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Development of Viticultural Practices to Improve Winegrape Performance

Experiment II: Effect of Canopy Location on Yield Components and Fruit Composition in Pinot noir Grapevines Trained to the Scott Henry Trellis System

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ABSTRACT

For this trial, established Pinot noir vines, located on the valley floor of the Umpqua Valley in Oregon were used. In 1996 and 1997 sixteen vines trained to the Scott Henry trellising system were separated into four different quadrants, determined by shoot orientation: Bottom canopy, shoots trained toward the ground; top canopy, shoots trained upwards; east orientation, shoots receiving the morning sunlight; and west orientation, shoots receiving afternoon sunlight. Yield components and fruit composition were measured for each quadrant. In 1996, wines were produced from fruit harvested by quadrant and subjected to sensory analysis. In 1996 the bottom canopy had higher yield, cluster weight, and titratable acidity than did the top canopy. In 1997 the top canopy had a higher yield than did the bottom canopy. In 1996 the east oriented canopy had a higher yield, cluster weight, and skin anthocyanins than did the west oriented canopy. Must soluble solids were not significantly different between vine canopy or orientation in 1996. In 1997 the west oriented canopy had higher brix, pH, and lower titratable acidity than the east oriented canopy. The bottom-east quadrant had a significantly higher yield than did the other three quadrants in 1996. There were no significant differences seen in quadrant yields in 1997. Significant differences were seen in wine attributes between the quadrants.

INTRODUCTION

The Scott Henry trellis was developed in the Umpqua Valley of Oregon by Scott Henry at Henry Estate Vineyards. This training system consists of two divided canopies, one trained up, and the other trained towards the ground. The key to the Scott Henry is the window left between the two canopies which allows sunlight to reach the clusters directly, and aids in air circulation in the fruiting area. The Scott Henry trellis and training system is being used in many wine grape regions, particularly in the New World. It is a promising trellis option for vineyards planted on high vigor sites. With the growing popularity of this trellis system, and the unique opportunity of having in close proximity, both the inventor of, and the original site the system was developed for, it is important to study the potentials of this trellis system.

MATERIALS AND METHODS

This trial was performed at Henry Estate Vineyards in the Umpqua Valley in 1996 and 1997. Two rows

of Pinot noir vines were selected from the vineyard in a high vigor area. Sixteen vines were randomly picked from the two rows and marked as trial vines. All 16 vines were trained in the S-shaped Scott Henry system. The vine spacing was 6ft. x l2ft. (1.88m x 3.66m).

Yield, fruit composition, and shoot morphology

The vines were harvested October 5, 1996 and September 29, 1997. The clusters in each of the four quadrants of each vine (top-east, top-west, bottom-east, bottom-west), were harvested, counted, and weighed separately. A subsample was then removed from each and crushed to determine must soluble solids (brix), pH, and titratable acidity. A 100 berry sample was frozen and later processed to determine skin composition. Post harvest in 1996 shoot number was determined by canopy, as was average node length and diameter for the top and the bottom canopies. In 1997 shoot number and pruning weights were measured in each quadrant. Maturity samples were taken on September 1, September 15, and September 22, 1997. On each sample date, 40 clusters (10 from each quadrant) were harvested from vines adjacent to the trial vines. The fruit from the maturity samples was weighed and processed to determine fruit composition.

Winemaking

In 1996 the harvested fruit from the two research rows was combined by quadrant, and divided into three fermentation replicates. Winemaking procedures were taken from Reynolds *et al.*, 1996 (1). The grapes from each treatment replicate (12 total) was crushed, desternmed, sulfited, and fermented in 20 gallon plastic food-grade pails. Caps were submerged two to three times daily by punching down. The wines were fermented 10 days on the skins, and then pressed off and put into 5 gallon glass carboys. A total of 24 five-gallon carboys were used, two five-gallon carboys per treatment replicate. At the end of fermentation, wines were racked and sulfited. The wine was bottled March 13, 1996, and was put to taste at the Pacific Agri-Food Research Center in Summerland, BC. A triangle test was used to determine differences between replications. Paired comparison tests were used to evaluate differences in specific attributes for all treatments.

