days to a high of 51 days (Table 1). During 2021 there were 2 to 18 days over 100°F for the sites, with the hottest days of the year occurring during the first week of June, the extreme heat wave in the last week of June, the last few days of July and the start of August, then in the second week of August. The highest reference vineyard average maximum of 113.0°F and absolute maximum of 115.5°F was observed on June 27th.

The 2021 growing season saw both average and absolute minimum temperatures that were slightly cooler than average at the reference vineyards. The coldest nights during the growing season occurred during the first to second weeks of April with temperatures dipping down to 27-34°F throughout the region and at a couple of sites in the second week of October when temperatures dropped into the low 30s. During these periods in April and October the sites experienced from no days to 10 days that dropped below 32°F. The median last frost in the spring occurred April 12th across the region but, like many years, there was a wide range from the earliest being March 30th (Elkton area site) to as late as April 15th (central AVA site) (Table 1). The median first fall frost was November 7th across the reference vineyard sites with a 26-day range from the earliest first frost on October 12th at two sites to all the other sites on November 7th, which was the same day as the Roseburg weather station. The resulting frost-free period median was 209 days in 2021, ranging 42 days across the sites from 180 days (central AVA site) to 222 days (Elkton area site).

Growing season precipitation was near average to significantly below average over most of the western US in 2021, with drought conditions widespread and increasing over the year. The PNW ended the season down by approximately 25-50% for the April through October months, with only isolated areas in western Washington, the northern Cascades, and Bitterroot Range in northern Idaho experiencing higher-than-average amounts. Statewide Oregon saw between 15-90% of the average growing season precipitation, with eastern and southern areas of the state experiencing the greatest deficits. For the Roseburg area, the dry winter continued into the growing season with June slightly wetter than average, then a moderately wet September and October. The June precipitation came mostly across nine days during June 6-14, totaling 1.46" during the time toward the end of bloom and start of fruit set, with the highest amount of 0.38" on June 12th. The Roseburg weather station saw 7.88" during the 2021 growing season, 20% (1.95") below average for the location (Figure 1). The highest single day event for Roseburg during the growing season was the 1.23" on September 17th, which was a record amount for that date.

Comparisons with Previous Years

Compared to past dormant periods at the reference vineyards (starting in 2004-05), the 2020-21 winter was slightly warmer than average for the period (Table 2). This past winter had both a lower number of cold nights compared to average (28 vs 32) and experienced moderately warmer than average absolute minimum temperatures. During the growing season, the 2021 vintage temperatures across the reference vineyards ended up 2.5-3.2°F warmer than average over the entire period (2004-2021). Average maximum temperatures were significantly higher than average while average minimum temperatures were slightly cooler compared to the long-term average due to the cool October. In terms of heat accumulation, the 2021 growing season GDD average of 2859 at the reference vineyards was the highest since 2015, 13% more than the 2004-2020 average (2526), 600-800 heat units warmer than 2010 and 2011, and just over 150 heat units lower than 2015, the warmest vintage to date in the Umpqua Valley and most of the western US (Table 2).

During the growing season, absolute maximum temperatures were significantly higher than average, and the sites experienced a higher number of days over 95°F during 2021. The absolute minimum temperatures observed at the reference vineyards during the growing season were moderately below the period average, while the average number of days below 32°F was two more than typical for the region. The last spring frost date was seven days later than the period average, and the latest since the 2013 vintage. The first fall frost date was seven days later than the period average, and the latest of the last five vintages. The average frost-free period in 2021 was 209 days, the same as the average over 2004-2021 and the longest over the last four vintages (Table 2).

Table 2 – Reference vineyard climate comparisons across the dormant (November 1–March 31) and growing seasons (April 1–October 31) for each year of the project.

