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UC Cooperative Extension helps Californians use water wisely

Last year was California's driest on record, and we are now facing our third straight year of drought. Growers have fallowed fields they can't irrigate and ranchers have sold cattle they can't feed, driving up food costs nationwide. Cities are feeling the pinch too because Governor Jerry Brown has asked for a voluntary 20% cut in urban water use. And rivers are so low that wildlife agencies have trucked millions of juvenile salmon from hatcheries toward the ocean. To help California adapt to drought, UC Division of Agriculture and Natural Resources (ANR) and UC Cooperative Extension (UCCE) researchers are finding ways for Californians to use less water.

"This drought is unprecedented — we've never had such a lack of rainfall since we started keeping track," says Doug Parker, who both directs UC

ANR's California Institute for Water Resources and leads the Division's Strategic Initiative on Water Quality, Quantity and Security. Also unprecedented is the mere trickle that California farmers are getting from the state and federal projects that deliver surface water to users in the Central Valley and elsewhere. That said, drought is nothing new here.

"California has always had droughts and will always have droughts," Parker says. "It's something we need to learn to live with."

During most years, agriculture uses 80% of the state's developed water, which doesn't include environmental allocations. "Farmers are looking for ways they can stretch their water budget," he says. Those who grow annual crops can simply plant fewer acres, and he estimates that about 5% of the irrigated cropland statewide will be fallowed this year.

But not every farmer has this option. Permanent crops like almonds and grapes need some water just to stay alive, so growers often turn to groundwater when supplies of surface water are cut. "This is not sustainable in the long run but is not a bad thing in the short run," Parker says. "It's a loan and we need to remember to pay it back." Downsides of overpumping

groundwater range from depleting supplies to land subsidence.

Urban areas typically use 20% of developed water. While cities have more water than agriculture has this year, many are still getting far less than they're used to. It's not as dire as it was during the last big drought in the 1970s, however, thanks to conservation measures like low-flow toilets and showerheads. "We learned our lessons," Parker says. "We actually use less water per person now."

Water-smart gardening

There's still plenty of room for city dwellers to conserve more water. About half of the water they use statewide — nearly 200 gallons a day per household — goes to landscaping. To help gardeners use water efficiently, the Marin Master Gardeners teamed up with the Marin Municipal Water District (MMWD) to offer free water audits called Garden Walks. With training from the MMWD conservation team, well over 100 Master Gardeners visit people's gardens to evaluate and consult on plantings and irrigation systems.

"One of the biggest problems is automatic irrigation systems that aren't maintained," says Steven Swain, UCCE environmental horticulture advisor for Marin and Sonoma counties. "Every year, we find some that are dumping hundreds of gallons a day, but the leaks are often underground so no one knew." Another problem that's easy to solve is outdated controllers, which, unlike modern versions, don't shut off automatically when it rains. Other fixes include xeriscaping as well as gardening in zones to make sure that water-loving plants share a dedicated irrigation circuit.

Now in its fifth year, the Garden Walks program saves participating households an average of 1,000 gallons annually. "We're saving a lot of water — about 23 million gallons over the life of the program," Swain says. The program pencils out financially too, costing ratepayers less per gallon saved than the baseline rate for a gallon used.

Other municipalities are taking note. "There's a lot of interest," Swain says. "We've gotten calls from other California counties and even Tacoma, Washington."

Efficient irrigation

Just as some garden plants are thirsty, there's no getting around that some crops need plenty of water. For example, avocados are shallow-rooted trees native to Central and South American cloud forests and need frequent irrigations throughout the day. Another difficulty is that California avocados grow along the coast from San Diego to Santa Cruz, where water is pricey and contains salts that can affect the trees' productivity.



Marin Master Gardener Jeanne Ballestrero, right, shows client Candace Berthrong, left, how to read her water meter for water leaks, and how to use the meter to manage water usage. Ballestrero is one of more than 100 Master Gardeners who have been trained in water conservation by the Marin Municipal Water District water district as part of the Garden Walks program.



Microsprinkler applying irrigation water in a mulched avocado grove.

Despite these challenges, California produced 151,000 tons of avocados valued at \$460 million in 2011, according to the California Department of Food and Agriculture's 2012–2013 Agricultural Statistics Review. Avocados are a top 20 commodity in the state, and California is the nation's top avocado-producing state by far.

While avocado growers can't use less water, they can boost their irrigation efficiency. "Sprinkler systems are like Tinker Toys so they can get out of whack — monitoring them optimizes water delivery," says Ben Faber, UCCE farm advisor for Ventura and Santa Barbara counties. "Avocado growers tend to be the best irrigators in the state," he says, adding that too much or too little water can cause serious root diseases.

Faber also works on citrus, another top 20 commodity in California. Altogether the state produced 2.5 million tons of oranges valued at \$656 million in 2011. In a trial, Faber tried watering orange trees on just one side, hoping to "fool them into thinking they were getting their usual amount." But that didn't work, so now he's testing drought-resistant rootstocks. "Deeper-rooted trees could get more of the winter rainfall, increasing orange production with less irrigation," he says.

