

6-26-2017

Corn Water Use and Evapotranspiration

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Recommended Citation

Licht, Mark and Archontoulis, Sotirios, "Corn Water Use and Evapotranspiration" (2017). *Integrated Crop Management News*. 2441.
<https://lib.dr.iastate.edu/cropnews/2441>

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Corn Water Use and Evapotranspiration

Abstract

Crop water use (transpiration) during the growing season is a major factor in attaining high yield potential. Soil water loss (evaporation) and crop water loss (transpiration) occur simultaneously; making predictions of evapotranspiration complex. Actual evapotranspiration values vary greatly from day to day (0.04 to 0.40 inches/day) because of the following factors:

- **Soil:** residue cover, soil texture, soil moisture in the profile
- **Crop:** crop type, growth stage, cultivar
- **Climate:** radiation, temperature, relative humidity, wind speed

Disciplines

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Integrated Crop Management

Corn Water Use and Evapotranspiration

June 26, 2017

Crop water use (transpiration) during the growing season is a major factor in attaining high yield potential. Soil water loss (evaporation) and crop water loss (transpiration) occur simultaneously; making predictions of evapotranspiration complex. Actual evapotranspiration values vary greatly from day to day (0.04 to 0.40 inches/day) because of the following factors:

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We used the APSIM model to calculate average evapotranspiration values for a central Iowa cornfield to provide information on crop water use and loss during the growing period. The model was previously calibrated for evapotranspiration predictions using eight years of daily evapotranspiration measurements from a USDA-LTAR experiment in central Iowa with corn grown under conventional tillage systems (Kimball et al., 2016).

From planting to V6 stage evaporation accounted for 70 percent of evapotranspiration while from V6 to R6 plant transpiration accounted for the 70 percent of the evapotranspiration for a 200 bushel per acre corn crop (Figure 1). Crop water use increased with leaf number progression. Water demand by corn was maximized around V18. At that stage, the average evapotranspiration was 0.2 inches per day.

