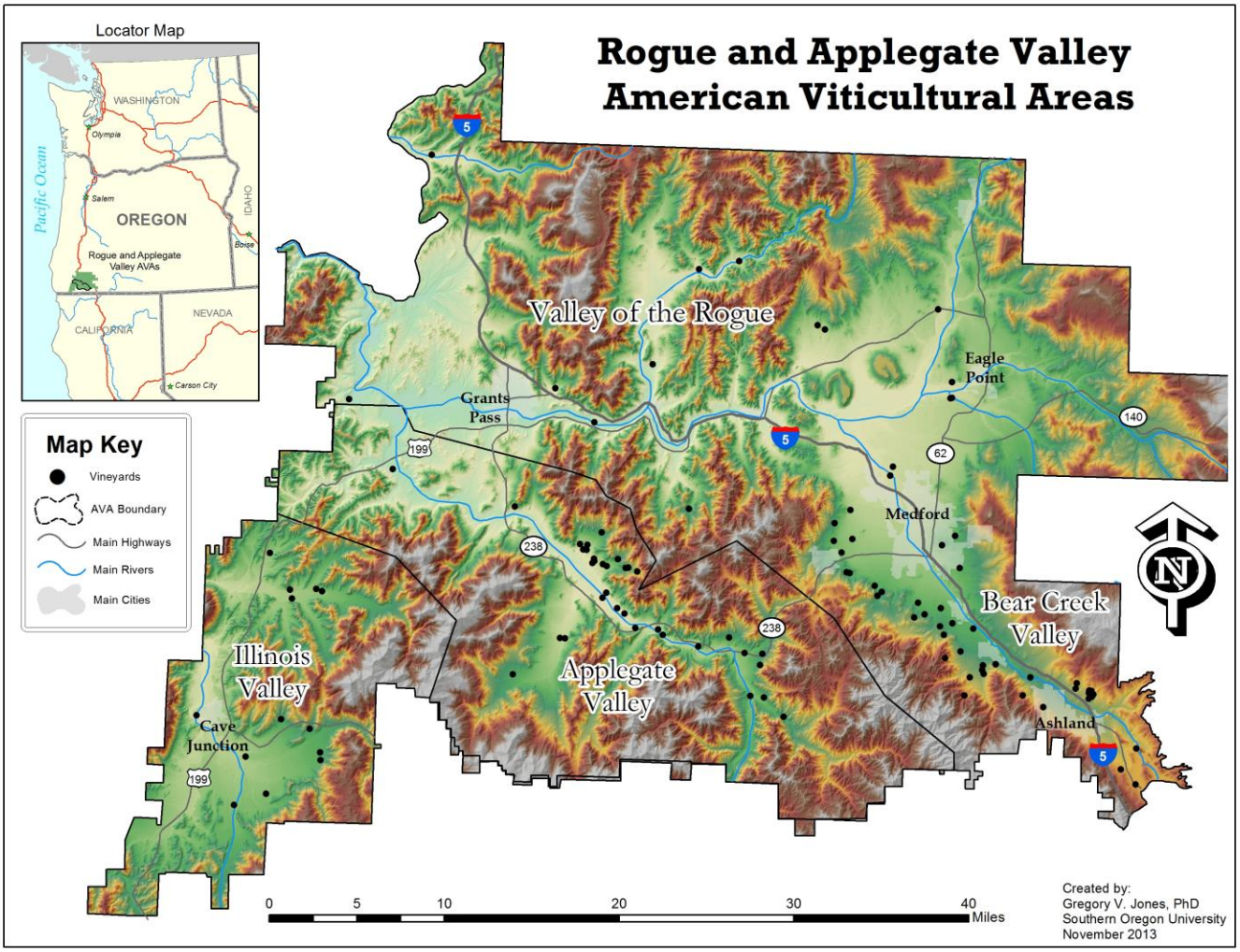
Vintage 2016
Rogue Valley Reference Vineyard Report



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Summary:
The 2016 vintage continued a run of warm and early vintages for the majority of the western US and throughout Southern Oregon. Another extremely warm winter and spring hastened early spring growth and followed with growing degree-day totals in Southern Oregon that ended just below the records set in the 2014 and 2015 vintages. Overall the growing season saw moderately lower maximum temperatures while minimum temperatures were slightly higher than average. The Rogue Valley vintage saw one mild frost period during the entire growing season, experienced one of the cooler Julys on record, and had fewer heat spikes over 95 and 100°F compared to what is normally seen in the summer, which combined with early spring growth, produced what may end being the longest frost-free season on record. Growers reported generally low impacts from weather risks in 2016, with the main issues being some effect from the late April frost and heat stress during flowering and fruit set at some sites and for some varieties. The phenological timing of bud break, bloom, and véraison during 2016 was similar to the last two seasons continuing the trends to earlier growth cycles, with generally good fruit set and then an early harvest that occurred from the first picking reported on September 2nd to the last picking reported on October 13th across the different varieties and sites. Growers reported composition levels at harvest that exhibited near average °Brix, lower than average acidity, slightly higher than average pH values, and yields that were slightly higher than average. Bird pressure was very low, largely due to the early harvest and timing with bird migrations, while many indicated increased pressure from turkeys, ground squirrels, gophers, and raccoons than seen in previous years. Other pest and disease pressure (e.g., mites, leafhoppers, mildew) was reported as very low to higher than expected at some sites.

