IRRIGATION SCHEDULING DEMONSTRATION IN WESTERN KANSAS[1]

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ABSTRACT

Irrigation-scheduling demonstration fields planted to corn were set up in eleven counties in southwestern Kansas. Each site was equipped with soil-water sensors at two locations and placed at three depths. Evapotranspiration (Et) data from the weather station at the Southwest Research-Extension Center (SWREC) were used to calculate water balance. A simple device called an Et gage was also installed along with a rain gage. Daily Et data were collected from the Et gages located at the SWREC weather station site. These were in good agreement with the Penman reference Et that was calculated from the weather data at the same location. Scheduling based on Et helped producers to take advantage of rainfall to meet the crop's water need. Soil sensors helped in validating soil water status and making irrigation scheduling decisions. Irrigation scheduling for better irrigation management is the key to water conservation. An intensive educational effort is necessary to make the adoption of irrigation scheduling by farmers a reality. Computer spreadsheet and software are now available that make data retrieval faster and allow quick decisions.

Keywords: Irrigation scheduling, soil-water sensors, evapotranspiration (ET)

INTRODUCTION

Irrigation scheduling means providing an appropriate quantity of water to the crop at the proper time to secure profitable production. Irrigation provides for consistent annual production of corn, grain sorghum, wheat, alfalfa, soybean, and sunflower in western Kansas. About 2 million acres in this region depend on the Ogallala aquifer, a confined system with extremely limited recharge. The water level is declining, and depletion of this nonrenewable reserve has become a major focus for economic sustainability. Introduction of center pivot irrigation systems has improved application uniformity, but irrigation scheduling and good management is required to achieve more efficient water use. Various methods are available to make a decision on irrigation timing and to calculate the amount. Farmers have used the appearance of the crop to decide when to irrigate. However, by the time the visual symptoms become apparent, the crop already has suffered from stress, and the optimum production may have been affected. Evapotranspiration (Et)-based irrigation with appropriate soil-water monitoring is the most scientific method to implement irrigation scheduling.

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Crop water demand is low in the early growing season. The root system is less prolific and is drawing from the top layer of the root zone. Information on crop water use (Et), available soil water capacity, and root depth may help in deciding on when to irrigate and how much water to apply. Early growing season provides ample opportunity to save water by applying only the amount needed.

Most of the farmers hire consultants who guide them through the season. Consultants want to avoid risks with water application, because water is considered to be a relatively cheap input. They use feel and appearance of soil to evaluate soil water status and tend to be conservative in their evaluation. This may lead to over application of water.

Kansas State University has launched an educational program, and County Extension Agents have set up demonstration sites to work one-on-one with owners/operators. The consultants are encouraged to participate in the program.

PROCEDURES

The farmer operators agree to keep irrigation application records and bulk yield data. Each demonstration site was equipped with soil-water sensors like gypsum blocks, Watermark* sensors, and tensiometers. Three types of sensors were used for the purpose of demonstration and validation of suitability according to soil textural type. These were set up in two locations per field at three different depths. The choices for depths of placement in 1999 were 9, 18, and 30 inches below the soil surface.

The Et data from the weather station at the Southwest Research-Extension Center was used to calculate water balance. Simple tools like atmometers (Et gage) and rain gages were set up to record Et and rainfall at each local site. Et gages helped the producer to visualize the concept of Et which otherwise is abstract since it is empirically calculated from weather data.

Southwest Kansas Groundwater Management District No.3 has installed 12 new weather stations, which will make Et data available to local farmers. A sample of the spreadsheet that was used to track water balance using ET data, rainfall, and soil water status is shown in Table 1.

RESULTS AND DISCUSSION

The reference Et data from Et gages and Penman reference Et from the K-State weather station at Southwest Research and Extension Center (SWREC) are shown in Fig. 1. The cumulative Et data gathered from Et gage for farms close to Garden City weather station (SWREC) are similar or within couple of inches for the season. Meyer farm is about 100 miles away and receives more rainfall. The Et gage data for this farm actually need be compared to Et data from a close by weather station.

*Mention of product name does not imply endorsement, nor criticism of others not mentioned.

Fig. 2 compares the daily Et data from Et gage, which was located at the same site where the weather station of SWREC is located. Et data from the gage tracks very well the Et reference data calculated using the weather data of the station and Penman equation.

Et data from the Southwest Research-Extension Center were posted manually on a web page in 1998. Attempt was made to automate the same in 1999. A spreadsheet has been developed to link data acquisition via the web browser from the web page. The producer or consultant can update the Et scheduling spreadsheet in the early morning. This helps make an irrigation decision quicker and easier. The web address for the Kansas State University is http://www.oznet.ksu.edu/wdl/wdl/et99b.htm.

Soil water monitoring results for the gypsum block at Stalker Farm is presented in Fig. 3. The gypsum block readings indicate the water status during the growing season. The soil water level at site one (1) started to fall by the end of July. The rainfall of August 2, 4, and 5, 1999, along with irrigation helped to restore the soil water back to normal level. This illustrates the value of having soil water sensors to check the soil water status. This is a good practice even though one may feel confident in using Et based scheduling alone.

Irrigation field days were held at each site for educational purposes. A series of educational seminars and hands-on training on Et-based irrigation scheduling also were presented in cooperation with the Groundwater Management District No.3. This effort will continue.

