Coastal San Luis Resource Conservation District
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IRRIGATION SYSTEM EVALUATION

For
Grower

DATE

EVALUATOR

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EVALUATION SUMMARY

CLIENT DATA

CLIENT	
ADDRESS	
PHONE	
EVALUATION DATE	

FIELD DATA (Field 1 KCV)

CROP	VINEYARD
ACREAGE	15
SOIL TYPE	LINNE-CALDO COMPLEX (Clay Loam)
ROOT ZONE DEPTH	6 feet
TOPOGRAPHY	Rolling 10%- 30% slopes

FIELD DATA (Field 2 BD)

CROP	VINEYARD
ACREAGE	10.5
SOIL TYPE	LINNE-CALDO COMPLEX (Clay Loam)
ROOT ZONE DEPTH	6 feet
TOPOGRAPHY	Rolling 10%- 30% slopes

SYSTEM DATA (Field 1 KCV)

MAINLINE	2.5 inch PVC
EMITTER	0.5 gph Netafim Woodpecker
FLOW METER	Yes (broken)
WATER SOURCE	Well
PRESSURE REGULATION	PR at each manifold
DISTRIBUTION UNIFORMITY (D.U.)	0.83 – Lower than average
APPLICATION EFFICIENCY (A.E.) (ESTIMATED)	98.7 % - under irrigated at peak demand

SYSTEM DATA (Field 2 BD)

MAINLINE	3 inch PVC
EMITTER	0.5 gph Netafim Woodpecker
FLOW METER	Yes (Seagate)
WATER SOURCE	Well
PRESSURE REGULATION	PR at each manifold
DISTRIBUTION UNIFORMITY (D.U.)	0.83 – Lower than average
APPLICATION EFFICIENCY (A.E.) (ESTIMATED)	97.9 % - Under irrigated at peak demand

OBSERVATIONS AND RECOMMENDATIONS

Low Pressure in portions of the field – May be th

High Pressure in portions of the field – Likely the

High pressure loss at filter (KCV) – May be

Scheduling – Set time

INTRODUCTION

the

PURPOSE

The purpose of this evaluation is to assess the DU and AE of the system in order to recommend system and scheduling improvements. The goal is to find ways to improve DU and AE by improving scheduling and system performance to reduce over-irrigation and improve water quality.

FIELD INFORMATION

the

SYSTEM INFORMATION

KCV

SCHEDULING INFORMATION

the

ANALYSIS

An

DISTRIBUTION UNIFORMITY

DU was calculated using the Irrigation Training and Research Center (ITRC) methodology. Emitter flow rate measurements and pressure measurements were taken throughout each field to determine DU. See Appendix I for location of flow measurements and pressures. See appendix III for detailed DU analysis. The calculated DU for each Management Unit is shown below:

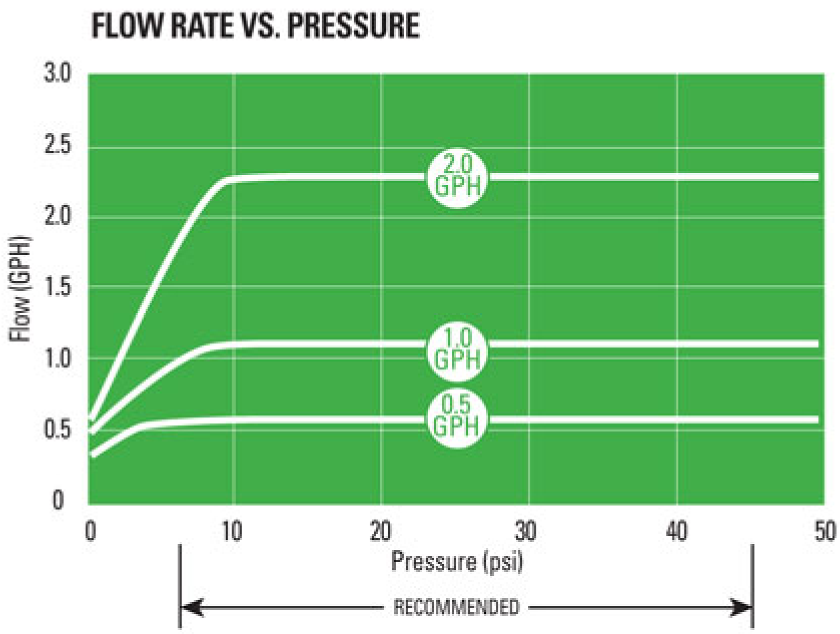
DU for KCV = 0.83

DU for BD = 0.83

As noted above, DU for the Management Unit considers pressure and flow variation throughout the entire field. DU for each individual block is likely in the range of 0.9 to 0.95 because the pressure and flow variations within each block are lower than the variations over the entire field.

