HOW TO CONDUCT AN IRRIGATION UNIFORMITY FIELD TEST

Vineyard water management is one of the most important factors affecting winegrape quality. Beyond the critical question of when to irrigate, the other key factor is deciding how much water to apply. A grower must know the vine water requirements between irrigations and the irrigation system's current performance to know how much water is actually getting to the vines. This handout provides a brief overview of how to perform an irrigation uniformity field test to determine how evenly water is being applied to the vines.

HOW EVENLY IS WATER APPLIED TO YOUR VINEYARD?
Ideally, each vine should receive exactly the same amount of irrigation water over the same period of time, but growers cannot rely on the manufacturer's data specification sheets to determine the drip system's rate of application. As the irrigation system ages, partial plugging of emitters by silt and clay, algae or chemical precipitates, and/or pressure losses or variations from equipment, cause the irrigation system to deliver different amounts of water throughout the irrigation block. As a result, growers can over-water some vines in order to satisfy the water needs of the vines in the areas where the system is not operating efficiently. This can result in wasted water via deep percolation and wasted energy and fertilizer, which may cause pollution of the groundwater. Alternatively, some vines may be under-watered, potentially impacting winegrape quality and quantity and resulting in uneven fruit ripening.

WHAT IS DISTRIBUTION UNIFORMITY?
Distribution Uniformity (DU) is a measure of how evenly irrigation water is applied across a field. The Application Rate is the average amount of water that is delivered to the vineyard block or individual vine over a period of time (acre-inches per hour or gallons per hour per vine). A DU field test can identify if there are any problem areas in the irrigation system that need to be addressed to optimize overall irrigation efficiency and achieve the desired application rate. DU field tests should be done regularly, just as winegrowers regularly measure, record and calibrate sprayers, Brix levels and uniformity, and conduct tissue, soil and water analysis, etc. DU field tests are simple and can be accomplished by vineyard workers that are given an understanding of the objectives and process for performing the field tests.

WHAT ARE THE RISKS OF A LOW DU VALUE?
The goal for is for the drip irrigation system to have a DU of 95% or better. Drip irrigation systems operating with DUs between 85% to 95% are acceptable, 75% to 85% should be improved; and below 75% need to be improved. To illustrate the problem with a low DU value, for a vineyard that applies about four (4) acre-inches of irrigation water annually, but has a 70% DU, the amount that the end of season differences between the high and low quarter portions of the vineyard is alarming: 5.2 acre-inches applied to the high quarter and 2.8 acre-inches to the low quarter - a difference of about 46% in applied water, fertilizer and pesticides.
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PRIOR TO FIELD WORK:

| Obtain a Map of the Block(s): | Obtain a map or an irrigation plan that will be used in the field to record the locations of DU samples. Select 16 or 40 sample sites located throughout the block (consider sample sites similar to those for berry and cluster sampling and where you would expect to find the highest or lowest pressures; i.e. top and bottom of slopes). The Google Maps Earth feature works well for this task. |
| Gather DU Test Equipment: | The basic tools needed are inexpensive and easily obtained and include: a pressure gauge (0-60 PSI, liquid filled) connected to a pitot tube, 100ml graduated cylinder, stop watch/smart phone, hole punch, goof plugs, nylon strainer bags, drip emitters to replace clogged emitters you come across, and field data sheets (available at: www.sustainablewinegrowing.org/docs/DUFIELDDataSheet.xlsx). Optional equipment: clip board/field desk, tape measure. |

IN THE FIELD:

| Measure Vine & Emitter Spacing: | Skip this step if spacing is already known. Otherwise measure and record the spacing on the field data sheet. |
| Measure and Record Line Pressures: | Pressure testing of emitters is performed with a simple pressure gauge fitted with a pitot tube. Near each of your 16 or 40 sample sites, make a hole in the drip hose with the hole punch, insert the pitot tube/pressure gauge into the hole to get the PSI reading, remove the gauge, insert a goof plug, and record pressure on the data sheet. Bring along a handful of identical emitters used in the vineyard to replace any partially or fully clogged emitters if found. |
| Catch, Measure and Record Emitter Flows: | At each of the sample sites, place the graduated cylinder under the emitter, and record the volume of water captured after 30 seconds. |
| Flush Lateral Lines: | Open the ends of a few lateral lines and place the nylon sock over the end of the hose to check for debris in the water. Note whether the debris is soil, algae or other material. Make a visual inspection of submain filters, air/vacuum relief valves, pressure relief valves. |

BACK IN THE OFFICE:

| Review Map for Pressure/Flow Patterns: | With the map in hand, review the line pressures and emitter flow volumes to look for a pattern or localization of high or low values. If a pattern exists, try to determine the cause: field elevation changes, pressure regulator/filter malfunction, blocked riser screens or emitter partial plugging. |
| Calculate the DU Value: | The easiest and recommended method to calculate the DU value is to use the Excel version of the field data sheet. Simply enter your recordings into the excel worksheet and it will automatically calculate the Application Rate (AR) of the emitters in Gallons per Hour (GPH) and Acre- Inches per Hour (Ac-In/Hr), the average of the lowest output emitters (called the Low Quarter - LQ), and the Distribution Uniformity. |

DID YOU KNOW?

There are cost share programs, such as the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP), that provide financial assistance to growers who implement improvements to their irrigation systems. Check with your local NRCS field office to learn more: http://offices.sc.egov.usda.gov/.
Determine if the DU Value is acceptable or if additional work is needed: If the DU value is under 85% then refer to the maintenance information below to help determine what steps can be taken to improve the evenness of irrigation distribution.

CAUSES OF POOR DISTRIBUTION UNIFORMITY AND HOW TO IMPROVE:

If a DU of 85% or less was found, consider the following areas for maintenance and improvements:

- **Emitter clogging**: Partial & complete emitter clogging is one of the main causes of poor DU. Clogging maybe caused by: physical, biological or chemical factors. However, many vineyards now use pressure compensating emitters and pre-set pressure regulating valves on risers that greatly diminishes pressure variations as a cause of low DU.
- **Insufficient maintenance & repairs**: flush, adjust and replace irrigation components.
- **Pressure variations**: systems with non-compensating emitters, poorly designed or installed systems with elevation changes, and insufficient adjustment of pressure regulating valves can all have pressure variations that need to be addressed. (A significant problem in microsprinkler systems.)
- **Other minor causes of poor DU are**: manufacturing variation, unequal drainage, and uneven emitter spacing.

SUMMARY:

DU testing over successive years provides growers with an indication of the irrigation system’s “health”. A high DU value of 90%+ is essential for growers seeking to produce winegrapes of high quality while achieving good water, energy and chemical use efficiencies. Thus, the results of a Distribution Uniformity test provide growers with the essential data necessary to correct non-uniformity problems caused by pressure or clogging problems and to implement precise irrigation scheduling practices that improve their financial bottom line by improving winegrape quality and yield and increasing the efficiencies of water, fertilizer and energy uses and lower expenses.

For more detailed information on Distribution Uniformity, including how to use a calculator (instead of the electronic field data sheet) for determining DU value and additional suggestions for how to improve the efficiency of your drip irrigation system, visit: www.sustainablewinegrowing.org/docs/DUArticle.pdf.

REFERENCES


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