Oregon Wine Advisory Board
Research Progress Report

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Pinot noir Maturity Research

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A research trial was started in 1987 at Woodhall III Vineyard in Alpine to analyze the changes in composition which occur during ripening of Pinot noir and to determine their effect on wine composition and quality. This study developed in response to industry experience and our own problems with trying to harvest the Pinot noir clonal trial. For instance, we usually obtain a range in maturity which often reflects differences in yield. Although the differences among clones are consistent, the seasonal differences can be greater in magnitude than the clonal differences.

Commercially, the time of harvest is based on experience and intuition, often requiring a certain element of luck, especially with respect to the weather. In 1984 the weather became cold and rainy in mid September when Pinot noir was at 17 to 19 degrees Brix. Fruit was harvested at the end of September at 18 to 20 degrees Brix. Harvesting later improved maturity at some sites but lowered it at others due to excessive water uptake and berry swelling. By contrast, the warm and prolonged ripening season of 1985 allowed Pinot noir to be harvested over a wide range of maturity frorn early to late, generating much opinion about the relationship of 'hanging' time on the vine to wine quality. In 1986 two weeks of heavy rain delayed what would have been an early season. Pinot noir was harvested before, during, and after the rains, again generating much controversy as to when was the best time to pick. By far the warmest and driest season on record was 1987. Sugar accumulated very early and in many cases was accompanied by abnormally low acidity and high pH, but this varied considerably frorn site to site. Some Pinot noir was harvested early at moderate Brix levels in order to maintain moderate acidity and pH. Other fruit was harvested later, often making it necessary to add tartaric acid to the must to bring the acidity and pH back into balance.

We know that in Oregon Pinot noir, aroma and flavor are highly variable and dependent on the development of the fruit at specific vineyard sites in any given season. Ideally, the 'optimal' harvest period maximizing varietal character should be evaluated for each vineyard by close observation and experience. Ripening starts at veraison as berries swell and become more elastic. Cluster weight and sugars increase, acidity decreases due to berry growth (dilution) and respiration of malic acid, and the pH increases. Color, tannin, aroma, and flavor develop progressively, but in a manner not well understood and not necessarily in step with changes in sugar, acid, and pH, which are the indices commonly used to monitor fruit maturity. Traditional concepts of maturity include 'physiological' and 'technological' maturity. The former is usually described as the point at which the berries and clusters reach their maximum size and sugar level, and the later is the point at which the compositional parameters such as Brix, titratable acidity, and pH reach the proper balance for the wine to be produced. The development of varietal aroma and flavor, however, does not necessarily correlate with either of the above concepts. In Oregon, varietal character can develop at relatively low sugar content in cool, prolonged ripening seasons as compared to warmer, early seasons. Flavor development may be strongly

related to the vine's own 'physiological' time clock, which is certainly influenced by site and climate. The changes that occur in Pinot noir duringthe last two to three weeks of maturation are critical to the composition and quality of the wine produced. At different stages of maturity Pinot noir may be green or herbaceous, floral or perfumey, minty or peppery, and have fruity flavors reminiscent of cherry, raspberry, orplum. 'Overripening' can also occur and is often accompanied by berry shriveling or raisening and the production of jammy, or pruney flavors.

Our Pinot noir maturity study was initiated to monitor closely the physical and chemical changes, and the development of aroma and flavor during ripening. In 1987 nine year old Pinot noir vines on a vertical trellis were cane pruned to 24 buds per vine at the Woodhall III Vineyard. Starting in early September a 50 cluster random sample was taken every three days into early October and frozen at -400C for later analysis. Fruit was harvested every six days and wines were produced in duplicate lots. The fruit sampling and the wine production covered the entire range of maturity from 'underripe' to 'overripe'. The frozen cluster samples are being analyzed for cluster weight, berry size, degrees Brix, titratable acidity, malic acid, tartaric acid, pH, potassium, anthocyanins, and polyphenolic content. Physical measures and physiological observations were also made during ripening, including the 'pull force' necessary to remove berries from clusters and the degree of lignification of the stems (green to brown).