CONCLUSION

Reference Et within the County may not differ irrespective of source of data as evidenced from the data obtained from weather station and Et gage. The soil sensors will aid in validating soil water status and help irrigation scheduling decisions. Irrigation scheduling for better irrigation management is the key to water conservation. Intensive educational effort is necessary to make the adoption of irrigation scheduling by farmers a reality. Spreadsheets and computer software are now available making data retrieval faster for quick decision.

ACKNOWLEDGEMENT

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Table 1. Irrigation Scheduling – Meyer Farm

User Input

Crop:	Corn	Acres Irrigated:	125 acres
Rooting Depth:	3 ft.	Irrigation Efficiency:	80%
Soil type:	FSL	Allowable Depletion:	50%
Water Holding Cap:	1.92 in/ft	Initial Depletion:	0 inches
Well flow Rate:	750 gpm	Root Zone WH Cap:	5.76 inches
		Allowable Depletion:	2.88 inches

Date	Effective Rainfall	Gross Irrigation	Etr	Growth Stage	Kc	Eta	Depletions
	Inch	Inch	Inch			Inch	Inch
June 27			0.15		0.80	0.12	0.45
June 28			0.22		0.81	0.19	0.57
June 29	0.75		0.16		0.82	0.13	0.76
June 30			0.07		0.84	0.06	0.14
July 1			0.07		0.85	0.06	0.20
July 2			0.19		0.86	0.16	0.26
July 3			0.26		0.87	0.23	0.42

Fig. 1. Et gage data of farms compared to Penman Etr at SWREC.

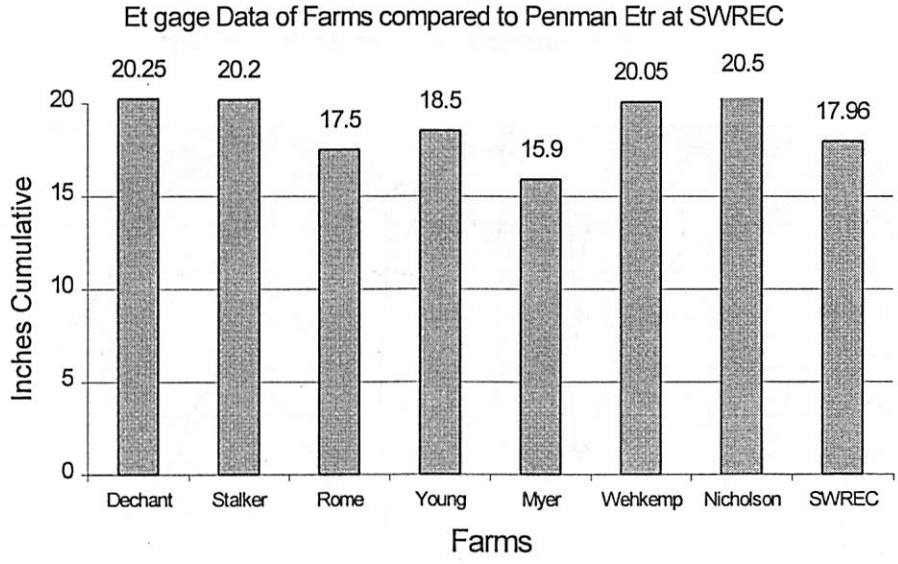

Fig. 2 Daily Et data: Et gage data compared to Penman Etr at SWREC

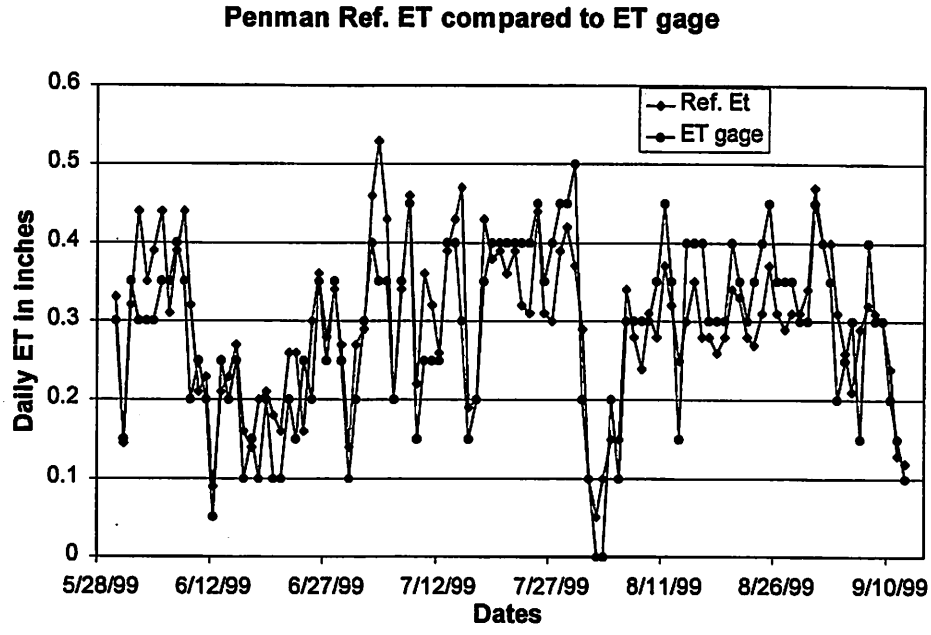

Fig. 3 Soil water status at Stalker Farm as observed from gypsum block.