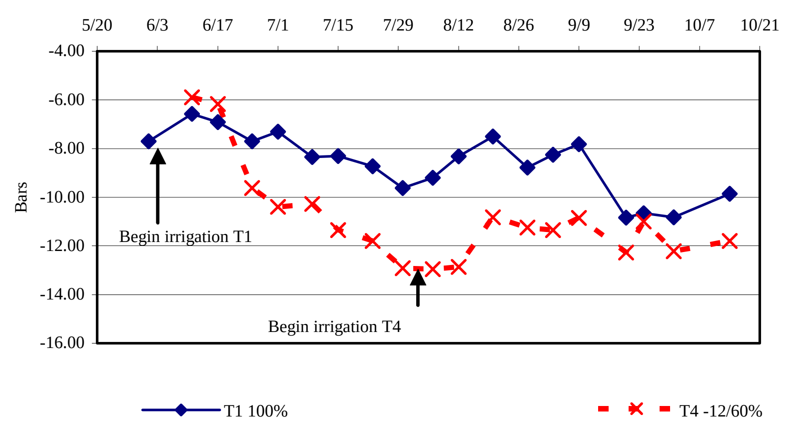
I. Monitoring Vine Performance to Evaluate Strategy

Measuring vine performance makes it possible to improve the irrigation both during the current year and for the following season. Post threshold measurements of leaf water potential and vegetative growth can be made during the season. Fruit quality, yield components, and maximum shoot length and pruning weights can be measured at harvest.

Post Threshold Midday Leaf Water Potential

Using the deficit threshold method, measurements of vine water status are made to determine when to begin irrigation. The pressure chamber can also be used to monitor the vine water status as it is influenced by the irrigation amounts determined by the RDI %. The time to measure vine water status, which is most meaningful, is just before an irrigation event. This measures the maximum water stress before the next irrigation. *Figure H-1* shows the leaf water potential of various irrigation regimes before and after weekly irrigation began. Post threshold monitoring can be used to determine the effect of the irrigation amounts and to validate the RDI %. Changes can be made to the irrigation volumes if results are inconsistent with expectations. Note that there can be a lag in leaf water potential recovery after significant water deficits as shown after irrigation began in Treatment 4 (*Figure I-1*).

Figure I-1. Leaf Water Potentials
Hopland Cabernet Sauvignon 2000



Vegetative Growth

Shoot length measurements are the most common evaluation of vegetative growth. They can be made at harvest (pre hedging) or at pruning if there is no hedging before harvest. Shoots can be measured in a two-week frequency to determine the rate of shoot growth (see *Chapter F, Determining When to Irrigate*). Measurement shoots are selected early in the season by flagging the shoots from the same relative cordon position on a number of vines in an irrigation block. The number can vary but typical is 2 shoots per vine with 2 vines per site and at least 3 sites per block. Shoot growth is quite variable, so more measurements will give a better estimate of the average.

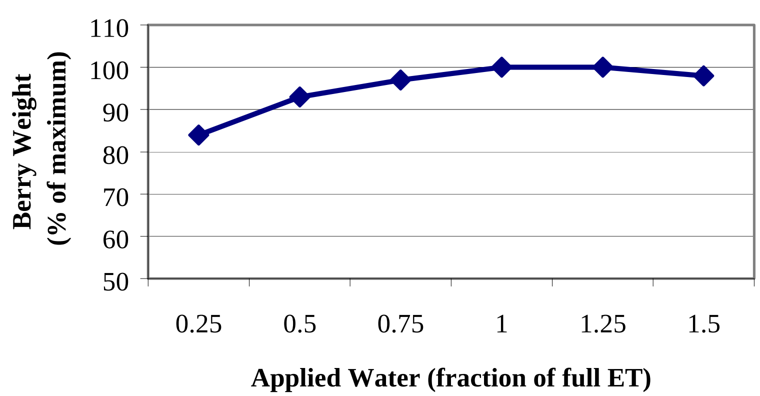
Pruning weights are also a good indication of vegetative growth when not hedged at harvest. Typically, the pruning weights of 10 vines per site and 3 sites per block are necessary to achieve a reasonable average. Measurement of spur diameter between the 1st and 2nd buds left on a spur is also gaining popularity since pre-harvest is becoming commonplace.

Yield

Yield

Yield is typically recorded as the delivered fruit from a block. It is important to keep blocks irrigated by different strategies separate to evaluate the effect of an irrigation regime. Berry size is an important yield component, which determines the ultimate yield. It is often the most important factor in yield differences in deficit irrigation studies. *Figure I-2* shows the average relationship between berry size and the portion of full water use (applied water) from six vineyards in 1998 (from L.E. Willams 1998). Berry weight was 97% of maximum at 0.75 of full potential water use.