The date presented here are our preliminary observations from the fruit, must and wine analysis from our six day harvest intervals. Cluster weight (berry size) reached a maximum by September 16, corresponding to the onset of 'physiological' maturity, and then decreased about 15% by September 22, due to moderate dehydration and berry softening. 'Pull force', measured as grams of force necessary to remove berries from clusters, decreased steadily during ripening (Fig. 1).

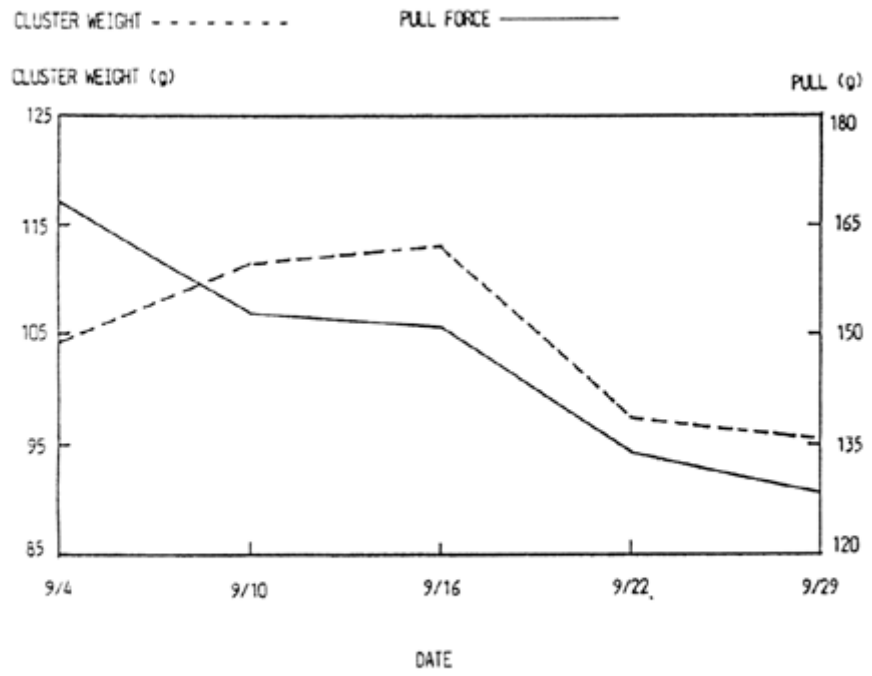

Fig. 1 Changes in cluster weight and pull force during ripening of Pinot noir in 1987.

Primary clusters with both green stems and brown stems were sampled on two dates, and the clusters were analyzed individually for sugar content and acidity. On September 10, clusters with green stems

averaged 19.6 degrees Brix (range 18.3 - 21.3) and 9.2 g/L titratable acidity, compared to 20.5 degrees Brix (range 19.2 - 22.5) and 8.8 g/L for clusters with brown stems. Six days later on September 16 there were fewer clusters with green stems, and the fruit composition had become more uniform. All clusters sampled then were 2l degrees Brix or higher and had similar acidity. This suggested that the degree of lignification (browning) of the stems maybe useful in assessing the uniformity of ripening in the vineyard and the onset of ,physiological' maturity. The 'ripeness' of the stems may also effect wine flavor in fermentations using whole clusters.

The fruit composition at the six day interval harvest dates is given in Table 1. The degree Brix increased steadily over the ripening period from 19.3 to 24.4. The titratable acidity (T.A.) decreased rapidly during the period of cluster growth and then slowed as the clusters reached their maximum size. The T.A. then remained fairly constant until September 22 after which it decreased sharply again (Fig. 2).

