Lodi Woodbridge Winegrape Commission
2000 Comprehensive Project Report

PROJECT TITLE:

Management of Merlot to Modify Vine and Wine Characteristics

PROJECT PERSONNEL:

Principle Investigator:
Terry L. Prichard, Water Management Specialist
Dept. of LAWR, Hydrologic Science
University of California, Davis
(209) 468-2085

Co-Investigators:
Paul S. Verdegaal, University of California Farm Advisor, San Joaquin County
Bibiana Guerra, Woodbridge Winery, Lodi
Kay Bogart, Sabastiani Winery, Sonoma

Cooperators:
Ron Slate Vineyard, Lodi, California
Rick Grenz, Vineyard Manager

Involvement of Investigators:

T. Prichard (20% of time). Coordinate project activities. Direct Staff Research Associate and Post Graduate Researcher activities in collection of data, analysis of data and preparation of reports.

P. Verdegaal (10% of time). Direct viticultural operations. Plan and supervise collection of vine physiological data.

B. Guerra, K. Bogart (5% of time). Crush fruit; provide chemical and organoleptic wine analysis.

All investigators will cooperate to determine treatments and provide a meaningful report.

OBJECTIVES:

(1) Measure effects of management regimes on must and wine parameters;
(2) Measure physiological effects of management regimes on vines and fruit;
(3) Utilize developed information to formulate management strategies to improve Merlot production in the Lodi District.

Treatments

The irrigation treatments allow for starting irrigation at different levels of water deficits and from that point, maintaining decreasing or increasing water deficits. Treatments 1 and 2 are irrigated at full potential water use beginning early in the growing season. The remaining treatments are not irrigated until a pre-determined leaf water potential threshold is reached. Threshold points are both 13 and 15 bars measured with a leaf water potential chamber. Once the trigger level is reached, an estimate of full potential water use of this vineyard and a regulated deficit irrigation factor will be used to determine the weekly irrigation volumes depending on the treatment (Table 1).

Crop level treatments will be compared in Treatments 3 and 4 with T4 having 20% reduced spurs. Leaf removal treatments will be compared across irrigation treatments T1 and T2 (full water use) and Treatments 3 and 6 (moderate deficits), Table 2

Treatment 10 was planted to a cover crop in the fall 1997. It continues to reseed and produce a good stand. A comparison will be made with Treatment 3, which is equivalent with respect to irrigation crop load and canopy management.

Table 1. 2000 Merlot Treatments, Lodi

Treatment	Water Potential Threshold (bars)	RDI %	Pruning Spurs	Leaf Removal	Cover
2	Minimum	100	20	Yes	No
3	-13	60	20	Yes	No
4	-13	60	14	Yes	No
7	-13	35	20	Yes	No
8	-15	35	20	Yes	No
9	-15	60	20	Yes	No
10	-13	60	20	Yes	Yes

Table 2. 2000 Merlot Treatment Comparisons, Lodi

Variable			Constant				
Irrigation		Treatment	Threshold	RDI	Pruning	Leaf Removal	Cover Crop
Threshold Within RDI	None	T2		None	Std	Yes	None
(Bars)	-13	T3		60	Std	Yes	None
	-15	T9		60	Std	Yes	None
	None	T2		None	Std	Yes	None
	-13	T7		35	Std	Yes	None
	-15	T8		35	Std	Yes	None
RDI Within Threshold	None	T2	None		Std	Yes	None
(Bars)	35	T8	-15		Std	Yes	None
	60	T9	-15		Std	Yes	None
	None	T2	None		Std	Yes	None
	35	T7	-13		Std	Yes	None
	60	T3	-13		Std	Yes	None
Leaf Removal	No	T1	None	None	Std		None
	Yes	T2	None	None	Std		None
	Yes	T3	-13	60	Std		None
	No	T5	-13	60	Std		None
Early Leaf Removal	Early	T6	-13	60	Std		None
	Std	T3	-13	60	Std		None
Pruning	Std	T3	-13	60		Yes	None
	< 20 %	T4	-13	60		Yes	None
Cover Crop	Yes	T10	-13	60	Std	Yes	
	No	T3	-13	60	Std	Yes	

In the first year of imposed treatments (1997), it was found that trying to maintain a specific level of deficit as per the treatment plan was exceedingly difficult. The plan was to measure water potential at the end of a one-week period, then estimate an appropriate irrigation volume that would maintain certain leaf water potential that a given treatment dictated for the next week. Using weekly irrigation followed by measuring water deficit at the most stressed level (just prior to irrigation) caused leaf water potential to be over or under the target period. This was primarily due to changes in the water demand caused by the climate or affected by residual soil moisture on the day of reading.

It was clear another approach was necessary, not only to provide control of the water deficit but also to define an irrigation strategy which growers/irrigators could easily emulate. Out of this experience and desire provide a more "user-friendly" methodology. A new approach was defined and put into practice in 1998.

The approach, called Deficit Threshold Irrigation Management, relies on a midday leaf water potential threshold of when to begin irrigation just as in 1997. How much water to apply, however, changes from that determined by a measurement of plant water status and irrigation volumes to try to maintain static leaf water potential. The new approach of determining how much to irrigate uses a method, which takes a portion of the full estimated vine water use required for one-week period. This portion of full water use is known as the regulated deficit irrigation factor (RDI). Leaf water potential is still measured as indicator of plant water deficit to confirm the desired level of water stress.