Conserving groundwater

Unlike avocados and oranges, wine grapes are naturally water thrifty. But water is scarce in Paso Robles, a premier wine grape-growing region that — like most Central Coast agricultural land — lacks water deliveries from the state and federal projects. "We depend almost entirely on groundwater," says Mark Battany, UCCE viticulture farm advisor for San Luis Obispo and Santa Barbara counties. "That sets us apart from much of the state." Grapes were California's

number two commodity in 2011, and wine grapes accounted for about half of the total production and value, at 3.4 million tons and \$2.1 billion, respectively.

In contrast to surface water, groundwater is not regulated in much of the state, and trends in reserves in many areas are going steadily downward. "The water table has been dropping in Paso Robles," Battany says. "Water availability is the number one issue that threatens our long-term productivity."

He's looking for ways to make wine grapes thrive with less water. "We're trying to think out of the box," he says. For example, vines are grown close to the ground because that's what works in Europe, but that might not be best for Paso Robles, where the air near the ground is often cold at night when the vines start to leaf out in the spring. Currently, some growers protect their vineyards from frost by sprinkling them with water (the transition from liquid water to ice produces heat, which insulates the delicate buds from the cold).

Battany is exploring an alternative to using irrigation for frost protection that could also help protect vines from summer heat and climate change. His approach hinges on the fact that air near the ground is coldest at night and hottest during the day. "Training the vines to grow taller could avoid both extremes," he says. As a first step, Battany is assessing the temperature of air at a range of heights above the ground.

During temperature inversions, wind machines might also offer water-free frost protection by mixing the higher-and-warmer air into the lower-and-colder air that surrounds the grapevines. To assess the likelihood that wind machines could ward off frost, Battany

UCCE farm advisor Mark Battany is testing the range of temperature at different heights above the ground to study temperature inversions and the possibility of a water-free frost protection method for vineyards. Below, Battany is installing one of the precision measurement stations used to evaluate temperature profiles.



is part of a team that is surveying springtime temperature inversions in vineyards in Santa Barbara, San Luis Obispo and Sonoma counties. Altogether, more than 60 towers are measuring the air temperatures at both 5 feet and 35 feet above the ground.

Conserving surface water

Vineyards in Mendocino County get water from the Russian and Navarro rivers — most years, that is. The rivers are “horribly low with the drought,” said UCCE Mendocino County viticulture and plant science advisor Glenn McGourty in late March, adding that flows were only at 30 cubic feet per second, a third of the usual rate for that time of year. Even so, he’s not too worried about the wine grapes right now. “Vineyards don’t use a whole lot of water, so they can probably squeak by,” he says.

McGourty is getting ready for a drier and warmer future, however. “We’re rethinking and redesigning vineyards,” he says. “Current rootstocks are from northern France, so they don’t take the heat well.” He’s testing varieties that send their roots deeper and varieties that thrive in hot places like Greece and Portugal. “We want to keep up with climate change and still make very good wine,” he says.

Another concern is Mendocino’s endangered and threatened salmonids, including Chinook and Coho salmon and steelhead trout. As in Paso Robles, wine grape growers in Mendocino use water to protect new growth from frost during spring — and this is when young salmonids need water in the streams that lead to the ocean, where they’ll spend most of their adult lives. McGourty is part of UC collaborations testing frost protection alternatives such as wind machines and applications of a mix of mineral oil and copper, which curbs the bacteria that help ice form on plants.

Saving salmon

Having water in rivers and streams is not enough to keep salmon alive — these fish also need the water to be cold. “In the middle of summer, water temperature can be more important than flow,” says Lisa Thompson, UCCE fisheries specialist at UC Davis. At temperatures of up to 70°F, the pools where salmon hide from predators are already close to being too warm for the adult spring-run Chinook salmon in Butte Creek near Chico. “It’s right on the line of what they can take,” Thompson says. “Some days get almost lethally hot.” Her fish and climate change models predict that the pools will be too hot for salmon in 50 years.

On days that are predicted to be extremely hot, resource agencies net fish and move them upstream to cooler waters. But that’s so stressful for the salmon that they often die. It’s also expensive, costing about \$10,000 to move a few hundred salmon.

Thompson has another suggestion for getting salmon through heat waves: bring cold water to them instead of bringing them to cold water. She envisions piping cold water into the bottom of the pools, which can be 24 feet deep in mountain streams. Given the cost and casualty rate of moving salmon, this approach “may be just as feasible,” she says.

Solutions can’t come soon enough for all of California’s water users, from salmon and other wildlife to farmers to people in cities. Not only is water demand growing, but we can’t necessarily count on all the water that we’ve gotten used to having. “The last 150 years have been wetter than the last 2,000 years,” says Lynn Ingram, professor in the UC Berkeley Department of Earth and Planetary Science. In other words, extended droughts could be the new normal — rather than the exception — in California.

—Robin Meadows

Pools in Butte Creek, near Chico, get too warm for salmon on the hottest spring days. Resource agencies have been netting hundreds of salmon at a time and trucking them to cooler waters upstream.



Lisa Thompson