TABLE 1. PINOT NOIR COMPOSITION AT HARVEST

Harvest Date	Brix g/100g	T.A. g/L	pH	Malate g/L	Tartrate g/L
9/4	19.3	11.3	3.17	5.7	7.8
9/11	20.3	7.9	3.40	4.2	6.8
9/16	21.1	7.2	3.27	4.1	7.2
9/22	22.8	7.3	3.34	3.4	6.4
9/29	24.4	6.2	3.60	3.2	7.3

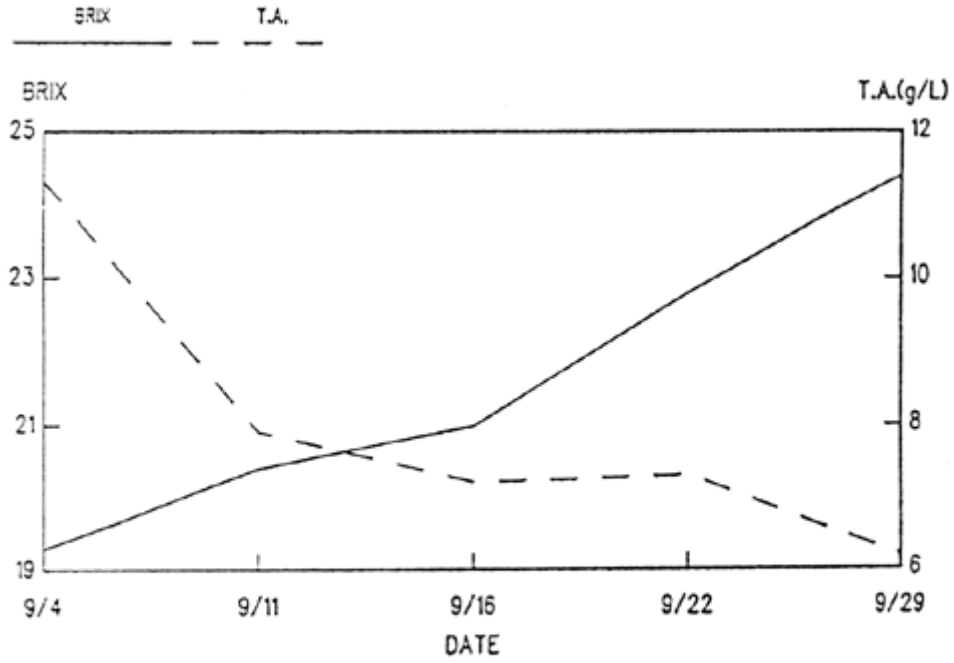

Fig. 2 Changes in Brix and titratable acidity (T.A.) during ripening of Pinot noir in 1987.

Malic acid content decreased until September 11, remained unchanged for a week, and then decreased again after September 16. Tartaric acid content, on the other hand, appeared to fluctuate and not to decrease dramatically during the ripening period after September 11. The pH increased up to September 11, decreased to a minimum by September 16, then increased dramatically after September 22. This rapid rise in pH corresponds with a dramatic increase in potassium content and marks the beginning of

'over ripening' (Fig. 3 & 4). Interestingly, by September 16 the tartaric acid content appeared to have increased slightly as the pH decreased, and this corresponded to the only time during ripening when there was any measurable precipitation. The direct effects of weather particularly on pH and acidity during the later stages of ripening can be very important harvest variables and need further investigation.

