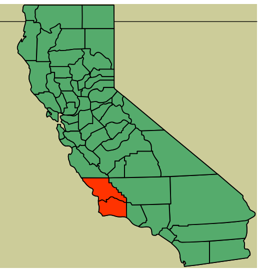
April 2006

University of California Cooperative Extension

Grape Notes

San Luis Obispo & Santa Barbara Counties



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Syrah Disorder update

In 2005, research continued into the factors behind 'Syrah Disorder' on the Central Coast. The 2005 work focused on salinity and irrigation stress effects, and expanded the virus testing of symptomatic plantings. Both leafroll virus and toxic effects due to sodium and boron are implicated as causes of the disorder in some plantings.

A variety of leaf symptoms have been observed with Syrah Disorder on the Central Coast. Some leaf symptoms resemble leafroll virus (late summer leaf reddening), while others more resemble salt effects (late summer marginal burning). The effects of irrigation levels and salinity on the expression of the latter symptoms were tested in 2005 at a vineyard east of Paso Robles. This planting on 5c and 110R rootstocks has in the past shown strong leaf burn symptoms in some seasons, but the presence of symptoms has been extremely variable from year to year.

Two different irrigation levels were applied, consisting of the grower standard amount, and 50% of this amount. Additionally treatments included gypsum at 4 tons/ac or no gypsum, for a total of four different combinations of irrigation and gypsum. In this case, the purpose of the gypsum application was to raise the electrical conductivity (EC) of the root zone; it was not applied as an amendment for soil sodium, as it is commonly used. The gypsum was applied on May 20, 2005, on one-foot wide bands beneath the vines; the irrigation treatments began June 15, 2005, and continued until harvest.

At a separate location in the same block, sodium chloride (non-iodized table salt) was applied to the soil surface at four different rates on August 3, 2005; rates were zero, 73 g, 146 g, and 216 g per vine. The sodium chloride was applied to the soil surface in a strip directly beneath the drip emitters, so that the subsequent irrigations would gradually dissolve the material and move it into the root zone. Plots were not replicated, and consisted of only five vines for each treatment.

Irrigation/Gypsum plots

Early season growth was normal throughout the block (Fig. 1). The abundant rainfall of the previous winter delayed the start of the irrigation program. No visual difference in leaf canopies were noted between the four irrigation/gypsum treatments until August. Leaf water potentials in mid-August began to show differences between the irrigation treatments (Table 1). By early September, leaf burn symptom began to show up in the entire block; symptoms appeared to be more severe in the 50% irrigation plots, but there were vines receiving full irrigation that were also showing similar burn symptoms. Leaf water potentials measured in September were very erratic, without the expected pattern that was seen a month earlier. Leaf burn symptoms became progressively worse throughout the block in

Also inside this issue:

Figure 1. Spring growth of canopy in late May, on the date of the gypsum application on the soil surface.

Table 1. Midday leaf water potentials, irrigation and gypsum plots

	Midday leaf water potential (bars)	
Treatment	**8/16/05**	**9/13/05**
100% irrigation, no gypsum	12.6 a	13.1 ac
100% irrigation, + gypsum	13.2 ab	10.4 ab
50% irrigation, no gypsum	14.2 b	8.0 b
50% irrigation, + gypsum	15.6 c	13.5 c

late September and early October; the lack of healthy leaves, combined with the high crop load, appeared to delay ripening considerably. The sample vines were harvested on October 12, 2005. Berry size was correlated with irrigation level, but differences in juice chemistry were minor between treatments (Table 2).

Sodium chloride plots

Observations on August 16, 2005, two weeks after the sodium chloride application, showed distinct visual differences between the four treatments (Fig. 2). Higher sodium chloride applications were correlated with increased leaf burn. Leaf water potentials measured on the same day were significantly different for all four treatments, but the pattern was unexpected, with the highest application having the lowest leaf water potential (Table 3); this may be due to the notable reduction of active leaf area by sodium and/or chloride toxicity.

Leaf blade tissue samples were taken for laboratory analysis in early September, and measured for toxic elements. Replicate samples were taken from the irrigation and gypsum experimental plots, from the sodium chloride test plots, as well as from symptomatic and non-symptomatic vines throughout the rest of the planting (Table 4).

