Ensuring the best performance of sensor-driven irrigation systems in vineyards

openaccessgovernment.org/article/ensuring-the-best-performance-of-sensor-driven-irrigation-systems-in-vineyards/174685/

Professor Pete W. Jacoby, from Washington State University, explains how to ensure the best performance of sensor-driven irrigation systems in vineyards

Over the past year, our team has published several articles [1,2,3] in Open Access Government reporting on the use of new and emerging technologies to enhance irrigation to address challenges of warming climatic conditions in winegrape growing regions of the world.

Combining novel forms of subsurface drip irrigation with sensor-driven irrigation scheduling is one system that can achieve overall crop water productivity. However, successful employment of these systems begins with proper installation to minimize interference with routine management practices. This paper addresses some issues that may arise for growers or researchers.

Dealing with existing infrastructure, including irrigation systems, plantings, vineyard maintenance and management practices, and workforce skills, may present obstacles to using certain practices without incurring additional investments and training of the workforce. Often, growers have installed drip irrigation systems with internal emitters set at predetermined spacings to deliver surface drip application.

Shifting to using subsurface irrigation

A shift to using subsurface irrigation may require a secondary dripline to be attached to allow for the installation of external emitters with attached micro-tubing to deliver water to individual vertical tubes in the case of Direct Root-Zone (DRZ) or similar systems.

The primary and secondary driplines can be equipped with valves to accommodate efficient use of deficit irrigation [4] between fruit set and completion of veraison for achieving fruit quality while using the primary system before and after this critical time in the production cycle. The primary line can also be used for applying fertigation and chemigation by surface drip.

The placement of new delivery devices near the base of the existing vines is often required to avoid damage from certain types of implements used to maintain unwanted sub-canopy vegetation, especially weeds, by mechanical control methods.

Sensor-driven irrigation systems in vineyards

Likewise, soil moisture sensors used to monitor soil water content or control automatic irrigation scheduling should be placed near the base of the vine for protection from implements. Such placement also enhances the accuracy of soil water determination when employing sensor-driven irrigation scheduling.

Additionally, sensors functioning through electronic capacitance must be carefully installed to ensure total contact with the soil. This installation requirement means that no voids or air pockets exist near the probe containing the sensors. Some types of soil water content probes are tapered by design, and using a tapered drill bit further ensures that the probe is in direct contact with soil. When installing individual soil water tensiometers, a soil/water slurry may be used to ensure immediate contact between soil and critical parts of the sensor.

Direct Root-Zone irrigation research

Recent research indicates that the DRZ irrigation system can be ideally installed when planting new vines by placing a single delivery tube within the same hole as the new vine. With established vines, the installation of vertical delivery tubes requires drilling a small hole into the soil near the base of each existing vine for tube placement.

Vines receiving DRZ irrigation have been found to rapidly develop deeper roots following the initiation of the subsurface water delivery [4]. Water has been shown to move in all directions from the point of release via capillary action of the soil and hydraulic redistribution action in the root system [5, 6], and root growth appears to correlate with water distribution and availability.

More on soil water sensors

Soil water sensors allow the grower to monitor soil water content and availability and ascertain the ideal timing and water quantity needed to maintain desired vine activity and stress levels to meet production goals. Matric potential tensiometers provide an early indication of expected vine water stress. When these sensors are linked to irrigation scheduling, the degree of vine water stress can be controlled to a desired range of stress by the grower using set points for timing and amount of irrigation.

It is suggested that sensors be placed in proximity to the sentinel vine and/or irrigation delivery point representative of the vineyard block. If multiple soil depths are used to record soil water content and/or soil water tension, a sentinel sensor should be selected to control irrigation scheduling according to depth. These settings can be modified as the grower gains experience using the automated system over time.

Sensors and electronically controlled valves can usually be operated with battery-powered activation unless more power is needed, and alternating electrical current is required to operate valves and pumps. Solar charging panels can be used in most cases to operate the system and record data from the recording sensors. Transmission of stored data to a cloud server is suggested for data storage, retrieval, analyses, and timely system maintenance.

Literature cited

1. Jacoby, P.W. 2024. Improving vineyard irrigation efficiency with soil water sensors. Adjacent Digital Politics Ltd., Crewe, Cheshire, UK.
   https://doi.org/10.56367/OAG-041-10909
2. Jacoby, P.W. 2023. Enhancing irrigation effectiveness in vineyards with innovative technologies. Adjacent Digital Politics Ltd., Crewe, Cheshire, UK.
   https://doi.org/10.56367/OAG-040-10909
3. Jacoby, P.W. 2023. Optimising subsurface drip irrigation for effective drought defence. Adjacent Digital Politics Lt., Crewe, Cheshire, UK.
   https://doi.org/10.56367/OAG-039-10884
4. Jacoby, P.W. 2023. Use of Deficit Irrigation to Enhance Winegrape Production Efficiency. In: Zhang, Q. (eds) Encyclopedia of Smart Agriculture Technologies. Springer, Cham.
   https://doi.org/10.1007/978-3-030-89123-7_179-1
5. Ma, X.C., P.W. Jacoby, K.A. Sanguinet. 2020. Improving net photosynthetic rate and rooting depth of grapevines through a novel irrigation strategy in a semi-arid climate. Front. in Plant Sci. 11:575303.
   https://doi.org/10.3389/fpls.2020.575303
6. Smart DR, Carlisle E, Goebel M, Nunez BA (2005) Transverse hydraulic redistribution by a grapevine. Plant Cell Environ 28:157–167. Transverse hydraulic redistribution by a grapevine – SMART – 2005 – Plant, Cell & Environment – Wiley Online Library
   https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-3040.2004.01254.x

Please Note: This is a Commercial Profile