

# **Measuring Crop Use (ET): How Much Water does Alfalfa Need for Maximum Yields**

*D. Zaccaria, R. Snyder, D. Putnam, A. Montazar, K. Little*

DWR-Funded Project (2014-2016)

***“Develop updated information on alfalfa water use  
under optimal agronomic conditions”***

***(NO GROWING LIMITATIONS DUE TO WATER DEFICIT, NUTRITIONAL SHORTAGES  
AND CROP DISEASES)***

- Alfalfa was established in November 2013 on a total of 6.0 acres around the two Lysimeters, each having 20 feet diameter and roughly 4 feet deep
- Alfalfa is irrigated by sprinkler irrigation inside the lysimeters and by border-checks in the surrounding area

## **Main Objectives are:**

1. Measure Alfalfa ET by means of 3 parallel methods (Lysimeters, Eddy Covariance and Surface Renewal) under the typical weather conditions of Central Valley
2. Determine the  $K_c$  along the crop season of Alfalfa, and within the crop cycles
3. Provide information to improve irrigation scheduling

## **Why this project is important?**

- Alfalfa is grown on a large acreage (about 1 million acres) in California, mostly to feed the Dairy, a 7 Billion \$/year industry, and international export & trade
- Alfalfa is probably the 2<sup>nd</sup> largest single agricultural water user in California. According to estimations (2010), Alfalfa uses approximately 5 Million Acre-feet of water
- Accurate estimation of alfalfa water requirements are of strategic relevance to:
  - State Water Planning and Water Allocation (California Water Plan)
  - Water transfer within the State among the different hydrologic regions and units (Water Transfer Program)
  - To promote more accurate farm water use

## Rationale

Irrigation decisions by alfalfa growers are based on periodically refilling the soil profile with what is lost by ET

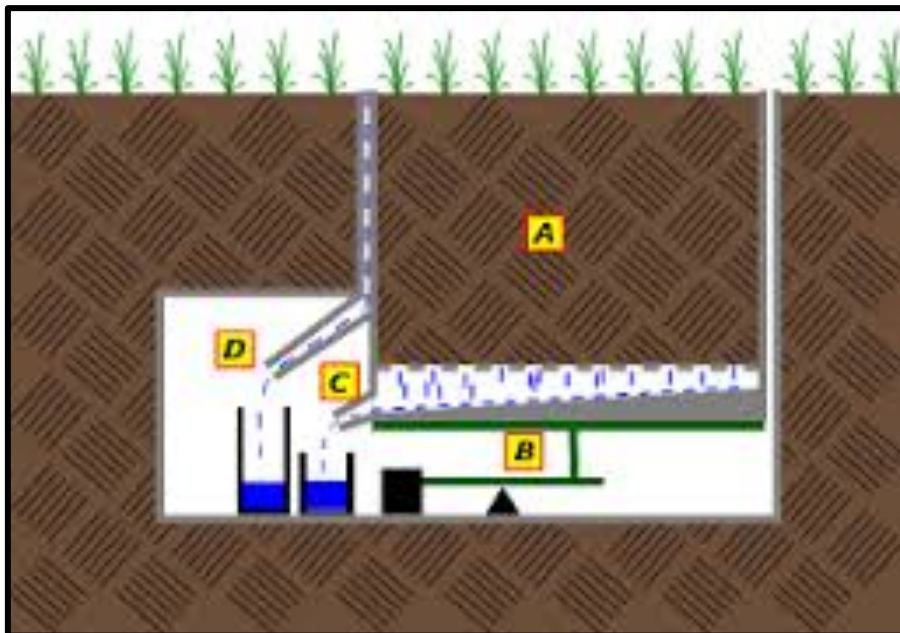
$$ET = ETo \times K_c$$

Daily **ETo** data can be obtained from CIMIS: <http://wwwcimis.water.ca.gov/>

The uncertainties are still in the **K<sub>c</sub>** component of the equation

- The most accurate way to assess water use (ET) by crops is given by lysimeters. Lysimeters are **PRECISION SCALES** measuring in continuous the weight changes of a tank of soil with a crop on the surface