Project Overview:
This project is a continuation of the 2003-2009 reference vineyard project which established a suite of reference vineyards in the Rogue and Applegate Valley AVAs 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 2010 vintage, the project has been scaled back to cover only temperature, phenology, and harvest composition from six sites (one in the Illinois Valley, two in the Applegate Valley, two in the Bear Creek Valley, and one in the Valley of the Rogue). At each of the six 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 Medford NWS station at the airport and the AgriMet station at SOREC. For phenological observations, the six sites submit dates for the four main events of bud break, bloom, véraison, and harvest for a mix 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 six sites and are then summarized for the region.

Climate:
The winter of 2015-16 (November 1 through March 31) was characterized by much warmer than average temperatures throughout the region and the western US. Temperatures during November through March at the Medford station were not as warm as the previous winter, but were 2.0°F above average while those at the reference vineyards were 1.5-2.5°F above the average of the last 13 years (Table 1 and 2). December and February were the warmest months of the winter with Medford temperatures running 2.9°F and 3.4°F warmer than normal, respectively (Figure 1). The winter had only two relatively cold periods, the end of November and early January when the coldest night occurred on

January 2nd with 19°F at the Medford station (Figure 1). During the same time periods the absolute winter lows at the reference vineyards dropped to 11.3°F to 21.6°F (Table 1). Like the previous winter, the remainder of the 2015-16 winter was mild with above average temperatures every month except November which was -1.1°F below average. During the dormant period from November to March the region experienced an average of 51 days below 32°F, which was substantially lower than the long term average (Table 2). While precipitation is not observed at the reference vineyards, values from the main climate stations in the region indicate that November was drier than average, followed by a much wetter than average December (+4.3 inches) and January (+1.8 inches) then a dry February and moderately wet March (Figure 1). Overall the winter ended up 7.8 inches or 51% above the long term average. During the period from November 2015 through October 2016 four individual days experienced 1.0 inches or greater rainfall, with two record daily rainfall events in October.