<i>Season/Variable</i>	<i>Year or Period</i>																		
Dormant Season (Nov 1 – Mar 31)	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	Average
Average Temperature (°F)	NA	43.7	42.3	42.7	40.9	42.2	43.6	43.9	41.9	43.4	42.9	47.1	45.3	43.3	43.4	42.5	43.7	43.8	43.3
Abs. Minimum Temperature (°F)	NA	23.3	16.0	15.9	16.4	14.1	8.8	18.5	22.0	20.6	5.6	17.3	17.5	25.3	19.2	21.0	24.4	22.3	18.1
# of Days < 32°F	NA	34	32	52	52	40	26	30	42	35	40	21	15	33	29	40	32	28	34
Growing Season (Apr 1 – Oct 31)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average
Growing Degree-Days	2636	2302	2458	2144	2243	2384	2039	2120	2380	2522	2971	3011	2760	2662	2655	2526	2796	2859	2526
Abs. Maximum Temperature (°F)	107.7	106.7	110.2	103.7	107.2	113.7	109.6	101.9	106.7	105.9	108.3	111.1	113.1	115.2	112.9	111.4	110.5	115.5	109.5
# of Days > 95°F	17	10	24	11	19	23	13	14	20	20	31	31	23	30	25	23	27	28	22
Abs. Minimum Temperature (°F)	33.9	30.1	23.3	28.5	24.2	28.1	27.6	27.3	29.4	29.2	30.8	30.8	33.2	28.6	24.7	23.7	19.6	26.7	27.8
# of Days < 32°F	0	2	4	2	7	5	2	6	2	2	0	1	0	3	3	4	4	5	3
Median Last Spring Frost	Apr-1*	Apr-13	Mar27	Apr-2	Apr-20	Apr-16	Apr-24	Apr-25	Mar31	Apr-14	Mar27	Apr-9	Feb 23	Mar22	Apr 3	Apr 8	Apr 8	Apr 12	Apr 5
Median First Fall Frost	Nov-5	Nov-4	Oct-26	Oct-27	Oct-11	Oct-12	Oct-19	Oct-26	Nov-9	Oct-29	Nov30	Nov24	Dec-7	Oct 31	Oct 18	Oct 10	Oct 22	Nov 7	Oct 31
Median Frost-Free Period	218	205	213	208	174	179	178	184	223	202	247	230	288	213	198	188	198	209	209

The maximum and minimum temperatures are the absolute values recorded for the entire region for that year and season. Frost dates and the frost-free period are the median observed over the entire region for that year. Note that the last spring frost in 2004 is from the Roseburg KQEN station observation, which correlates reasonably well with the reference vineyard sites in other years.

Phenology:

Summarizing the phenological observations over the reference vineyards and across all varieties shows a median bud break of April 15th (Table 3). During the spring of 2021 bud break was observed over a prolonged period of three weeks across all varieties and sites, reported as early as April 7th and as late as April 28th. The median date of flowering was June 4th with over a month between the earliest (June 1st) and latest (July 2nd, high elevation site) sites across the region and over all varieties. Véraison and the start of the ripening phase during 2021 occurred over a 27-day period during late July to late August (median August 9th). The earliest véraison was observed on July 29th while the latest was observed on August 25th. Harvest ranged over a 46-day period from August 31st (for sparkling wine) to October 16th across varieties and sites with a median date of September 30th (Table 3).

Average intervals between phenological events (an important measure of vine and berry development timing) shows that bud break to flowering during 2021 had a median of 48 days; that flowering to véraison was 65 days on average; and that véraison to harvest was 53 days on average (Table 3). These intervals had 6 to 13-day standard deviations across sites and varieties, but a very wide range between the shortest and longest intervals due to site elevation differences. For 2021, the length of the bud break to harvest period averaged 167 days with 40 days between the shortest and longest by site and variety.

Table 3 –Phenological date and interval characteristics for the 2021 vintage averaged over sites and varieties.

<i>Event/Interval</i>	<i>Median</i>	<i>Standard Deviation</i>	<i>Latest or Longest</i>	<i>Earliest or Shortest</i>
Bud Break	April 15	5 days	April 28	April 7
Flowering	June 4	12 days	July 2	Jun 1
Véraison	August 9	8 days	August 25	July 29
Harvest	September 30	11 days	October 16	August 31
Bud Break to Flowering	48 days	13 days	80 days	43 days
Flowering to Véraison	65 days	12 days	76 days	38 days
Véraison to Harvest	53 days	6 days	68 days	45 days
Bud Break to Harvest	167 days	11 days	186 days	146 days

Comparisons with Previous Years

The main phenological events for the 2021 vintage were near the averages when compared to the previous seventeen vintages (Table 4). The median bud break was two days later than average and close to the average of the last few vintages. Bloom was nine days earlier than the period average, over four weeks earlier than the cool 2011 vintage and just a few days later than the warm 2015 and 2016 vintages. Median véraison dates during 2021 averaged six days earlier than average, varying by +/- 8 days over sites and varieties, and occurring nine days earlier than in the 2020 vintage. The median harvest date was five days earlier than average, over four weeks earlier than the cool 2010 and 2011 vintages, but 3-12 days later than the 2013-2016 vintages.