This approach reduces the need to take as many measurements of leaf water potential after the threshold is reached. The leaf water potential measurements are used as an indication the RDI factor (see below) is appropriate, rather than using the reading to determine irrigation volumes. The RDI factors for 1999 are shown in Table 1.

$$ETo \times Kc \times Krdi$$

Where	ETo	=	evapotranspiration reference value for the Lodi CIMIS station
	Kc	=	crop sunlight interception coefficient (vineyard shaded area)
	Krdi	=	regulated deficit irrigation factor which is a percent of full vine water use

<u>2000 Activities</u>

Treatments were imposed beginning fall 1998 with the germination of an annual ryegrass cover crop in Treatment 10 in the row centers on both sides of the experimental vines. Differential pruning was performed in January 2000 followed by differential irrigation, and leaf removal. Pruning weights were collected at pruning to assess differences in vegetative growth.

Data collected include vegetative growth measured as shoot growth, canopies measured as land surface shaded and canopy penetrating light at the fruit level measured biweekly from veraison through harvest, and water use is measured by neutron probe. Leaf water potential was measured weekly pre-veraison through harvest.

Leaf removal occurred on June 7 in the leaf removal treatments. Unfortunately the grower’s crew also removed the non-leaf removal treatments a few days later. This eliminated treatments 1, 5, and 6 since they would be duplicates of other treatments. Water potential thresholds were reached for the –13 bar treatments on 6/22/00 while the –15 bar treatments were delayed by 28 days to 7/20/00. This was about the same time as last year (1999). This is a result of approximately the same amount of stored moisture and similar climatic conditions for the time between the two thresholds. In other years with more severe climatic conditions during early July, the time period resulted in a 10 - 15 days period to go from –13 to –15 bars. In 2000 and 1999, the 28-day difference between thresholds was the result of any cool period during this time, which allowed the soil moisture supplying power of the soil not to become overpowered by the climatic water demand.

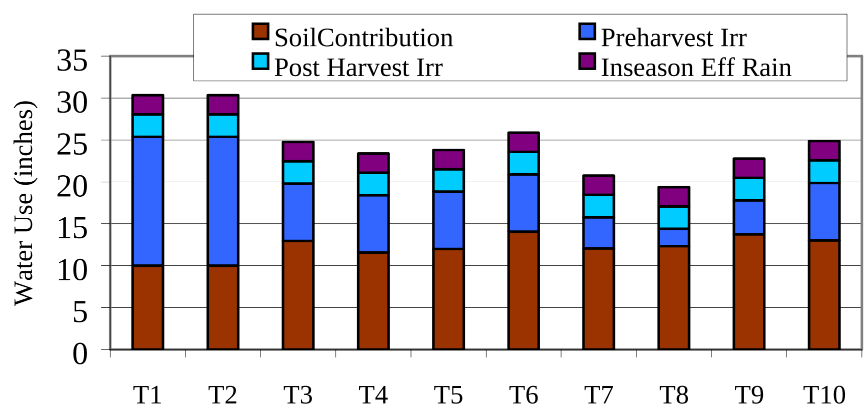
Water Use

The amount of water consumed by each treatment was the summation of water volumes extracted from the stored rootzone moisture, effective in-season rainfall and irrigation. Figure 1 and Table 3 show the amounts of each component to reach the total water consumed by the average of each treatment.

Table 3. 2000 Merlot Water Volumes Consumed and
Relative Volumes of Each Treatment in Comparison to Treatment 1, Lodi

Treatment	Soil Contribution	In-Season Effective Rain	Pre-Harvest Irrigation	Percent of Potential
T1	10.02	2.29	15.34	100
T2	10.02	2.29	15.34	100
T3	12.96	2.29	6.83	80
T4	11.57	2.29	6.83	75
T5	12.01	2.29	6.83	76
T6	14.06	2.29	6.83	84
T7	12.08	2.29	3.69	65
T8	12.35	2.29	2.06	60
T9	13.76	2.29	4.04	73
T10	13.04	2.29	6.83	80

Figure 1. 2000 Merlot Water Use and Sources, Lodi



Leaf Water Potential. Midday leaf water potential data were collected from each treatment. Measurements were made from 11:00 am to 2:00 pm on clear sky days with normal (85-95 °F) temperatures. Data presented below are grouped into threshold and RDI for comparison. The full potential irrigation (T1) was irrigated May 24, 2000 and weekly thereafter at an amount to equal full potential water use each week. The leaf water potential remained as less than –10 bars until August when it increased in stress to –11 bars (Figure 2).

Figure 2 shows the treatments with the –13 bar threshold. The treatment receiving 60% RDI generally maintained leaf water potential at the –13 level throughout the season after the initiation of irrigation on June 22, 2000. The –13 bar threshold followed by a 60% RDI (13/60) recovered after a two-week lag period then stabilized at near the –13 bar threshold for the rest of the season. The 35% RDI did not respond to the more limited irrigation volume, then slowly increased in stress towards harvest reaching –15.6 bars. The cover crop treatment (13/60cc), which had a threshold of –13 and an RDI of 60%, expressed more water stress in the early season (May and early June) than its companion no cover treatment (13/60). The cover treatment responded to irrigation then finished the season with more than a bar more stress then the no cover treatment.