The primary cause of non-uniformity in the system is pressure variation. These variations result in flow rate variations when the pressure range is outside of the pressure compensating range of the emitters. The majority of the pressures in the field were within the optimal pressure range for the Netafim Woodpecker emitters. However, some pressures were found to be outside the effective pressure compensating range resulting in non-uniform water distribution (see Appendix I for more information). Figure 1 below shows the optimal pressure range for these emitters according to the manufacturer. Keeping the pressures in the field well within the optimal range will improve system DU.

Figure 1. Pressure Compensation Range



APPLICATION EFFICIENCY

Application Efficiency was evaluated for each management unit for irrigation events occurring during the vegetative growth stage prior to fruiting. AE for the fruit production stage is assumed to be 100% because the vines are under irrigated. In this phase nearly all of the water applied contributed to the irrigation target.

Application Efficiency for each management unit was estimated based on available flow rate data. The Flow rate for KCV was assumed to be 35 gpm based on historical information. The flow rate for BD was 33 gpm according to the flow meter. In both fields the amount of water applied closely matches the irrigation target indicating a high AE value. This may indicate under irrigation at peak crop demand. The AE calculations are presented below.

Application Efficiency

Producer:	Hofer	Field:	BD	Date:	5/22/2012

Amount of water typically applied during Peak ET

AE =	Average depth to target	=	0.240	inches
	Average depth applied		0.243	inches

AE = **98.7% inches ***

* High AE indicates under irrigation at Peak Demand

Application Efficiency

Producer: Hofer Field: BD Date: 5/22/2012

Amount of water typically applied during Peak ET

AE =	Average depth to target	=	0.318	inches
	Average depth applied		0.325	inches

AE = **97.9% inches ***

* High AE indicates under irrigation at Peak Demand

SCHEDULING

Mr. Hofer uses sophisticated tools to schedule irrigation events. He monitors soil moisture tension and leaf pore pressure to determine how much water to apply. The following scheduling evaluations indicate that he may be under irrigating during peak demand. Under irrigation is desirable during fruit production, but may not be desirable prior to fruit production.

Micro Scheduling Check

Producer: Hofer   Field: BD   Date: 5/22/2012

Amount of water typically applied during Peak ET

Inches = $\frac{96.3 \times Q\ (gpm) \times \text{Set time}}{\text{Area (SQFT)}}$

Q = 33 gpm *
Set Time = 7 hours**
Area = 2.1 Acres *****

Inches = **0.243 inches**

Estimate of crop water use between irrigations during Peak ET

Inches = ET x Days between irrigations

Days = 2 days
Peak ET = 0.12 inches / day***

Inches = **0.240 inches**

Application currently meets Peak Crop ET demand without adjustment for DU. To ensure all vines receive adequate water prior to fruiting, set time should be adjusted to account for DU.

Irrigation Target adjusted for DU

Inches = $\frac{\text{Peak Crop Demand}}{\text{DU}}$

DU = 0.83 ****
Demand = 0.24 inches

Inches = $\frac{0.24}{0.83}$ = **0.289 inches**

Set time adjusted to account for DU

Hours = $\frac{\text{Irrigation Target} \times \text{Area}}{96.3 \times Q\ (gpm)}$

IT = 0.29 inches
Area = 2.1 Acres *****
Q = 33 gpm *

Hours = $\frac{26450.89157}{3177.9}$ = **8.32 hours**

*	Estimated flow rate based on records taken before flow meter stopped working
**	Set time per block
***	Peak daily ET assuming 60% canopy
****	DU for entire field. DU for individual block may be higher.
*****	Area per block (average) 10.5 ac / 5 blocks

Micro Scheduling Check

Producer: Hofer   Field: KCV   Date: 5/22/2012

Amount of water typically applied during Peak ET

Inches = $\frac{96.3 \times Q\ (gpm) \times Set\ time}{Area\ (SQFT)}$

Q =	35	gpm *
Set Time =	7	hours**
Area =	1.6667	Acres *****

Inches = **0.325 inches**

Estimate of crop water use between irrigations during Peak ET

Inches = ET x Days between irrigations

Days =	2.65	days
Peak ET =	0.12	inches / day***

Inches = **0.318 inches**

Application currently meets Peak Crop ET demand without adjustment for DU. To ensure all vines receive adequate water prior to fruiting, set time should be adjusted to account for DU.