For the 2021 vintage, the period between bud break and bloom of 48 days was significantly shorter than the period average by 13 days (Table 4). The bloom to véraison period was two days longer than the

Table 4 – Reference vineyard average phenology comparisons for each year of the project. Note that the 2011-2021 vintage numbers come from fewer sites and varieties than the previous years (see text for details). Note that ‘d’ stands for days.

<i>Stage or Interval</i>	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	<i>Average</i>	
Bud Break																				
Median	4/1	4/2	4/22	4/9	4/22	4/21	4/16	5/1	4/22	4/11	4/4	3/27	3/30	4/18	4/20	4/18	4/14	4/15	4/13	
Std. Deviation	7 d	11 d	4 d	7 d	8 d	5 d	7 d	7 d	4 d	7 d	7 d	8 d	6 d	7 d	5 d	4 d	4 d	5 d	6 days	
Flowering																				
Median	6/5	6/13	6/14	6/9	6/23	6/16	7/2	7/3	6/21	6/9	6/10	6/1	6/1	6/17	6/15	6/12	6/11	6/4	6/13	
Std. Deviation	5 d	7 d	5 d	7 d	6 d	6 d	6 d	5 d	5 d	4 d	6 d	7 d	5 d	5 d	4 d	6 d	9 d	12 d	6 days	
Véraison																				
Median	8/13	8/14	8/14	8/12	8/19	8/19	8/30	9/9	8/26	8/12	8/9	7/31	8/6	8/14	8/15	8/2	8/18	8/9	8/15	
Std. Deviation	7 d	10 d	9 d	9 d	9 d	7 d	11 d	8 d	7 d	6 d	7 d	9 d	7 d	9 d	9 d	8 d	7 d	8 d	8 days	
Harvest																				
Median	10/5	10/10	10/8	10/7	10/15	10/8	10/19	10/26	10/3	9/27	9/22	9/23	9/18	10/6	10/4	9/29	10/2	9/30	10/4	
Std. Deviation	9 d	12 d	9 d	10 d	9 d	8 d	6 d	6 d	8 d	9 d	11 d	13 d	11 d	9 d	12 d	9 d	10 d	11 d	10 days	
Bud Break to Flowering																				
Median	65 d	76 d	54 d	61 d	64 d	56 d	75 d	63 d	59 d	57 d	65 d	63 d	64 d	62 d	56 d	54 d	56 d	48 d	61 days	
Std. Deviation	7 d	14 d	6 d	8 d	6 d	7 d	6 d	7 d	4 d	5 d	8 d	9 d	6 d	5 d	3 d	4 d	9 d	13 d	7 days	
Flowering to Véraison																				
Median	68 d	61 d	62 d	63 d	59 d	63 d	58 d	65 d	68 d	65 d	63 d	63 d	64 d	58 d	62 d	58 d	68 d	65 d	63 days	
Std. Deviation	6 d	8 d	8 d	8 d	6 d	6 d	10 d	4 d	5 d	6 d	6 d	7 d	7 d	5 d	7 d	8 d	10 d	12 d	7 days	
Véraison to Harvest																				
Median	55 d	51 d	51 d	56 d	55 d	51 d	46 d	49 d	41 d	44 d	44 d	48 d	45 d	51 d	48 d	58 d	46 d	53 d	50 days	
Std. Deviation	11 d	15 d	10 d	11 d	10 d	9 d	10 d	8 d	7 d	8 d	11 d	9 d	12 d	10 d	12 d	8 d	6 d	6 d	10 days	
Bud Break to Harvest																				
Median	185 d	194 d	168 d	175 d	174 d	171 d	185 d	177 d	164 d	166 d	173 d	172 d	170 d	170 d	169 d	170 d	171 d	167 d	173 days	
Std. Deviation	13 d	13 d	8 d	13 d	11 d	9 d	8 d	9 d	7 d	11 d	10 d	14 d	13 d	10 d	13 d	7 d	8 d	11 d	10 days	

period average (63 days). The average length of time between véraison and harvest was 53 days, three days longer than the period average, and seven days longer than the 2020 vintage. The average bud break to harvest interval of 167 days in 2021 was shorter than average by six days, but roughly similar to the last ten vintages. Even though the individual dates of phenological events vary quite a lot from year to year, the long-term data for these intervals between events continues to converge toward very consistent lengths for each growth interval for the region.