Figure H-2. Relative berry weight vs. fraction of potential ET (applied water)



Fruit Quality

Visual estimates of fruit quality include the amount of sunburn, shrivel, and rot. Fruit quality can be assessed by measuring soluble solids (ºBrix), pH, titratable acidity (TA), and Malic acid content. Each of these measurements along with the comments from the winemaker should be used to evaluate the success of any irrigation regime.

Appendix

Drip System Evaluation Form

Sampled drip emitter	Location	Water (ml) collected in 30 seconds	Emitter discharge rate (gph)	Ranking
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				
31				
32				
33				
34				
35				
36				

Avg. discharge rate of all sampled emitters = _______gph
Avg. discharge rate of the low 25% of sampled emitters = ________ gph

$$\text{Emission Uniformity (\%)} = \frac{\text{Avg. discharge rate of the low 25\% sampled emitters}}{\text{Avg. discharge rate of all the sampled emitters}} \times 100$$

= ______________ × 100 = ________%

Sample Data Sheet

Drip System Evaluation Form

Sampled drip emitter	Location	Water (ml) collected in 30 seconds	Emitter discharge rate (gph)	Ranking
1		17	0.54	31
2		14	0.44	3
3		15	0.48	10
4		16	0.51	24
5		15	0.48	11
6		17	0.54	32
7		15	0.48	12
8		16	0.51	25
9		14	0.44	4
10		17	0.54	33
11		17	0.54	34
12		15	0.48	14
14		15	0.48	13
15		16	0.51	26
16		14	0.44	6
17		15	0.48	15
18		16	0.48	16
19		13	0.41	1
20		15	0.48	17
21		14	0.44	7
22		15	0.48	18
23		16	0.51	27
24		13	0.41	2
25		17	0.54	35
26		15	0.48	19
27		16	0.51	28
28		14	0.44	8
29		15	0.48	20
30		15	0.48	21
31		17	0.54	36
32		16	0.51	29
33		15	0.48	22
34		16	0.51	30
35		14	0.44	9
36		15	0.48	22

Avg. discharge rate of all sampled emitters = _0.48_ gph
Avg. discharge rate of the low 25% of sampled emitters = _0.44 gph

$$\textit{Emission Uniformity (\%)} = \frac{\textit{Avg. discharge rate of the low 25\% sampled emitters}}{\textit{Avg. discharge rate of all the sampled emitters}} \; x\ 100$$

$$\text{Emission Uniformity (\%)} = \frac{0.44}{0.48} \times 100 = 92\%$$

Average Weekly Non-Rain Eto
Lodi, CA CIMIS Stations # 42 and #166

	Inches		Inches
January 1-7	0.19	July 1-7	1.86
January 8-14	0.20	July 8-14	1.82
January 1-21	0.29	July 15-21	1.72
January 22-28	0.30	July 22-28	1.69
January 29-Feburary 4	0.34	July 29 to August 4	1.68
February 5-11	0.40	August 5-11	1.63
February 12-18	0.56	August 12-18	1.56
February 19-25	0.63	August 19-25	1.49
February 26-March 3	0.61	August 26 to September 1	1.45
March 4-10	0.71	September 2-8	1.37
March 11-17	0.80	September 9-15	1.23
March 18-24	0.93	September 16-22	1.17
March 25-31	1.10	September 23-29	1.05
April 1 - 7	1.14	September 30 to October 6	0.97
April 8-14	1.28	October 7-13	0.88
April 15-21	1.24	October 14-20	0.78
April 22-28	1.43	October 21-27	0.66
April 29-May 5	1.57	October 28 to November 3	0.54
May 6-12	1.58	November 4 to 10	0.50
May 13-19	1.59	November 11 to 17	0.40
May 20-26	1.67	November 18-24	0.32
May 21-June 2	1.67	November 25-December 1	0.34
June 3-9	1.74	December 2-8	0.26
June 10-16	1.82	December 9-15	0.24
June 17-23	1.85	December 16-22	0.22
June 24-30	1.80	December 23-29	0.21
		December 30-31(partial week)	0.05

