Overview on the Pistachio ET and Salinity Project
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Research project funded by CDFA – Specialty Crop Block Program (2015-2018) aiming at

"Updating Information on Evapotranspiration (ET) and Crop Coefficients (Kc) of Mature Pistachio Orchards Grown with Micro-Irrigation on Increasingly Saline Soils in the San Joaquin Valley of California"

Context:

✓ Current Pistachio production in California is around 332,000 acres (250,385 bearing and 79,582 non-bearing acres), with total production of 448,000 Tons; value generated is $1.5 Billion (CDFA, 2017)

✓ In the last 15 years Pistachio acreage largely expanded on salt-affected grounds (current estimate is ~ 20-25% of total pistachio acreage and prospects of increase)

✓ Little and outdated information is available to growers on actual water use (ET and Kc) of pistachio orchards grown on saline soils with micro-irrigation systems

Expansion of Pistachio acreage in the San Joaquin Valley occurred at the cost of Cotton acreage

![Graphs showing the rise and fall of Cotton and the increase in Pistachio bearing acreage.](image)
Crop Evapotranspiration (ET) is the total amount of water lost to the atmosphere through soil evaporation and plant transpiration.

ET rate depends on:

- Crop growth stage and canopy size/density (the bigger the canopy the higher is the light interception, the higher the ET)
- Solar Radiation (+)
- Air Temperature (+)
- Relative Humidity (-)
- Wind Speed (+)
- Available Soil Moisture (+)
- Soil-water salinity (ECe)

**Main Objectives of the Pistachio ET & Salinity Project are:**

1. Determine the actual ET and Kc of well-watered mature pistachio orchards grown on increasingly saline soils with micro-irrigation over the course of two consecutive crop seasons (2016-2017)
2. Characterize the relationships between soil salinity, canopy cover/light interception, and actual pistachio ET
3. Develop and validate a grower-friendly tool to predict ET and Kc based on canopy cover and light interception
4. Provide recommendations to pistachio growers and farm managers for irrigation scheduling

**Accurate information on Pistachio water use are of strategic relevance for:**

- Promoting more efficient and accurate on-farm water use
- Increasing the productivity of water and energy ($/Ac-ft; $/KWh)
- The State Water Planning (California Water Plan) and accurate water allocations (Water Coalitions and Irrigation Districts)
- Water transfer within the State among the different hydrologic regions (Water Transfer Program)
Activities conducted during the 2016 and 2017 Crop Seasons:

- Instrumented 4 pistachio study orchards (2 non-salt affected and 2 saline) with field sensors and measurement devices
- Measured actual ET and calculated Kc at the 4 study orchards over the 2 crop seasons as related to differences in canopy cover and light interception among and within orchards
- Measured Light Interception, canopy area/volume on multiple dates with ground measurements and airborne remote sensing flight overpasses
- Conducted soil salinity surveys on the footprint areas of the ET stations to characterize soil-water salinity and its relations to canopy cover, light interception & actual ET
- Monitored plant water status with midday stem water potential and dendrometers, and soil water status with watermarks and tensiometers
- Measured additional parameters such as canopy & vegetation, trunk diameter, crop yield and quality

Light Interception by Tree Canopy in the Different Pistachio Orchards:
**Actual Pistachio Evapotranspiration and Crop Coefficients:**

- Non salt-affected orchards with ~ 75% canopy cover under micro-irrigation have seasonal ET of about **36-40 inches** (May-October) and max Kc of **0.90**

- Salt-affected orchards have **significantly lower ET and Kc** than non-salt affected orchards

- **Soil Evaporation (E)** could be significant in salt-affected orchards, thus irrigation can be reduced to avoid unnecessary water losses

Salinity reduces plant growth, canopy size & density, resulting in less light interception and thus in less transpiration by the trees.

Salinity decrease the soil osmotic potential resulting in less water uptake and probably lower stomatal conductance, thus in less crop transpiration fluxes.

In salt-affected orchards more sunlight (energy) reaches the soil causing more soil evaporation, if soil is wet. As such, soil evaporation can be a significant avoidable water loss.
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