Composition:

For the 2021 vintage, grower-submitted harvest composition values reflect a near average sugar accumulation showing a median 23.3 °Brix with a moderately wide range from 21.0 to 26.3 °Brix across sites and varieties (Table 5). Harvest titratable acidity averaged 6.2 g/L in 2021 with a reported minimum of 3.7 g/L to a maximum of 8.0 g/L while pH numbers averaged 3.47 with a range from 3.29 to 3.80 over all sites and varieties. Yields averaged 2.1 tons/acre across the sites and varieties, ranging 2.8 tons/acre from a low of 0.8 to a high of 3.6 tons/acre (Table 5).

Table 5 –Harvest composition characteristics for the 2021 vintage averaged over sites and varieties.

<i>Region</i>	°Brix	TA (g/L)	pH	Yield (T/acre)
Median	23.3	6.2	3.47	2.1
Standard Deviation	1.2	1.2	0.13	0.8
Maximum	26.3	8.0	3.80	3.6
Minimum	21.0	3.7	3.29	0.8
Range	5.3	4.3	0.51	2.8

Comparisons with Previous Vintages

The 2021 vintage harvest composition values from the sites give a general comparison with the 2004 through 2020 vintages (Table 6). Average °Brix values of 23.3 were slightly below the period average and consistent with many recent vintages. Average titratable acidity of 6.2 g/L was slightly lower than the period average (6.5 g/L) but within the variations seen in many of the last ten vintages. Median pH values in 2021 were slightly higher than the long-term average, similar to the last ten vintages, and had lower than average site and variety variation. Yields reported from the sites show that the 2021 vintage was moderately below the period average (-13%) but moderately higher than the 2020 vintage. The range of 2.8 tons/acre across sites and varieties in 2021 was very high and was reported that it came from likely bud damage from low temperatures in late October and early November 2020 and rain during the last part of flowering and fruit set in June (Table 5).

Table 6 - Comparison of the overall harvest composition values (all varieties) for each year of the project. *Note that the 2011-2021 vintage numbers come from fewer sites and varieties than the previous years (see text for details).

<i>Value</i>	<i>Harvest Numbers</i>																			<i>Average</i>
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021		
°Brix	24.1	24.0	24.4	23.5	23.7	23.5	22.5	21.5	23.6	23.5	23.4	24.1	24.0	23.4	23.8	23.0	23.5	23.3	23.5	
TA (g/L)	6.6	6.9	6.5	7.1	6.8	6.4	7.6	7.8	6.3	5.6	5.9	5.9	5.8	6.2	6.4	6.4	6.8	6.2	6.5	
pH	3.50	3.38	3.46	3.33	3.42	3.41	3.31	3.40	3.50	3.56	3.50	3.51	3.50	3.40	3.41	3.40	3.42	3.47	3.44	
Yield¹	1.7	2.4	2.8	2.8	2.5	2.4	2.0	2.9	1.9	2.6	2.7	2.7	2.9	2.7	2.4	2.6	1.6	2.1	2.4	

¹ Tons per acre

Grower Comments and Overall Impacts:

Combining weather-related impacts (from the sections above) and numerous grower comments provide a general summary for the 2021 vintage and include: 1) while having a relatively late spring frost in the region, no damage was reported by the reference vineyards, 2) leading up to flowering there were major swings between abnormally high and low temperatures, followed by a relatively longer than average bloom to fruit set period that was very warm to start and then ended with a wet period. These conditions likely played a role in fruit set being moderately down for some later sites (smaller clusters, smaller berries, hens and chicks, and shatter prevalent), resulting in lower yields; 3) the extreme heat of late June did not appear to cause much damage; 4) rain events in mid-September slowed ripening, but dry conditions prevailed afterward; 5) a fairly long harvest period provided a less rushed crush, with fruit quality reported as very good with balanced sugar, acid, and pH; 6) disease pressure was reported as none or significantly down across the region; 7) pest pressures reported were some from mites but quite high from leafhoppers which caused visible canopy damage; and 8) average to lower than average bird pressure due to harvest timing, with later varieties and sites experiencing slightly higher bird pressure.