Sample Irrigation Scheduling Worksheet -

Date	A = Historical Eto[a]	B = Crop Coefficient[b]	C = A x B: Potential Water Use	D = RDI Coefficient[c]	E = Soil Contribution	F = Effective Rainfall[d]	G = [(C x D) - E - F]: Net Irrigation Requirement	H = Emission Uniformity[e]	I = G/H:Gross Irrigation Amount	J = Vine Spacing[f]	K = (I x J x .623): Gallons per Vine/ Period	L = Average Application Rate	M = (K/L): Hours of PREDICTED Irrigation Time
Period	Inches/Period	Kc	(in)	RDI %	(in)	(in)	(in)	(%)	(in)	(sq feet)	(gal/week)	(gph/vine)	(hours)
Jly 8-14													
Jly 15-21													
Jly 22-28													
Jly 29 to Aug 4													
Aug 5-11													
Aug 12-18													
Aug 19-25													
Aug 26 to Sept 1													
Sept 2-8													
Sept 9-15													
Sept 16-22													
Sept 23-29													
Sept 30 to Oct 6													
Oct 7-13													
Oct 14-20													
Oct 21-27													
Oct 28 to Nov 3													

Total													

Gallons per vine applied though harvest =

Hours of irrigation time through harvest =

Sample Irrigation Scheduling Worksheet - Lodi, CA

ETo and precipitation are the averages of daily data from 1984 to 2003.
Data from the Lodi (CIMIS #42) and West Lodi (#166) weather stations

Assumptions
1. Leaf Water Potential trigger was reached July 8th.
2. Harvest Date was October 1.

Date	A = Historical Eto[a]	B = Crop Coefficient[b]	C = A x B: Potential Water Use	D = RDI Coefficient[c]	E = Soil Contribution	F = Effective Rainfall[d]	G = [(C x D) - E - F]: Net Irrigation Requirement	H = Emission Uniformity[e]	I = G/H:Gross Irrigation Amount	J = Vine Spacing[f]	K = (I x J x .623): Gallons per Vine/ Period	L = Average Application Rate	M = (K/L): Hours of PREDICTED Irrigation Time
Period	Inches/Period	Kc	(in)	RDI %	(in)	(in)	(in)	(%)	(in)	(sq feet)	(gal/week)	(gph/vine)	(hours)
Jly 8-14	1.82	0.68	1.24	0.5	0.2	0	0.42	92	0.45	77	21.8	0.96	22.7
Jly 15-21	1.720	0.68	1.17	0.5	0.2	0	0.38	92	0.42	77	20.1	0.96	20.9
Jly 22-28	1.692	0.68	1.15	0.5	0.2	0	0.38	92	0.41	77	19.6	0.96	20.4
Jly 29 to Aug 4	1.676	0.68	1.14	0.5	0.2	0	0.37	92	0.40	77	19.3	0.96	20.1
Aug 5-11	1.626	0.68	1.11	0.5	0.2	0	0.35	92	0.38	77	18.4	0.96	19.2
Aug 12-18	1.556	0.68	1.06	0.5	0.2	0	0.33	92	0.36	77	17.2	0.96	17.9
Aug 19-25	1.494	0.68	1.02	0.5	0.2	0	0.31	92	0.33	77	16.1	0.96	16.7
Aug 26 to Sept 1	1.448	0.68	0.98	0.5	0.2	0	0.29	92	0.32	77	15.2	0.96	15.9
Sept 2-8	1.368	0.68	0.93	0.5	0.2	0	0.27	92	0.29	77	13.8	0.96	14.4
Sept 9-15	1.225	0.68	0.83	0.5	0.2	0	0.22	92	0.24	77	11.3	0.96	11.8
Sept 16-22	1.171	0.68	0.80	0.5	0.2	0	0.20	92	0.22	77	10.3	0.96	10.8
Sept 23-29	1.054	0.68	0.72	0.5	0.2	0	0.16	92	0.17	77	8.3	0.96	8.6
Sept 30 to Oct 6	0.974	0.68	0.66	1		0	0.66	92	0.72	77	34.5	0.96	36.0
Oct 7-13	0.883	0.68	0.60	1		0	0.60	92	0.65	77	31.3	0.96	32.6
Oct 14-20	0.779	0.68	0.53	1		0	0.53	92	0.58	77	27.6	0.96	28.8
Oct 21-27	0.660	0.68	0.45	1		0	0.45	92	0.49	77	23.4	0.96	24.4
Oct 28 to Nov 3	0.540	0.68	0.37	1		0.32	0.05	92	0.05	77	2.4	0.96	2.5
Total			14.75		2.40		5.96		6.47				

[a] http://wwwcimis.water.ca.gov/cimis **or** http://ucipm.ucdavis.edu

[b] Crop Coeficient calculated based on 40% midday land surface shaded (0.68)

[c] Regulated Deficit is 50% (0.5)

[d] Effective rainfall is calculated from actual rainfall. Calculations are not shown on this sheet.

[e] Under deficit irrigation, Irrigation Efficiency is assumed equal to Emission Uniformity.

[e] spacing 7 x 11 ft = 77 ft sq.

Gallons per vine applied though harvest = 191.3

Hours of irrigation time through harvest = 199.3