Figure 2. 2000 Merlot Midday Leaf Water Potential, Lodi

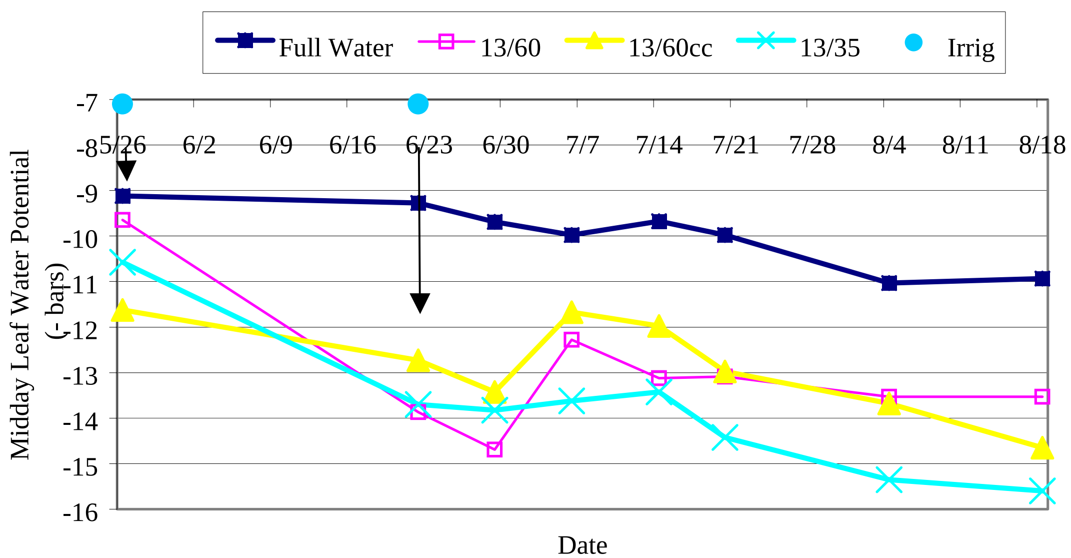


Figure 3 shows the –15 bar threshold treatments and the full water for comparison. Both treatments reached the –15 bar threshold on July 20, 2000 with irrigation commencing the same day. The same pattern exists for the –15 bar threshold as the –13 bar threshold in that the RDI of 60% stabilized the leaf water potential over time while the 35% increased in stress to 15.6 before harvest.

Figure 3. 2000 Merlot Midday Leaf Water Potential, Lodi

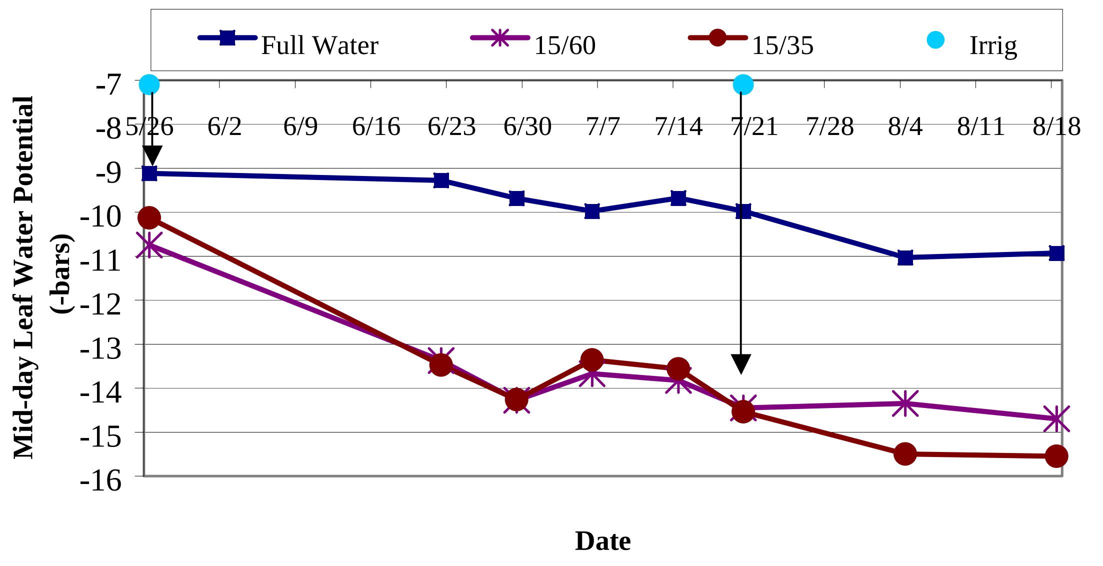
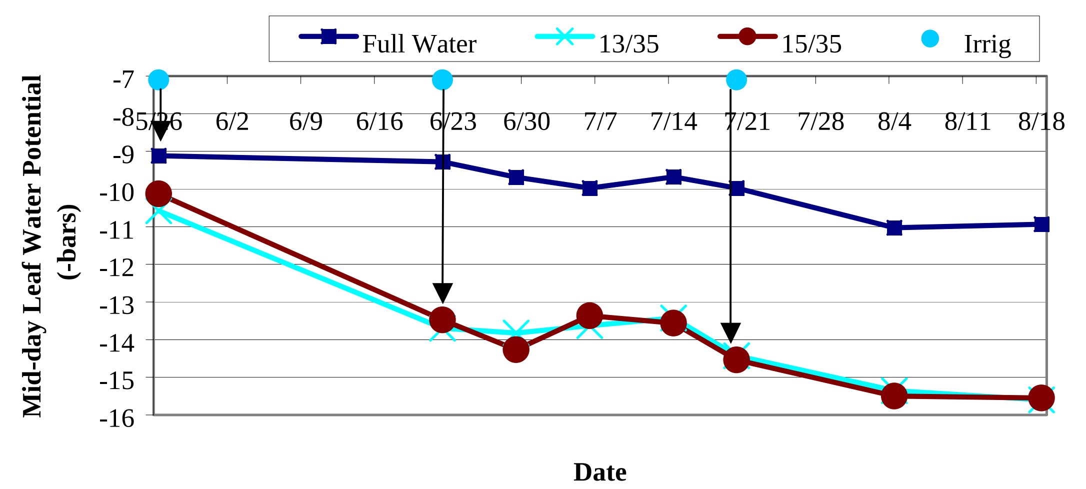


