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Atmometers

A flexible tool for irrigation scheduling.

Irrigation scheduling based upon crop ET (evapotranspiration) is often perceived as too difficult or too time consuming for many producers and crop advisers. However, there are tools available that reduce the work and the complexity associated with sound ET-based irrigation scheduling. Atmometers are one of these tools. The primary purpose of these instruments is to provide actual crop ET at any field location they are installed. This information is visually displayed on a site tube mounted in front of a ruler on the instrument. Reading the site tube is as easy as reading a rain gauge. Therefore, a grower or consultant can use an atmometer to quantitatively gauge how crop water use varies with changing weather conditions.

Essentially, an atmometer acts as mini-weather station that, when properly installed, will provide reference ET (ET_r) at a reasonable cost and with little effort. One Colorado supplier sells a modified atmometer (ETgage®). They are easy to install and require little maintenance. Studies conducted by CSU and the USDA in Fort Collins show that an atmometer will provide ET_r values that closely match ET_r calculated from weather station data (Figure 1). This ability to provide reliable ET makes atmometers especially useful for areas that do not have nearby weather stations or for people that do not have ready access to this information. A consultant or grower can install an atmometer to help schedule irrigations for many fields within a several mile radius. Also ET data from an atmometer may be more convenient and site specific than other sources.

Atmometer placed between irrigated fields.

Atmometer

Atmometers basically consist of a wet, porous ceramic cup mounted on top of a cylindrical water reservoir. The ceramic cup is covered with a green fabric (canvas or Gor-Tex®) that simulates the canopy of a crop. The reservoir is filled with distilled water that evaporates out of the ceramic cup and is pulled through a suction tube that extends to the bottom of the reservoir. Underneath the fabric, the ceramic cup is covered by a special membrane that keeps rain water from seeping into the ceramic cup. A rigid wire extending from the top keeps birds from perching on top of the gauge.

Atmometers are typically mounted on a wooden post near irrigated fields. A good location for placement is a border ridge in an alfalfa field. However, you may also locate the instrument alongside a dirt road if surrounded by low-growing irrigated crops. The site should represent average field conditions. Do not install near farm buildings, trees, or tall crops that may block the wind. Additionally, avoid placement near dry, fallow fields. The top of the ceramic cup should be 39 inches above the ground. The manufacturer of a modified atmometer sold in Colorado (ETgage®) provides detailed instructions on how to install and maintain their instrument.

The following is a brief description of how to use an atmometer to help schedule irrigations.

- ♦ The atmometer has two movable red markers on the site tube. Record height of water in the sight tube at the start of an irrigation event. The top marker can be used to record the initial height of water.
- ♦ Crop water use can be estimated by recording the drop in water level over a period of days. To determine the actual water use for a crop that has not fully completed its canopy, you need to multiply the drop in water level by a crop coefficient (multiplier) supplied in literature that comes with the atmometer (see Table 1) to estimate actual water use over a period of days. For crops at full canopy, water loss from the atmometer will be practically equal to actual crop ET.

