OPTIMIZING AGRICULTURAL WATER USE AND MANAGEMENT

Public awareness of water shortages is increasing as the pressures of growing populations increase the demand for water. Rural areas are experiencing mounting pressure to provide more water for expanding urban areas at the expense of water supplies needed to support rural and agricultural communities. The ARS Watershed and Water Availability research program develops solutions that improve water management for efficient agricultural production. The following accomplishments in 2021 highlight ARS advancements in irrigation technology and decision support systems for addressing the challenges associated with agricultural water use.

A novel, water-conserving microgreen growing system. Feeding the increasing world's population with shrinking arable land and water resources requires novel alternatives to soil-based cultivation systems and creative solutions to minimize water usage.
ARS scientists in Beltsville, Maryland, developed a biodegradable, hydrogel-based "artificial soil" that minimizes water use and labor. By improving water retention/delivery and root zone aeration, this new technology supports a full 14-day growth cycle for microgreens, which equals conventional production yields without the daily watering requirements. This current technology supports facilitating live plant shipping and user-friendly vegetable growth kits for health-conscious consumers and novice urban farmers. Early and enthusiastic feedback and adoption from urban farmers indicates potential widespread adoption by the urban farming industry. In addition, NASA scientists are investigating using this technology for producing food during space travel.

> **ARS scientists are using infrared thermometers to measure crop canopy temperatures for irrigation scheduling. Four locations are testing a commercial system based on the technology to provide decision support for variable-rate center pivot irrigation, further reducing the water required for optimal yields.**

New satellite algorithm provides improved evapotranspiration measurements for crop water use and irrigation management. Recent droughts in the western United States have put tremendous strain on water resources, and there is increased pressure on the agricultural community to improve irrigation efficiency. However, established satellite evapotranspiration (ET) algorithms, particularly thermal algorithms that work well in the western United States, have limited utility for managing irrigation in specialty vegetable crops. ARS researchers in Riverside, California, and Maricopa, Arizona, evaluated a new thermal satellite ET algorithm based on the ECOsystem Spaceborne Thermal Radiometer Experiment (ECOSTRESS) on the International Space Station that flies over the Earth's surface once every four days and found that ECOSTRESS works very well for measuring crop water use in the western United States. This discovery provides another tool that could be adapted to help farmers improve irrigation scheduling.

Sctillometery for assessing temperature and vapor flux over vineyards. A laser-based method called sctillometery has been developed by ARS researchers in Corvallis, Oregon, for assessing temperature and moisture changes over large heterogeneous vineyards. These techniques allow for long term measurement of fine scale changes in vineyards without interfering with vineyard operations. This approach will aid the development of improved predictive models for pest and pathogen spread and disease development. Additionally, this approach will lead to improved assessment of water use and the development of predictive models for plant growth that will aid vineyard managers' decision making.

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A new and rugged ground-based method estimates crop water use. Farmers in the drought-stricken western United States require better tools to improve precision irrigation management. Reliable ground-based sensors can complement efforts to quantify crop water use and measure crop stress remotely with satellites and drones. ARS researchers in Davis, California, along with University of California-Davis collaborators, found a way to utilize rugged infrared temperature sensors to measure crop water use and stress down to the single plant level. This new method determines crop water use by measuring changes in crop temperatures every second. The effectiveness of this new method was shown in vineyards and tree crop orchards by comparing measurements against gold standard methods. This breakthrough enables the use of these durable, readily available sensors to improve precision irrigation management and environmental stewardship.

Cheung, Lance. Kitayama Brothers, Inc. (KBI) hydroponic greenhouses with micro irrigation have been in use for years in their 40 acres of green houses on Thursday, August 27, 2015, in Watsonville, CA. https://flic.kr/p/BwvBDn