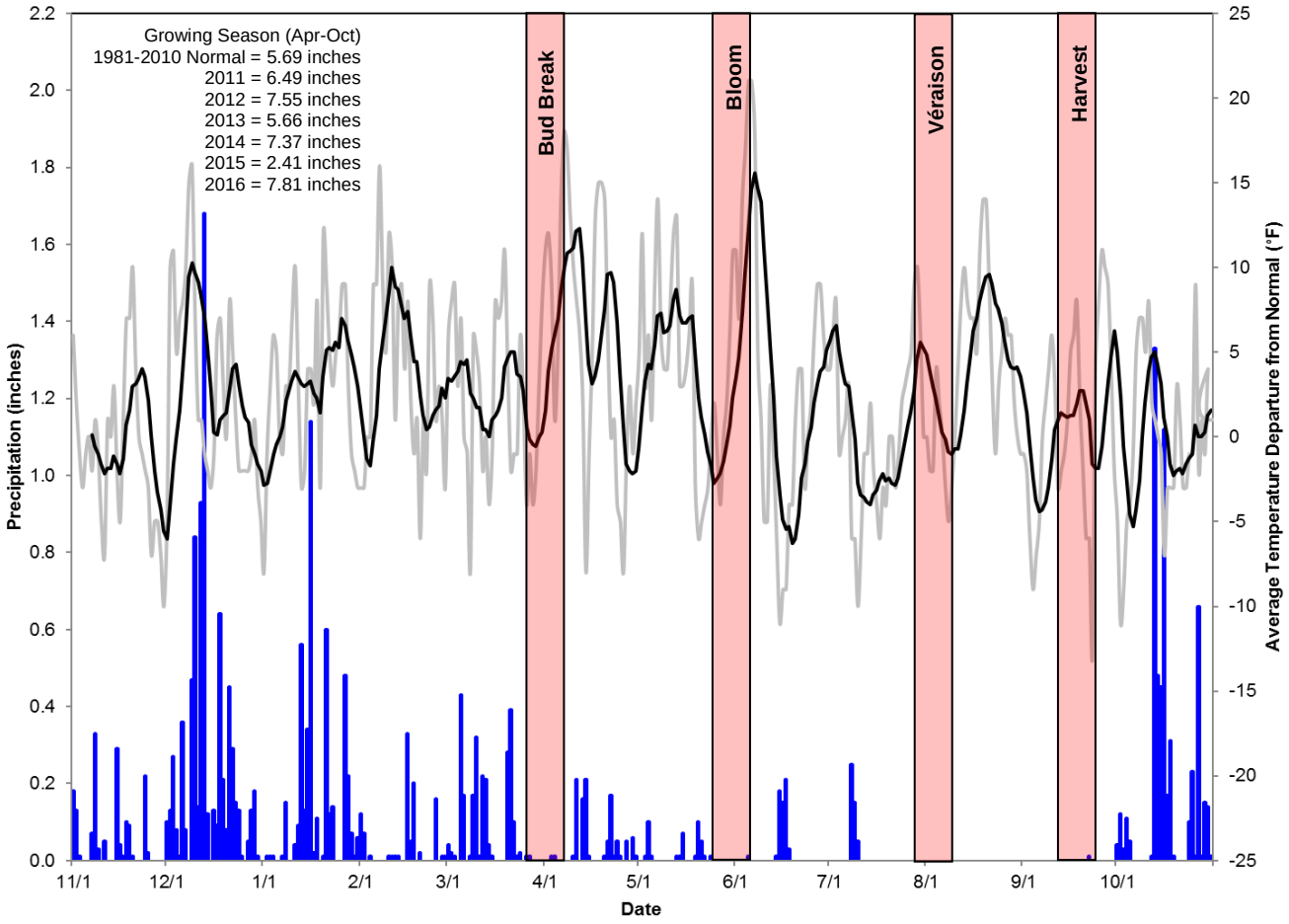

Figure 1 – Daily average temperature departures from normal and precipitation for November 1, 2015 to October 31, 2016 from the Medford Airport weather station. The gray line is the day to day temperature departures from normal, the black line is the weekly average departures, and the blue bars are daily 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).

Following a warm second half of winter in the western US, April continued the trend at 5.5°F warmer than average for Medford and anywhere from 2-8°F in wine regions throughout the west. February through April was a combined 4-6°F warmer than average in the region and resulted in an early bud break from the last week of March through the second week of April, averaging April 4th (see more in the phenology section that follows). The warm spring continued into May and was followed by an early start to summer with June running 3-5 degrees above normal statewide. Late winter rains appeared to

have provided enough soil moisture for spring growth, but was followed by a dry April through June leaving slight to moderate drought conditions heading into the summer. The warm spring and early summer produced a region-wide average bloom date on May 31st (Figure 1) with only a trace of rain during the main portion of the bloom period. Temperatures in July were a surprise, dropping off the records set during the spring months to only 0.1°F above normal and was the coolest July in over 20 years. During one of the cool periods in early July over a half an inch of rainfall fell, with one record breaking day rainfall amount that ultimately made it also one of the wetter Julys in many years. After the cool July the region-wide average véraison occurring on August 5th, but the month progressively warmed with temperatures in the Rogue 4-5°F warmer than normal. Similar to the growing season in 2015, there were only four heat spikes in 2016 reaching 15°F above normal, which typically happens 7-10 times per summer. During these heat events temperatures reached over 100°F twelve times. The warmest periods in the summer occurred during June 1-7, July 27-30 and August 12-20 when daily temperatures were consistently over 95°F and the highest temperature of 109°F was observed on August 19th at the Medford station (all-time records were broken at Medford August 19-21). September 2016 started off relatively cool (Figure 1), slowing ripening slightly. Ultimately September ended up near average in terms of temperatures (0.3°F above average at Medford) and roughly 1 inch down in overall rainfall. Harvest started very early for some with the first picking reported on the 2nd of September, but the bulk of the harvest came in from September 10th to roughly October 1st in the region (median harvest date of September 21st). The early move through harvest in September was welcomed as even though October was relatively warm, it was very wet with more than 4 inches more than normal precipitation during the month and two record breaking single day rainfall amounts (Figure 1).

Overall the growing season daily temperature departures observed at the Medford weather station were 2.2°F warmer than the 1981-2010 climate normals. This was cooler than both the 2014 and 2015 vintages. Of the four main wine growing regions in Oregon, the Rogue Valley had intermediate differences for average temperatures for the 2016 vintage; with the other regions seeing 1.1-2.9°F above average during April-October. After the moderately wet conditions during the dormant period (51% above average), rainfall during the growing season totaled 7.81” at the Medford station which was 37% above average for the location (Figure 1). Although it should be noted that nearly 5 inches of the growing season total occurred in October after the majority of the harvest was done.

From a growing degree-day (GDD) standpoint spring heat accumulation started off much warmer than average, and even higher than the very warm 2014 and 2015 vintages. However, by the end of June the spring ended up being similar to the 2015 vintage and the second highest heat accumulation in spring (April-June) during the observed period of record for Medford (1928-2016). The cool July resulted in the growing season heat accumulation in 2016 dropping below the last two vintages (Figure 2) which it never made up, especially with the cool October.

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 2001-2015 averages. As is common in most springs, 2016 saw wide swings in heat accumulation during April through June, with numerous peaks that occurred from the days with the greatest temperature departure from average (Figure 1). The warm spring and very warm period in early June are clearly evident as is the relatively cool July. While the rest of the growing season saw a few daily departures of higher than normal accumulation, especially in mid-August, conditions were closer to normal through the end of the growing season. GDD accumulation for 2016 ended up at 3604 for the Medford weather station (3015 at the Medford Agri-Met station at SOREC). The 3604 GDD is lower than experienced in 2014 (3896) and 2015 (3917) but substantially more

than the 1981-2010 normals (2970) and the 2001-2015 average (3326) (Figure 2). Compared to other locations statewide, Medford ended up with the highest heat accumulation compared to state's four main wine producing regions with McMinnville the lowest (2566). For the first time in the data record, Roseburg accumulated more heat (3287) than Milton-Freewater (3239).