RESULTS AND DISCUSSION

Yield and yield components

Tables 1 and 2 summarize yield components measured for each canopy, orientation, and then for each quadrant of the Pinot noir vines trained to the Scott Henry system in 1996 and 1997. In 1996 the bottom canopy had a significantly higher yield and cluster weight when compared to the top canopy. The east oriented canopy had a significantly higher yield and a higher cluster weight than did the west canopy in 1996. In 1996 the bottom-east quadrant had a significantly higher yield when compared to the other three quadrants. There were no significant differences in berry weight seen in 1996. In 1997 the top canopy had a significantly higher yield and a higher cluster weight than the bottom canopy. There were no significant differences in yield or berry weight between the four quadrants in 1997, although the top-west quadrant did have significantly more clusters per square meter. Overall, yields were higher in 1997 than in 1996.

Table 1: Yield and fruit composition data as affected by canopy and orientation in the Scott Henry trellis system.

Year			Yield (Kg/m^2)	Yield ('Tons/A)	Brix	pH	TA	Cluster wt.(g)	Clusters/ m^2
1996	Canopy	Bottom	0.88	3.92	23.1 a[1]	3.11 b	8.62 a	163.55 a	6 a
		Top	0.66	2.94	23.3 a	3.15 a	8.07 b	147.92 b	4 a
					ns	**	**	**	ns
	Orientation	West	0.66	2.94	23.2 a	3.12 a	8.58 a	145.32 b	4 a
		East	0.88	3.92	23.2 a	3.14 a	8.11 b	166.16 a	6 a
					ns	ns	**	***	ns
	Canopy x Orientation								
	Bottom-east		0.54 a[1]	2.41 a	23.0	3.10	8.36	175.68	3
	Bottom-west		0.34 b	1.52 b	23.2	3.11	8.88	151.43	2
	Top-east		0.34 b	1.52 b	23.4	3.17	7.86	156.64	2
	Top-west		0.33 b	1.46 b	23.3	3.14	8.28	139.21	2
	Main Effects								
	Canopy		**	**	ns	**	**	**	ns
	Orientation		**	**	ns	ns	**	***	ns
	Canopy x Orientation		**	**	ns	ns	ns	ns	ns
1997	Canopy	Bottom	0.68 b[1]	3.04 b	24.1 a	3.29 a	5.49 a	159.80 a	4
		Top	0.96 a	4.28 a	24.2 a	3.25 a	5.77 a	169.80 a	5
			**	**	ns	ns	ns	ns	
	Orientation	West	0.89 a	3.96 a	24.6 a	3.31 a	5.29 b	154.61 b	5
		East	0.75 a	3.36 a	23.8 b	3.22 b	5.99 a	175.08 a	4
			ns	ns	*	***	***	*	
	Canopy x Orientation								
	Bottom-east		0.33	1.47	23.8	3.23	5.85	164.27	2 b
	Bottom-west		0.35	1.57	24.5	3.34	5.15	155.36	2 b
	Top-east		0.42	1.89	23.8	3.21	6.15	185.88	2 b
	Top-west		0.54	2.39	24.5	3.27	5.44	153.86	3 a
	Main Effects								
	Canopy		**	**	ns	ns	ns	ns	***
	Orientation		ns	ns	*	***	***	*	***
	Canopy x Orientation		ns	ns	ns	ns	ns	ns	*

[1]ns, *, **, *** indicate not significant and statistically significant at the 0.05, 0.01, and 0.001 levels.
Values followed by the same letters do not differ significantly.

Table 2: Yield and fruit composition data as affected by canopy and orientation in the Scott Henry trellis system.

