Validation of Evapotranspiration (ET) estimates and crop coefficients for Iceberg Lettuce using Weighing Lysimeters

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Abstract

Efficient water management remains a high priority in the southwestern United States. Disputes over water between nations, states, municipalities, and agricultural and urban interests are commonplace and agricultural interests are being challenged to use water resources more efficiently. The lower Colorado River region of southern California and Arizona produces more than 90% of the nation's leafy vegetables during the winter months. Lack of reliable crops coefficients is an obstacle to adaptation of irrigation scheduling methodologies. With previous funding from the United States Bureau of Reclamation we constructed weighing lysimeters to monitor evapotranspiration in crops. With this initial funding we successfully constructed, installed and calibrated weighing lysimeters in Yuma. We also calculated preliminary crop coefficients for lettuce. The objective of this proposal is to validate these ET data for iceberg lettuce during a different cropping season. Overall, the results of these data collected in 2011 agree with that with collected previously in 2008 and validate our ET estimates for lettuce.

Background Data

Over 7.2 million acre feet (9 billion m^3) of Colorado River water are diverted in California and Arizona. Approximately 4.2 million acre feet (5 billion m^3) are diverted at the Imperial Diversion Dam near Yuma to largely irrigate crops in the lower Colorado River region of southern California and Arizona. This region includes the Coachella and Imperial Valleys of southern California, the lower Colorado River food plain of southern California and Arizona, and a segment of the Gila River flood plain in Arizona. Disputes over water between nations, states, municipalities, and agriculture and urban interests are commonplace. Agriculture interests, including those in the lower Colorado River region, are being challenged to use water more efficiently.

Efficient irrigation depends on knowledge of when to irrigate, how much water to apply (water depth), and how to operate the irrigation system to apply the required water depth efficiently. The first two questions pertain to irrigation scheduling while the third question pertains to system design and management. While irrigation management has been an issue, we have developed information aimed at efficient irrigation management for surface systems over the past decade with funding from the United States Bureau of Reclamation (Sanchez et al., 2008a; 2008b; Zerihun et al., 2001; 2005). . However, limited information exists to accurately estimate ET, and appropriate crop coefficients for calculating ET from weather based ET^o estimates for irrigation scheduling are lacking. Recently, with funding from the United States Bureau of Reclamation we constructed weighing lysimeters and estimated preliminary ET and crop coefficients for lettuce. However, the validity of these estimates needs to be verified under a wider range of growing conditions.

The objective of this project is to use the weighing lysimeters constructed with previous funding to validate the ET estimates and crop coefficient generated under different growing conditions.

Methods

Four lysimeters were constructed using methodology described by others (Allen and Fisher, 1990). The lysimeters are 1.0 m^2 and 1.0 m depth. We used load cells for continuous measurement of ET as described by Allen and Fisher 1990. These lysimeters were constructed and installed in the summer of 2007. The lysimeteters are surrounded by a larger field area that is cropped identically to those produced inside the lysimeters. These lysimeters were successfully used for iceberg lettuce in the winter of 2007-2008. In these studies, we measured ET in weighing lysimeters in the fall of 2011 to validate estimates we made previously in 2008.

Results

The results of data we collected in 2008 are shown in Figures 1 and 2. The data collected in 2011 as part of this study are shown in Figures 3 and 4. . The water use in 2011 was similar to 2008 and the crop coefficient information is similar within the noise of this type of data and the lysimeters. The generalized crop coefficient curve is shown in Figure 5.