Blade tissue sodium levels were below the 0.3% value listed by Christensen[1] as being toxic for grapes, except in the two highest sodium chloride treatments. However, the leaf blades showed the leaf margin discoloration (dark staining) and necrosis consistent with Christensen's description of sodium toxicity (Fig. 3); this suggests that Syrah may be prone to suffer sodium toxicity problems at lower tissue levels the varieties Christensen observed. There was a large difference in sodium levels between the symptomatic and non-symptomatic vines outside of the experimental areas; the non-symptomatic vines largely came from an elevated area of the block that appeared to have better soil drainage. The chloride levels do not appear to be high enough to cause toxic effects except in the sodium chloride plots. The leaf symptoms in the sodium chloride plots were essentially the same as seen in the rest of the block, except that they arrived sooner and were more severe. Very high boron levels were seen in all samples, well above the 150 ppm level listed as toxic in blades[2], again with the exception of the non-symptomatic vines in the elevated portion of the block. Some leaves showed marginal spotting, also suggesting boron toxicity.

A sample of the irrigation water taken in August was submitted for lab analysis (Table 5). Both sodium

Table 3. Midday leaf water potentials of sodium chloride treatments, 8/16/05 (two weeks after application).

Treatment	Leaf water potential (bars)
Zero NaCl	12.2 a
73 g NaCl per vine	15.3 b
146 g NaCl per vine	10.5 c
216 g NaCl per vine	7.5 d

Table 2. Harvest Results, Syrah Irrigation & Gypsum Treatments; October 12, 2005

Treatment	Berry wt. (g)	Brix	TA (gTar/100 ml)	pH
100%, no Gypsum	0.88 a	20.7 a	0.58 a	3.58 a
100%, + Gypsum	0.85 a	20.9 a	0.58 a	3.54 a
50%, no Gypsum	0.74 b	19.9 a	0.60 a	3.53 a
50%, + Gypsum	0.76 b	19.9 a	0.63 a	3.43 b
Treatment	Malic (g/L)	K (ppm)	Total Phenolics (AU)	Anthocyanins (ppm)
100%, no Gypsum	1.08 a	2180 a	44.0 a	419 a
100%, + Gypsum	0.92 a	2069 ab	48.2 a	498 ab
50%, no Gypsum	0.91 a	2142 a	50.4 a	485 ab
50%, + Gypsum	0.82 a	1975 b	55.8 a	554 b

Figure **2**. Appearance of vines treated with single soil surface applications of sodium chloride (NaCl); photos taken on August 16, 2005, thirteen days after treatment. **1**=zero NaCl, **2**=73g/vine NaCl, **3**=146g/vine NaCl, **4**=216g/vine NaCl.

(Na) and boron (B) are at levels that will lead to increasing toxicity problems in the absence of adequate leaching.

At the test vineyard, it appears that both boron and sodium toxicities are involved with the severe leaf burn symptoms seen in some seasons. It is likely that the levels of these two elements in the root zone are variable from year to year, depending upon the amount and effectiveness of leaching, either by winter rainfall and/or winter irrigation. With the combination of low soil permeability and the significant levels of sodium and boron in the irrigation water, the levels of these two elements in the root zone will likely increase over time unless adequate annual leaching occurs.

Virus testing in 2004 at the same site also indicated Leafroll 1 in four of the six vines tested; however, in seasons such as 2004 when the sodium/boron symptoms did not appear, the leafroll symptoms were very mild (Fig. 4).

Syrah Virus Testing

The results of virus testing for the 2004 and 2005 seasons are presented in Tables 6 and 7. Of the 81 samples tested, 27% were positive for one or more strains of leafroll virus. Half of the samples returned negative results for all tested viruses; however, a negative result does not indicate that a virus is not present. In many vineyards, only one symptomatic vine was tested, due to budget limitations; future surveys will target the most symptomatic plantings that have returned negative results so far.

References:

1. Christensen, P. Use of Tissue Analysis in Viticulture. UC Cooperative Extension Publication NG10-00.
2. Nicholas, P. 2004. Soil, Irrigation and Nutrition. SARDI, Adelaide, South Australia.

Table 4. Leaf blade toxicity components, fall 2005 sampling

Irrigation and gypsum experimental plots			
Treatment	Sodium (Na, %)	Chloride (Cl, %)	Boron (B, ppm)
100%, no Gypsum	0.15 a	0.068 a	275 a
100%, + Gypsum	0.08 b	0.043 b	277 a
50%, no Gypsum	0.08 b	0.045 b	289 a
50%, + Gypsum	0.06 b	0.045 ab	271 a
Sodium chloride plots			
Treatment	Sodium (Na, %)	Chloride (Cl, %)	Boron (B, ppm)
Zero NaCl	0.218	0.08	271
73 g/vine NaCl	0.294	0.43	250
146 g/vine NaCl	0.484	0.81	322
216 g/vine NaCl	0.464	0.80	337
Rest of planting (outside of experimental areas)			
	Sodium (Na, %)	Chloride (Cl, %)	Boron (B, ppm)
Non-symptomatic vines	0.029	0.03	143
Symptomatic vines	0.272	0.07	339

Thanks to the American Vineyard Foundation and the ongoing cooperation of numerous Central Coast growers for their support with this trial work.