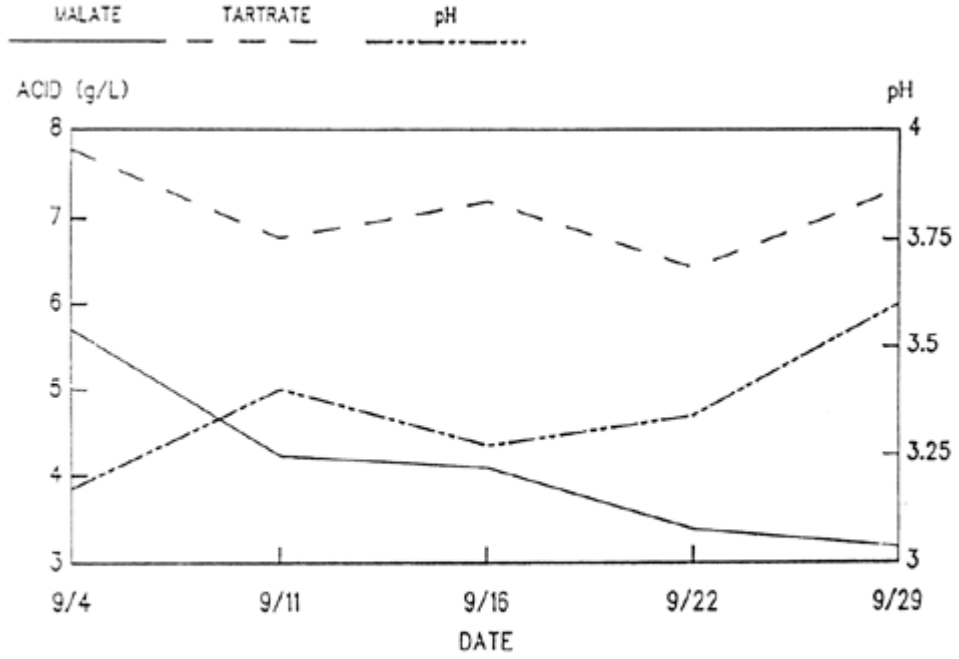

Fig. 3 Changes in malate, tartrate, and pH during ripening of Pinot noir in 1987.

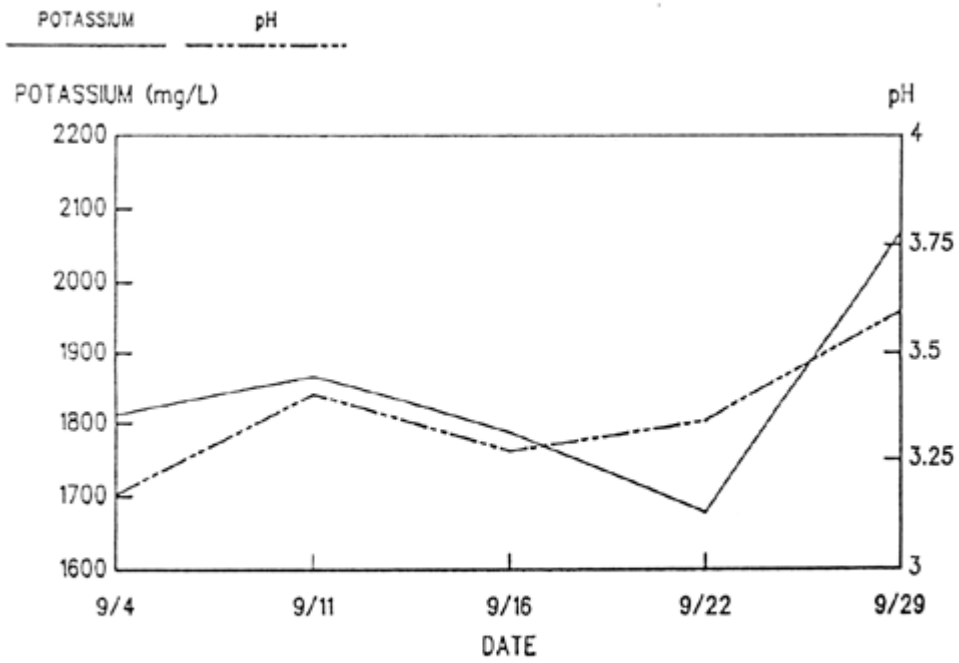

Fig. 4 Changes in potassium and pH during ripening of Pinot noir in 1987.

Analysis of the new wines before malolactic fermentation is given in Table 2. Duplicate wine lots were produced from each harvest date and duplicate chaptalized lots were produced for the first three harvest dates. Addition of sugar was done near the end of fermentation in order to increase the potential alcohol to 12.8%.Thechaptalized lots were fermented on the skins an average of three days longer than the controls. All the wines were inoculated with malolactic bacteria (Erla) after yeast fermentation in order to observe separately the effects of maceration and malolactic fermentation (MLF) on acidity and pH. After completion of MLF moderate tartaric acid additions will be made to lower the pH and to attain a proper taste balance in the different lots as necessary.