Literature Cited

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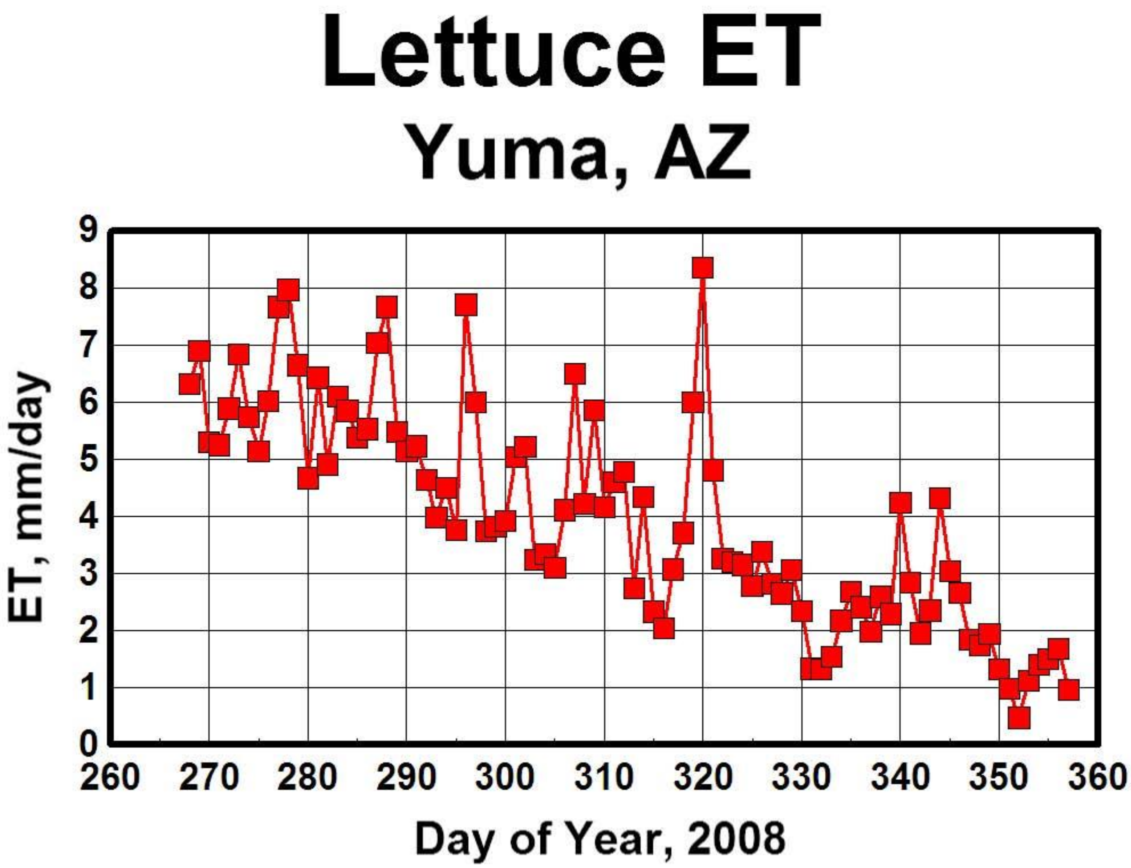

Figure 1. Measured ET in fall 2008.

