Irrigation System Evaluation Report

[redacted]

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May 2024

Sponsored by:

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Summary Information

Date:	May 13, 2024
Contact:	[redacted]
Evaluators:	Lauren Danna, Hailey Leurck
Location:	Paso Robles
Planted Area:	[redacted]
Crop:	Vineyard
Irrigation Type:	Pressure Compensating On-line Drip Emitters

Site tested:	Vineyard Block H03
Overall Distribution Uniformity:	**0.82 – Good**
Nominal Emitter Flow Rate:	0.50-gph
Average Field Emitter Flow Rate:	0.52-gph

I. Introduction

The Upper Salinas-Las Tablas Resource Conservation District (US-LT RCD) conducts Irrigation System Evaluations through the Mobile Irrigation Lab (MIL) program which was developed by Cal Poly's Irrigation Training and Research Center. This evaluation calculates the irrigation efficiency of an existing irrigation system to provide suggestions for improvements to the system.

II. Description of Site and Irrigation System

[redacted] is located at [redacted] and consists of approximately [redacted] acres of wine grapes. According to the United States Department of Agriculture's (USDA) Web Soil Survey, soils at the block evaluated are in both Gazos Shaly Clay loam, 9 to 30 percent slopes and Gazos Shaly Clay loam, 30 to 50 percent slopes (Attachment 2). In both Gazos Shaly Clay areas, soil texture is typically channery clay loam to unweathered bedrock. Parent material is residuum weathered from shale.

Groundwater pumped from 3 different wells located within the property supplies water to the upper and lower ponds on site where water is then delivered to the irrigation system through the main, sub-mains and lateral lines. Water from the well is filtered through a series of screen and sand media filters at the pump station (Photo 2). A booster then pushes the water from the pump station to it's irrigation system location and specifically, flow meter (Photo 3). Fertilizer is incorporated into the irrigation system downstream of the filter during the spring and as needed throughout post-harvest. Netafim pressure compensating drip emitters with nominal flow rates of 0.5-gph are used throughout the vineyard. Each plant has one designated emitter.

III. Irrigation Evaluation

a. Distribution Uniformity Evaluation

Application and discharge uniformity of the drip system was evaluated at three locations in Block H35 (Attachment 1). The emission rate of 16 individual emitters was measured at each location (Attachment 3). The distribution uniformity (DU) in Block H35 was 0.82 – considered good for drip systems (Table 1). The average discharge rate calculated in the block evaluated was in line with the 0.5-gph nominal flow rate at 0.52-gph.

Table 1. Uniformity and Flow Characteristics of the System

DU Area	DU	Emitter Discharge Rate	Pressure
		(gal/hr)	(psi)
A	0.88	0.48	72
B	0.89	0.59	49
C	0.85	0.49	68
Overall	0.82	0.52	

DU = Distribution uniformity

b. System Design and Operation Evaluation

Pressure was evaluated at the head and tail end of several laterals (Attachment 3). The pressure readings were affected by elevation changes. Unequal drainage occurs when some emitters at low elevations may continue to drain for an additional amount of time after the irrigation is turned off. This is particularly important on sloping ground since it may cause some areas of the field to be over-watered, reducing the overall DU of the vineyard. Pressure was above the recommended range for Netafim emitters at areas A and C. Area B was on the cusp at a PSI of 49 (Attachment 5). The utilization of pressure compensating emitters should reduce the variability associated with changes in topography.

There were a few leaks noted in the field. Small leaks identified in rows evaluated were flagged with orange flagging tape on the vineyard trellis. Evaluators noted many emitters installed with incorrect orientation, pointing out to the sides rather than directly down (Photo 6). Spacing of emitters was uneven throughout the block. Uneven spacing can significantly reduce overall DU. Most vines appeared to have one designated emitter, however the placement of the emitter in respect to the vine varied (see emitter placements in Photo 7 & 8). The proper orientation of emitters is essential in an operation with sloping topography as water ejected from the emitters will travel along the lateral lines causing irregular irrigation distribution.

c. Maintenance

Leaks: There were many small leaks identified throughout the lateral lines; mainly leaking emitters observed throughout the block.

Sediment: Rows 46 and 87 were flushed to determine if material is present in the system. No amount of sediment was observed in Row 46 results (Photo 4). Row 87 flush resulted in a decent amount of sediment (Photo 5). The water and sediment flushed in Row 87 had a scent, possibly from animal waste in the pond.

Sagging lines/orientation of emitters: Adjust lateral lines that are sagging to improve orientation of emitters (Photo 7). Adjust emitter orientation to be fixed in the down-facing direction.

IV. Recommended System Improvements

The overall DU for [redacted] is good. However, the following are several recommendations that, if implemented, will improve water management in the vineyard:

1. Survey lateral lines during irrigation events for leaks and tighten, reconnect, or replace faulty equipment throughout the block.
2. Continue to flush irrigation lines regularly to avoid sediment buildup and potential plugging of emitters. Consider treating irrigation water with chemicals/organic nutrients.
3. Adjust sagging lateral lines.
4. Adjust emitter orientation so all emitters are facing down
5. Remove hose screen washers from the risers (if installed) to gain more consistency in pressures throughout the block.
6. Consider reducing the water pressure supplied to lateral lines.
7. Adjust uneven spacing of emitters.