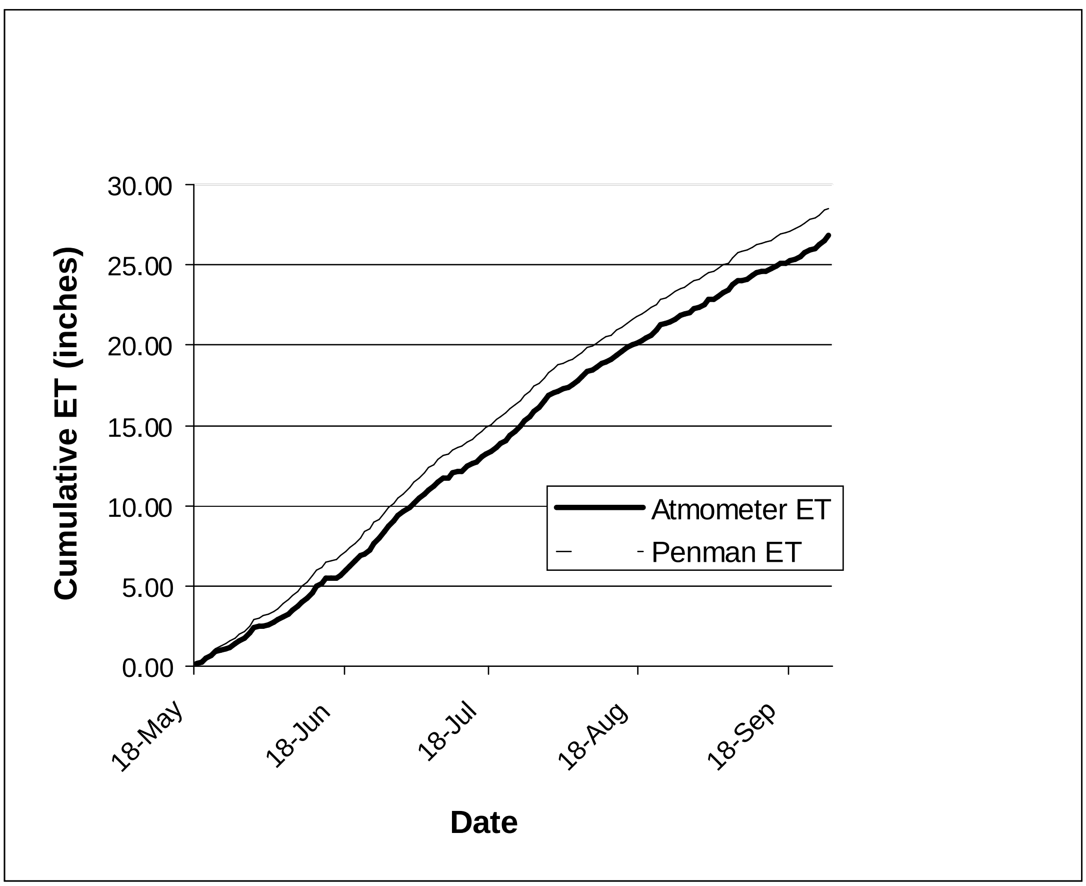

Figure 1: Comparison of Atmometer ET to Penman ET. **Source: Bausch and Altenhofen.**

Atmometer

♦ Irrigation is needed when the accumulated ET_r x crop multiplier equals the allowable depletion for that soil type and growth stage (see Table 1).

Example #1:

- The crop corn is 6-leaf and the ETgage drops 1.45" over an 8-day period from the last irrigation.
- The crop coefficient is 0.55 so the crop used about 0.8" during this time. This value is equal to the 0.8" depletion for this growth stage.
- Irrigation water should be applied to refill the soil profile (~0.8") in time to avoid crop stress.

♦ Another way to estimate the next irrigation event with an atmometer is to move the 2nd marker on the sight tube below the marker set at the last irrigation to the amount of allowable depletion for the crop growth stage. However if the crop has not covered canopy, you have to divide the allowable depletion by the crop coefficient to determine actual depletion. When the water in the sight tube reaches the bottom marker, irrigation is required if no rain is received.

Example #2:

- The corn is 8-leaf, the multiplier is 0.65", and the allowable depletion is about 1.25". 1.25 ÷ 0.65 = 1.9"
- If you set the 2nd marker 1.9 inches below the initial water level, you should irrigate in time to refill the profile before the water level approaches the 2nd marker.

♦ If a significant rainfall occurs (>0.1") you can move the markers down on the site tube to factor in the additional moisture.

As these examples illustrate, once an allowable depletion is determined, using the atmometer to help schedule irrigations is as simple as reading a rain gauge. It is especially useful for center-pivot users or surface irrigators that know their applications amounts. In these cases, you should irrigate when the site gauge drops to the same amount as the typical irrigation application.

When using any ET-based irrigation scheduling, field verification of soil moisture status is a good idea. Field probing can confirm needed irrigation and provide confidence in using ET-based scheduling. An atmometer can also be used in conjunction with computer scheduling software such as Cropflex, especially if users do not have internet access. This tool can also help growers deal with salinity problems by providing ET over a period of time to determine leaching rations.

Growers interested in trying an atmometer for a season should contact your regional CSU Cooperative Extension water specialist.

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Table 1. Examples of allowable depletion for corn for typical Colorado sandy loam soil.

Corn leaf stage	Rooting depth (inches)	Crop coefficient	Total rootzone available H_2O (inches)	Allowable rootzone depletion (inches)
4	9	0.35	0.9	0.54
6	15	0.55	1.6	0.8
8	21	0.65	2.3	1.25
10	30	0.90	3.4	1.7
12 & up	36+	1.0	4.1	2.0