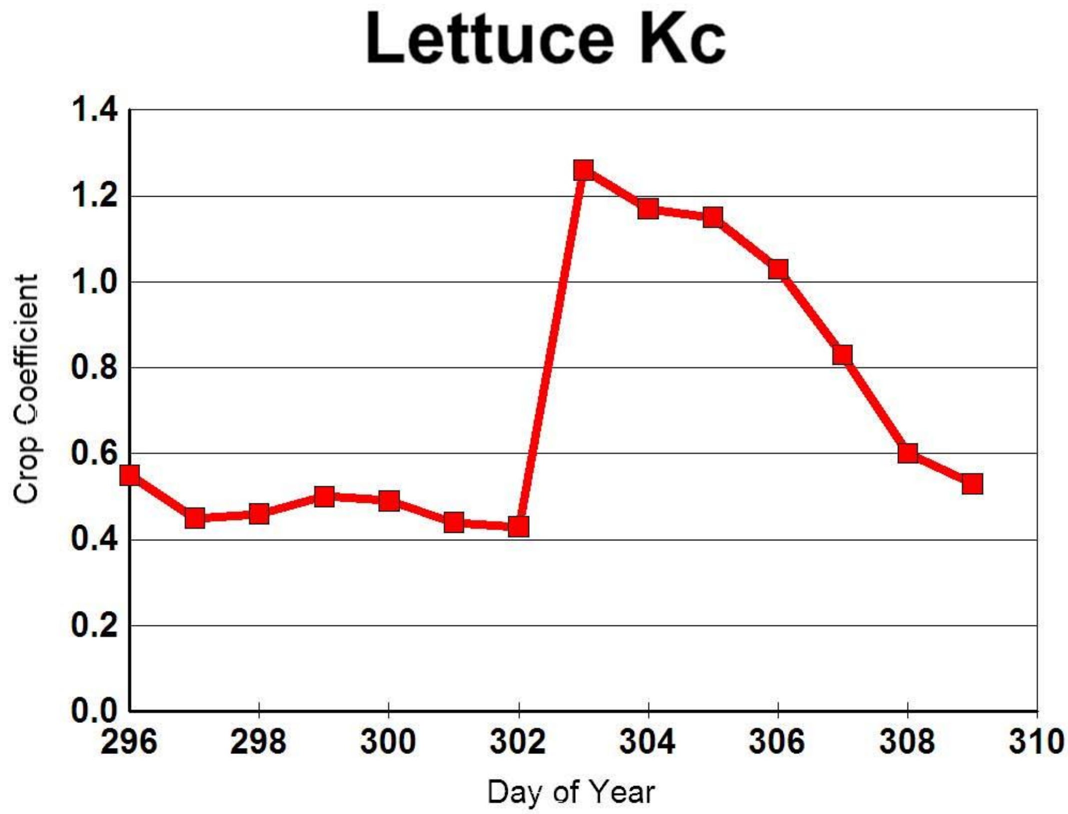

Figure 2. Calculated crop coefficients in fall 2008.