Year			Berry wt.(g)	Berries/ Cluster	Sugar (Kg/Vine)	clusters/ shoot	shoots/ m^2	% Fruit set
1996	Canopy	Bottom	1.19 a	138 a	0.20	2.36 a	2 a	na
		Top	1.15 a	129 a	0.16	1.77 b	3 b	na
			ns	ns		**	**	
	Orientation	West	1.13 a	129 a	0.16	na	na	na
		East	1.21 a	138 a	0.20	na	na	na
			ns[1]	ns				
	Canopy x Orientation							
	Bottom-east		1.20	147	0.12 a			
	Bottom-west		1.18	130	0.08 b			
	Top-east		1.22	129	0.08 b			
	Top-west		1.08	129	0.08 b			
	Main Effects							
	Canopy		ns	ns	**	**	**	
	Orientation		ns	ns	**			
	Canopy x Orientation		ns	ns	**			
1997	Canopy	Bottom	1.44 a	111 a	0.17 b	1.8	1.1 b	55
		Top	1.50 a	114 a	0.23 a	1.9	1.4 a	53
			ns	ns	***		***	
	Orientation	West	1.48 a	106 a	0.22 a	1.6	1.2 b	56
		East	1.47 a	119 a	0.18 a	2.1	1.4 a	51
			ns	ns	ns		**	
	Canopy x Orientation							
	Bottom-east		1.43	115	0.08	1.8 b	1.0	48 b
	Bottom-west		1.46	108	0.09	1.9 b	1.2	62 a
	Top-east		1.50	124	0.10	1.5 b	1.3	54 b
	Top-west		1.49	104	0.13	2.3 a	1.6	51 b
	Main Effects							
	Canopy		ns	ns	***	ns	***	ns
	Orientation		ns	ns	ns	**	**	ns
	Canopy x Orientation		ns	ns	ns	*	ns	*

[1]ns, *, **, *** indicate not significant and statistically significant at the 0.05, 0.01, and 0.001 levels. Values followed by the same letters do not differ significantly.

Fruit composition

Fruit composition data for 1996 and 1997 are summarized in Tables 1 and 2. In 1996, the bottom canopy had a significantly lower pH and a higher titratable acidity when compared to the top canopy. The east oriented canopy, in 1996, had a significantly lower titratable acidity when compared to the west canopy. In 1996, the east canopy had significantly higher mg anthocyanins per berry weight than did the west canopy (Table 3). In 1997 there were no significant differences in fruit composition between the bottom and top canopies. However, in 1997 the west oriented canopy had a significantly higher brix, pH, and a lower titratable acidity when compared to the east canopy. There were no significant differences in fruit composition between the four quadrants in either year.

Table 3: Skin composition data as effected by canopy and orientation in the Scott Henry trellis system.

Year			Skin wt. (g)	% Skin/ Berry wt.	mg anthocyanins /g berry wt	mg anthocyanins /mg skin wt
1996	Canopy	Bottom	0.139 a	12 a	0.553 a	4.033 a
		Top	0.140 a	12 a	0.545 a	3.963 a
			ns[1]	ns	ns	ns
	Orientation	West	0.132 a	12 a	0.517 b	3.956 a
		East	0.147 a	12 a	0.580 a	4.037 a
			ns	ns	**	ns
	Canopy x Orientation					
	Bottom-east		0.150	12	0.568	3.921
	Bottom-west		0.130	11	0.538	4.145
	Top-east		0.150	12	0.592	4.146
	Top-west		0.130	12	0.498	3.778
	Main Effects					
	Canopy		ns	ns	ns	ns
	Orientation		ns	ns	**	ns
	Canopy x Orientation		ns	ns	ns	ns

[1]ns, *, ** indicate not significant and statistically significant at the 0.05 and 0.01 levels.
Values followed by the same letters do not differ significantly.