Figure 4 illustrates the leaf water potential for the two 35% RDI treatments and the full water for comparison. The patterns of leaf water potential are quite similar. This indicates the threshold may be of lesser importance than the RDI in influencing leaf water potential after the threshold.

Figure 4. 2000 Merlot Midday Leaf Water Potential, Lodi



<u>Harvest</u>

Weekly berry samples were collected to assess the fruit ripening process and to estimate harvest date. The harvest date of each treatment was determined by °brix of berry samples with a target of 24.0 °brix. Harvest of the fruit occurred over a 15-day period, August 29 through September 13, 2000 (Table 4). The full water treatments (T1 and T2) were the last harvested. The cover crop (Treatment 10) also was harvested with the full water treatments and at the highest °brix (Table 4).

Table 4. 2000 Merlot Harvest, Lodi

Treatment	Harvest Date	°Brix
2	Sept. 13	24.5
3	Aug 31	24.0
4	Aug 31	24.0
7	Aug 29	24.5
8	Aug 29	25.5
9	Aug 29	25.5
10	Sept. 12	26.1

YIELD

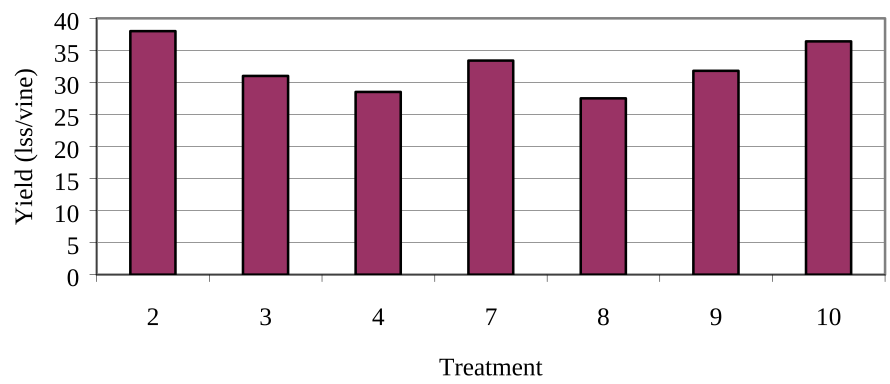
Significant differences in vine yield were found between irrigation strategies, pruning level, but not between cover crop/no cover treatments (Table 5 and Figure 6). No bunch rot was found in any treatment. The full water treatments (T2 at 38.0 pounds/vine) yielded more than all other treatments but was significantly more than Treatments 4 (13/60 with 20 spurs/vine) and 8 (15/35). It should be noted that the cover crop treatment had the highest yield (not significant) of the less than full water treatments. Cluster number was lowest in the reduced pruning treatment (T4), however not as much as would have been expected by a 20% reduction in spurs. This may indicate merlot does not have the capacity to produce increased clusters as a response to additional irrigation water as does cabernet sauvignon. Yield differences were found to be a result of both fruit load (berries per vine) and berry weight (Figures 7 and 8).

Table 5. 2000 Merlot Harvest Data, Lodi

Treatment	Yield (lbs/vine)	Clusters per vine	Cluster Wt (lbs)	Berries per vine	Berry size (gms)	Berries per cluster
2	38.0 a	95.4 ab	0.40 a	11,125	1.55 a	117
3	31.0 ab	95.4 ab	0.33 bc	10,258	1.37 ab	108
4	28.5 b	84.2 b	0.34 bc	9,826	1.33 ab	116
7	33.4 ab	101.8 a	0.33 bc	11,126	1.36 ab	109
8	27.5 b	89.2 ab	0.31 c	10,140	1.23 b	114
9	31.8 ab	97.8 a	0.32 bc	11,566	1.25 b	118
10	36.4 a	95.3 ab	0.38 ab	11,410	1.44 ab	120
P =	0.0097	0.0063	0.0262	ns	0.0069	ns

Common letters among means within columns denote no significant different at P ≤ 5% using Tukey's mean separation.