Table 5. Syrah salinity plot irrigation water test, August 2005

			Below are in meq/l						
pH	EC	SAR	Ca	Mg	Na	Cl	B	HCO3	CO3
8.1	0.82	6	1.05	0.98	6.19	1.2	0.6	4.6	< 0.1

Figure 3. Fall leaf blade symptoms. On the left is a blade from the high sodium chloride treatment, showing distinct black staining and necrotic margins due to sodium and/or chloride toxicity; on the right is a blade from an untreated vine in the surrounding area, showing similar but less severe symptoms; these latter tissues tested high in sodium and boron, but not in chloride.

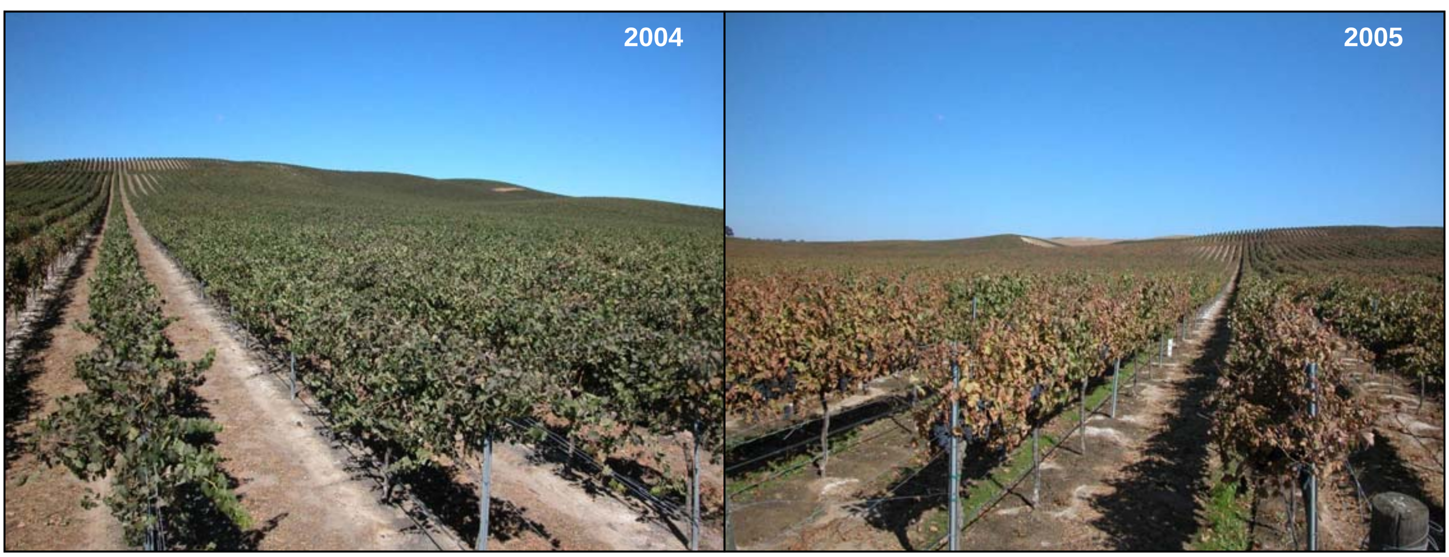

Figure 4. Fall view of test block. In 2004 (left), the canopy remained healthy well beyond harvest. In 2005 (right), the leaf burn symptoms began to appear at the end of August and were widespread by late September when this photo was taken.

Table 6. 2004 Virus testing, UC Davis Foundation Plant Services Laboratory; Syrah sample locations throughout San Luis Obispo and Santa Barbara Counties

	LR-1	LR-2	LR-5	LR-9	GVA	GVB	GVD	GV-Univ	RG
1	+	-	-	-	-	-	-	-	-
2	+	-	-	-	-	-	-	-	-
3	+	-	-	-	-	-	-	-	-
4	+	-	-	-	-	-	-	-	+
5	+	-	-	-	-	+	-	-	-
6	+	-	-	-	-	-	-	-	+
7	+	-	-	-	-	-	-	-	-
8	+	-	-	-	-	-	-	-	-
9	+	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	+	-
15	+	-	-	-	-	-	-	-	+
16	+	-	-	-	-	-	-	-	-
17	+	-	-	-	-	-	-	-	-
18	+	-	-	-	-	-	-	-	+
19	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-
25	-	+	+	+	+	-	+	-	-
26	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-
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35	-	-	-	-	-	-	-	-	-
36	-	-	-	-	-	+	-	-	-
37	-	-	-	-	-	+	-	-	-
38	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-