Shoot morphology

Table 2 summarizes the shoot morphology data from 1996 and 1997. In 1996 the bottom canopy had more clusters per shoot, but fewer shoots per square meter than did the top canopy. In 1997 the top canopy had more shoots per square meter. Also in 1997 the east oriented canopy had more clusters per shoot and more shoots per square meter than did the west canopy. In 1997 the top-west quadrant had significantly more clusters per shoot than did the other three quadrants. Percent fruit set was significantly higher in the bottom-west quadrant at 62%.

Maturity sampling

Table 4 summarizes the data taken from the three maturity sampling dates. On the September 01, 1997 sampling date, the top canopy had a higher berry weight than the bottom canopy, and the east oriented canopy had a higher berry weight than did the west canopy. On the final sampling date (Sept. 22, 1997), the top canopy had a significantly lower pH than did the top canopy. On this same date, the west canopy had a lower titratable acidity than the east canopy. Figures 1, 2, and 3 show the average increase in brix and pH, and the average drop of titratable acidity over the sampling dates.

Table 4: Maturity sampling on Pinot noir grapevines trained to the Scott Henry trellis.

Sample Date			Cluster weight (g)	Berry weight (g)	Brix	pH	TA
09.01.97	Canopy	Bottom	193.19 a	1.35 b	19.4 a	3.18 a	11.11 a
		Top	198.44 a	1.51 a	19.5 a	3.17 a	11.33 a
			ns[1]	**	ns	ns	ns
	Orientation	East	199.69 a	1.52 a	19.2 a	3.16 a	11.81 a
		West	191.94 a	1.35 b	19.7 a	3.20 a	10.63 b
			ns	**	ns	ns	*
	Canopy x orientation	Bottom-East	186.25 a	1.42 a	19.0 a	3.15 a	12.05 a
		Bottom-West	200.13 a	1.29 a	19.8 a	3.22 a	10.18 a
		Top-East	213.13 a	1.61 a	19.3 a	3.17 a	11.57 a
		Top-West	183.75 a	1.41 a	19.7 a	3.18 a	11.09 a
			ns	ns	ns	ns	ns
09.15.97	Canopy	Bottom	153.50 a	1.50 a	21.4 a	3.16 a	8.89 a
		Top	200.81 a	1.44 a	20.7 a	3.12 a	9.31 a
			ns	ns	ns	ns	ns
	Orientation	East	182.38 a	1.45 a	21.2 a	3.13 a	9.39 a
		West	171.94 a	1.49 a	21.0 a	3.15 a	8.81 a
			ns	ns	ns	ns	ns
	Canopy x orientation	Bottom-East	157.38 a	1.46 a	21.3 a	3.13 a	9.06 a
		Bottom-West	149.63 a	1.54 a	21.5 a	3.19 a	8.73 a
		Top-East	207.38 a	1.43 a	21.0 a	3.13 a	9.72 a
		Top-West	194.25 a	1.45 a	20.4 a	3.11 a	8.90 a
			ns	ns	ns	ns	ns
09.22.97	Canopy	Bottom	179.44 a	1.52 a	22.9 a	3.27 a	7.16 a
		Top	212.44 a	1.56 a	22.9 a	3.22 b	7.44 a
			ns	ns	ns	*	ns
	Orientation	East	205.44 a	1.56 a	22.7 a	3.22 a	7.67 a
		West	186.44 a	1.52 a	23.2 a	3.27 a	6.94 b
			ns	ns	ns	ns	**
	Canopy x orientation	Bottom-East	183.00 a	1.53 a	22.7 a	3.24 a	7.55 a
		Bottom-West	175.88 a	1.51 a	23.1 a	3.30 a	6.78 a
		Top-East	227.88 a	1.59 a	22.6 a	3.20 a	7.79 a
		Top-West	197.00 a	1.54 a	23.3 a	3.24 a	7.10 a
			ns	ns	ns	ns	ns

[1]ns, *, ** indicate not significant and statistically significant at the 0.05 and 0.01 levels.
Values followed by the same letters do not differ significantly.