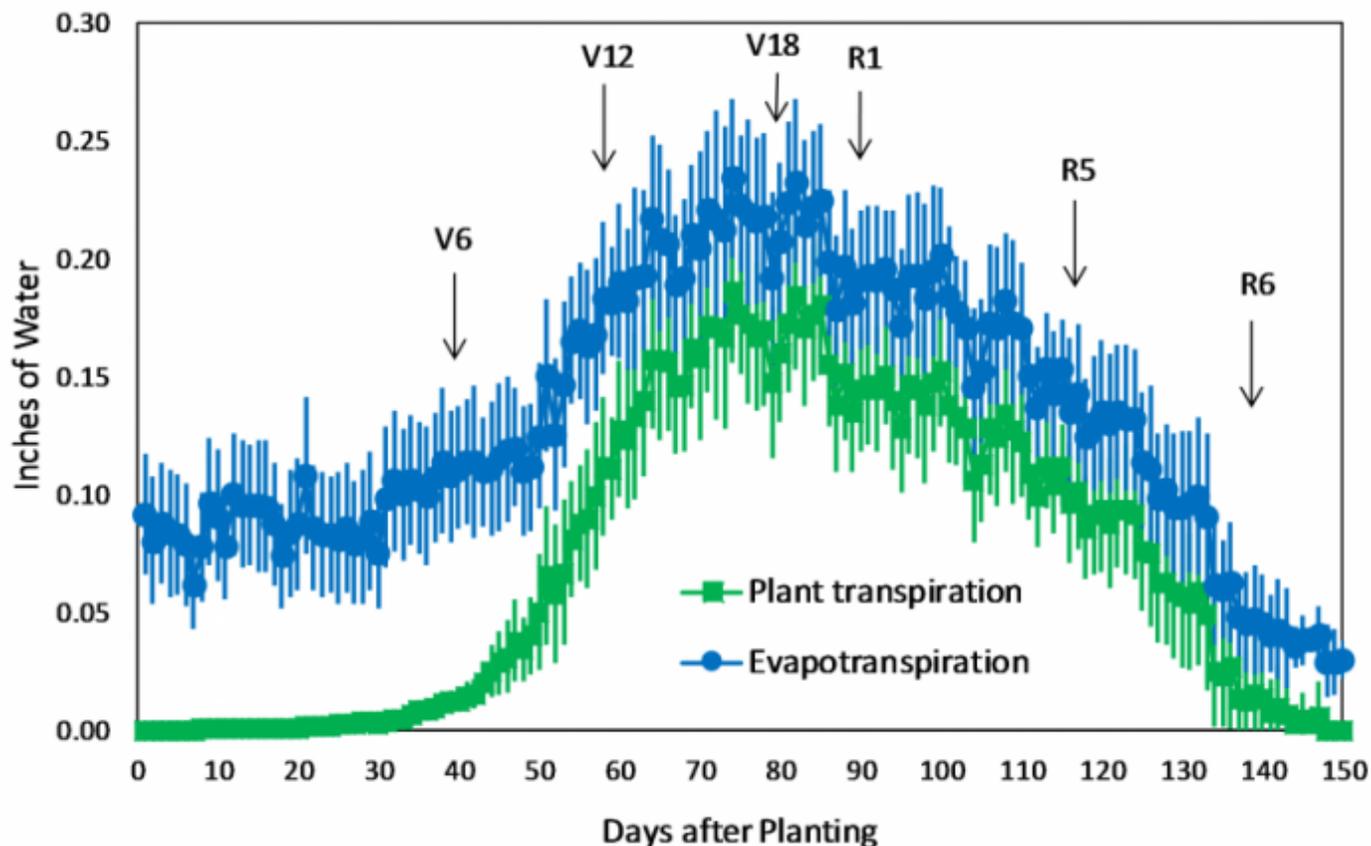


Figure 1. Evapotranspiration and plant transpiration values from planting through crop maturity for a 110-day corn hybrid growing in central Iowa. Data are average values across 35 simulations that includes different weather years using the well-calibrated APSIM model for this environment. The average simulated yield across 35-years was 200 bushels per acre.

In extreme situations such as high wind speed, high temperatures, low relative humidity, and adequate soil moisture the rate of evapotranspiration can be as high as 0.4 inches per day. For daily estimates of crop water use for different cropping systems across Iowa see [FACTS](#). For example, Figure 2 shows 2017 FACTS predictions for crop transpiration and soil water availability for a central Iowa corn field. This clearly shows how variable the crop water use can be from day to day.

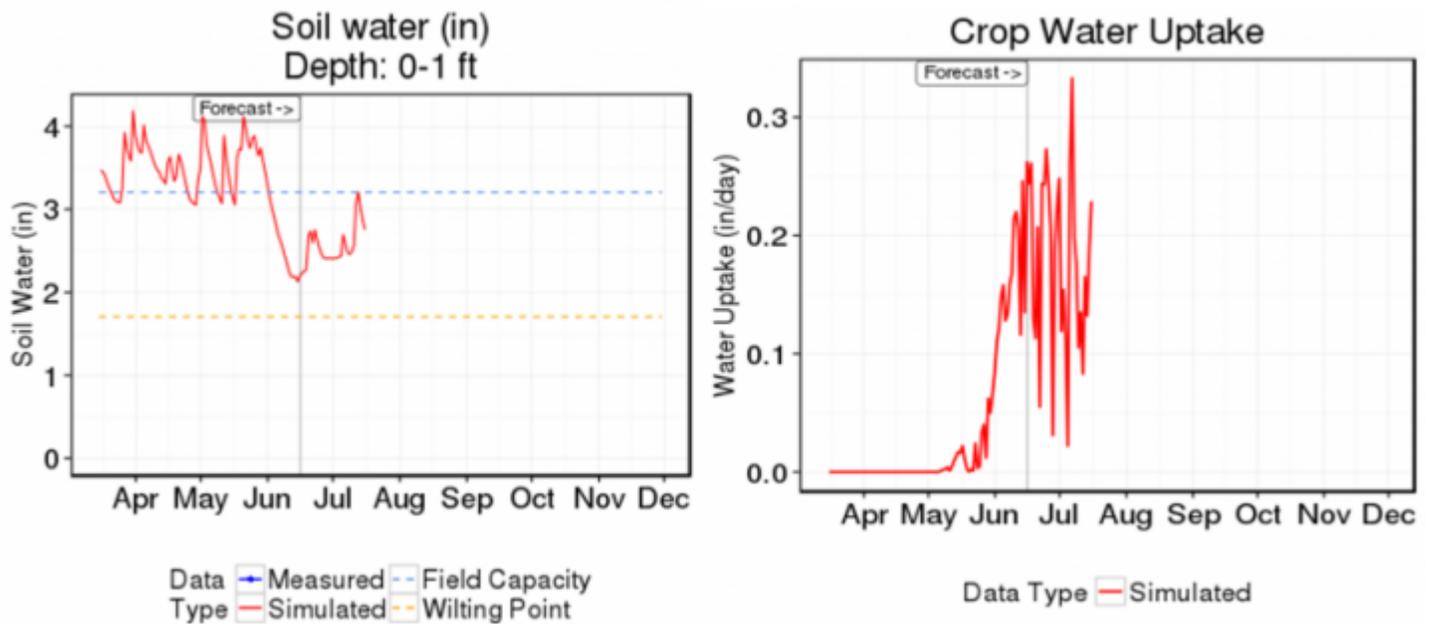


Figure 2. Simulated soil water (left panel) and crop water uptake (right panel) at a central Iowa FACTS corn field planted on April 24, 2017. On the soil water panel, the blue dashed line represents field capacity and the orange dashed line represents the wilting point.