Figure 6. 2000 Merlot Yield Comparison, Lodi



Yield Component Analysis

An attempt was made to develop a relationship between the independent variables and the dependent variables, in this case, yield in pounds per vine. The procedure quantifies the linear relationship between variables and measures the strength of the relationship. Using simple regression, the number of berries per vine explains the largest amount of the variability in yield at 57.9 percent (adjusted r^2) (Figure 9). Berry weight by itself explains 43.7 percent (adjusted r^2) of the variation in yield (Figure 10).

Figure 7. 2000 Merlot Fruit Load, Lodi

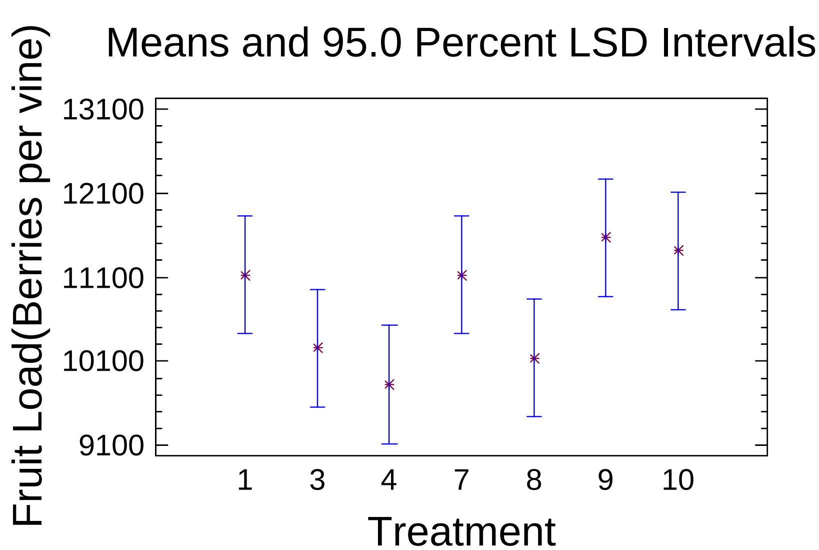


Figure 8. 2000 Merlot Berry Weight, Lodi

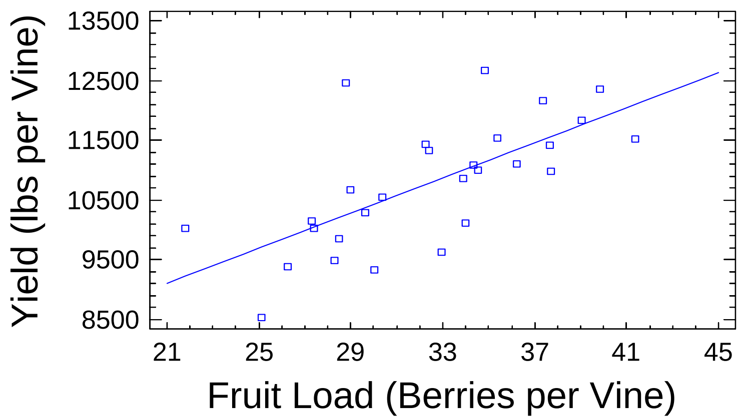


Figure 9. 2000 Merlot Regression of Yield vs. Fruit Load, Lodi

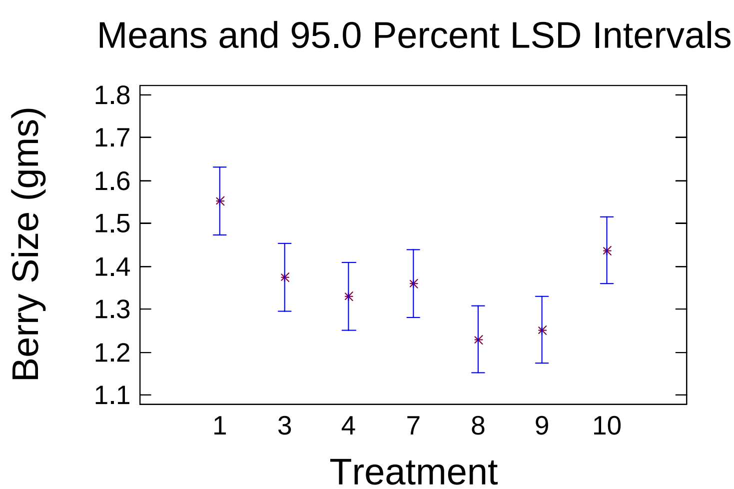
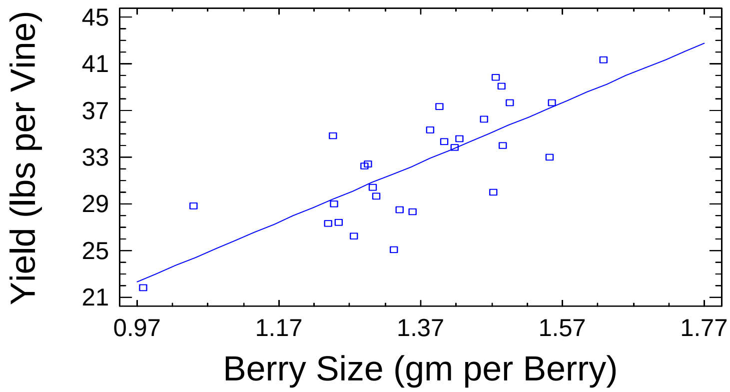


Figure 10. 2000 Merlot Regression of Yield vs. Berry Size, Lodi



Vine Canopy Response

Vine canopy responses to water deficits were measured as the maximum percentage of land surface shaded by the canopy and pruning weights.

