IRRIGATION SCHEDULING DEMONSTRATION FOR WATER CONSERVATION IN WESTERN KANSAS

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ABSTRACT

Irrigation provides for consistent annual production of corn, grain sorghum, wheat, alfalfa, soybean, and sunflower in western Kansas. About two million acres in this region depend on the Ogallala aquifer, a confined system with very limited recharge. The water level is declining and depletion of this non-renewable 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 efficient water use. Achievement of higher efficiency and thereby conserving water is dependent on adoption of irrigation scheduling by individual farmers. A demonstration and education program established in nine counties in southwest Kansas has shown that in a normal rainfall year there are periods when stopping the center pivot irrigation system is possible.

Keywords: Irrigation, Ogallala aquifer, irrigation scheduling, soil-water sensors, and evapotranspiration (ET).

INTRODUCTION

Irrigation scheduling tools like soil water sensors, evapotranspiration (ET) data, and computer-software to keep track of a water budget are available, yet field adoption of irrigation scheduling is limited. Unlike other agricultural inputs, irrigation necessitates continuous decision making during the entire crop season. Crop water demand although varied in quantity, is continuous through the growing season. Farmers in western Kansas tend to simplify the situation by

turning on the pivot system and keeping it going until the end of the season. This may be appropriate for irrigation wells with insufficient capacity. Long hot days with southwest dry winds make them fearful of falling behind in satisfying the crop demand. They like to keep the soil profile fully charged.

Crop water demand is low in the early growing season. The root system is less prolific and is drawing from top layer of the reserve. Information on crop water use (ET), available soil water capacity, and root depth may help in deciding on when to irrigate and how much to apply, especially at this time when the root zone is small.

Most of the farmers hire consultants who guide them through the season. Consultants do not want to take risk with the water application since this is considered to be a relatively cheap input. They use a push rod or regular soil probe to evaluate soil water from feel and appearance.

Kansas State University has launched an educational program and has set up demonstration sites to work one on one with the owners/operators. The agricultural consultants were invited to become involved in the program by the owner of the demonstration fields and the County Extension Agent.

MATERIALS AND METHODS

Irrigation scheduling demonstration fields were set up in nine counties within southwest Kansas. The farmer operator agreed 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. These were set up in two locations per field at three different depths. The choices for depth of placement in 1998 were nine (9), eighteen (18), and thirty (30) inches from soil surface.

The reason for using three types of sensors was to see which type suits the particular soil type. Periodically soil samples are taken for gravimetric evaluation of soil water. Neutron access tubes were established at two sites with two different soil textures (Ulysses silt loam and Tivoli fine sand).

ET data from the weather station at Southwest Research and 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.

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

Southwest Kansas Groundwater Management Districts #3 has installed twelve 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 below:

1998 IRRIGATION SCHEDULES

Field: Root zone depth, ft.:

Soil Type: Available Water Holding Capacity, in./ft.:

Allowable Depletion, %: Allowable Depletion, inches:

Initial Depletion, inches:

Month	Day	Rain	Net Irrigation		ETr	Growth stage	Crop coeff	Crop ET	Soil water Depletion	
			1	2					1	2
May	14	0	0	0	0.24	Emerge	0.20	0.05	0.05	0.05
May	15	0	0	0	0.28		0.20	0.06	0.11	0.11
May	16	0	0	0	0.39		0.20	0.08	0.19	0.19
May	17	0	0	0	0.34		0.20	0.07	0.26	0.26
May	18	0.5	0	0	0.09		0.20	0.01	0.00	0.00