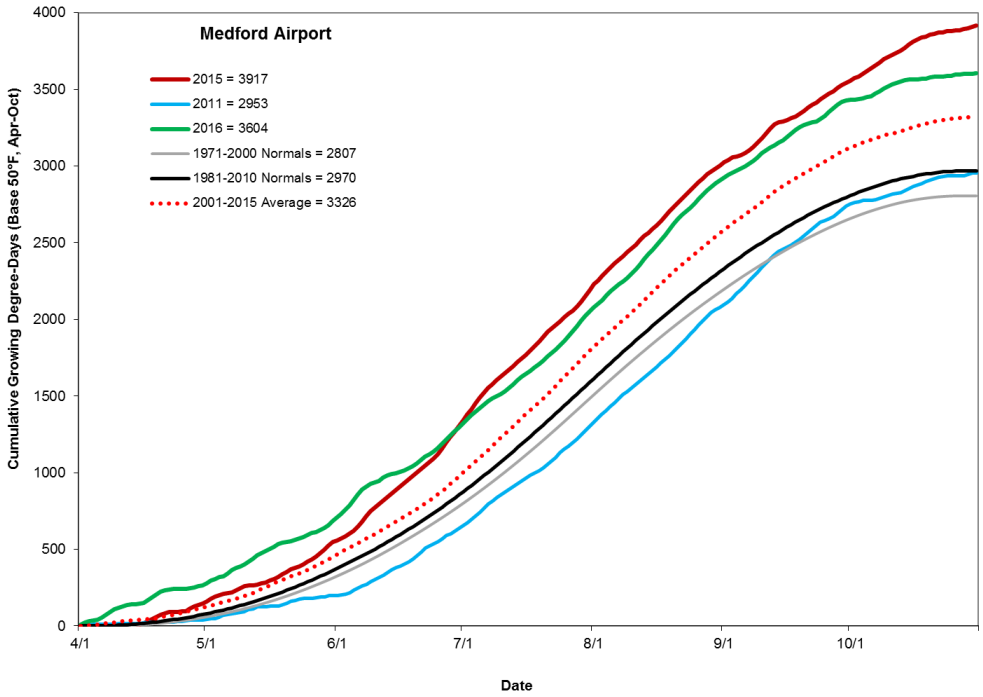

Figure 2 – Growing degree-day accumulation during April-October 2016 from the Medford Airport weather station (green line). The long-term averages shown are for the 1971-2000 climate normals (gray line), 1981-2010 climate normals (black line), the 2001-2015 period average (red dotted line), 2015 the previous 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.

For the 2016 vintage, site temperature data from the reference vineyards showed that the average GDD accumulation was 2778 with a standard deviation of 234 units (Table 1). Maximum accumulation was 3237 GDD (a Bear Creek Valley site) while the minimum was 2603 GDD (Illinois Valley site). In terms of heat extremes there were 34 days on average with temperatures over 95°F across the region, ranging from a low of 25 days to a high of 43 days (Table 1). In addition, there were numerous days over 100°F for the region (8-14 depending on the site), with most occurring during early June, late July and scattered throughout August. The hottest days of the year were over a three-day period during August 18-20 when an overall reference vineyard average maximum of 113.8°F was observed. However, the 2016 vintage saw maximum temperatures nearly 1°F cooler on average compared to those in 2015.

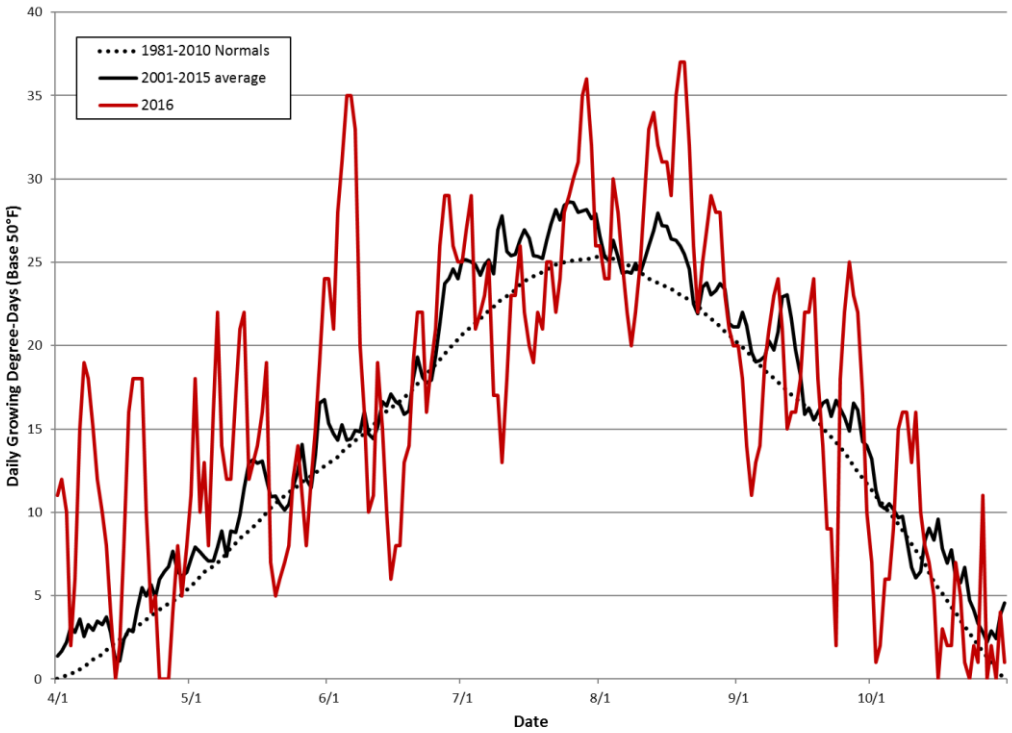

Figure 3 – Same data as in Figure 2, but shown as daily growing degree-day values during April-October 2016 from the Medford Airport weather station (base 50°F). The long-term averages are derived from the 1981-2010 climate normals and the average from the 2001-2015 period of record.