Current Conditions:

While the drought of the last couple of years is still with us, precipitation amounts have risen since October across the PNW, albeit too much, too soon for some areas of western Washington and British Columbia. As of early December, over 97% of the western US remains in some level of drought with even the most extreme drought conditions (extreme and exceptional) continuing to hover near 50%. Drought zones also extend into the Rockies, much of the Plains, most of Texas, and the western Great Lakes, with even portions of US east of the Mississippi River showing some short-term drought. Short- and long-term drought indicators from seasonal outlooks point to the PNW across to portions of the northern Rockies seeing continued improvement through the first half of the winter. However, the outlook continues to show the long-term drought in California, into the southwest, and up into the Rockies, while also indicating the likelihood of drought developing further in Texas and the southern Plains.

While there are numerous factors that drive our regional weather and climate, the two broader influences that are very prominent are Tropical Pacific and North Pacific sea surface temperatures.

Similar to last winter, the Tropical Pacific has moved into La Niña conditions. The Climate Prediction Center (CPC) has reported that SSTs in the east-central Pacific are approximately 1.5-3.0°F below average, with patterns in all key atmospheric variables consistent with La Niña conditions. Most model forecasts point to the Tropics exceeding the threshold of La Niña SST conditions then returning to ENSO-neutral levels during late spring to early summer. The official CPC/IRI outlook and other agency outlooks are consistent with these model forecasts, calling for a 95% chance of La Niña lasting through the winter. Therefore, a La Niña advisory is in effect. Now with meteorological winter in place and La Niña conditions, the forecast leads me to believe that we will likely see a pattern that is consistent with historical analogs where the PNW has a greater chance of being wetter than average (roughly 70%), while California and the southwest have a greater chance to remain dry. The seasonal forecast is so far holding true with a cold and wet first half of December and what appears to be a more favorable winter precipitation regime. Even California and the Rockies has received more than anticipated.

For the North Pacific, a large area in the Gulf of Alaska continues cooler than average with circulation over the region helping to mix cooler waters to the surface. Warm SSTs still exist over a large area in the central North Pacific, and cooler SSTs are occurring southwest from California and across the ENSO zone in the tropics showing a classic La Niña pattern in tropical SSTs (see above). These conditions have the Pacific Decadal Oscillation moving between neutral to a strong negative phase currently. This type of pattern in cooler North Pacific SSTs supports the seasonal forecast showing the tendency for a cooler/wetter PNW, transitioning to cool and near average precipitation in northern California and to slightly cool and dry overall during the winter in most of the rest of California.

The End of the Project

This vintage report is the last from a project that we started in 2004 with great enthusiasm, little funding, and an uncertain time frame. But we made it work for 18 years! I have been so fortunate to be able to conduct this research. Driving the back roads of Southern Oregon seeing our beautiful landscapes where many a vineyard have been planted and tended by great people. I have seen dogs come and go, but mostly pee on my tires. I have learned that a high percentage of automatic gates don't work consistently. I know that I have been a pest to the reference vineyard participants asking for data and information, but it was their collaborative support that provided the framework for the research, so I am thankful for them putting up with me. I hope that everyone has learned a little something from the research, I know I have.

While I have left academia and am now in the industry, I will continue to attempt to provide weather and climate insights for growers and producers ... once a weather/climate geek, always a weather/climate geek! This year's report will be discussed at an Umpqua Valley Winegrowers Association meeting after the first of the year and inform my talks in February and March for the two Oregon Wine Symposium events (one virtual and one live). So please attend one of these if you can.

I do plan to write up a paper for publication that will combine both the Rogue and Umpqua projects that fully details our climate and grape-growing during this project. Stay tuned.

I will continue to write my monthly Weather and Climate Summary and Forecasts, which can be found here (<https://www.abacela.com/Reports>). If you would like to sign up for the monthly reports, please send me an email (greg@abacela.com). I have also created a website for my publications and other research, you can find them at (<https://www.climateofwine.com/>).

Finally, I would like to acknowledge the support of the Oregon Wine Board, who funded the first few years of the project, then the Umpqua Valley Winegrowers Association who continued the support.

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