

SURVEY OF WINEGRAPE IRRIGATION PRACTICES IN THE SACRAMENTO-SAN JOAQUIN VALLEY OF CALIFORNIA

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Abstract:

Context and purpose of the study

In California vineyards, irrigation is considered as one of the most important decisions growers will make. Recent research has revealed that decisions of when to begin irrigation and how much water to apply have considerable consequences for final grape quality and hence wine quality. However, it is unclear whether and to what extent the average winegrape grower uses objective data to begin irrigating or to determine the amount of water to apply. We proposed to survey winegrape growers in north-central California and determine to what extent they utilize objective data in their irrigation practices. We wished to learn whether they are aware of irrigation technology and use it, or whether they are aware but have declined for some reason to adopt it.

Materials and methods

We proposed to survey the irrigation practices of winegrape growers in the Lodi-Woodbridge Winegrape District (LLWD), spanning most of San Joaquin County and part of Sacramento County, north-central California. Survey questions were designed to address irrigation practices, estimate water use, and evaluate grower awareness of winegrape water requirements and local climatic and soil conditions. The survey document consisted of 32 questions in four categories: grower demographics; current irrigation systems and practices; guidelines followed when making irrigation decisions; and perceived needs regarding irrigation guidance. One hundred fifty-five growers responded to the survey.

Results

Survey responses indicated significant interest among winegrape growers for more information about water management. Well over half of respondents (64.5%) indicated they would like more information on irrigation, and 74.5% lacked a plan for dealing with severe water restrictions. When asked about their current source(s) of information on irrigation, 66% cited their own experience; one third cited consultants; fewer than 25% consulted viticulturists; and only 6% talked with farm advisors. The vast majority indicated that decisions related to irrigation initiation were based at least in part on visual inspection, often citing past experience. Soil sensors, plant sensors and data from the California Irrigation Management Information System (CIMIS) were accessed by smaller numbers of growers, generally in combination with other approaches. Most respondents were aware of climate change, but only 51% followed research in water conservation. Drip irrigation accounted for 91% of the total area irrigated (over 43,000 acres), and groundwater was cited by 95% of respondents as the source of irrigation water. Most respondents affirmed knowing the application rate and uniformity of their irrigation systems, yet when asked whether they had actually evaluated these parameters, similar numbers replied "yes" and "no". Most growers denied having vineyard blocks with large vigor contrasts, but many stated that they adjust irrigation to deal with vigor variability. When asked to indicate preferred resources for information on grapevine irrigation, 74 (47.7%) selected written materials; 68 (43.8%) chose online materials; and 65 (41.9%) mentioned extension workshops. Going forward, additional surveys will be urgently needed to assess the state of water usage by California winegrape growers given the current situation of severe multi-year droughts.

Keywords: Grapevine, Irrigation, Water usage, Climate change

1. Introduction

In winegrape vineyards, irrigation decisions can have considerable consequences for final grape yield and quality, and ultimately for wine quality. New technologies allow for close monitoring of evapotranspiration (ET), soil water content, and vine water status. ET estimates are generally available on a wide area basis, provided usually by a branch of government. However, technology is affordable enough that growers can obtain soil water content and vine water status on an individual vineyard basis. Private companies also offer services that provide the desired measurements.

However, the availability of technology and the adoption of that technology by growers are two different things. It is unclear whether and to what extent the average winegrape grower uses objective data to begin irrigating or to determine the amount of water to apply. Despite the availability of information, growers may feel more comfortable with their experience and intuition as guidance. The main objection to this traditional method is a belief that growers are pro-active and tend to “do” rather than “not do.” The result is more likely that too much water is being applied, resulting in water waste and excessive vine growth. Research has shown that a too-dense canopy has increased disease pressure and shaded grape clusters, both resulting in lower wine quality and lower economic returns.

For this project, we surveyed winegrape growers to determine the extent to which they utilize objective data in their irrigation practices. We wished to learn whether they are aware of technology and use it, or whether they are aware but have declined for some reason to adopt it. Survey results could serve as the basis for educational efforts aimed at better utilization of water resources and better winegrape quality, both of which would ultimately be of economic benefit to growers.

We used the Lodi-Woodbridge Winegrape District (LLWD) for this study, spanning most of San Joaquin County and part of Sacramento County. This study area has several advantages. First, it is located in the Sacramento-San Joaquin River Delta region, an area where efforts towards water conservation, use efficiency and quality are considered critical. Secondly, LLWD has a wide range of soil types that vary in their depth, water-holding capacity, and depth to water table, and this is likely to influence how growers view and use water. Thirdly, LLWD has a large number of vineyard owners who range from large growers (> 1000 hectares) to small growers (<10 ha). Therefore, we can test whether “large” equates to technical sophistication, and hence whether large growers have an advantage over smaller growers, who may have lower resources available to them. Finally, the LLWD has had an active program, in concert with University of California Extension personnel, for improvement of cultural practices.

