IRRIGATION SCHEDULING USING EVAPOTRANSPIRATION (ET)

Understanding the changing demand of almond trees based on water use by evapotranspiration, or ET, is a first step toward optimum irrigation scheduling. ET scheduling accounts for the loss of water through soil surface evaporation and transpiration through openings in the leaves. In almonds, ET will change throughout the year according to weather (e.g., heat and humidity impact evaporation) and time of year or crop stage (e.g., lower leaf surface in early season equals lower transpiration).

Crop Water Use (ETc) = Reference Evaporation (ETo) x Crop Coefficient (Kc)

ETc (almond water use) in inches of water can be time-framed to the day, week, month, or season in order to assess the orchard's water requirements for irrigation scheduling purposes.

ETo (reference ET) information is available from a variety of sources, but most well-known is the California Department of Water Resources' CIMIS network of nearly 100 California weather stations that provide daily reference evapotranspiration values (www.cimis.water.ca.gov).

Thirty-year average evapotranspiration reference rates (ETo)[1] and almond (ETc)[2] for several CIMIS zones within almond-producing areas of California (adapted from UC ANR Pub. 8515)

		Zone 12[4]		Zone 14[5]		Zone 15[6]		Zone 16[7]	
	Kc[3]	ETo	ETc	ETo	ETc	ETo	ETc	ETo	ETc
Jan	0.4	1.24	0.5	1.55	0.62	1.24	0.5	1.55	0.62
Feb	0.41	1.96	0.81	2.24	0.92	2.24	0.92	2.52	1.04
Mar	0.62	3.41	2.11	3.72	2.3	3.72	2.3	4.03	2.49
Apr	0.8	5.1	4.09	5.1	4.09	5.7	4.57	5.7	4.57
May	0.94	6.82	6.44	6.82	6.44	7.44	7.02	7.75	7.31
Jun	1.05	7.8	8.2	7.8	8.2	8.1	8.51	8.7	9.14
Jul	1.11	8.06	8.93	8.68	9.61	8.68	9.61	9.3	10.3
Aug	1.11	7.13	7.9	7.75	8.59	7.75	8.59	8.37	9.28
Sep	1.06	5.4	5.73	5.7	6.05	5.7	6.05	6.3	6.68
Oct	0.92	3.72	3.41	4.03	3.69	4.03	3.69	4.34	3.97
Nov	0.69	1.8	1.23	2.1	1.44	2.1	1.44	2.4	1.64
Dec	0.43	0.93	0.4	1.55	0.66	1.24	0.53	1.55	0.66
Totals (in)									
Yearly			49.75		52.61		53.73		57.70
Crop Season[8]			47.43		49.69		51.06		54.56
Non-crop Season[9]			2.32		2.92		2.67		3.14

[1]Normal year evapotranspiration of unstressed grass (reference crop, ETo) 30-year CIMIS average for the respective zone.
[2]Evapotranspiration rates for almonds were calculated by multiplying ETo by the crop coefficient (Kc).
[3]Almond crop coefficient (UC ANR Pub. 8515).
[4]Zone 12 ETo rates from Chico, Fresno, Madera, Merced, Modesto, and Visalia.
[5]Zone 14 ETo rates from Newman, Red Bluff, and Woodland.
[6]Zone 15 ETo rates from Bakersfield, Los Banos and westside San Joaquin Valley.
[7]Zone 16 ETo rates from Coalinga and Hanford.
[8]Crop season ETc rates March-Nov 15.
[9]Non-crop season ETc rates Jan, Feb, Nov 16-30, and Dec.
[10]1 Inch equals 27,154 gallons/acre.

california almonds
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Reference Evapotranspiration Zones

1. **COASTAL PLAINS HEAVY FOG BELT** lowest ETo in California, characterized by dense fog
2. **COASTAL MIXED FOG AREA** less fog and higher ETo than zone 1
3. **COASTAL VALLEYS & PLAINS & NORTH COAST MOUNTAINS** more sunlight than zone 2
4. **SOUTH COAST INLAND PLAINS & MOUNTAINS NORTH OF SAN FRANCISCO** more sunlight and higher summer ETo than zone 3
5. **NORTHERN INLAND VALLEYS** valleys north of San Franciaco
6. **UPLAND CENTRAL COAST & LOS ANGELES BASIN** higher elevation coastal areas
7. **NORTHEASTERN PLAINS**
8. **INLAND SAN FRANCISCO BAY AREA** inland area near San Francisco with some marine influence
9. **SOUTH COAST MARINE TO DESERT TRANSITION** inland area between marine & desert climates
10. **NORTH CENTRAL PLATEAU & CENTRAL COAST RANGE** cool, high elevation areas with strong summer sunlight; zone has limited climate data & the zones selection is somewhat subjective
11. **CENTRAL SIERRA NEVADA** mountain valleys east of Sacramento with some influence from delta breeze in summer
12. **EAST SIDE SACRAMENTO-SAN JOAQUIN VALLEY** low winter & high summer ETo with slightly lower ETo than zone 14
13. **NORTHERN SIERRA NEVADA** northern Sierra Nevada mountain valleys with less marine influence than zone 11
14. **MID-CENTRAL VALLEY, SOUTHERN SIERRA NEVADA, TEHACHAPI & HIGH DESERT MOUNTAINS** high summer sunshine and wind in some locations
15. **NORTHERN & SOUTHERN SAN JOAQUIN VALLEY** slightly lower winter ETo due to fog and slightly higher summer ETo than zones 12 & 14
16. **WESTSIDE SAN JOAQUIN VALLEY & MOUNTAINS EAST & WEST OF IMPERIAL VALLEY**
17. **HIGH DESERT VALLEYS** valleys in the high desert near Nevada and Arizona
18. **IMPERIAL VALLEY, DEATH VALLEY & PALO VERDE** low desert areas with high sunlight & considerable heat advection

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UNIVERSITY OF CALIFORNIA, DAVIS

STATE OF CALIFORNIA
ARNOLD SCHWARZENEGGER, GOVERNOR

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LESTER A. SNOW, DIRECTOR

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Almond Board of California
1150 9th St., Suite 1500
Modesto, CA 95354 USA

T: 209.549.8262