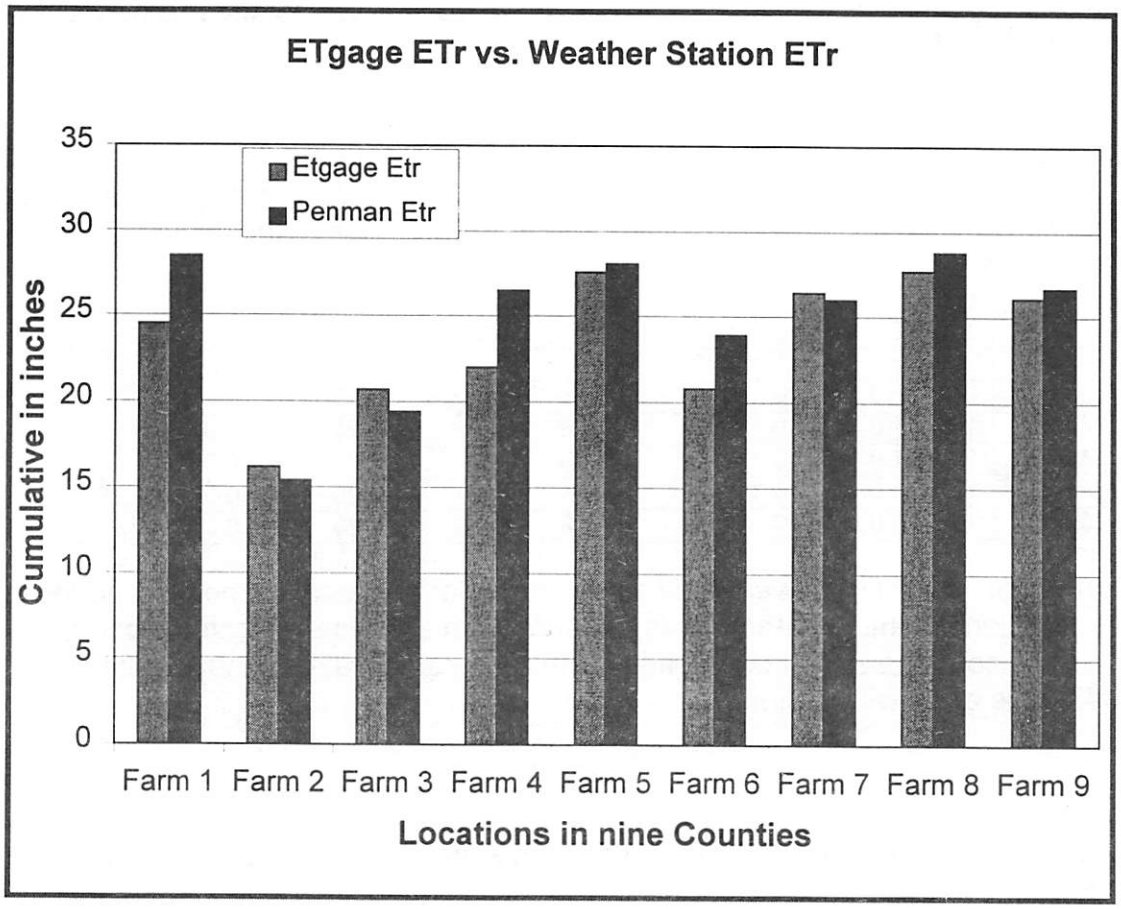
Irrigation 'Field Days' were held at the site for educational purpose. A series of educational seminars and hands on training on ET based irrigation scheduling were also presented in cooperation with the Groundwater Management District #3. This effort will continue.

RESULTS

This project was started in 1997. The plan in the first year was to record the present condition without interfering with farmer's irrigation plan. This gave us the information to see if there were any opportunities to turn off the system occasionally. In 1998, we experienced hot and dry spell from mid June to mid July. Soil water level in some fields fell below management allowable depletion (MAD) level. Rain helped out fortunately before the reproductive stage and production did not suffer. Some fields with sandy soil showed some scorching in spite of good soil water condition.

The reference ET data from ET gauge and Penman reference ET from Groundwater Management District (GMD) weather stations in the Counties within District #3 are shown in Figure 1. The cumulative ET from both the sources are in good agreement for the growing season.

Figure 1: Reference ET data from ET gauge at the Farm and Penman reference ET from the KSU and GMD #3 weather stations.



The differences seen for Farm No.1 and Farm No. 4 are due to non-availability of data from GMD weather stations. The comparison was made to the data obtained from Kansas State University weather station at Garden City Research Station in Kansas.

Soil water monitoring done by gypsum block for Farm No. 5 are presented in Fig.2. The dry weather period is reflected in the data set. The soil water tension rose to nine (9) bars between mid-June to mid-July. The irrigation system was able to catch up after a rainfall that came on July 9 (0.4") and July 13 (1.1"). Tensiometer and Watermark sensors showed similar trends within their limits of reading scale.

