Do You Have Enough Water to Grow Avocados?

By Tim Spann, PhD
Spann Ag Research & Consulting, LLC

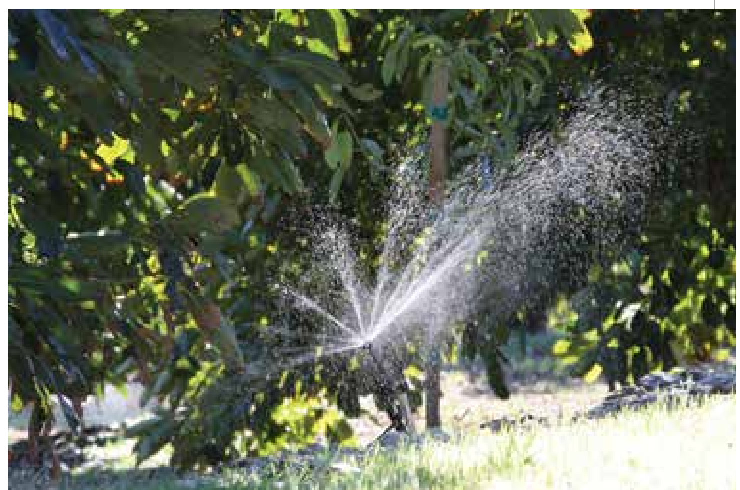
If you drive through the west side of the San Joaquin Valley you will see acres and acres of fallow land along with acres and acres of mostly almonds and pistachios. A lot of that fallow land is owned by the almond and pistachio growers, but they can't plant it. The reason is that the water rights associated with each acre of land on the west side aren't sufficient to grow the thirsty almonds and pistachios that have become the cash cow of the valley. So, the work-around is to own a lot of land and use the total allocated water to irrigate just a portion of the land, thus allowing more thirsty crops to be grown.

Historically this tactic hasn't been necessary for avocados — not because they don't need the water, but because water has been more available in California's avocado growing regions. Unlike the Central Valley that has always relied upon water delivery through the State Water Project, southern avocado growing regions have been largely reliant on Colorado River water and ground water, while northern avocado growing areas have been reliant on ground water and local reservoirs. However, changes in recent years due to overdemand on ground water resources, overallocation of Colorado River water, and prolonged periods of drought have changed the water availability picture for avocado growers. Is it time to start thinking like a west side almond grower?

How Much Water Do Avocados Need?

In California, the generalized answer to this question is three acre-feet per year per acre of mature trees assuming about 110 trees per acre. Of course, this varies considerably by location (e.g., Morro Bay vs. Temecula), aspect, heat waves and the need to run a leaching fraction to compensate for poor quality water.

The determination of having enough water available isn't quite as simple as dividing three acre-feet by 365 days and coming up with the need for 2,740 gallons per day per acre. Most growers will not be irrigating every day, so that volume of water needs to be summed across multiple days — for example, irrigating every 7 days equates to needing about 20,000 gallons per acre. But that still doesn't get us there. The trees' water needs are not equal over the course of the year, it varies with the season from a low of less than 10 gallons per tree per day in winter to as much as 50 gallons per day per tree in summer. That's a range of 6,000 gallons per acre per week in winter to about 40,000 gallons per acre per week in summer. Using 15 gallon per hour microsprinklers would require a run time of 24 hours to apply 40,000 gallons of water per acre.



That said, no irrigation system is 100% efficient. New systems could be 90% efficient or better, reported as the distribution uniformity or DU. A DU of 0.9 means your system is 90% efficient. Older irrigation systems could have DUs well below 0.9, possibly as low as 0.7 or worse. It pays to maintain your irrigation system. Whatever the difference is between 1 and your actual DU needs to be added to your irrigation volume. For example, to apply 40,000 gallons per acre to the trees through a system with a DU of 0.9, 44,445 gallons need to be run to account for the 10% loss in the system.

Similar to compensating for irrigation system DU, water quality needs to be compensated for as well by calculating a leaching fraction. It's important to have a current water quality analysis of your irrigation water, regardless of its source, so you can accurately calculate the necessary leaching fraction. A leaching fraction is the amount of water that needs to be applied above the crop's water needs to compensate for the salinity of the irrigation water and maintain an acceptable root zone salinity level (see the resources section at the end of this article for links to information on calculating a leaching fraction). Leaching fractions are reported in percentages and can be found on most agricultural water analyses. The required leaching fraction is additive to the volume needed to compensate for system DU, so in our ongoing example of 40,000 gallons per acre per week with a system DU of 0.9 if the required leaching fraction is 10%, we now need to apply just under 50,000 gallons per acre per week.

How Do You Know If You Have Enough Water?