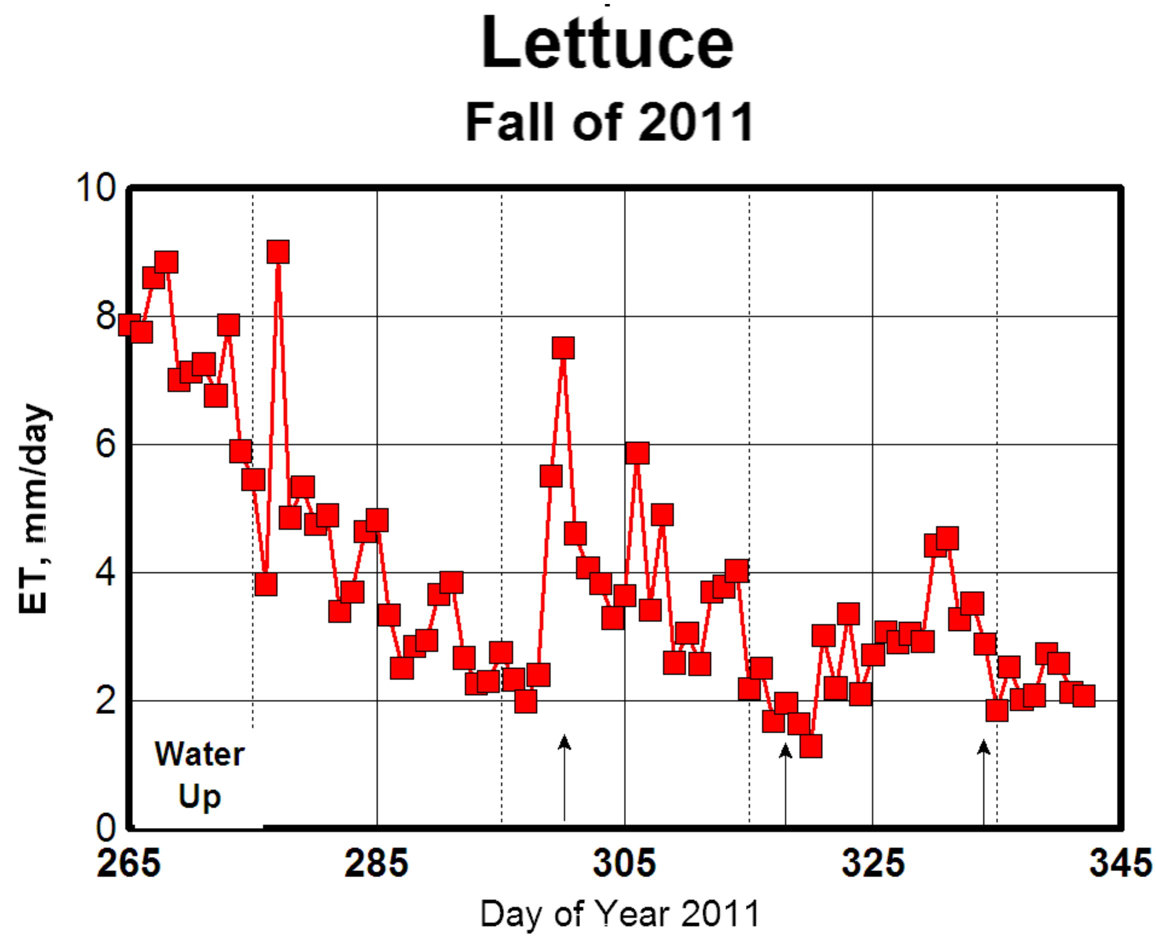

Figure 4. Estimated ET in fall 2011.