V. Implementation

1. For additional information, please contact Lauren Danna at the US-LT RCD 805-460-7272 x3 or lauren@us-ltrcd.org
2. For additional agricultural engineering recommendations and potential implementation assistance for conservation practices, contact Hilary Phillips, District Conservationist of the Natural Resources Conservation Service (NRCS) at the USDA Templeton Service Center; 805-536-3174 or hilary.phillips@usda.gov.

VI. Glossary of Concepts and Terminology

a. Irrigation Efficiency

Irrigation efficiency (IE) is the amount of water that is used to grow a crop compared as a ratio to the total amount of water applied:

$$IE = \frac{Amount\ of\ \ water\ used\ \ for\ crop\ \ production}{Total\ water\ applied}$$

An irrigation efficiency greater than 0.9 or 90% is considered high, and an IE of less than 0.6 or 60% is considered low. An IE of 0.6 would mean that 60% of the applied water is used in the production of the crop, and that 40% of the applied water is lost to evaporation, deep percolation and run-off. In most cases deep percolation and run-off represent a majority of these losses. The objective this evaluation was to help the farmer to attain an IE of 80% or higher.

The main factors that influence irrigation efficiency are: 1. distribution uniformity, 2. irrigation scheduling, 3. maintenance and management, and 4. soil variability. Addressing any or all of these factors can lead to a more efficient use of water, but it is important to consider which of these factors most influences IE and which can be addressed most affordably. For example, though converting from a sprinkler to a drip system can be a costly but effective strategy to improve distribution uniformity, improving the maintenance and operation of a sprinkler system might also provide as much improvement in irrigation efficiency as switching to drip for much less cost.

b. Incorporating DU results into an irrigation schedule

A well designed and maintained irrigation system will uniformly distribute water to a crop. Furrow, sprinkler, and drip systems can be designed and operated to maximize distribution uniformity (DU), but often poor management or design limitations reduce the uniformity of these systems. The DU of a system is often evaluated by measuring the application rate at 20 or more locations in a field. Data points are used to calculate the distribution uniformity of the lowest quarter (DU_{lq}), which is the average application rate of the lowest 25% of the measurements divided by the average of all the application rates measured:

$$DU_{lq} = \frac{\textit{average of lowest } 25\% \textit{ of application rates measured}}{\textit{average of all application rates measured}}$$

Much like irrigation efficiency, a high DU_{lq} (>0.9) indicates that a system has a high distribution uniformity. As DU becomes higher (approaching 1.0) the irrigation requirement is lower:

Irrigation requirement = Crop ET/DU

In other words, systems with a high DU, need less water to assure that all areas of a field receive the desired amount of water. If crop ET is 2 inches and the DU of a system is 0.80, then to assure that 2 inches of water is applied to the driest area of a field, 2.5 inches must be applied:

2.5 = 2 inches/0.8

By improving the DU from 0.80 to 0.90, 2.2 inches are needed to assure that 2 inches of water are applied to the driest quarter of the field, a 15% savings in applied water. The improvement in uniformity will also minimize over-irrigating other areas of the field, reducing the risk of water logging the crop, and reduce the power usage by the pump

Attachment 1 – Field Map

Attachment 2 – Soil Map (Web Soil Survey)

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
144	Gazos shaly clay loam, 9 to 30 percent slopes	0.0	0.0%
145	Gazos shaly clay loam, 30 to 50 percent slopes	4.7	100.0%
Totals for Area of Interest		**4.7**	**100.0%**

Attachment 3 – Field Data

	Location A: Block: 35 Row: 10	**Location B: Block: 35 Row: 46**	**Location C: Block:35 Row: 87**
Pressure Readings			
Head of Line (psi):	72	49	68
Tail of Line (psi):	76	78	60
Catch Can Readings			
Collection Time (min):	5	5	5
Hose pressure at Emitters (psi):	72	49	68
Collected Volume (mL):			
1	145	175	160
2	150	235	135
3	195	200	135
4	160	170	150
5	140	190	150
6	135	165	150
7	185	210	165
8	135	190	130
9	135	160	140
10	150	180	130
11	180	175	155
12	150	205	180
13	135	200	190
14	135	175	200
15	130	175	155
16	170	165	155

Attachment 4 – Photographs

Photo 1. Pond connected to Pump house that feeds irrigation system.

Photo 2. Pump house, booster pump, and filter system.

Photo 3. Flow meter at block.

Photo 4. Line flush results from line 46.

Photo 5. Line flush results from line 87.

Photo 6. Poor emitter orientation.

Photo 7. Sagging lateral lines.

Photo 8. Inconsistent emitter spacing and placement.

Attachment 5 - Netafim Emitter Specifications