Following the mild winter, the absolute minimum temperatures during the growing season were quite warm during the 2016 vintage. The coldest nights during the growing season occurred in early and late April (April 5-6 and 25-26) with temperatures dipping down to their lowest on April 26th (29.3-33.2°F at the reference vineyards) throughout the region (Table 2). During the growing season there were sites that saw no days that dropped below 32°F to one site experiencing four (mostly in April) resulting in an average of one frost day during 2016. The median last frost in the spring occurred April 26th across the region, however a few sites saw their last spring frost occur on March 8th (Table 1). In terms of the first fall frost only one reference vineyard site in the Illinois Valley saw temperatures drop below 32°F before the end of October (when temperature sensors were downloaded), while the first fall frost occurred on December 5th at the Medford weather station (one of the latest first fall frosts on record). Counting the first fall frost as December 5th for those sites that did not see an October frost, the resulting frost free period median was 223 days in 2016, ranging 103 days from 169 to 272 or more in the region.

Comparisons with Previous Years

Compared to past dormant periods at the reference vineyards (starting in 2003-04), the 2015-16 winter was 1.7°F above average (Table 2). This past winter also had substantially fewer than average number of days below 32°F (51 vs. 75 on average) and had relatively cold absolute minimum temperatures isolated in a few days in late November and early January. During the growing season, the 2016 vintage temperatures across the reference vineyards ended up 1.0-1.5°F cooler than those experienced during the 2014 and 2015 vintages. Average maximum temperatures were slightly cooler than average while average minimum temperatures were slightly warmer compared to the long term average. In terms of heat accumulation, the 2016 growing season GDD at the reference vineyards was moderately higher than the 2003-2016 average (2651), 300 or more heat units warmer than 2010 and 2011, but lower than the 2015 and 2016 vintages (Table 2).

Table 1 – Rogue Valley reference vineyard dormant season (November 1-March 31, 2015-16) and growing season (April 1-October 31, 2016) climate characteristics. Note that the dormant season minimum temperature value is the average absolute low temperature experienced. Growing degree-days are calculated from April-October 2016 (base of 50°F with no upper cut-off). *Note that **only one** site experienced their first fall frost prior to 11/1 and the Medford station's first frost was 12/5.

Dormant Season (Nov 1 – Mar 31)	***Average***	***Standard Deviation***	***Maximum***	***Minimum***	***Range***
Average Temperature (°F)	42.8	0.5	43.7	42.4	1.3
Absolute Minimum Temperature (°F)	16.4	3.7	21.6	11.3	10.2
# of Days < 32°F	51	6	55	40	25
Growing Season (Apr 1 – Oct 31)	***Average***	***Standard Deviation***	***Maximum***	***Minimum***	***Range***
Growing Degree-Days	2778	234	3237	2603	634
Growing Season Average Temperature (°F)	62.7	1.1	65.0	61.9	3.1
Average Maximum Temperature (°F)	82.4	2.7	86.7	79.9	6.8
# of Days > 95°F	34	14	43	25	18
Average Minimum Temperature (°F)	45.4	2.5	48.9	42.1	6.8
# of Days < 32°F	1	1.4	4	0	4
Median Last Spring Frost (date or days)	4/26	20 days	4/26	3/8	49 days
Median First Fall Frost (date or days)	12/5	*	*	*	*
Median Frost Free Period (days)	223	33 days	272	169	103

Table 2 – Reference vineyard climate comparisons across the dormant (November 1 – March 31, 2015-16) and growing seasons (April 1 – October 31, 2016) for each year of the project. *Note that for the 2012-2016 vintages the data come from fewer sites than the 2003-2010 period (see text for details).