Legend:

LR-1 = Leafroll strain 1
LR-2 = Leafroll strain 2
LR-5 = Leafroll strain 5
LR-9 = Leafroll strain 9
GVA = Grapevine virus A (Kober Stem Grooving)
GVB = Grapevine virus B (Corky Bark)
GVD = Grapevine virus D (associated with rugose corky wood disease)
GV-Univ = Universal primer for vitiviruses like GVA
RG = Red globe strain of Leafroll 2

Table 7. Virus testing for 2004 & 2005, commercial lab PCR; Syrah sample locations throughout San Luis Obispo and Santa Barbara Counties

2004	LR-1	LR-2	LR-5	GVA	GRSPaV	Fleck	RG
1	-	-		-	+	-	-
2	-	-		-	+	-	-
3	-	-		-	+	-	-
4	-	-		-	-	-	-
5	-	-		-	+	-	-
6	-	-		-	-	-	-
7	-	-		-	+	-	-
8	-	-		-	-	-	-
9	-	-		-	-	-	-
10	-	-		-	+	-	-
11	-	-		-	-	-	-
12	-	+		-	-	+	-
13	-	+		+	-	+	-
14	-	-		-	-	-	-
15	-	+		-	+	-	-
16	-	-		-	+	-	-
17	-	-		-	+	-	-
18	-	-		-	+	-	-
19	-	-		-	-	-	-
20	-	-		-	-	-	-
2005							
21	-	-	+	-	-	+	-
22	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-
24	-	+	+	-	-	+	-
25	-	+	-	-	-	-	-
26	-	-	-	-	+	-	-
27	-	-	-	-	+	+	-
28	-	+	-	-	-	+	+
29	-	-	-	-	-	-	-
30	-	-	-	-	+	-	-
31	-	+	-	-	-	-	-
32	-	-	-	-	+	-	-
33	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-
36	-	-	-	-	+	-	-
37	-	-	-	-	+	+	-
38	-	-	-	-	+	-	-

All samples negative for: LR-3, LR-4, LR-6, LR-7, GVB, GVD, Fanleaf

Legend:

LR-1 = Leafroll strain 1
LR-2 = Leafroll strain 2
LR-5 = Leafroll strain 5
GVA = Grapevine virus A (Kober Stem Grooving)
GVB = Grapevine virus B (Corky Bark)
GVD = Grapevine virus D (associated with rugose corky wood disease)
GRSPaV = Grapevine Rupestris Stem Pitting
Fleck = Grapevine Fleck Virus
RG = Red globe strain of leafroll 2

Updated crop coefficients for California vineyards

Updated equations that describe the evolution of crop coefficients throughout the growing season are now available for a variety of winegrape trellis systems.

Dr. Larry Williams of UC Davis has completed several years of work developing crop coefficients for vineyards in California. The equations describe the evolution of the crop coefficient throughout the growing season, as a function of the growing degree days (GDD) accumulated over the season. The equations are shown below in Table 8.

These equations are most easily used in a spreadsheet with local growing degree days. Note that the GDD in the equations must all be in degrees Celsius; the equations won't work properly with degrees Fahrenheit.

For all the equations in Table 8, the first term (for example, 0.47 for the VSP trellis) is the crop coefficient for a fully developed canopy; thus, if one only requires the mid-summer or later crop coefficient, this can be estimated by simply by using this first term, without doing the full calculation over the entire growing season. The crop coefficients listed in Table 1 are all for 11 ft. rows; these coefficients need to be adjusted for different row widths by using the relationship demonstrated below, in this example for calculating the fully-developed crop coefficient for 8 ft. VSP rows, starting with the table value of 0.47 for 11 ft. rows:

Kc (8 ft) = Kc (11 ft) x (current spacing / desired spacing)

= 0.47 x (11 ft / 8 ft)

= 0.65

An example of a spreadsheet calculation is shown in Figure 1 below, along with a demonstration of how the crop coefficient equation is entered in the Excel spreadsheet cell for each calculation.

