**Condition Change: UC ANR contributed to improved water use efficiency**

**Issue**

More than nine million acres of farmland in California are irrigated, representing roughly 80% of all water used for businesses and homes. The state faces challenges to meet its water demands. As the state’s population expands and agricultural uses of water are curtailed to meet new sustainable groundwater management guidelines, there can be an expected decrease in water availability and increased competition between urban, environmental, and agricultural water uses. These issues create a need to identify new solutions to improve water use efficiency on agricultural lands and in the urban sector in and around homes, to meet increasing demands.

**Methods**

UC ANR conducts research projects throughout the state to identify more efficient water practices and extends them to growers, managers, decision-makers and the public to transform how Californians use water.

Effort by the scientists at the UC Agriculture Experiment Station (AES) has led to new methods to understand water use and improve efficiency. At the UC Davis AES location infrastructure and new models were put into place to improve spatial and temporal resolution of data in the California Irrigation Management Information System (CIMIS), which will help growers understand water stresses on ecosystems (Susan Ustin). One project collected empirical data on the water requirements for wine grape production in the San Joaquin Valley, to determine the water footprint of grapevines as a function of three irrigation treatments (Larry Williams). Breeding, genetics, weed control, and irrigation management are being evaluated at the UC Riverside AES location as strategies to lessen the impacts of the water used for turfgrass in urban landscapes and the ornamental and horticultural industries (James Baird, Amir Haghverdi, and Lorence Oki).

University of California Cooperative Extension (UCCE) research is improving the accuracy of models to estimate crop water use of coastal berry and vegetable crops by using weather data from CIMIS stations (Michael Cahn).

A collaborative research project by UCCE scientists is being carried out at the Desert Research Extension Center and two commercial spinach fields in Imperial County to assess the viability drip system configurations, nitrogen regimes, and plant establishment through drip instead of overhead irrigation in spinach. Research showed that drip irrigation reduced spinach downy mildew incidence approximately four to five times compared with overhead sprinkler irrigation. Downy mildew is the most important disease in spinach production, in which crop losses can be significant. Another project focused on Subsurface Drip Irrigation (SDI) trials for alfalfa, sugar beets, and dehydrated onions indicate that the technology has the potential to improve yields and the efficiency of water and fertilizer use (Aliasghar Montazar).

Two UCCE scientists conducted research on evapotranspiration rates and shared the results of the topography effects on vineyard evapotranspiration (ET). The scientists further provided expertise to the El Dorado Water Agency's Agricultural Committee, worked with their consultant to improve estimates of crop evapotranspiration, and contributed to the agency’s development plan and report (Lynn Wunderlich and Daniele Zaccaria).

UCCE scientists used technologies to implement Regulated Deficit Irrigation as a best management practice for water use efficiency while improving the quality of red wine grape varieties. In 2018 and 2019 the Rancho California Water District supported a water savings trial in eight vineyards in Temecula Valley using wireless technology. The wireless system is able to provide daily updated recommendations of irrigation times based on vine properties and data obtained from a local CIMIS weather station. Irrigation scheduling information was provided to the 250 members of the Small Winegrowers Association and shared through two workshops (Carmen Gispert).

A team of UCCE scientists conducted irrigation trials to identify the actual water needs of landscape plants newly available or being introduced to the market. The scientists evaluated 26 new perennial plant selections in both sun and shade, in two climate zones, and classified them as low, moderate, or high-water users. Open Houses, attended by dozens of growers and Master Gardeners provides growers/breeders/brokers with their end-users’ opinion of the new plants and helps them make decisions about which plants will be profitable at market. The scientists have provided information for 174 plant species/cultivars over the life of the project. Per the California water law, Model Water Efficient Landscape Ordinance (MWELO), the Water Use Classification of Landscape Species online database (WUCOLS) or other research-based water use information from an approved institution must be used in the development of the landscape water budgets required to receive permits pertaining to the installation of new and renovated landscapes. UCCE is the only approved institution currently doing this kind of trial. (Karrie Reid).