Land Surface Shading. Land surface shading by the canopy was measured at maximum canopy expansion on July 15. The canopy size was maximized at 49-56 percent (Table 6).

Table 6. 2000 Merlot, Lodi

Treatment	Land Surface Shading (%)	Pruning Mass lbs/vine	Crop:Pruning Ratio
2	56	4.20 a	9.2 bc
3	54	3.67 ab	8.5 bc
4	55	4.15 a	7.0 c
7	53	3.37 b	10.0 b
8	52	3.39 b	8.1 bc
9	53	3.38 b	9.4 bc
10	48	2.51 c	14.7 a
P =	ns	0.0014	0.0001

Common letters among means within columns denote no significant different at P $\leq$ 5% using Duncan's mean separation.

Prunings. The weights of prunings were found to be significantly different as a result of the imposed treatments (Table 6). They varied from a high of 4.2 pounds per vine to a low of 2.5 pounds per vine. Necessary hedging of the vines midseason to improve access for cultural operations and prior to mechanical harvest no doubt influenced this parameter, especially in the full water treatments. In general, the full water treatments (T1 and T2) were in the larger prunings group with the cover crop treatment being lowest.

Crop Yield to Pruning Ratio. The relationship of yield per unit of prunings was developed to assess the balance of vegetative to reproductive structures. Significant differences were found to exist between treatments (Table 6). Lowest ratio was 7.0 for the reduced spurs treatment (T4) due primarily to the reduced yield. The highest ratio was achieved by the cover crop treatment (T10) due to reduced vegetative growth. The full water treatment 1 was in middle of the pack at 9.2 by virtue of both highest yield and most vegetative growth.

Juice

Juice pH varied between treatments from 3.48 to 3.63 (Table 9). The highest pH juice was from the reduced spur treatment 4. A group with a juice pH between 3.48 and 3.52 includes Treatments 7, 8, and 9. These treatments represent either a more severe threshold or RDI. Juice malate concentration was similar to past years with the full water treatment significantly higher than all other treatments. Malate concentration was lowest in the more severe threshold (–15 bars) and cover crop treatments (T8, T9, and T10) averaging 1234 ppm.

Titratable acidity varied greatly between treatments. The full water and moderate deficit treatments (–13/60%) were highest while the more severe threshold (T8 and T9), more severe RDI (T7), and cover crop treatments were in the lowest group averaging 4.4g/L. The treatments, which were highest in malic acid, were also highest in titratable acidity.

Table 9. 2000 Merlot Juice Analysis, Lodi

Treatment	Harvest Date	°Brix		pH		Titratable Acidity (g/L)	
2	9/13	24.0	d	3.55	bc	5.15	abc
3	8/31	23.8	d	3.61	ab	5.33	a
4	8/31	24.2	bcd	3.63	a	5.20	ab
7	8/29	24.8	bc	3.52	cd	4.73	bcd
8	8/29	25.1		3.48	d	4.53	d
9	8/29	24.9	b	3.50	cd	4.63	cd
10	9/12	25.9	a	3.56	bc	3.83	e
P =		0.0000		0.0011		0.0002	

Common letters among means within columns denote no significant different at $P \leq 5\%$ using Duncan's mean separation.

Table 10. 2000 Merlot Juice Analysis, Lodi

Treatment	Malate (ppm)		Potassium (ppm)		Ammonia (ppm)	
2	2050	a	1450	a	100.3	a
3	1706	c	1513	a	105.8	a
4	1863	b	1563	a	107.0	a
7	1613	cd	1313	b	61.8	b
8	1331	f	1263	bc	104.8	a
9	1481	de	1263	bc	83.8	ab
10	1388	ef	1175	c	60.5	b
P =	0.0000		0.0000		0.0110	

Common letters among means within columns denote no significant different at $P \leq 5\%$ using Duncan's mean separation.

Wine Analysis

Table 11. 2000 Merlot Wine Analysis, Lodi

Treatment	Alcohol % v/v	Titratable Acid g/l	pH	Volatile Acidity	Phenols Abs.280	Yellow Abs. 420	Red Abs. 520	Abs. 620	Hue 420/520	Intensity 420+520
2	13.7	4.5	4.10	0.62	41.3	2.86	2.71	0.90	1.055	5.57
3	13.1	4.6	3.99	0.57	44.6	2.97	2.96	0.83	1.003	5.93
4	13.2	4.6	4.04	0.56	46.0	2.54	2.48	0.75	1.024	5.02
7	14.3	5.1	3.88	0.59	44.3	2.61	2.80	0.74	0.932	5.41
8	14.7	5.2	3.79	0.63	45.1	3.13	3.49	1.05	0.897	6.62
9	14.7	4.9	3.82	0.58	46.6	3.24	3.67	0.99	0.883	6.91
10	14.8	5.7	3.86	0.59	50.7	2.56	2.99	0.66	0.856	5.55