Table 1. Crop coefficient equations	
Trellis type or training system	Seasonal Kc equation (11 ft rows)
VSP	$0.47 / (1 + e^{(-(x - 525)/301)})$
California sprawl	$0.82 / (1 + e^{(-(x - 275)/150)})$
Quadrilateral cordons	$0.93 / (1 + e^{(-(x - 300)/175)})$
Lyre, Wye or V trellis	$0.79 / (1 + e^{(-(x - 300)/150)})$
e = 2.71828	
x = GDD (base 10 C), from March 15	

	A	B	C
1	**Month**	**Cumulative GDD***	**Kc****
2	March (15-31)	54	0.08
3	April	249	0.13
4	May	479	0.22
5	June	701	0.30
6	July	1036	0.40
7	August	1395	0.45
8	September	1731	0.46
9			
10	* GDD is in degrees Celsius, base = 10 C		
11			
12	** The equation in cell C2 is:		
13	= 0.47 / (1 + EXP (- (B2 - 525) / 301))		
14			

Figure 1. Example spreadsheet calculation using the VSP crop coefficient equation and monthly cumulative growing degree days in degrees Celsius.

Kaolin clay crop protectant for sunburn control

Cabernet Sauvignon in the Paso Robles area was treated with a kaolin clay crop protectant for sunburn control. Fruit analysis suggested that treatments did affect light transmission to the berries, but not necessarily leading to improved quality under the test conditions.

Introduction

Sunburn of winegrapes can be a problem in many of the warmer climate areas of California, especially where vine canopies have low or moderate vigor. Rows with a north-south orientation in particular can be prone to sunburn of the fruit that faces west, which receives full afternoon sun.

Kaolin-clay crop protectants may have some useful applications for sunburn protection in these situations. In this use, the product is applied in a narrow band that covers the fruiting zone only, generally only on the side of the vine row that is most exposed to the sun. A spreader-sticker is included with the application to enable the product to adhere to the berries.

This project intended to determine if there were any measurable differences in the physical and chemical properties of grapes treated with a kaolin clay crop protectant in this manner as compared to untreated grapes.

Materials and Method

A field trial was conducted in a commercial planting of Cabernet Sauvignon east of Paso Robles, CA. The six-year old vines were oriented in north-south rows, using a vertical shoot position (VSP) trellis. Prior to the study, only east side shoots were vertically positioned, while the west side shoots remained un-positioned. On July 19, 2005, with vines at approximately 50% veraison, twelve sample plots were designated on twelve adjacent rows; each sample plot consisted of five contiguous vines along the same row. On each sample plot, the west-side shoots were positioned vertically by stringing a temporary additional foliage wire approximately 0.5 m above the cordon. On six of the twelve sample units, a kaolin-clay based crop protectant (Surround™ WP, Engelhard Corp.) was applied over a 0.35 m wide swath encompassing the fruiting zone with a single-nozzle hand-held sprayer. Two back-to-back applications were made at 30 minute intervals. Each application was at the rate of 11.3 kg/ha (10.1 lbs/ac). A surface active agent (K-90, Knapp Manufacturing) was added at the rate of 0.62 ml agent per liter (8 oz/100 gals) to enable adhesion of the solution to the berries. Harvest samples were taken on October 7, 2005; samples were taken from the center three vines of the group of five vines in each sample unit. Berry samples consisted of 10 berries each from 10 clusters on each of the three vines, which were measured for berry weight. Additionally, 20 random clusters with west exposure were selected from the three vines for laboratory analysis of juice and seed characteristics.

Figure 1. Treated fruit (left) and untreated fruit (right), viewed from the west side of the row, one month after application.

Table 1. Basic berry and juice characteristics

Parameter	Treated	Untreated
Brix	25.5 a	25.6 a
pH	3.56 a	3.55 a
TA	4.28 a	4.31 a
Avg. Berry weight (g)	0.923 a	0.908 a

Results and Discussion

Visual inspection after spraying indicated that the kaolin product adhered to the berries as desired. Observations over the next 10 weeks indicated that the material did not appear to diminish notably; as such no additional treatments were applied.

Berry weights, soluble solids, pH, and TA were not significantly different between the two treatments (Table 1). Likewise, grape extractions and FOSS analysis also showed no significant differences between treatments (Tables 2 and 3). The Glories Method (Table 4) for measuring phenolic maturity did show significantly lower potential and extractable juice anthocyanins for the treated grapes, while the MP, an index of seed maturity, was higher for the treated grapes. The MP indicates the contribution of tannins from seeds to the total phenol content; it typically tends to decrease during ripening. Likewise, the richness of the phenolic compounds (RPT) was significantly lower in the treated grapes.

The differences noted above between the treated and untreated grapes resemble the differences between shaded and light-exposed fruit. The production of phenolic compounds is in part a response to light exposure by the fruit; as such the treatments may have excluded light in a manner similar to canopy shading.

At harvest, numerous clusters of the untreated fruit did have obvious berry sunburn symptoms; it was not possible to visually assess any sunburn of the treated fruit due to the presence of the kaolin material. Further work with this material as a sunburn inhibitor may consider investigating how the timing of application(s) affects ripening and quality parameters.

