3.2 Irrigation Scheduling

*Applicability*

This best management practice is used to determine when to irrigate a crop and is intended for agricultural producers that have access to irrigation water in adequate quantities and at times required by the producer. Advanced irrigation scheduling methods are particularly applicable to pressurized irrigation systems, including agricultural center pivot and linear sprinkler irrigation, micro-irrigation systems, and nursery/floral irrigation systems that have an adequate water supply and delivery systems.

*Description*

Irrigation scheduling is a generic term for the act of scheduling the time and amount of water applied to a crop based on the amount of water present in the crop root zone, the amount of water consumed by the crop since the last irrigation, and other management considerations such as salt leaching requirements, deficit irrigation management strategies, and crop yield relationships. Irrigation scheduling is a water management strategy that reduces the chance of too much or too little water being applied to an irrigated crop. Extensive publications exist regarding irrigation scheduling, many of which are documented in “Evapotranspiration and Irrigation Water Requirements” by the American Society of Civil Engineers, Manual No. 70. The most common irrigation scheduling methods are:

1)  Direct measurement or estimation of soil water content, soil water potential, or crop stress including soil sampling (gravimetric water content determination); use of soil water sensors (tensiometers, gypsum blocks, time domain reflectometry, electrical conductivity, time domain transmissometry, and others); use of plant-based indicators (infrared thermometry or infrared photography of crop canopy, plant leaf water potential), and other methods.

2)  Irrigation scheduling methods based on soil water balance equations. These equations range from very simple “checkbook” accounting methods to complex computer models that require input of local weather data measurements such as temperature, humidity, solar radiation, and wind speed. Texas A&M AgriLife Extension maintains a network of weather stations that are used to determine the “Reference Evapotranspiration” in some urban (for turf water irrigation scheduling) and agricultural locations in Texas. Local on-site evapotranspiration estimates can also be obtained through on-site weather stations, as these tools with “plug and play” telemetry are commercially available and increasingly affordable, as well as part of advanced “smart” irrigation controllers that integrate local weather data. Quality of data depends on proper siting and calibration of sensors.

*Implementation*

Each type of irrigation scheduling method has specific steps required for implementation. The manufacturers of soil water measurement equipment typically provide detailed instructions on how to install and operate their equipment. Soil water balance implementation information can be obtained from Texas A&M AgriLife Extension– Texas Evapotranspiration Network web site (texaset.tamu.edu) ET User’s Guide for Growers. This guide has step-by-step instructions for using evapotranspiration for scheduling irrigations.

*Scope and Schedule*

All irrigators, to one degree or another, schedule their irrigations. However, only a small percentage of agricultural producers use advanced irrigation scheduling methods. The producer has to balance crop water needs with availability of irrigation water, capacity of the irrigation system, labor and other factors. In many cases, especially in more arid areas, limited water supplies and limited irrigation capacities affect irrigation management options. Under these conditions, deficit irrigation management strategies may be used to maximize water use efficiency or to maximize economic return on the limited irrigation resources available. This may include selecting lower water use crops, limiting irrigated area, timing irrigation applications for most beneficial crop growth stages (yield and/or quality of many irrigated crops can be especially dependent on adequate soil moisture at one or more critical periods in crop growth.) , and upgrading to more efficient irrigation systems.

Costs of irrigation are compared with economic losses due to reduced crop yield and/or quality if irrigation is delayed, reduced, or no water is applied. Irrigation scheduling can be implemented at any time during crop production. However, best results are realized when an irrigation scheduling protocol is developed prior to planting a crop, considering all of the production and economic limitations. Most crops benefit from consistent irrigation management strategies.

*Measuring Implementation and Determination of Water Savings*

To document this best management practice, the agricultural water user should document and maintain one or more of the following records:

* Records of the amount of rainfall, irrigation dates, and volumes (depth) of water applied during each irrigation and the method of application;
* Records of the location and information collected from direct measurement of soil moisture; and
* Copies of irrigation scheduling program reports or printouts.Commercial services that monitor and report multiple of the above criteria and provide information throughout the season are very useful in improving irrigation scheduling. These services are most useful in pressurized irrigation systems where water flow and pressure measurements can be logged.

The amount of water saved by implementing advanced irrigation scheduling is difficult to quantify, likely varies from year to year, and is strongly influenced by weather variation, crop type (and water demand), cropping practices, irrigation water quality, and total amount of water used to irrigate. The Pacific Northwest Laboratory (1994) attempted to verify estimates of reduction in the amount of irrigation water pumped in the Grand County Public Utility District resulting from the implementation of irrigation scheduling. The public utility district estimated savings of 0.3 to 0.5 acre-feet per acre, but actual savings could not be confirmed or disproved by the Pacific Northwest Laboratory’s review.

*Cost-Effectiveness Considerations*

The cost for implementing advanced irrigation scheduling methods depends on the method of scheduling used and the number of fields scheduled, the type of scheduling program, and the cost for technical assistance. Depending on the producer’s investment in the crop ($200 to $1,200 per acre) and the cost of water ($10 to $50 per acre per irrigation), the producer may choose to irrigate independently of any irrigation scheduling program.

*Determination of Impact on other Resources*

Other than water savings, energy usage is the primary resource impact resulting from implementing this best management practice. Energy usage per acre-foot of water used can be calculated if the volume of water used is measured (see Volumetric Measurement of Irrigation Water Use Best Management Practice) and the energy required to pump the water is measured (or determined from energy bills, for instance). However, as discussed in an earlier section, the amount of water saved is difficult to quantify.

*References for Additional Information*

1. 1)  *Evapotranspiration and Irrigation Water Requirements, Manuals and Reports on Engineering Practice No. 70*, 332 p., American Society of Civil Engineers, 1990
2. 2)  *Texas AgriLife Research Centers.* http://agriliferesearch.tamu.edu/units/centers
3. 3)  *Texas Evapotranspiration Network, Texas A&M University-College Station,*

Department of Biological and Agricultural Engineering. http://texaset.tamu.edu/

1. 4)  *Applicability and Limitation of Irrigation Scheduling Methods and Techniques*,

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Organization. http://www.fao.org/docrep/W4367E/w4367e04.htm

*Acknowledgments-None*