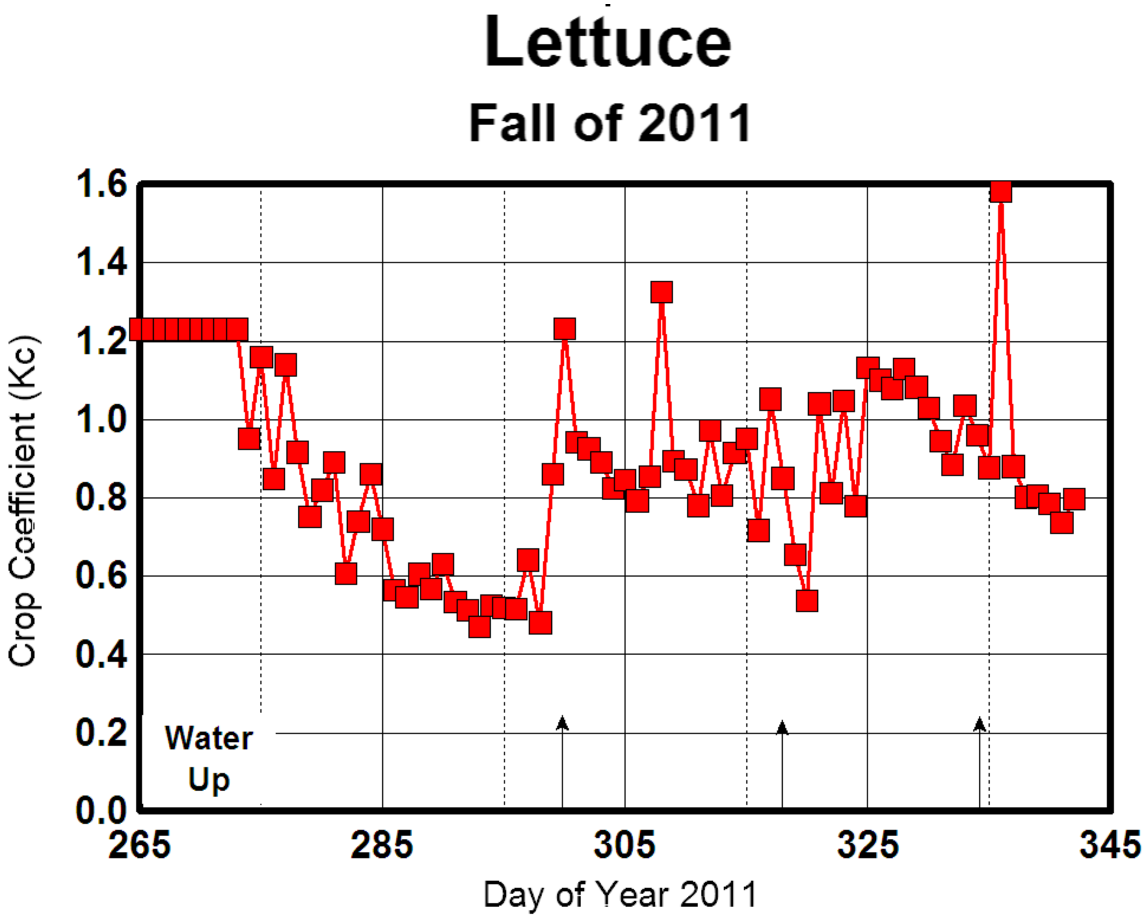

Figure 5. Calculated crop coefficients in fall 2011.

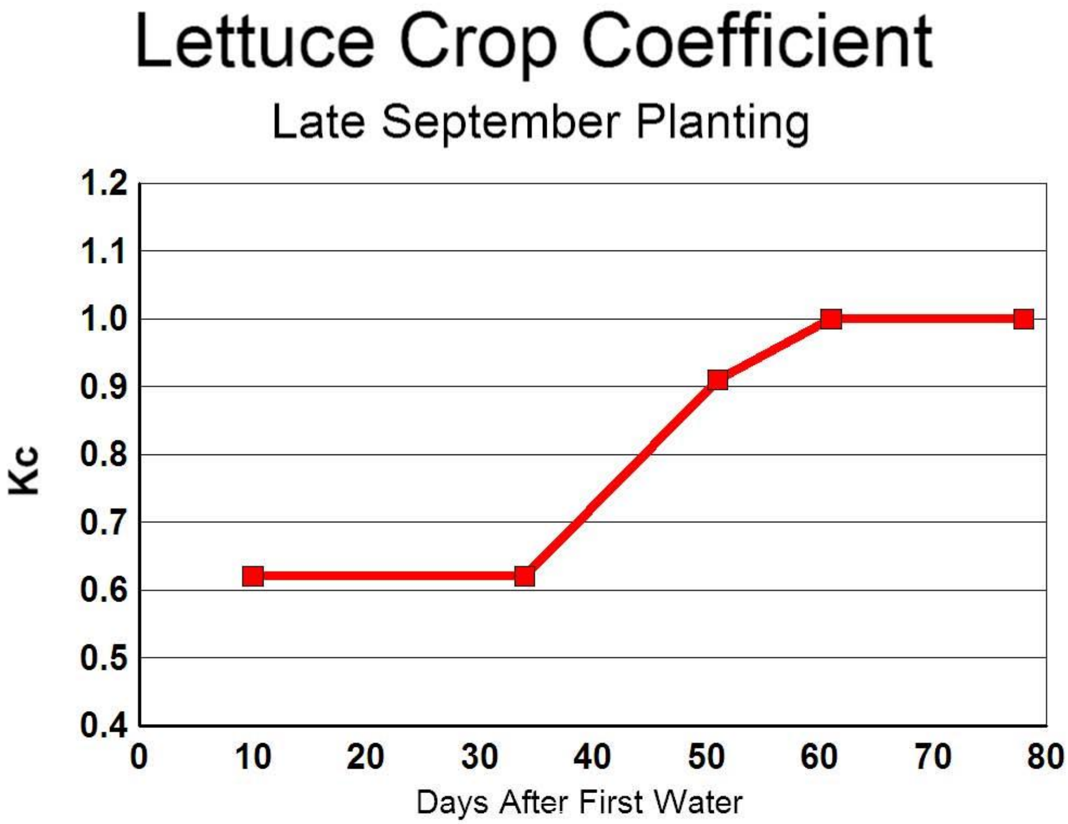

Figure 5. Generalized crops coefficients for fall lettuce.