

► Weather - And Sensor - Based Methods For Irrigation Scheduling And Water Management

Presented by Dr. Daniel K. Fisher

Research Agricultural Engineer, USDA-Agricultural Research Services

Better irrigation scheduling and improved water management are topics of increasing interest and concern. Competition over dwindling water supplies, and future changes and uncertainties in rainfall and water availability, will affect irrigated agriculture, a large user of water resources. While water use by agricultural producers is of benefit to all, improvements in water management will also be of benefit to agricultural productivity and sustainable operations.

Irrigation scheduling has long been advocated as an improved water-management technique which agricultural producers can employ to better utilize water resources, reduce crop stress, and stabilize or improve crop yields. Proper scheduling of irrigations can also result in savings in energy and labor costs, and reductions in runoff of water and agricultural chemicals. While much work has been done to develop a variety of scheduling tools, producers are hesitant to adopt these objective, scientific methods, and continue to rely on subjective, visual indicators to make critical water-management decisions.

There is often a misconception about the term “irrigation scheduling” and what is involved in its use. Irrigation scheduling is basically the use of some type of objective information to decide if it is time to turn on the water and irrigate the field. Irrigation scheduling is another tool available to the producer to offer guidance and help in making decisions regarding application of a valuable production input, namely water, and need not be a complicated or time-consuming endeavor. By collecting and evaluating this information, the producer can better determine the need for and appropriate timing of water application to address crop water needs and fit irrigation in with other production operations.

A variety of methods and tools are available to monitor the water resources and offer guidance in making irrigation and water-management decisions. The most commonly used methods fall into two broad categories; weather-based computer-software and models, and sensor-based hardware and electronic instrument systems. The methods differ in the types of equipment used, information input for analysis, information output to the user, and cost and labor involved in installation and operation of the systems.

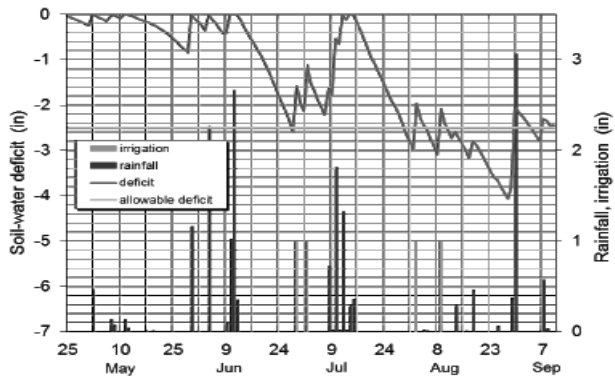
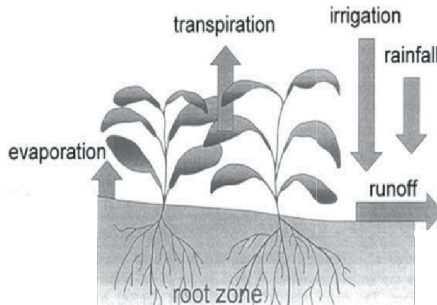
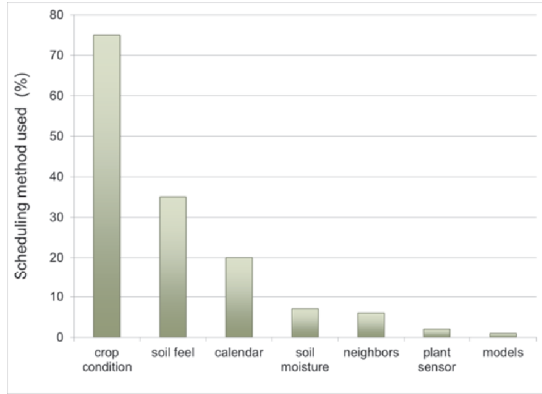
Weather-based methods estimate crop-water use and available soil-water resources for the region using weather and crop information. The water-balance approach, often referred to as the checkbook method, tracks the movement of all water coming into and out of the soil. Crop-water use is estimated from local weather data and crop-specific parameters, and combined with rainfall and irrigation

information to obtain a daily accounting of water use and accumulated soil-water deficit. When the deficit reaches an allowable level, an irrigation is signaled, and water is applied to recharge the depleted soil-water reserves.

Weather-based models are available as stand-alone computer programs, with newer, internet browser-based utilities being released in many regions around the country. Mobile/smartphone apps are also being developed to offer convenient and timely information in a readily available format. Water-balance models usually involve little, if any, additional investment to install or use with an existing computer or internet access, and require minimal investment of time and labor to periodically update weather data and analyze model output.

Sensor-based methods range from simple hand tools for periodic sampling to automated, electronic sensors and datalogger systems for continuous, season-long monitoring. Old-school methods, involving soil probes or augers, provide access to real, tangible conditions in the soil and root zone, but require time and effort to visit and sample the fields, as well as some experience in interpreting the look and feel of the soil to evaluate moisture conditions and determine whether insufficient moisture is available to the crop.

For detailed monitoring, electronic datalogging instruments and soil and plant sensors provide continuous, automated measurements. Utilizing sensor data requires more of an investment to purchase and main-



tain the instrumentation, and some time and effort to install and configure the sensors and sensing equipment. Additional time and labor may be needed to periodically visit monitoring locations to download data, and to analyze and interpret the information. With rapid advances in wireless, cellular, and internet access, sensor systems are increasingly being made available with remote data-transmission capabilities, resulting in more convenient and timely access to sensor information. By regularly monitoring sensor readings, the producer can determine when an allowable level is reached, soil-moisture levels become limiting, and an irrigation is needed.

Irrigation scheduling tools enable the monitoring of water resources on a daily basis. With knowledge of current conditions throughout the growing season, real-time scheduling of irrigations can be achieved. Real-time scheduling, however, is not always the goal or an option for some producers. The information can also be used in a retrospective, diagnostic manner, for post-season evaluation of irrigation activities and crop-water use. Sensors can be installed and measurements collected passively throughout the season, or water-balance models run after harvest. Data are then examined, in conjunction with other production

information, to evaluate how irrigation and production operations affected soil-water resources and crop yields. Changes or adjustments may be suggested for the following season to improve efficiency of irrigations, avoid over- or under-watering, and improve overall water-management activities.