Winemaking

A triangle test indicated no significant differences between replications. Table 5 summarizes the data from the paired comparison tests given for aroma and flavor. There were no significant differences found in the berry/cherry aroma between the four quadrants. The top-west quadrant was found to have an overall higher aroma intensity when it was compared to the top-east quadrant. The top two quadrants (top-east and top-west) were found to have significantly more red color than the two bottom quadrants (bottom-east and bottom-west). The top-east and top-west quadrants were found to have more berry flavor than the bottom-east quadrant. There was no significant differences found between the four

quadrants in overall flavor intensity. The top-east quadrant was found to have a better finish (aftertaste) than the bottom-east quadrant.

Table 5: Paired comparison test on Pinot noir wines from each vine quadrant of the Scott Henry system.

Berry/cherry aroma

Comparison[1]	times selected[2]	times selected
Quadrant 3 vs 4	7	11
Quadrant 4 vs 2	11	7
Quadrant 3 vs 2	11	7
Quadrant 1 vs 4	8	10
Quadrant 1 vs 3	11	7
Quadrant 1 vs 2	10	8

Berry flavor

Comparison	times selected	times selected
Quadrant 3 vs 4	11	7
Quadrant 4 vs 2	4	14*
Quadrant 3 vs 2	8	10
Quadrant 4 vs 1	5	13*
Quadrant 3 vs 1	10	8
Quadrant 1 vs 2	11	7

Overall aroma intensity

Comparison	times selected	times selected
Quadrant 3 vs 1	8	10
Quadrant 4 vs 3	8	10
Quadrant 4 vs 2	9	9
Quadrant 3 vs 2	7	11
Quadrant 4 vs 1	7	11
Quadrant 1 vs 2	14*	4

Flavor intensity

Comparison	times selected	times selected
Quadrant 4 vs 2	9	9
Quadrant 1 vs 4	11	7
Quadrant 3 vs 1	12	6
Quadrant 3 vs 4	8	10
Quadrant 2 vs 3	7	11
Quadrant 2 vs 1	6	12

Red color

Comparison	times selected	times selected
Quadrant 4 vs 1	0	18
Quadrant 1 vs 3	17***	1
Quadrant 1 vs 2	8	10
Quadrant 3 vs 4	4	14
Quadrant 2 vs 4	17***	1
Quadrant 2 vs 3	17***	1

Overall finish/aftertaste

Comparison	times selected	times selected
Qaudrant 3 vs 1	11	7
Qaudrant 4 vs 2	3	15**
Qaudrant 3 vs 2	7	11
Qaudrant 1 vs 2	8	10
Qaudrant 4 vs 3	7	11