TABLE 2. NEW WINE ANALYSIS

Harvest Date	Potential Alcohol %	T.A. g/L	pH	Potassium mg/L	Anthocyanins mg./L	
					Control	Chaptalized
9/4	10.8	8.4	3.47	1812	153	125
9/11	11.4	6.9	3.70	1867	208	143
9/16	11.8	6.2	3.72	1788	198	149
9/22	12.8	6.4	3.79	1678	245	———
9/29	13.7	6.0	3.80	2068	238	———

The anthocyanin content as measured in the new wines is plotted against the degree Brix at harvest in Fig. 5. The anthocyanins appear to increase in two discrete stages. The first stage from September 4 to 11 corresponds to a period of increasing cluster weight and berry size. From September 11 to September 16 the anthocyanin content changed little as the clusters increased slowly to their maximum size. The second increase in anthocyanins occurred with onset of cluster weight loss. Analysis of cluster samples for anthocyanins on a per berry basis may show a transition from anthocyanin synthesis to concentration effects due to dehydration. After September 22, however, the anthocyanin content did not appear to increase further. Surprisingly, the chaptalized wine lots consistently had lower anthocyanin levels than the controls despite a longer fermentation on the skins (Table 2). This maybe due to increased pigment - tannin interactions during prolonged maceration. How this effects long term color stability and the sensory character of the wine are yet to be determined.

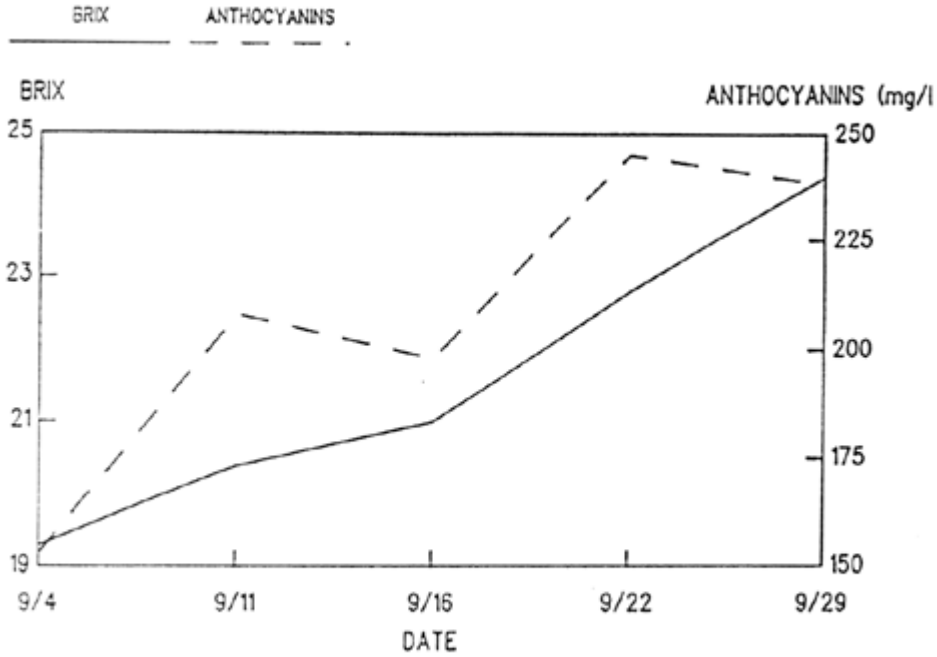

Fig. 5 Changes in Brix vs anthocyanins during ripening of Pinot noir in 1987.

The new wines are now being analyzed and will undergo preliminary sensory evaluation by an industry panel this spring in order to evaluate the aroma and flavor differences at the different stages of maturity.

Fruit development during ripening will vary year to year, and for this reason it is important to continue the Pinot noir maturity research. 1988 will undoubtedly be another unique and different Oregon harvest season. Processing may have a pronounced effect on the expression of Pinot noir character, and we intend to combine the maturity study with specific processing practices which may be important. These include addition of sugar and acid, use of whole clusters during fermentation, and length of skin maceration time. Research will focus on the effects of maturity and processing on wine composition, aroma and flavor, color stability, and wine quality. Preliminary analytical work will also begin to correlate aroma and flavor chemistry with specific sensory characteristics.

We hope to obtain a better understanding of the changes which occur during Pinot noir ripening, how to monitor these changes, and how they effect wine quality. This will help in the development of harvest indices for evaluating maturity. The process of ripening is complex, but with more information we will be able to have more consistent control over wine style and quality.