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AN EASY METHOD OF ESTIMATING POTENTIAL EVAPOTRANSPIRATION[1]

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Stress from lack of moisture reduces crop yields in Kansas more than any other factor. Even irrigation farmers lose potential yields to such stress, particularly by corn, sorghum, and soybeans, usually during July and August.

To help irrigation farmers tell how much moisture is being used and lost by plants, we have developed an easy way to estimate potential evapotranspiration. Potential evapotranspiration (PET) is evaporation from a wet surface that is limited by the energy it can absorb. The more energy it absorbs, the higher evaporation is. So it is much higher on a sunny than on a cloudy day.

PET depends primarily on energy from the sun. Various methods of estimating PET require data on solar radiation, temperature, humidity, and wind speed. Because solar radiation and average temperature are relatively easy to measure, we chose what is called the Priestley-Taylor method of estimating PET.

The National Weather Service and several Agricultural Experimental Stations and Fields measure both solar radiation and temperature—as do other stations around the State

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maintained by the Evapotranspiration Laboratory.

Figs. 1-3 show the relationship between daily solar radiation and daily PET at various mean temperatures. The values for solar radiation are given in units used by the National Weather Service: cal $cm^{-2}day^{-1}$. For Kansas, a clear summer day would typically have about 650 cal $cm^{-2}day^{-1}$; a cloudy day, about 450; an overcast day, about 150 cal $cm^{-2}day^{-1}$.

Example Calculations:

Suppose you wanted to know the potential evapotranspiration for corn. The solar radiation was 600 cal $cm^{-2}day^{-1}$, maximum temperature was 30°C (86°F) and minimum temperature was 25°C (77°F). You would calculate the average temperature as (30 + 25)/2 = 27.5°C (81°F). Look on Fig. 1 (wheat-corn) and select the appropriate point between the 30 and 20°C lines. The PET value is approximately 0.24 inch of water. If maximum and minimum temperatures are not available, use the noon temperature.

Actual Evapotranspiration

Under a **full crop cover** and water not limiting (plants not severely stressed), actual evapotranspiration (ET) and PET are approximately equal. Therefore, under normal cropping conditions ET equals PET for an extended period during the summer—from pretasselling to blister stages in corn and from flowering to seed filling in soybeans. Under situations of low crop cover, (e.g. poor stand development, early and late in the growing season, and with winter wheat in western Kansas), actual evapotranspiration can be considerably less than PET. Then, evaporation from the soil surface begins to play an important role. The Evapotranspiration Laboratory has developed a computer program to handle situations of incomplete cover and water stress.

While the above procedure provides only an approximation of daily PET, it allows one to make a quick estimate of daily water loss from several crops during much of July and August in Kansas when irrigation to avoid stress is most important.

Scheduling of irrigation has been determined by the amount of water in the root zone

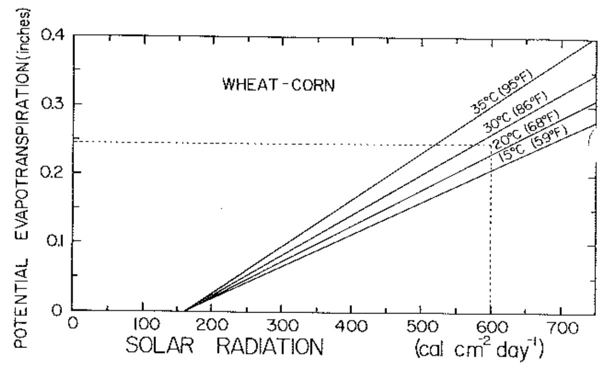

Fig. 1. Potential evapotranspiration for winter wheat and corn as a function of solar radiation and mean temperature.

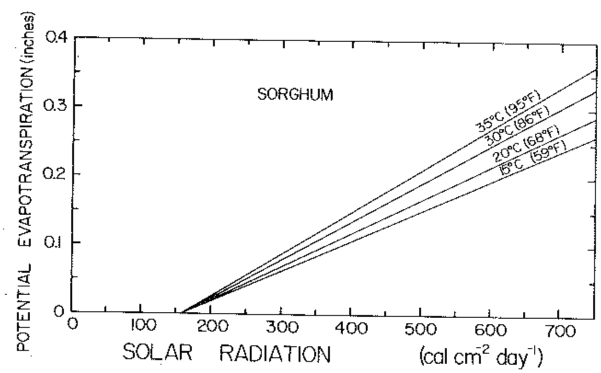

Fig. 2. Potential evapotranspiration for sorghum as a function of solar radiation and mean temperature.

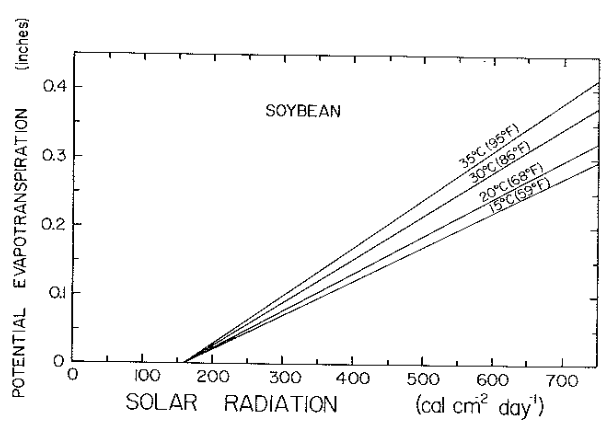

Fig. 3. Potential evapotranspiration for soybean as a function of solar radiation and mean temperature.

and by the growth stage of the crop. Generally, the reproductive stages (heading, pod-forming, tassel-silking) are more sensitive to water stress than the vegetative stage. In Kansas, the amount of water in root zone is primarily controlled by precipitation/irrigation and evapotranspiration. To maintain the root zone at an optimum soil water content, evapotranspiration losses must be matched by rain or irrigation. For example, 2 inch irrigation on corn can be used up in eight hot days (8 x .25 inch).