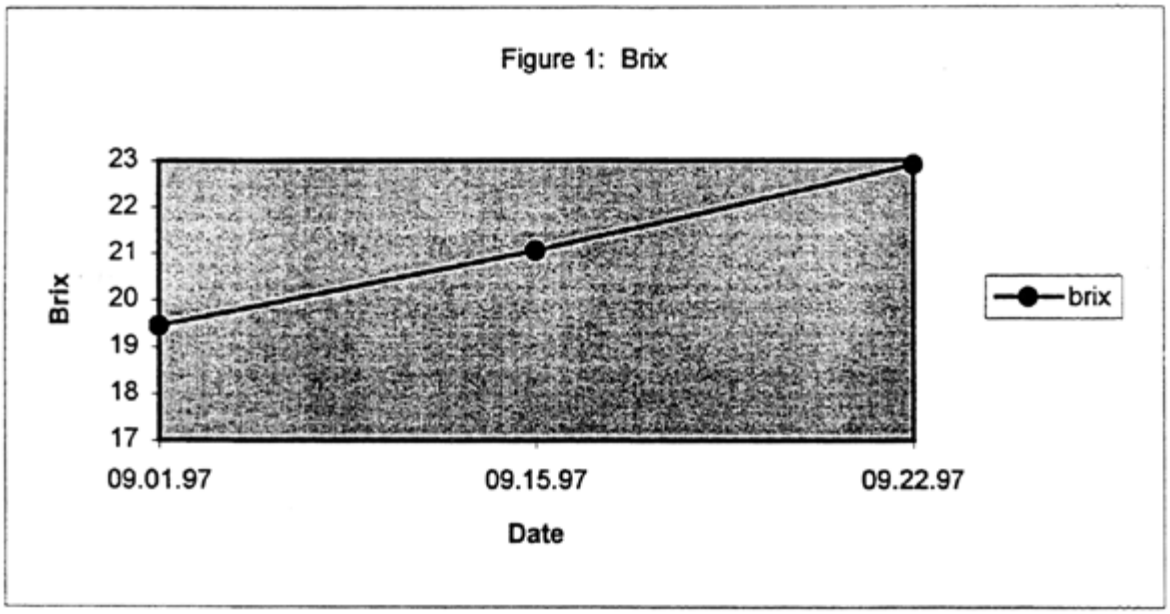
[1]Quadrant 1: Top-west; quadrant 2: Top-east; quadrant 3: Bottom-west; quadrant 4: Bottom-east

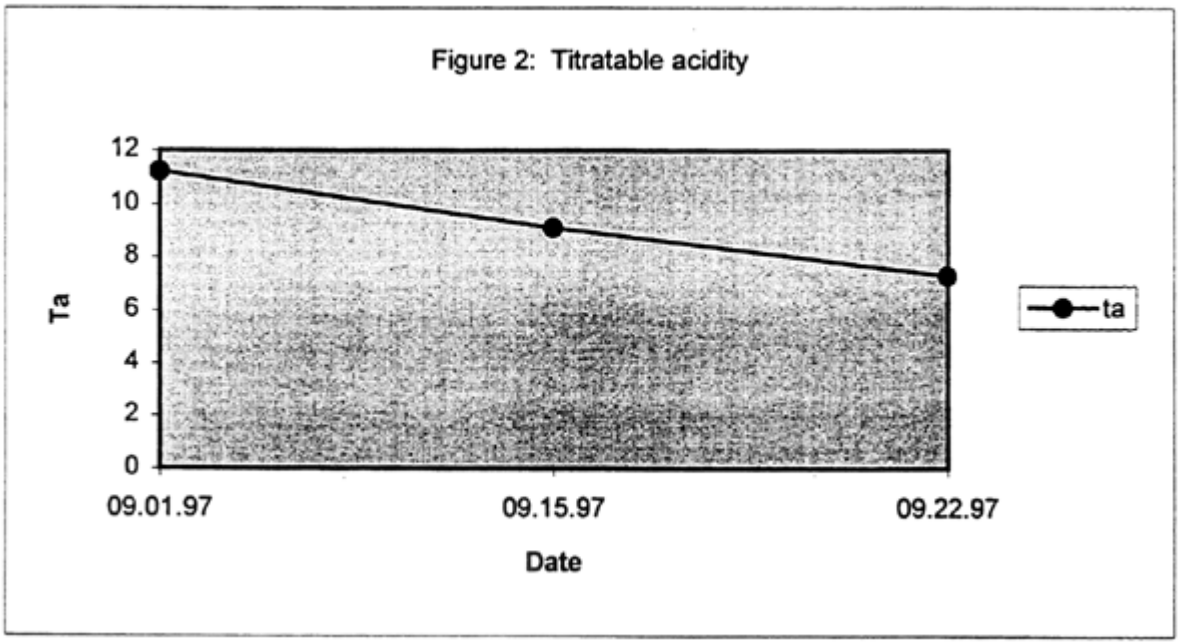
[2] *, **,*** indicate not significant and statistically significant at the 0.05, 0.01 and 0.001 levels.