**LYSIMETERS** measure the Water lost by Soil (E) & Plants (T)



- Lysimeters are expensive and complicate devices to build and operate

**There are more portable and less expensive methods, such as Eddy Covariance, Surface Renewal and Bowen Ratio**

## RESULTS FROM THE STUDY IN 2014

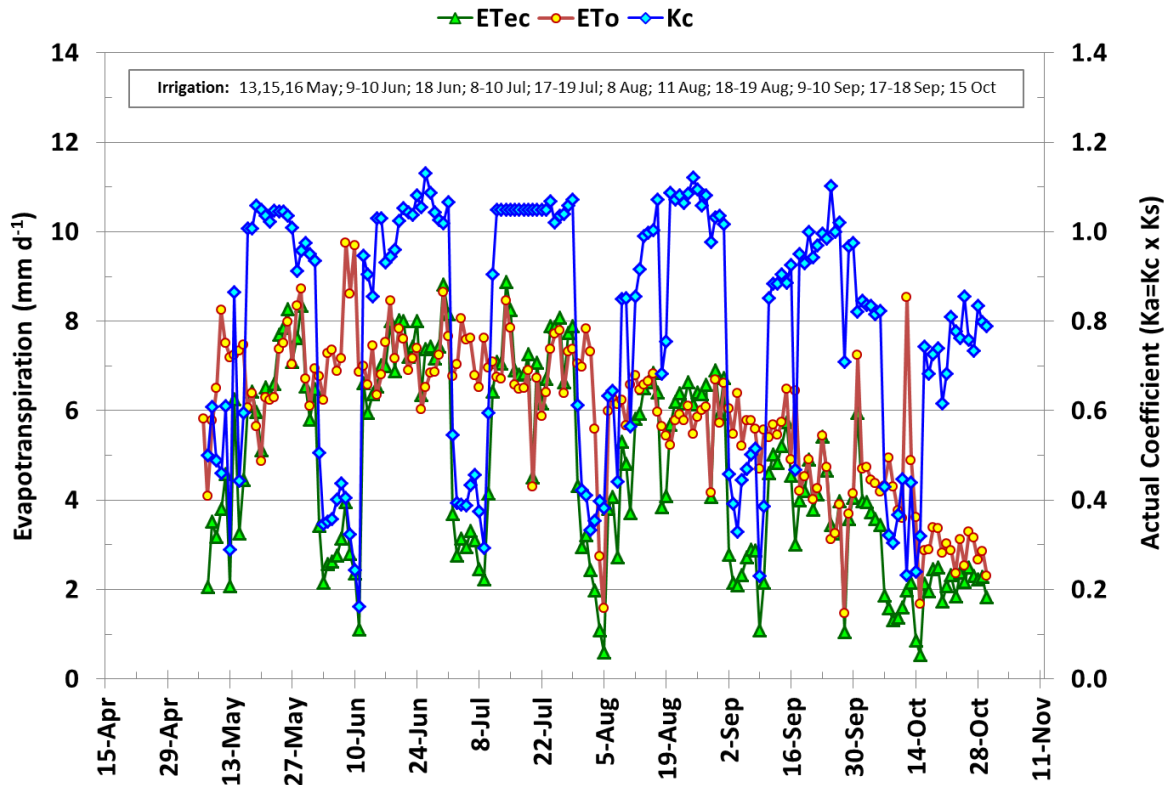


Figure 1. ETo, ETc and Kc for Alfalfa lysimeter study 2014

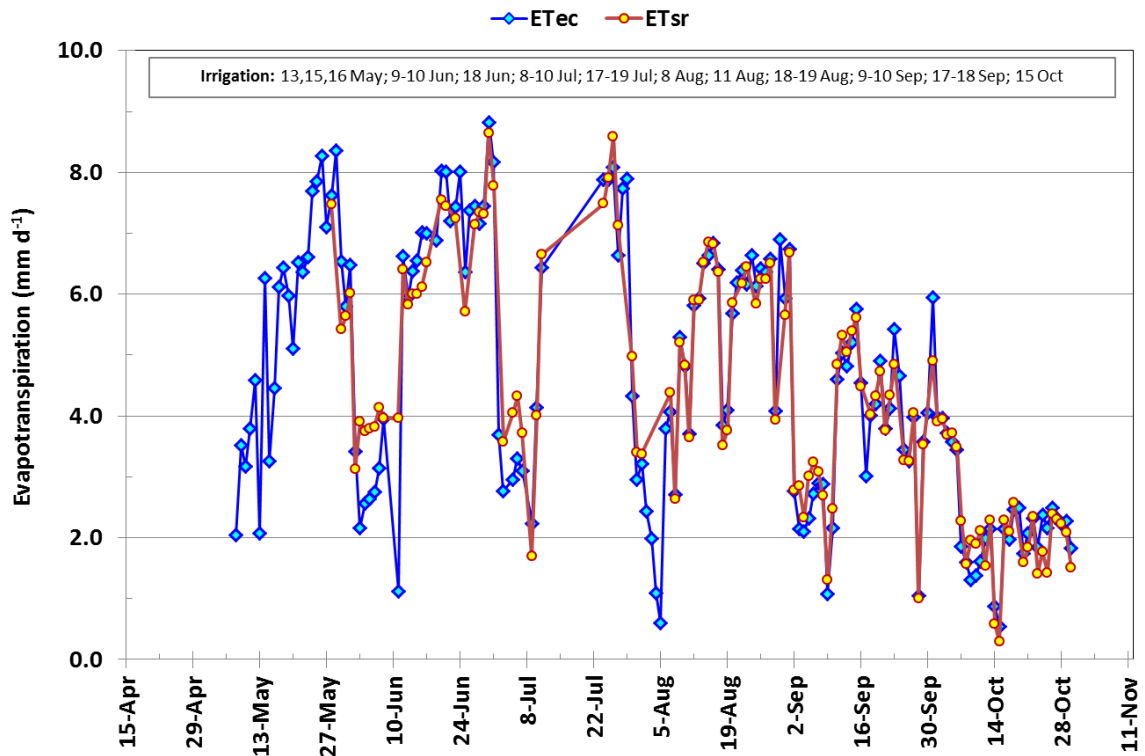


Figure 2. ET from eddy covariance (sonic) and from surface renewal (thermocouple)