Irrigation Target adjusted for DU

Inches = $\frac{Peak\ Crop\ Demand}{DU}$

DU =	0.83	****
Demand =	0.32	inches

Inches = $\frac{0.32}{0.83}$ = **0.383 inches**

Set time adjusted to account for DU

Hours = $\frac{Irrigation\ Target \times Area}{96.3 \times Q\ (gpm)}$

IT =	0.38	inches
Area =	1.6667	Acres *****
Q =	35	gpm *

Hours = $\frac{27815.978}{3370.5}$ = **8.25 hours**

*	Estimated flow rate based on records taken before flow meter stopped working
**	Set time per block
***	Peak daily ET assuming 60% canopy
****	DU for entire field. DU for individual block may be higher.
*****	Area per block (average) 15 AC / 9 blocks

Water destination diagrams are used to show the portion of the field that is over irrigated or under irrigated. In these fields, the irrigation target closely matched the irrigation applied. This results in 50% of the field being over irrigated and 50% of the field being under irrigated. Improving the overall DU will result in more uniform water application and reduce the amount of over, or under irrigation. By adjusting the irrigation target to account for DU, the amount of under irrigation will be reduced resulting in 87.5% of the field being over irrigated, which may be desirable prior to fruiting. This is accomplished by increasing the set time to apply more water. The adjusted irrigation target is determined by dividing the amount of water the crop consumes by the DU.

$$\text{Adjusted Irrigation Target} = \frac{\text{Desired Depth Applied}}{\text{DU}}$$

The following Water destination diagrams show the amount of the field that is currently over and under irrigated.

Figure 2. Water Destination Diagram (KCV)

Figure 3. Water Destination Diagram (BD)

RECOMMENDATIONS

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Distribution Uniformity

DU for this system is lower than expected. The major cause of non-uniformity in this system is pressure variation. The lower than expected DU is partially related to the evaluation of the entire Management Unit rather than each irrigated block. However, significant pressure variations were found in the field. These variations result in flow rate variations when the pressure range is outside of the pressure compensating range of the emitters.

1. Low pressure – Areas of low pressure were found in the field (see Appendix I). These may be caused by the following:
    a. Inadequate system pressure caused by excessive loss at the filter. Recommend increasing backflush frequency and maintain filter.
    b. Faulty Pressure regulation valves. Recommend maintaining, adjusting or replacing faulty regulators.
    c. Plugging in the lines. Recommend main line and manifold flushing.
    d. Leaks. Recommend checking for and repairing any sub-surface leaks.
2. High Pressure – Areas of high pressure were found in the field. This can be caused by a faulty pressure regulator. Recommend adjusting or replacing the pressure regulator. See Appendix I for approximate location.

Non-uniformity can also be contributed to unequal drainage. This occurs when some emitters run longer than others when as the line drains. This is a minor cause in this system and is unavoidable due to the topography. The best way to reduce the effects of unequal drainage is to decrease the irrigation frequency and increase the set time. This is not recommended for this system because it may result in too much stress on the crop.

Scheduling

DEFINITIONS

Application Efficiency (AE)– The ratio of the average depth of irrigation water infiltrated and stored in the root zone to the average depth of irrigation water applied, expressed as a percent. AE is typically used to describe the performance of a single irrigation event.

Available Water Holding Capacity (AWHC) – Amount of water that a soil can hold in its root zone.

Beneficial Use – The amount of water that contributes to crop production including the leaching fraction.

CIMIS – California Irrigation Information Management System.

Deep Percolation - Infiltrated irrigation water that moves below the plant root zone. This is non-beneficial leaching.

Distribution Uniformity (DU) - A measure of how uniformly water is applied to the area being watered, expressed as a decimal. The higher the DU, the better the performance of the system.

DU Low Quarter (DUlq) - Average of the lowest quarter of samples, divided by the average of all samples.

Evapotranspriation (ET) - term used to describe the sum of evaporation and plant transpiration from the Earth's land surface to atmosphere. The amount of water removed from the soil by plant the plant or evaporation.

GPM – Gallons per Minute

Irrigation Target – Amount of water required to be applied to the field in order to replenish water used by the crop.

Leaching Fraction - The fraction of infiltrated irrigation water that percolates below the plant root zone for the purpose of mitigating soil salinity.

PSI – Pressure measurement in Pounds per Square Inch

Set Time – Length of time an irrigation system is run for a single irrigation event.

Soil Moisture Depletion (SMD) – The amount of water removed from the soil by the crop that needs to be replenished by irrigation.

Unequal Drainage – unequal distribution of water created when irrigation lines drain out unevenly. Typically caused by uneven topography.

APPENDIX I: MAP

APPENDIX II: SOILS INFORMATION

APPENDIX III: DISTRIBUTION UNIFORMITY RESULTS