In summary, the berry and juice characteristics of Cabernet Sauvignon that received two back-to-back applications of a kaolin-clay crop protectant and adjuvant at 50% veraison in mid-July were largely indistinguishable from untreated fruit. However, the treated fruit did display significantly lower potential and extractable anthocyanins and seed maturity by Glories Method, and lower phenolic richness; such characteristics are consistent with fruit that develops under more shaded conditions. Other winegrape varieties may show different results with the same treatments.

Thanks to the J. Lohr Winery and Engelhard Corporation for their support with this trial.

Table 2. Grape Extractions

Parameter	Treated	Untreated
HCl 280nm corr	56.60 a	55.03 a
Total Phenols	52.60 a	51.03 a
Tannins	21.21 a	21.24 a
Total red pigments	29.62 a	29.05 a
Total Anthocyanins	29.30 a	28.95 a
Free Anthocyanins	14.00 a	13.62 a
420nm	2.72 a	2.72 a
520nm	2.79 a	2.80 a
Color Density	5.51 a	5.52 a
Hue	0.98 a	0.98 a

Table 3. FOSS Results

Parameter	Treated	Untreated
Maturity Index		
Sugar (Glucose-Fructose) g/l	10.0 a	10.0 a
Sugar (Brix/Baume) Deg. Brix	26.0 a	25.9 a
Sugar (Density) g/ml	12.0 a	12.0 a
Degree % vol	15.8 a	15.7 a
Total Acid g/l H2SO4	2.93 a	2.97 a
pH	3.31 a	3.31 a
Tartaric Acid g/l	4.7 a	4.7 a
Malic Acid g/l	0.28 a	0.27 a
Volatile Acid g/l Acetic Acid	0.13 a	0.14 a
Polyphenol Index	10.4 a	11.4 a
OD 280	20.4 a	19.9 a
OD 520	2.82 a	2.72 a
Color Intensity	6.98 a	7.07 a
Ammonia mg/l	91 a	94 a
Alpha Amino Nitrogen mg/l	165 a	166 a
Total Assimilable Nitrogen mg/l	256 a	259 a
Potassium mg/l	795 a	746 a
Sanitary Index		
Grey Rot	17.2 a	15.7 a
Acid Rot	14.8 a	15.3 a
Yeast Activity	29.3 a	29.2 a
Lactic Bacteria	0.00 a	0.00 a

Table 4. Glories Method & Phenolic Richness

Parameter	Treated	Untreated
Anthocyanins (mg/L), pH 1 (potential)	280.3 a	608.4 b
Anthocyanins (mg/L), pH at 3.2 (extractable)	164.8 a	350.6 b
Anthocyanin Extractability (%)	41.15 a	42.30 a
MP (%)	68.6 a	48.4 b
RPT	21.2 a	28.5 b

Leaf temperature as an indicator of vine water stress

Research over the past two seasons has evaluated the use of automated leaf temperature measurements as a potential method for assessing vine water stress. The method was able to measure significant differences in leaf temperature between different irrigation treatments.

A well-watered vine transpires more water than a vine undergoing water stress. When a vine transpires water, the evaporation of that water tends to cool the leaf surface. Thus, different levels of water stress lead to differences in leaf temperature. This project set out to determine if such differences in temperature could be measured with inexpensive devices in a manner that might prove useful for practical management or for applied research.

Leaf temperatures were measured using thermistors, which are electrical resistors whose resistance value changes with temperature. The thermistors were measured with Hobo® dataloggers, with a resolution of 0.03 °C. The main physical challenge of the project was to reliably attach the small thermistors to the underside of the leaves in such a way that would not significantly alter the temperature or otherwise disrupt the leaf function; the homemade clamping devices shown in Figure 1 have worked well in this regard.