Season/Variable	***Year***														
Dormant Season	***2002-03***	***2003-04***	***2004-05***	***2005-06***	***2006-07***	***2007-08***	***2008-09***	***2009-10***	***2010-11***	***2011-12***	***2012-13***	***2013-14***	***2014-15***	***2015-16***	***Average***
Average Temperature (°F)	NA	42.8	41.1	40.3	40.8	39.2	39.9	41.1	40.5	39.6	40.5	40.3	45.0	42.8	41.1
Absolute Minimum Temperature (°F)	NA	18.4	18.1	16.0	9.8	15.0	12.4	8.4	15.3	16.3	15.2	-7.2	15.0	11.3	12.6
# of Days < 32°F	NA	51	84	77	77	96	85	65	72	101	82	86	45	51	75
Growing Season	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***Average***
Growing Degree-Days	2903	2737	2463	2699	2510	2535	2680	2300	2223	2559	2638	3042	3049	2778	2651
Absolute Maximum Temperature (°F)	113.1	111.9	108.9	114.6	110.2	111.5	115.6	111.3	105.1	106.2	108.8	109.0	113.0	113.8	110.9
# of Days > 95°F	47	42	37	40	25	36	36	29	24	30	37	48	40	34	36
Absolute Minimum Temperature (°F)	20.9	30.1	26.4	23.3	21.6	19.7	21.6	21.5	23.3	30.0	25.9	25.6	27.6	29.3	24.8
# of Days < 32°F	10	5	10	17	10	22	16	13	15	5	17	3	7	1	11
Last Spring Frost (date)	5/1	4/2	4/19	5/8	4/27	5/5	4/30	5/6	5/6	5/10	5/1	4/28	4/9	4/26	4/27
First Fall Frost (date)	10/10	10/25	9/25	10/11	9/24	10/9	10/2	10/23	10/25	10/21	10/3	11/11	11/1	12/5	10/19
Frost Free Period (days)	162	206	159	156	150	157	155	170	172	164	154	197	206	223	174

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.

During the growing season, absolute maximum temperatures were moderately higher than average while the number of days over 95°F during 2016 were moderately lower than the last two vintages but near the long term average. The absolute minimum temperatures observed at the reference vineyards during the growing season were significantly warmer than the period average, while the number of days below 32°F was much lower than average. The last spring frost date was right at the time period average (April 27th), while the first fall frost date was likely more than a month later than the time period average (only observed at one of the reference vineyards prior to the end of October). The result was another very long frost free period, the longest in this data record and likely the longest ever observed in the region (Table 2).

Phenology:

Summarizing the phenological observations for the entire region and across all varieties shows a median bud break of April 4th (Table 3). During the spring of 2016 bud break was observed over a 15-day period for all varieties and sites, reported as early as March 27th and as late as April 11th. The median date of flowering was May 31st with two weeks between the earliest (May 25th) and latest (June 8th) sites across the region and over all varieties. Véraison and the start of the ripening phase during 2016 occurred over a 28-day period during the third week of July through the third week of August (median August 5th). The earliest véraison was observed on July 23rd while the latest was observed on August 20th. Harvest dates ranged over 41 days from September 2nd to October 13th across varieties and sites with a median date of September 21st (Table 3).

Average intervals between phenological events (an important measure of vine and berry development timing) shows that bud break to flowering during 2016 had a median of 57 days; that flowering to véraison was 69 days on average; and that véraison to harvest was 44 days on average (Table 3). These intervals had 4 to 11-day standard deviations across sites and varieties, but a very wide range between the shortest and longest intervals due to site differences. For 2016, the length of the bud break to harvest period averaged 172 days with 34 days between the shortest and longest.

Table 3 –Phenological date and interval characteristics for the 2016 vintage averaged over sites and varieties. Note that for the 2010-2016 vintages the data come from fewer sites (see text for details).

Event/Interval	*Median*	*Standard Deviation*	*Latest or Longest*	*Earliest or Shortest*
Bud Break	April 4	4 days	April 11	March 27
Flowering	May 31	4 days	June 8	May 25
Véraison	August 5	7 days	August 20	July 23
Harvest	September 21	10 days	October 13	September 2
Bud Break to Flowering	57 days	4 days	65 days	50 days
Flowering to Véraison	69 days	6 days	82 days	56 days
Véraison to Harvest	44 days	11 days	69 days	30 days
Bud Break to Harvest	172 days	10 days	191 days	157 days

Comparisons with Previous Years

For the Rogue Valley the main phenological events for the 2016 vintage were significantly earlier than average when compared to the previous vintages (Table 4). The median bud break was 13 days earlier than average and a few days earlier than observed in both 2014 and 2015. Bloom was 13 days earlier than the period average, over four weeks earlier than the cool 2011 vintage but within a couple of days

Table 4 – Reference vineyard average phenology comparisons for the 2003 to 2016 vintages. *Note that the 2010-2016 vintage numbers come from fewer sites and varieties than the previous years (see text for details).