The results of this survey will provide the basis for educating growers at future meetings and workshops to improve irrigation practices, not only in the LLWD but throughout California. Education professionals may identify the need for educational aids that assist in understanding irrigation and assist in incorporating those decisions into practice. The survey can also provide for the documentation of water-savings, with the comparison of current (“before”) and future (“after”), an important further documentation of growers’ move to practices under the theme of Sustainable Viticulture.

2. Material and methods

This project was conducted with the assistance of collaborators in the Biological and Agricultural Engineering Department; the Land, Air and Water Resources Department at UC Davis (i.e., Dr. Rick Snyder, LAWR and Dr. M. Delwiche, Ag/Environmental Irrigation); as well as farm advisors and colleagues of UC Cooperative Extension. The survey consisted of a wide mailing to growers in 2012.

The final survey document consisted of 32 questions. Part 1 (8 questions) included questions on grower age, experience, title, county location, and approximate area planted in different grape varieties. Parts 2 (12 questions) and 3 (5 questions) focused on current irrigation systems and practices, as well as on growers' knowledge of water management recommendations. Part 4 (6 questions) probed growers' needs and desires for additional information on water management and irrigation decision-making. The survey document was sent by US mail in 2012 to 800 growers in San Joaquin, Sacramento, Yolo and Solano counties.

Hypothesis: The hypothesis at the core of this project is that current vineyard irrigation practices are too often based on empirical evaluation and untested assumptions, resulting in unnecessary water usage, or over-watering. This practice leads to decreased grape quality and diminished monetary returns for the growers. The survey questions address irrigation practices, estimate water use, and evaluate grower awareness and knowledge about winegrape water requirements and local climatic and soil conditions.

3. Results and discussion

3.1. Respondent Demographics

Survey responses were received from 155 individual growers. Of these, 143 identified as Vineyard Owners, 9 as Managers, 1 as a Viticulturist and 2 as "Other". The majority (n=131) identified as growers only, while 2 participated in "Custom Crush" and 21 stated they also operate a winery. Most (n=134) indicated that they are members of a local wine growers' association. Most respondents gave their age as over 50 years (n=134, 86.5%), with only 21 respondents under age 50 and a single respondent under age 30. Over sixty percent (n=94, 60.6%) had been active in viticulture for more than 25 years, while 11 (7%) reported 10 or fewer years of experience in the field. Most respondents were located in San Joaquin County (n=140). Eleven responses were received from Sacramento County, 1 from Yolo County, and 3 respondents declined to identify a county. Reported vineyard size ranged from <10 acres (n=23) to over 5,000 acres (n=2), with 101 vineyards at or below 100 acres, and an additional 36 between 100 and 500 acres. Chardonnay accounted for the greatest total acreage, followed by Cabernet Sauvignon, Zinfandel and Merlot as the four major grape varieties planted.

3.2. Current Irrigation Systems and Practices

Respondents were asked to report the number of acres irrigated by (1) surface irrigation, (2) sprinklers, (3) low volume (e.g., drip) irrigation, and (4) sub-irrigation (blocking drain tiles to sub water up into the crop rootzone). If growers selected "sprinklers", we then asked whether the sprinklers were used for frost protection, irrigation, both frost protection and irrigation, or cooling. We also asked about the water source for irrigation: water district deliveries, river pumping or another surface water source, or groundwater pumping. We then asked a series of more detailed questions regarding application rate and uniformity of the irrigation system, and to assess methods of controlling vine vigor.

Drip irrigation was by far the most prevalent method, accounting for an estimated 90.9% of the area irrigated (over 43,000 acres). Surface irrigation accounted for 4.5%, followed by sub-irrigation at 3.1%, and sprinklers at 1.5%. The use of sprinklers was reported by 10 growers for approximately 717 acres. Seven of these growers indicated using sprinklers for both frost protection and irrigation; 2 responded that they used sprinklers only for irrigation, and 1 indicated sprinkler use for frost protection only. Regarding the source of irrigation water, most growers stated they used primarily groundwater (n=148), with 19 citing the local water district and 17 citing surface water.

A large majority of respondents (n=120) stated that they knew the application rate of their irrigation system, and a majority (n=94) indicated they also knew the distribution uniformity of their systems. However, when we

asked whether growers had evaluated the water application rate and uniformity of their irrigation systems, responses were almost equally divided: 74 answered "yes" and 68 replied "no", with 12 declining to answer.

Nearly 120 growers (n=119) stated that they also used their drip irrigation system for fertigation. Sixty-eight affirmed practicing regulated deficit irrigation (RDI). Most growers (n=97) denied having vineyard blocks containing large vigor contrasts between vines, but 50 affirmed having vineyard blocks with large vigor contrasts. Interestingly, 111 growers stated that they adjust their irrigation management to deal with vineyard vigor variability; 45 indicated they use "alternate row" cover crop to control vine vigor, and 33 stated they use "every row" cover crop for this purpose.