The full irrigation and the moderate water stress Treatments 2 through 4 (–13/60%) had the highest pH, averaging 4.04 (Table 11). The most severe threshold (–15) Treatments 8 and 9 were the lowest, averaging 3.81. The cover crop treatment (T10) also reported a lower pH of 3.86 when compared to its like non-cover Treatment 3 at 3.99. Color intensity (420+520nm) of the full and moderate deficit treatments (2 – 4) averaged 5.51 while the treatments with the –15 bar threshold (8 and 9) averaged 6.77. These results indicate a greater treatment effect on color intensity and pH results from the –15 bar threshold than the –13 bar threshold. The 35 RDI percent post-threshold slightly improved pH and color intensity over the 60 RDI percent (T7 vs. T3 and T8 vs. T9). The cover crop improved the pH but not the color intensity. Titratable acidity was improved with the more severe (-15) threshold and cover crop treatments.

Wine Evaluation

A panel of 20 experienced tasters ranked the wines. When the different irrigation regimes were compared, the two high (-15 bars) threshold treatments were significantly preferred, whereas the full irrigation and the lowest threshold treatments (-13/60%) were least preferred ($p<0.05$). Table 12 shows the total points and ranks for each of the wines. The tasting results follow closely the juice analysis quality parameters indicating the juice analysis is a good indicator of wine quality. The cover crop treatments (T10) compared favorably with the more severe threshold wines. This was not the case in 1999 when the cover crop wine was the lowest ranked wine. The tannin concentration of the cover crop wine was significantly less in 2000 leading to a more approachable young wine and they're for a more competitive wine in the tasting.

Table 12. 2000 Merlot Wine Preference, Lodi

Treatment No	Treatment	Total Points	Rank
2	Full	65	7 c
3	-13/60%	45	5 b
4	-13/60%	48	6 b
7	-13/35%	44	4 b
8	-15/35%	38	2 a
9	-15/60%	35	1 a
10	-13/60%	39	3 a

Ranks with the same letter not significantly different ($p<0.05$)

SUMMARY

This study is being conducted to evaluate an approach to vine water management that will provide growers the a method to know when to begin to irrigate, when to schedule subsequent irrigations, and how much water to apply each time they irrigate. This research project utilizes measurements of midday leaf water potential (LWP) as a trigger to determine when to begin supplying irrigation water. After a threshold LWP has triggered the start of the irrigation season, water is supplied at a fraction (RDI %) of full vine water use. It is our goal to use water management, defined as the timing and quantity of applied water, to impose vine water deficits as a means of producing desirable must and wine characteristics.

The experimental site is located in a mature Merlot vineyard near Lodi, California. The trellis system is a bilateral cordon and established on Freedom rootstock.

The 2000 season was similar to the 1999 season was characterized by a relatively dry spring and cool summer. Due to lack of spring rain, irrigation was started approximately one month earlier in the full water treatment than in 1998. Leaf water potential averaged near –10 for the period May through September in the full water treatment (T1). Leaf water potential thresholds were reached for the –13 bar treatments on 6/22/99 while the –15 bar treatments were delayed by four weeks to 7/20/99. The RDI 60% levels maintained or reduced the water deficits towards harvest while the RDI 35 % resulted in deficits increasing up to harvest.

Significant differences in vine yield were found between irrigation strategies but not between pruning level or cover crop treatments. The average of the full water treatment (T2) at 38.0 pounds/vine was more than all other treatments but not significant from the cover crop (T10) at 36.4 pounds/vine. It should be noted that the cover crop treatment had a significantly higher yield than the comparable irrigation strategy Treatment 3. The least cluster numbers were found on the reduced spur treatment (T4); however it was not significant from many of the other treatments. The full water did not have a higher cluster number. This may indicate merlot does not have the capacity to produce increased clusters as a response to additional irrigation water as does cabernet sauvignon. Yield differences were found to be a result of both fruit load (berries per vine) and berry weight.

Juice pH varied between treatments from 3.48 to 3.63. The highest pH juice was from the reduced spur Treatment 4. A group with a juice pH between 3.48 and 3.52 includes Treatments 7, 8, and 9. These treatments represent either a more severe threshold or RDI. Juice malate concentration was similar to past years with the full water treatment significantly higher than all other treatments. Malate concentration was lowest in the more severe threshold (–15 bars) and cover crop treatments (T8, T9, and T10) averaging 1234 ppm.

Titratable acidity varied greatly between treatments. The full water and moderate deficit treatments (–13/60%) were highest while the more severe threshold (T8 and T9), more severe RDI (T7), and cover crop treatments were in the lowest group averaging 4.4g/L. The treatments, which were highest in malic acid, were also highest in titratable acidity.

A panel of 20 experienced tasters ranked the wines. When the different irrigation regimes were compared, the two high (–15 bars) threshold treatments were significantly preferred, whereas the full irrigation and the lowest threshold treatments (–13/60%) were least preferred ($p<0.05$). Table 12 shows the total points and ranks for each of the wines. The tasting results follow closely the juice analysis quality parameters indicating the juice analysis is a good indicator of wine quality. The cover crop treatments (T10) compared favorably with the more severe threshold wines. This was not the case in 1999 when the cover crop wine was the lowest ranked wine. The tannin concentration of the cover crop wine was significantly less in 2000 leading to an a more approachable young wine and there for a more competitive wine in the tasting.