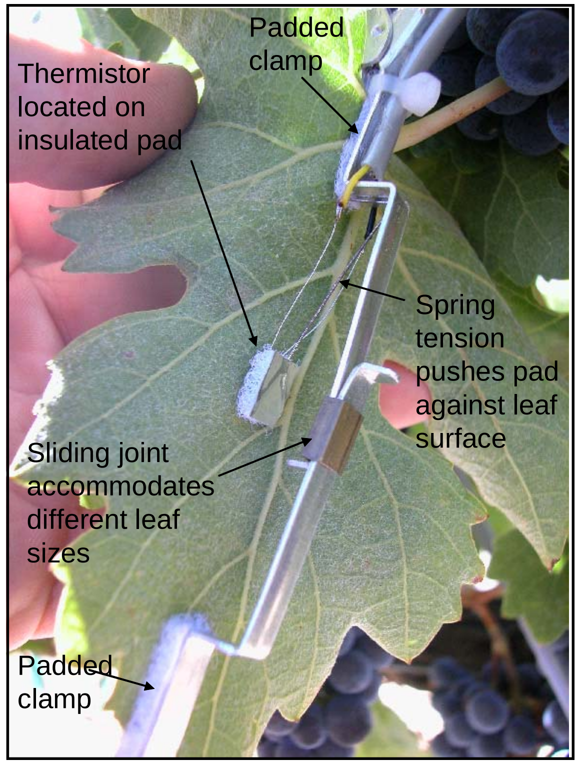

Figure 1. View of the leaf temperature sensor from the underside of the leaf. The thermistor is about the size of a pinhead, and is kept in constant contact with the underside of the leaf blade.

Test vines were mature Cabernet Sauvignon on north-south rows, under four different levels of irrigation, east of Paso Robles. The control irrigation received 65% ETc, and treatments were then different percentages (50%, 75%, 100%, 125%) of this control amount. In each irrigation treatment, three replicate vines were monitored; on each vine, five east-facing and five west-facing mature leaves had sensors attached from late June to late September. Irrigation treatments started several weeks before the sensors were installed. Additional sensors measured air temperature in each treatment. All sensors were read every 15 minutes during the entire study period.

Analyzing the large amount of measurements was made easier by averaging the differences between leaf and air temperatures for select time periods. In Figure 2, the daily average difference in temperature for the time period 8 am to 12 noon is shown. The more positive the number on the y-axis, the higher the leaf temperature relative to the air temperature, and therefore the lower the vine transpiration rate. From 2 pm to 6 pm, the differences in temperatures between treatments were less notable, likely due to stomatal closure (Table 1).

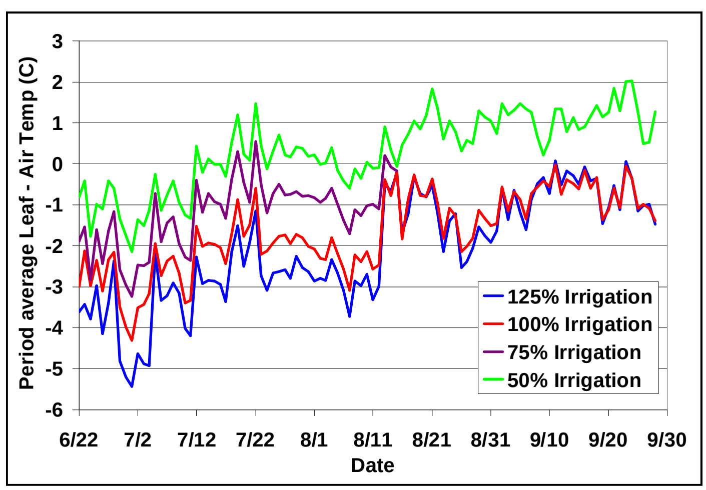

Figure 2. Average difference between leaf and air temperature for the four irrigation treatments; the data shown are for the period 8 am—12 noon on each day. The 75% treatment sensors were removed on August 15 for use at another location.

In Figures 3-6 on the following page, the behavior of leaf temperature with respect to air temperature is shown for the single 24-hour period of August 3, 2005; the east and west side measurements are indicated separately for each irrigation treatment. Looking at the four figures, they all demonstrate the same basic pattern:

at night, there is virtually no difference between leaf and air temperatures. At sunrise, the east side leaves warm relative to the air, while the west side leaves cool, and this pattern remains until solar noon (around 1 pm), at which time the pattern reverses, with the west side becoming warmer and the east side cooler. Interestingly, the largest differences in temperature between treatments are occurring well before noon.

These results suggest that automated measurements of leaf temperature using very inexpensive devices may have future applications for continuously monitoring vine water stress.

Table 1. Period average leaf-air temperature differences for select time periods, 8/3/05; **average of both east and west** side canopies for each test vine (n=3)			
Treatment	0800 - 1200 Leaf – Air temp (C)	1400-1800 Leaf – Air temp (C)	0600-2000 Leaf – Air temp (C)
125%	-2.85 a	-1.42 a	-2.09 a
100%	-2.34 a	-1.09 a	-1.68 a
75%	-0.84 b	-0.59 a	-0.88 b
50%	0.02 b	-0.75 a	-0.60 b
P =	*0.0027*	*0.2595*	*0.0006*