Stage Interval	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*Average*
Bud Break															
Median	4/18	4/2	4/15	4/25	4/19	4/30	4/23	4/20	5/2	4/24	4/15	4/11	4/1	4/4	4/17
Std. Deviation	10 days	8 days	10 days	9 days	10 days	9 days	10 days	9 days	10 days	4 days	4 days	7 days	7 days	4 days	8 days
Flowering															
Median	6/11	6/4	6/19	6/12	6/10	6/22	6/15	6/27	7/1	6/16	6/8	6/5	6/2	5/31	6/13
Std. Deviation	10 days	6 days	7 days	6 days	7 days	8 days	8 days	8 days	6 days	5 days	6 days	9 days	6 days	4 days	7 days
Véraison															
Median	8/20	8/11	8/22	8/16	8/16	8/24	8/20	8/31	9/3	8/22	8/11	8/11	8/5	8/5	8/17
Std. Deviation	7 days	6 days	9 days	6 days	6 days	7 days	8 days	7 days	9 days	8 days	6 days	4 days	8 days	7 days	7 days
Harvest															
Median	10/7	10/1	10/19	10/9	10/9	10/14	10/7	10/26	10/26	10/7	9/26	9/24	9/16	9/21	10/6
Std. Deviation	12 days	10 days	10 days	12 days	12 days	9 days	13 days	12 days	6 days	12 days	14 days	13 days	13 days	10 days	11 days
Bud Break to Flowering															
Median	52 days	64 days	65 days	48 days	52 days	51 days	52 days	66 days	57 days	53 days	55 days	56 days	61 days	57 days	56 days
Std. Deviation	10 days	7 days	10 days	9 days	10 days	7 days	8 days	9 days	11 days	6 days	6 days	10 days	10 days	4 days	8 days
Flowering to Véraison															
Median	69 days	68 days	64 days	67 days	68 days	65 days	64 days	66 days	66 days	63 days	66 days	64 days	64 days	69 days	66 days
Std. Deviation	9 days	9 days	9 days	6 days	8 days	9 days	8 days	10 days	6 days	6 days	6 days	9 days	6 days	6 days	8 days
Véraison to Harvest															
Median	48 days	50 days	59 days	52 days	54 days	52 days	47 days	57 days	50 days	43 days	50 days	45 days	45 days	44 days	50 days
Std. Deviation	8 days	10 days	11 days	11 days	11 days	9 days	12 days	14 days	9 days	10 days	14 days	14 days	13 days	11 days	11 days
Bud Break to Harvest															
Median	172 days	186 days	189 days	168 days	174 days	166 days	163 days	188 days	175 days	168 days	165 days	165 days	165 days	172 days	173 days
Std. Deviation	15 days	12 days	14 days	14 days	14 days	11 days	16 days	15 days	9 days	13 days	14 days	14 days	16 days	10 days	13 days

as observed during the warmest vintage to date 2015. Median véraison dates during 2016 were 12 days earlier than average, varying by +/- 7 days over sites and varieties, and occurring nearly 30 days ahead of the cool 2011 vintage and on the same date as the warm 2015 vintage. The 2016 median harvest date was 15 days earlier than average, over one month earlier than the cool 2010 and 2011 vintages, and a few days earlier than the 2014 and five days behind the 2015 vintage.

For the 2016 vintage, in spite of the very warm late winter and spring, the average time between bud break and bloom of 57 days was right at the period of record average (Table 4). The bloom to véraison period in 2016 of 69 days was three days longer than the period average (66 days). Both of these early growth phases continue to be the most consistent growth periods year to year. The average length of time between véraison and harvest was 44 days in 2016, six days shorter than the period average. The average bud break to harvest interval of 172 days in 2016 was right at the period average, but slightly longer than the last two 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 2016 vintage, grower-submitted harvest composition data clearly reflect a warm season showing an average 24.1 °Brix with a range from 22.5 to 27.0 °Brix across sites and varieties (Table 5). Harvest titratable acidity averaged 5.0 g/L with a minimum of 4.1 g/L to a maximum of 6.0 g/L while pH numbers averaged 3.49 with a range from 3.30 to 3.80 over all sites and varieties. Yields averaged 3.3 tons/acre across the sites and varieties, ranging 2.2 tons/acre from a low of 1.2 to a high of 7.2 tons/acre (Table 5).

Table 5 –Harvest composition characteristics for the 2015 vintage averaged over sites and varieties.

Region	°Brix	TA (g/L)	pH	Yield (T/acre)
Median	24.1	5.0	3.49	3.3
Standard Deviation	1.2	0.6	0.13	1.2
Maximum	27.0	6.0	3.80	7.2
Minimum	22.5	4.1	3.30	2.2

Comparisons with Previous Vintages

The 2016 vintage harvest composition values from the sites give a general comparison with the 2003 through 2015 vintages (Table 6). Average °Brix values of 24.1 was right at the fourteen-year average and similar to the last four vintages. Average titratable acidity of 5.0 g/L was moderately lower than the period average (6.0 g/L) but very similar to the 2014 and 2015 vintages. Median pH values in 2016 were slightly higher than the long term average and had slightly higher than normal site and variety variation. Yields reported from the sites show that the 2016 vintage was lower than the last two vintages and right at the period average. The large range of 2.2 tons/acre across sites and varieties in 2016 was less than past vintages (Table 5).

Table 6 – Reference vineyard average harvest composition comparisons for the 2003 to 2015 vintages. *Note that the 2010-2015 vintage numbers come from fewer sites and varieties than the previous years.

Parameter	*Harvest Numbers*														
	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*Average*
°Brix	24.4	24.5	23.4	24.1	23.6	23.9	23.5	23.2	23.8	24.0	24.2	24.5	24.4	24.1	24.0
TA (g/L)	6.1	5.8	6.3	5.9	6.3	6.2	5.9	7.1	7.0	5.5	6.3	5.4	5.4	5.0	6.0
pH	3.42	3.49	3.39	3.50	3.37	3.43	3.55	3.47	3.42	3.56	3.45	3.49	3.50	3.49	3.47
Yield[1]	2.9	2.6	2.8	3.1	3.2	3.0	2.9	2.2	3.9	2.9	3.6	3.8	4.2	3.3	3.2

[1] Tons per acre

Conclusions:

The 2016 vintage in Southern Oregon started early, cooled down in the middle and then ended early. While not as warm as the 2014 and 2015 vintages, 2016 ended up the fourth warmest year during the period of record for Medford. Similar to last year, the 2016 growing season was largely free from extreme weather risks, with only one mild frost event recorded in late April, no rain during bloom but some heat stress, and very little rain during the bulk of harvest. There were a couple of instances of isolated small hail that caused some damage, but otherwise the vintage was a very low risk growing season. While in the middle of a long term significant drought over many areas of the west, winter and spring rains helped bring Southern Oregon out of the extreme drought category and provided enough soil moisture to initiate strong vegetative growth. The season also saw very little heat stress with maximum temperatures lower than normal and heat spikes fewer than normal. The result was an early and average to slightly above average harvest of well-balanced fruit.