Higher corn yields require more water transpiration and therefore more evapotranspiration (Figure 3). Typically, a 150 bu/ac corn uses 16 inches of water, 200 bu/ac corn uses 20 inches of water, and 250 bu/ac corn uses 22 inches of water. For every inch of evapotranspiration corn yield increases by approx. 17 bushels.

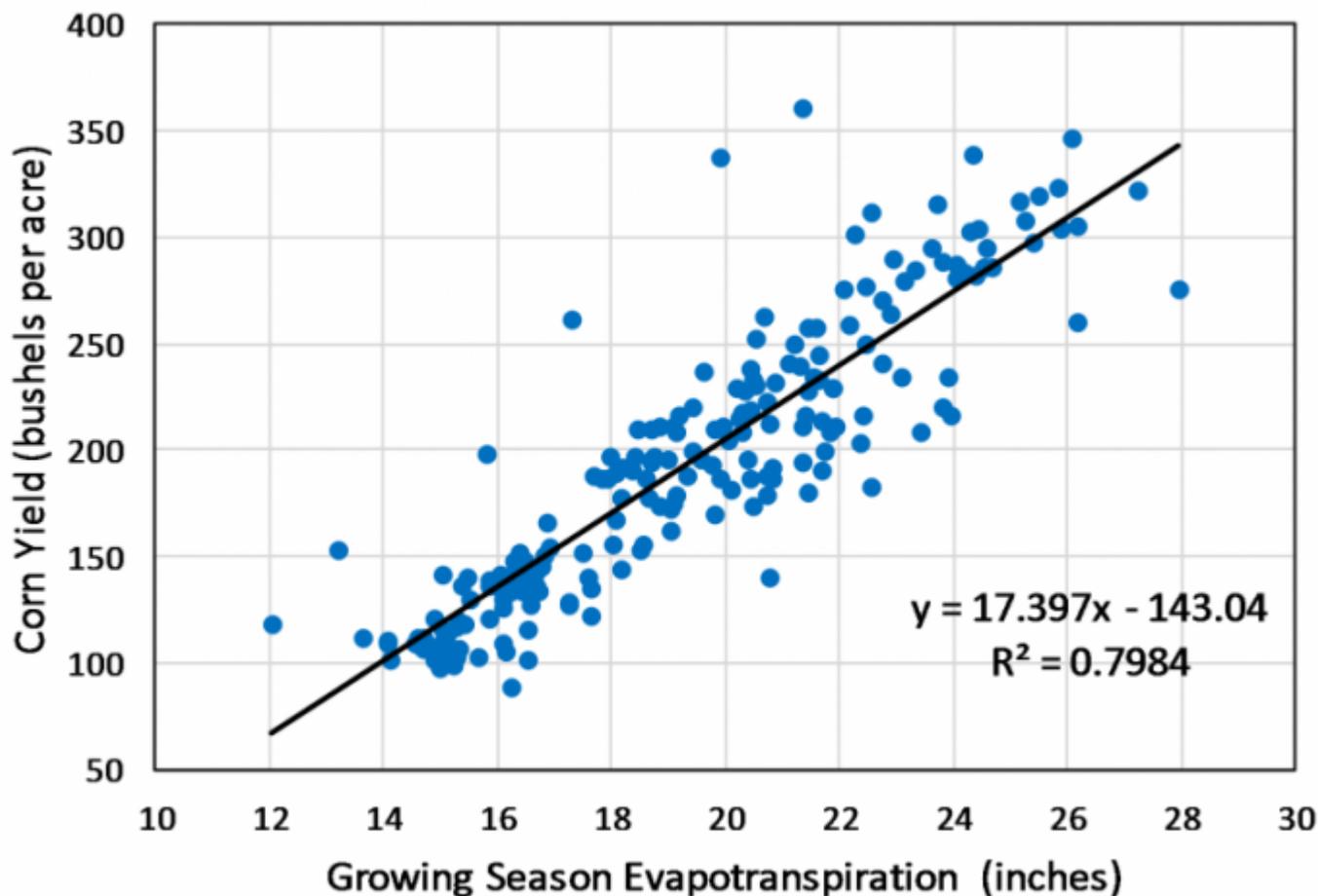


Figure 3. Relationship between corn yields and evapotranspiration.

A lack of soil moisture will reduce evapotranspiration rates and therefore crop yields. In a previous [ICM News article](#) we talked about corn roots growing at approximately one inch per day. Root growth requires available soil water. And the growth of roots allows the plant to explore a greater volume of soil and continue to take up moisture from deeper soil depths as shallower depths become depleted.

Reference

Kimball, B., K. Boote, J. Hatfield, L.R. Ahuja, C. Stockle, S.V. Archontoulis, C. Baron, B. Basso, et al. 2016. Prediction of evapotranspiration and yields of maize: An inter-comparison among 29 maize models. ASA-CSSA-SSSA annual meeting, Phoenix, AZ. 6-9 November 2016.

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Category: Crop Production

Crop:

Corn

Tags: evapotranspiration Corn water use

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