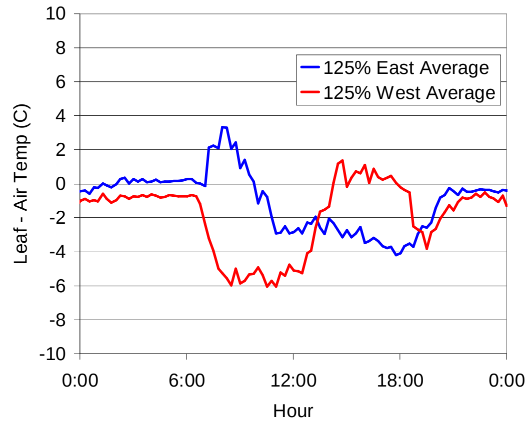

Figure 3. Average east side and west side leaf temperature measurements for a single day (8/3/05); 125% irrigation treatment.

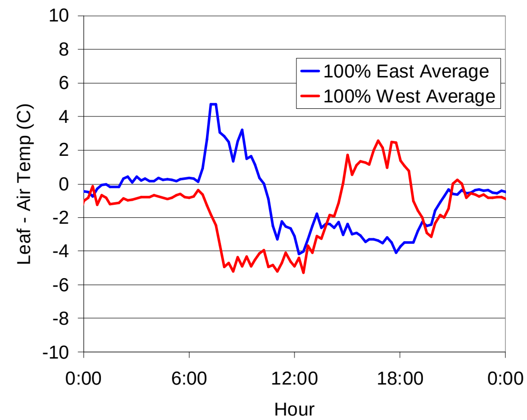

Figure 4. Average east side and west side leaf temperature measurements for a single day (8/3/05); 100% irrigation treatment.

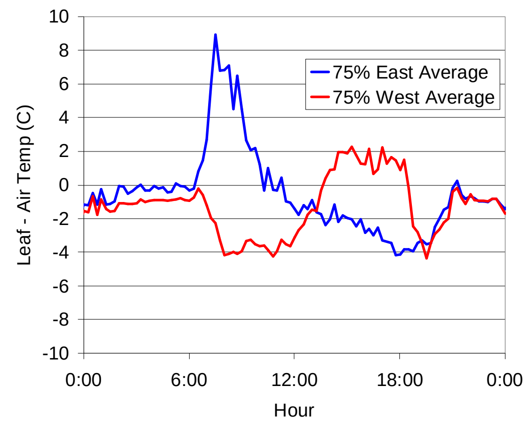

Figure 5. Average east side and west side leaf temperature measurements for a single day (8/3/05); 75% irrigation treatment.

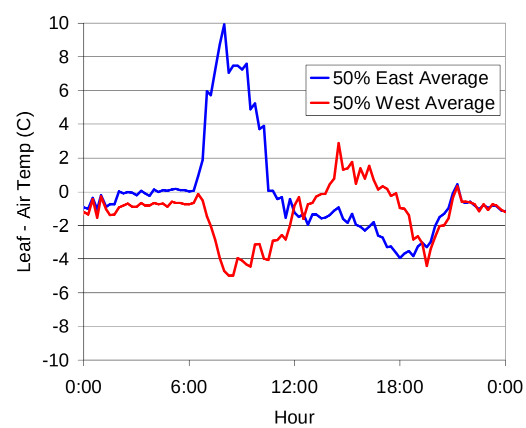

Figure 6. Average east side and west side leaf temperature measurements for a single day (8/3/05); 50% irrigation treatment.

Thanks to the American Vineyard Foundation for their support with this trial.

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Grapevine Clean Plant Workshop

When: June 20, 2006, 8:30 am—4:30 pm

Where: UC Davis Campus, DaVinci Building

What: The California Grapevine Registration and Certification (R&C) program is currently undergoing review. This workshop has been organized to introduce attendees to some of the technical issue which will need to be considered as the revised regulations are developed by the California Department of Food and Agriculture (CDFA). Space is limited!

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Cost: $49

New UC Publication:

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By Blaine Hanson, Neil O'Connell, Jan Hopmans, Jirka Simunek, Robert Beede

Fertigation is the process of applying fertilizer through an irrigation system by injecting the fertilizer into the irrigation water. Microirrigation can apply water and chemicals in precise amounts and locations through a field. This manual helps guide users through strategies and decision making for fertigation with nitrogen, phosphorus and potassium, and gypsum. It discusses the environmental effects of chemical applications, and focuses on nitrogen management to reduce groundwater pollution. The guide also covers the characteristics of selected fertilizers commonly used for fertigation, long- and short-duration strategies, how to calculate injection rates, frequency considerations, how to apply fertilizers uniformly, mixing considerations, injection devices, and how to prevent backflow. UC ANR Publication 21620

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