Another UCCE project’s research to improve water use efficiency has included the development of a novel device to enable untended measurements of irrigation water over multiple years. This work is being used to develop accurate water duty factors (the relationship between the area of a crop irrigated and the quantity of irrigation water needed for the entire growth period of the crop) for crops and regions, which will help ensure sustainable management of groundwater (Mark Battany).

As a result of UC ANR research, outreach and education, participants learned and adopted practices that lead to improved water use efficiency. Outcomes with specific measured indicators follow.

**Outcomes**

**Participants learned about recommended irrigation practices.**

* As a result of the irrigation scheduling information, formal and informal surveys indicated 62 winegrowers gained knowledge of irrigation strategies and learned of the advantages of using Reduced Deficit Irrigation to improve wine quality. Daily adjustment of evapotranspiration data can save 10% of water by reducing irrigation time during the colder periods. An estimate of implementing this practice across the 1,200 acres of vineyards in the valley could result in savings of $195,600 in water purchases for the wine grape growers in Temecula. It also has the potential to increase crop value per ton by 10-20% ($155-$310 per ton), thus increasing the profit margin for the region from a total of $829,240 to $1,462,880 per year. (Carmen Gispert)

**Participants adopted recommended irrigation or other water and soil management practices.**

* Two research participants in the spinach irrigation study that adopted drip irrigation increased the efficiency of water and nitrogen use by about 10%. (Aliasghar Montazar)
* As a result of the UCCE information shared on irrigation practices for winegrowers, eight wineries in the Temecula Valley purchased and installed irrigation equipment to schedule irrigation in their vineyards using Reduced Deficit Irrigation. (Carmen Gispert)

**Science-based information was applied to water quality policy and decision-making.**

* The El Dorado Water Agency is able to more accurately estimate future crop water needs and used the crop evapotranspiration estimates to determine the future agricultural demand on El Dorado's "West Slope". Agricultural producers, locally and around the world can benefit from improved actual estimates of crop coefficients and crop water use, resulting in improved water and crop management, higher yields, and better quality with minimized losses. (Lynn Wunderlich and Daniele Zaccaria)
* The Monterey County Water Resource agency personnel are using a database of the daily crop estimates to calibrate their ground water extraction model, in compliance with the Sustainable Ground Water Management Act. (Michael Cahn)
* The San Luis Obispo County Planning Department used the water duty factor developed for hemp in the Paso Robles area to conduct their water offset program when growers change crops to hemp. Without this information it may not have been possible to cultivate hemp in the county. (Mark Battany).
* The critical water-use information identified through the irrigation trials for landscape plants is being added to the California Department of Water Resources, Water Use Classification of Landscape Species online database (WUCOLS). The information helps anyone doing landscaping to create MWELO-compliant water budgets and thereby conserve water. (Karrie Reid)

**Change in condition change: Water saved.**

* As a result of using subsurface drip irrigation (SDI) and following the UCCE irrigation and nitrogen management recommendations, a sugar beet grower in the Imperial Valley was able to conserve 20% water (100 acre feet of water), and about 20% nitrogen fertilizer in 70 acres. This trial and the other SDI trials in the Imperial Valley demonstrate that SDI could be an effective on-farm water conservation practice in the low desert that could positively impact 200,000-acre alfalfa hay, 25,000 acres sugar beets, 9,000 acres spinach, and 15,000-acre onions fields. (Aliasghar Montazar)

These aforementioned measured outcomes have enabled water users to better understand and adopt water use efficiency measures to help California reduce its water demand while maintaining crop yields. Ultimately, improved water management will increase water cost savings, and reduce water usage, benefiting the end user and reducing the over pumping of groundwater in California. For example, it was estimated in 2000, that California growers can save approximately $64.7 million per year by using California Irrigation Management Information System (CIMIS) weather data to inform more efficient water practices. Thus, UC ANR contributes to the public value of protecting California’s Natural Resources.