The reference vineyard temperature observations reflect the general conditions seen across Oregon and the region. The dormant period was extremely warm in terms of average temperatures, but also reflected in the extremes with absolute minimums generally higher than average and fewer days below 32°F. The warm winter did not skip a beat in the spring with an extremely warm April. As a result, bud break came earlier than average. The warm-up continued in May and was followed by the warmest overall month of the summer, June. The surprise for the year was July, where a cool down produced one of the coolest Julys in the last 20 years. Growing degree-day accumulation averaged 2778 over the sites, which was lower than the last two vintages but still higher than average. Heat extremes during 2016 were slightly below average with twelve days above 100°F and 34 days above 95°F averaged over the region. Phenological observations from the sites showed a significantly earlier than average growth and ripening timing. The year was quite similar to 2015, and even with a cool July 2016 ripening progressed ahead of average. Interestingly, the 2016 harvest started earlier than the 2015 harvest but finished just slightly behind 2016 in average dates. The intervals between growth stages remained generally consistent compared to other years, indicating consistent growth cycles even in the last few warm vintages. Basic composition values reflect the warmer than normal vintage with °Brix levels average, acid levels much lower than average, slightly above average pH values, and average yields.

Comments on the season submitted by growers tended to reflect the relatively long and generally risk-free growing season. Many stated that the season was very early and that harvest came early and finished quickly. Individual comments reveal that overall the bloom period was dry and resulted in nearly ideal flowering and fruit set, while some indicated that later varieties were likely impacted by one of the few heat spikes of the year in early June (Figure 1). Overall the general impression from growers was that berry set was good with cluster numbers and weights average to moderately up for some varieties and sites. In terms of bird pressure, growers noted very low to no pressure, but indicated increased pressure from turkeys, ground squirrels, gophers, and raccoons compare to that seen in previous years. Other pest pressure was also stated being variable with some mentioning that that mealybug, mite and leafhopper pressure was low to average but that deer were still aggressive due to the continuing drought conditions. Comments concerning disease issues tended to indicate a relatively low pressure year for many, although some early season botrytis was seen and that the wet and cool July brought powdery mildew pressure to a month when little is normally seen.

The warmer conditions during the past five vintages (2012-2016) throughout the western US has been linked to a moderate rebound in sea surface temperatures over both the North and Tropical Pacific Ocean. The shift from a cooler tropical Pacific (La Niña conditions) to neutral and then El Niño conditions

in the tropics (warmer waters) over the last three years, and the continuation of substantially warmer waters off the west coast from British Columbia south to Baja has brought climatic conditions back to normal or warmer than normal over the western US. Similar to the past few vintages, the warmer sea surface temperatures continued to influence the west in 2016 with a more normal marine layer along the coast, and moderately higher minimum and maximum daytime temperatures over the western US. However, the cool July was likely at least partially due to a waning of these conditions in the North Pacific.

What does the 2016-17 winter and the spring of 2017 hold for the western US and Southern Oregon? Currently a moderate La Niña is in place in the Tropical Pacific and is forecast to transition to neutral conditions in the spring of 2017. The big transition has come in the North Pacific where ocean temperatures have cooled tremendously. The result is that the western US is seeing broadly cooler conditions than we have seen the last couple of winters, with a classic split in the La Niña pattern of being wet from Northern California into the PNW and relatively dry from the Bay Area southward. Historical data would point to a moderately wet and cool to cold first half of the winter followed by a moderately dry and cold second half of the season. Forecasting conditions during the late winter and into spring of 2017 will depend on how the dynamic patterns of sea surface temperatures in the Pacific play out and how the Tropical to Arctic circulation of the atmosphere responds. The evidence currently would point to a cooler spring than we have seen in a few years. As ocean and atmospheric conditions over the next 2-3 months unfold we will have a much better picture of what the spring of 2017 will bring to Oregon and the rest of the western US. Further updates will be provided as more information becomes available.

Future Work

- The observation network will continue with the reduced number of sites (six) and focus on site temperatures, phenology, and harvest composition and yields for the foreseeable future.
- An overview presentation will be given at the annual meeting of the Rogue Valley Winegrowers Association which will be held on February 4, 2016 (see RVWA email newsletter and web site announcements for further details).
- The results will also be used to provide a Southern Oregon component to the Oregon Wine Symposium's "Vintage Overview" session during February 21-22, 2016 in Portland at the Oregon Convention Center.
- A synthesis report with further in-depth analyses of the study will be compiled and made available as more data are gathered and processed.

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