3.3. What guidelines do growers follow when making irrigation decisions?

We asked respondents to identify their sources of irrigation advice: farm advisors, consultants, viticulturists, equipment companies, and/or their own knowledge and experience, with multiple answers encouraged. We asked about methods used to decide when to initiate irrigation and how much water to apply, including California Irrigation Management Information System (CIMIS) evapotranspiration (ET) data, soil moisture measurements, plant-based measurements, past history, and/or visual evaluation of plants, soil and weather. We also included questions about familiarity with irrigation recommendations published by the Wine Institute and the Lodi Winegrape Commission and asked whether irrigation is a topic the growers discuss with their colleagues during informal and/or professional meetings.

In response to a question regarding their source of irrigation advice (with multiple answers encouraged), most (n=103) indicated they relied on their own knowledge and experience; 46 used a consultant; 23 consulted a viticulturist; 10 consulted farm advisors and 8 referred to equipment companies. Growers indicated that their decision to initiate irrigation was informed by visual inspection (133 responses), by past history (60 responses), or by consulting soil sensors (51 responses); 26 relied on CIMIS and Crop coefficient (Kc) values to estimate crop evapotranspiration; the same number reported performing plant-based measurements such as leaf or stem water potential, sap flow, dendrometer, leaf porometer, plant temperature, and 3 reported using an evaporation station or pan evaporation to estimate crop ET. When asked what information they used to determine how much irrigation to apply, growers most frequently cited visual inspection (131 responses), followed by past experience (110 responses), the use of soil sensors (41 responses), CIMIS ET and Kc values (21 answers) and direct plant-based measurements (20 answers). Ninety-nine were aware of published water management recommendations from either the Code of Sustainable Winegrowing Workbook (the Wine Institute/CAWG) or the Lodi Winegrape Commission ("Lodi Rules"), and 103 participants affirmed often talking about irrigation topics with fellow growers.

3.4. How do growers characterize their current needs regarding irrigation decisions?

Lastly, we asked questions to determine growers' satisfaction with available resources for irrigation and water management, and to gauge their familiarity with recent research developments in water conservation and crop water use. One hundred respondents (64.5%) affirmed wanting more information about grapevine irrigation; 50 (32.2%) stated they were not satisfied with currently available resources. Furthermore, 116 (74.5%) stated they had not yet made plans for water management if their water supply were to be severely restricted. Seventy-nine (50.1%) stated that they follow research developments in water conservation and crop water use, and 128 (82.5%) affirmed awareness of the concept of climate change. When asked to select types of resources they would like to have at their disposal for better information on grapevine irrigation (with multiple responses encouraged), 74 (47.7%) mentioned written materials; 68 (43.8%) mentioned online materials; and 65 (41.9%) mentioned extension workshops.

3.5. Summary

Well over half of respondents indicated that they would like more information about irrigation methods, and at the time of the survey, three-quarters did not have a plan in place for dealing with severe water restrictions. Similar numbers of growers favored written materials, online information and live extension workshops as methods of disseminating information. Interestingly, when asked about their current source(s) of information and advice on irrigation methods, over half cited their own experience, while about one third cited consultants; fewer than 25% consulted viticulturists, and less than 10% talked with farm advisors. The vast majority indicated that their decisions related to irrigation initiation were based at least in part on visual inspection, also citing past experience. Soil sensors, plant sensors and CIMIS data were used by smaller numbers of growers, generally in combination with other approaches. Most respondents were aware of the concept of climate change, but only 79 of 155 said that they follow research developments in water conservation.

At the time of this survey, drip irrigation accounted for 91% of the area irrigated (over 43,000 acres), and groundwater was cited by 95% of respondents as the source of water for irrigation. Most respondents affirmed knowing the application rate and uniformity of their irrigation systems, yet when asked whether they had evaluated these parameters for their irrigation systems, similar numbers replied "yes" and "no". Nearly 120 growers used their drip irrigation system for fertigation. Sixty-eight practiced regulated deficit irrigation (RDI). Most growers denied having vineyard blocks with large vigor contrasts between vines; but many stated that they adjust irrigation to deal with vigor variability. Cover crops were also used by a significant number of growers to manage vigor variability.

4. Conclusions

Responses to this survey indicated a significant level of interest among winegrape growers in the greater Sacramento-San Joaquin area for more information about vineyard water management. Survey responses indicated heavy reliance on personal experience and visual inspection when making decisions about irrigation, with a minority of growers seeking out consultants, viticulturists or farm advisors. A majority of respondents expressed a need for more information about irrigation methods, and most did not yet have a plan in place for dealing with severe water restrictions. Since this survey was first conducted, California has undergone a multi-year drought that has intensified since 2014.

5. Acknowledgments

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6. Literature cited

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