The results of this and past years in this trial indicate the approach of using leaf water potential as a trigger to begin irrigation and to use portions of full water ET to schedule subsequent application volumes is an effective and reliable method of irrigation scheduling that takes into account quality and yield parameters.

Lodi Woodbridge Winegrape Commission
2000 Executive Summary

PROJECT TITLE: **Management of Merlot to Modify Vine and Wine Characteristics**

PROJECT PERSONNEL:

Principle Investigator:
Terry L. Prichard, Water Management Specialist
Dept. of LAWR, Hydrologic Science
University of California, Davis
(209) 468-2085

Co-Investigators:
Paul S. Verdegaal, University of California Farm Advisor, San Joaquin County
Dan Rivers, Postgraduate Researcher, Dept LAWR, UC Davis
Bibiana Guerra and Julie Alderman, Woodbridge Winery, Lodi
Kay Bogart, Sebastiani Winery, Sonoma

Cooperators:
Ron Slate Vineyard, Lodi, California
Rick Grenz, Vineyard Manager

Involvement of Investigators:

T. Prichard (20% of time). Coordinate project activities. Direct Staff Research Associate and Post Graduate Researcher activities in collection of data, analysis of data and preparation of reports.
D. Rivers (100% of time). Perform field operations. Collect, and reduce data. Assist in report preparation.
P. Verdegaal (10% of time). Direct viticultural operations. Plan and supervise collection of vine physiological data.
B. Guerra, J. Alderman, K. Bogart (5% of time). Crush fruit; provide chemical and organoleptic wine analysis.

This study is being conducted to evaluate an approach to vine water management that will provide growers the a method to know when to begin to irrigate, when to schedule subsequent irrigations, and how much water to apply each time they irrigate. This research project utilizes measurements of midday leaf water potential (LWP) as a trigger to determine when to begin supplying irrigation water. After a threshold LWP has triggered the start of the irrigation season, water is supplied at a fraction (RDI %) of full vine water use. It is our goal to use water management, defined as the timing and quantity of applied water, to impose vine water deficits as a means of producing desirable must and wine characteristics.

The experimental site is located in a mature Merlot vineyard near Lodi, California. The trellis system is a bilateral cordon and established on Freedom rootstock.

The 2000 season was similar to the 1999 season was characterized by a relatively dry spring and cool summer. Due to lack of spring rain, irrigation was started approximately one month earlier in the full water treatment than in 1998. Leaf water potential averaged near -10 for the period May through September in the full water treatment (T1). Leaf water potential thresholds were reached for the –13 bar treatments on 6/22/99 while the –15 bar treatments were delayed by four weeks to 7/20/99. The RDI 60% levels maintained or reduced the water deficits towards harvest while the RDI 35 % resulted in deficits increasing up to harvest.

Significant differences in vine yield were found between irrigation strategies but not between pruning level or cover crop treatments. The average of the full water treatment (T2) at 38.0 pounds/vine was more than all other treatments but not significant from the cover crop(T10) at 36.4pounds/vine It should be noted that the cover crop treatment had a significantly higher yield than the comparable irrigation strategy treatment 3. The least cluster numbers were found on the reduced spur treatment (T4) however it was not significant from many of the other treatments. The full water did not have a higher cluster number. This may indicate merlot does not have the capacity to produce increased clusters as a response to additional irrigation water as does cabernet sauvignon. Yield differences were found to be a result of both fruit load (berries per vine) and berry weight.

Juice pH varied between treatments from 3.48 to 3.63. The highest pH juice was from the reduced spur treatment 4. A group with a juice pH between 3.48 and 3.52 includes Treatments 7, 8, and 9. These treatments represent either a more severe threshold or RDI. Juice malate concentration was similar to past years with the full water treatment significantly higher than all other treatments. Malate concentration was lowest in the more severe threshold (-15 bars) and cover crop treatments (T8, T9, and T10) averaging 1234 ppm.

Titratable acidity varied greatly between treatments. The full water and moderate deficit treatments (-13/60%) were highest while the more severe threshold (T8 and T9), more severe RDI (T7), and cover crop treatments were in the lowest group averaging 4.4g/L. The treatments, which were highest in malic acid were also highest in titratable acidity.

A panel of 20 experienced tasters ranked the wines. When the different irrigation regimes were compared, the two high (-15 bars) threshold treatments were significantly preferred, whereas the full irrigation and the lowest threshold treatments (-13/60%) were least preferred ($p<0.05$). Table 12 shows the total points and ranks for each of the wines. The tasting results follow closely the juice analysis quality parameters indicating the juice analysis is a good indicator of wine quality. The cover crop treatments (T10) compared favorably with the more severe threshold wines. This was not the case in 1999 when the cover crop wine was the lowest ranked wine. The tannin concentration of the cover crop wine was significantly less in 2000 leading to an a more approachable young wine and there for a more competitive wine in the tasting.

The results of this and past years in this trial indicate the approach of using leaf water potential as a trigger to begin irrigation and to use portions of full water ET to schedule subsequent application volumes is an effective and reliable method of irrigation scheduling that takes into account quality and yield parameters.