To start, what is your water source and how much water can it supply? If you have a well, what is your pumping capacity? For how long can that well sustain that pumping capacity? If you recently purchased your property and don't know the history of the well it may be a wise investment to have a well company do an inspection and a pump test of the well. During a pump test, water will be pumped from the well as fast as possible to determine the maximum output of the well, and the water level in the well will be monitored to see how much it drops during pumping and how long it takes to recover after pumping.

If you receive your water through a municipal water district, what size water meter do you have? How much water can that meter supply to your grove? For district water it is worth considering worst case scenarios, such as heatwaves. When you and all your neighbors will be irrigating simultaneously, will you still have the maximum flow you expect?

How many acres do you plan to irrigate at a given time? In our ongoing example of 40,000 gallons per acre per week with a DU of 0.9 and a leaching fraction of 10% using 15 gallon per hour microsprinklers the flow would be 1,650 gallons per hour (assuming 110 trees and sprinklers per acre) for 30 hours. That's not a terribly high flow rate, but what if you have 100 acres and need to irrigate 20 acres at a time so you can irrigate the entire grove every week? Now you need to be able to run 33,000 gallons per hour (550 gallons per minute) for 150 hours out of 168 hours per week. You better not plan on having any equipment failures... ever!

Regardless of your water source, it is never wise to plan on operating at your system's maximum capacity 24/7. I'm not a very conservative person naturally, but when it comes to irrigation I am, and I would not exceed 75% of my system's capacity at the most. So, let's walk through a new example the way it should be done.

You just bought a property that has been planted in avocados historically, but it needs rehabilitation. The property has 30 acres planted with old trees and a 2-inch water meter with a maximum flow of 170 gallons per minute. This grove is in Temecula so the district water is primarily Colorado River water and you've determined you need a leaching fraction of 15%. Can you replant the entire 30 acres?

How big can your irrigation blocks be?

- Maximum flow rate 170 gallons per minute × 75% = 128 gallons per minute
- 128 gallons per minute max flow x 60 minutes per hour = 7,680 gallons per hour
- You pick a 10 gallon per hour sprinkler to try to maximize your block sizes = 768 sprinklers
- You want to replant Hass trees at 15 ft x 15 ft or 194 trees per acre with one sprinkler per tree
- 768 sprinklers ÷ 194 trees per acre = 4 acres per irrigation block

Now how long do you need to irrigate at peak need in summer?

- Based on California Irrigation Management Information System (CIMIS) data an acre of mature healthy avocados uses about 37,500 gallons of water per week
- You plan to install a brand-new irrigation system and can achieve a DU of 0.92
- 37,500 gallons of water per week ÷ 0.92 = 40,760 gallons per week
- Your water analysis says you should use a leaching factor of 15%
- 40,760 gallons per week x 0.15 = 6,113 gallons for leaching
- 40,760 gallons per week + 6,113 for leaching = 46,874 gallons per week per acre applied water needed
- You have 194 trees per acre so 46,874 ÷ 194 = 242 gallons per tree per week
- 242 gallons per tree per week ÷ 10 gallons per hour sprinklers = 24 hours of irrigation per week in summer

Now that you know how many acres you can irrigate at once and how long you should irrigate at peak need you can answer the final question: how many acres can you farm effectively?

- Assuming you are willing to irrigate 6 days a week and 24 hours a day there are 144 hours of available irrigation time (6 days x 24 hours per day)
- Divide the number of hours of irrigation time available by the hours of irrigation needed, which is 144 available hours ÷ 24 hours needed irrigation = 6
- 6 is the number of irrigation blocks you can run in a week
- 6 blocks x 4 acres per irrigation block = 24 acres that can be farmed with the available water

Based on these calculations you can replant 24 of the 30 acres.

Recently, the California Avocado Commission Production Research Committee began a research and grower outreach prioritization exercise. One of the committee members wrote down, "Irrigation. Irrigation. IRRIGATION!" as their top priority, commenting that there isn't hardly a single grower out there who couldn't improve their irrigation practices. I believe that is true. Without proper irrigation management, fertilizer management is inefficient at best. Over watered trees will suffer from root health issues and set poor crops. Under irrigated trees will suffer from drought stress and grow poorly and set poor crops. Stressed trees are more susceptible to pests and disease and set even poorer crops.

This all highlights the importance of doing the math and farming the acres for which there is water available. Farming more acres than you have water for severely limits yield potential of the grove. For something so critical to the success of your grove, isn't it worth taking a few minutes to do some math and make certain you have the ability to properly manage your trees for the long haul?

Resources

Estimating Leaching Fraction Requirements, UC Cooperative Extension Stanislaus County: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/dd_jardins/ddj_140_lf.pdf

How to calculate the recommended leaching fraction, Gary Spinelli, UCCE San Diego County, YouTube tutorial: https://www.youtube.com/watch?v=84Y1CkSNngE