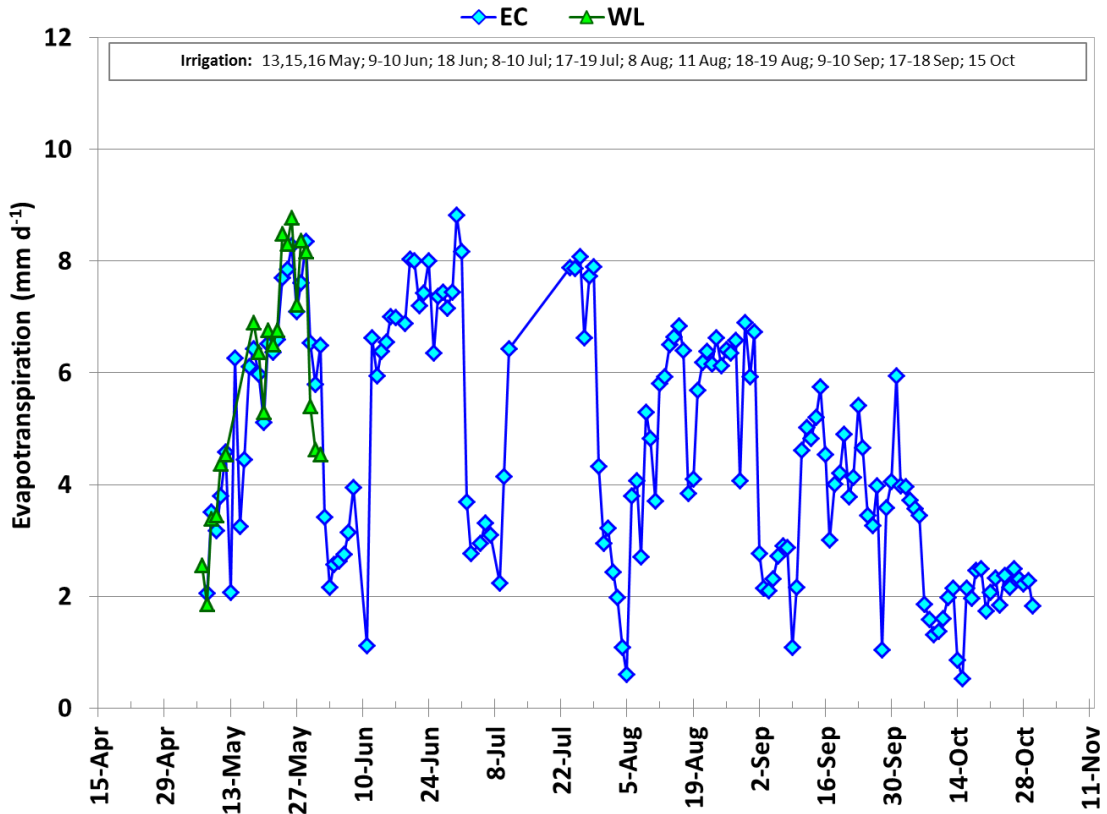


Figure 3. Comparison of ET<sub>c</sub> from eddy covariance with weighing lysimeter.

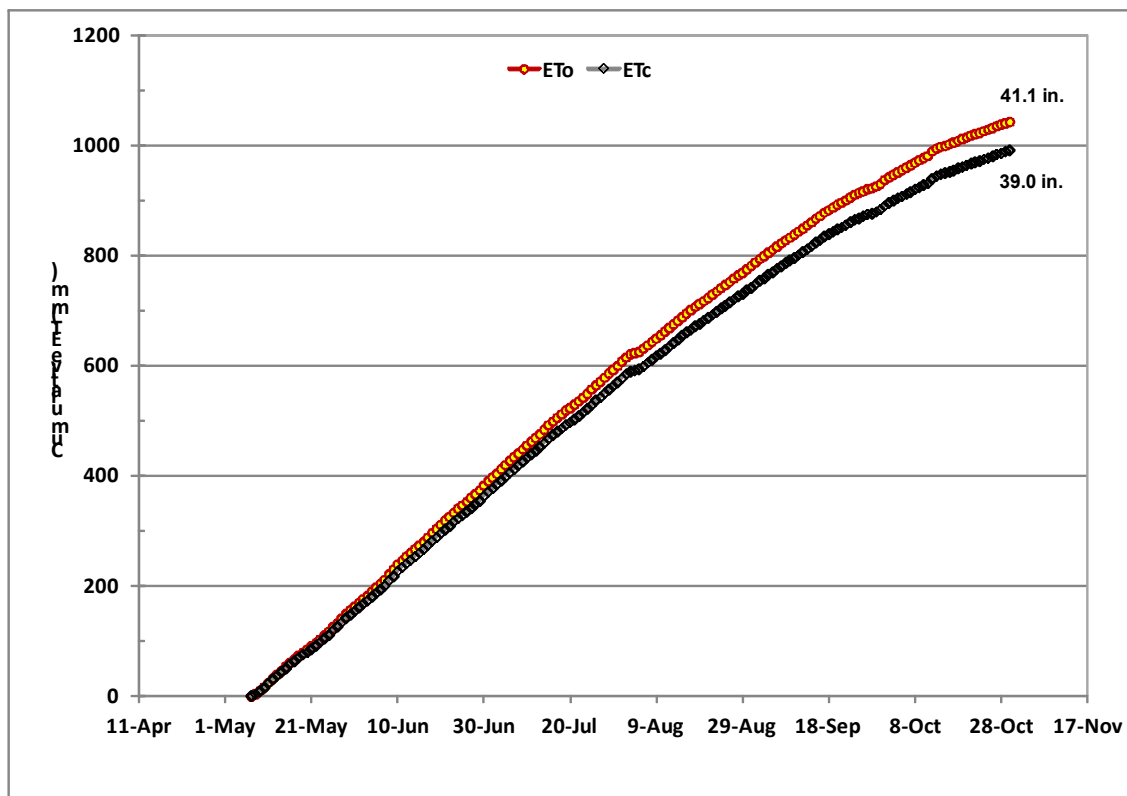


Figure 4. Cumulative ETo and ET<sub>c</sub> from the Alfalfa study 2014 (May 8<sup>th</sup> – Oct. 30<sup>th</sup>)

## **General Information**

CIMIS  $ET_o$  and weather data: <http://www.cimis.water.ca.gov/>

Seasonal Crop Coefficient:

$K_c = 0.95$  averaged over the season

Cycle Crop Coefficient:

$K_c \approx 0.40$  after cutting until irrigation

$K_c = 1.05$  to  $1.10$  from 2-3 days after irrigation until the next cutting