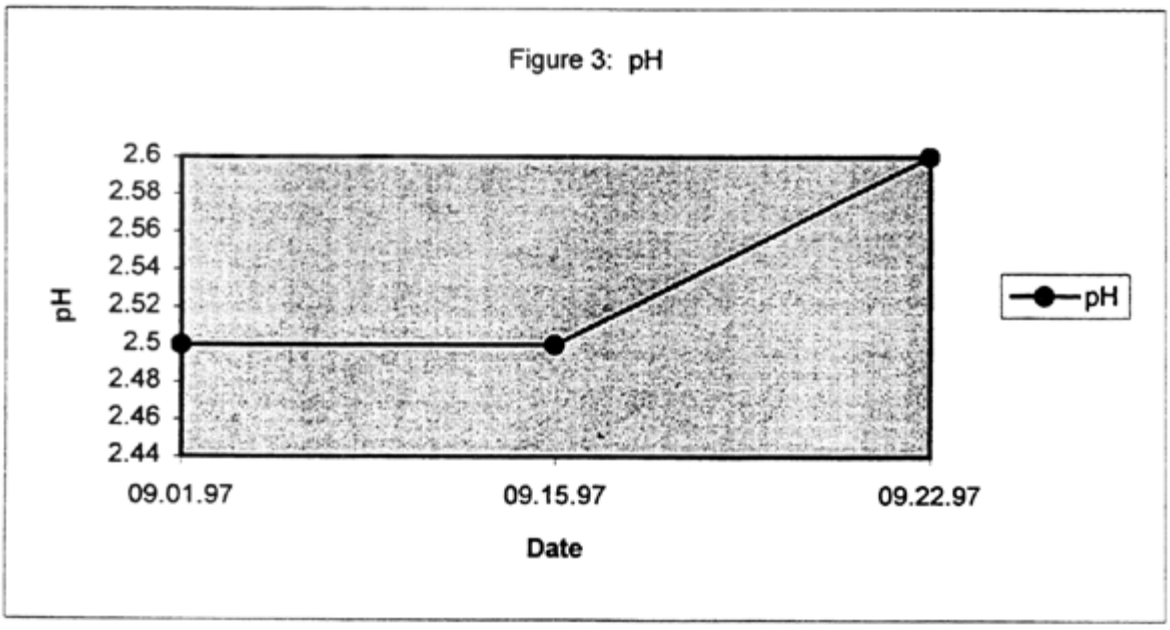
CONCLUSIONS

This study seems to show that there are yield component differences between not only top and bottom canopies of the Scott Henry system, but also in canopy orientation to the sun, i.e. receiving morning sunlight or afternoon sunlight. In 1996 the most productive area of a Pinot noir vine was the bottom canopy on the side that receives direct morning sunlight. Also in 1996 there were more significant differences in fruit quality between the two canopy locations (top and bottom). In 1997 the quadrant yields were not significantly different, but the top-west quadrant had the highest yield. This may be partially due to the significantly higher number of buds left at pruning in the top canopy. Fruit quality was effected more by canopy orientation (east and west) in 1997. The differing results that were found in 1996 and 1997 may be a result of yearly weather fluctuations, microclimate differences, and canopy management practices. In both years, varying differences were seen between the canopy location and canopy orientation. Altering bud numbers per cane and shoot positioning during the growing season seem to effect the microclimate enough to create differences in several yield components and shoot morphology aspects. These quadrant differences were also large enough to impact some aspects of wine aroma, color, flavor, and finish.

Figures 1, 2, and 3: The average changes in brix, pH, and titratable acidity over three sampling dates.







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1. Reynolds, A.G., S. Yerle, B. Watson, S. Price, and D. A. Warble. 1996. Fruit Environment and Crop Level Effects on Pinot noir. III. Composition and Descriptive Analysis of Oregon and British Columbia Wines. Am. J. Enol. Vitic. 47-3:329-339.