Figure 2: Soil water tension data obtained using gypsum blocks

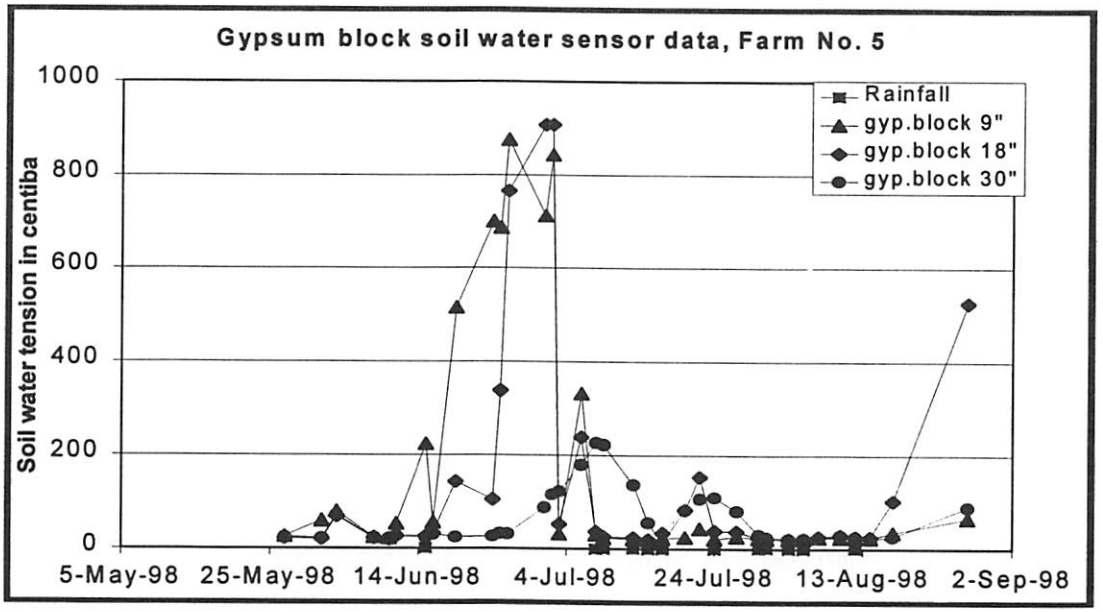
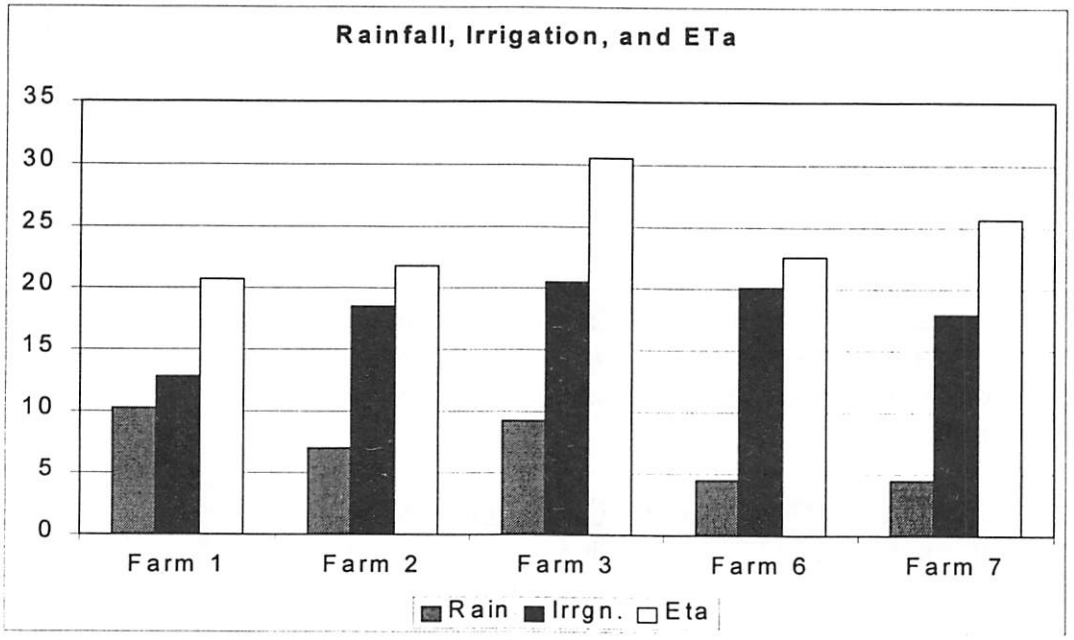


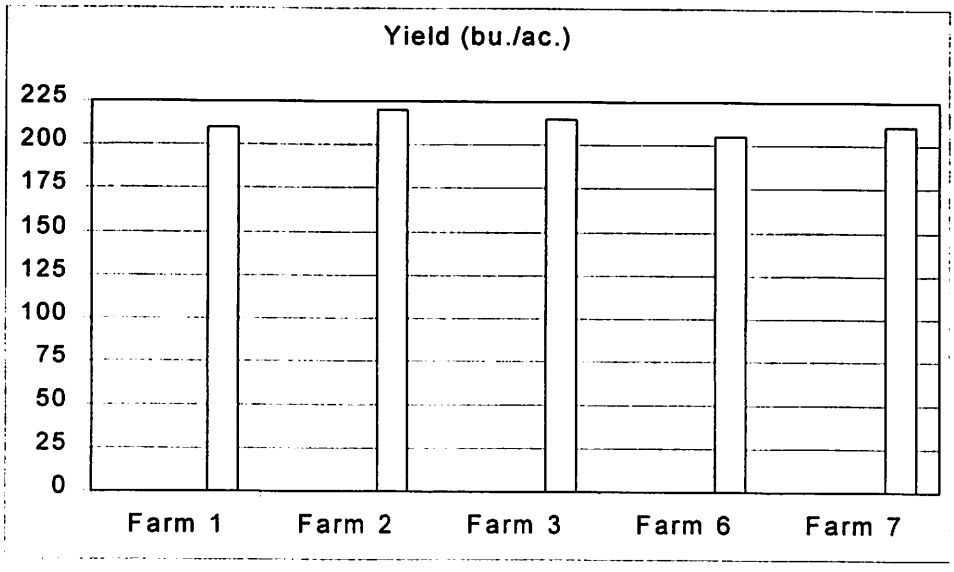
Figure 3 shows rainfall amount and irrigation applied as compared to ET actual (ETa). It is seen that the scheduling procedure helped the producers to take advantage of rainfall to meet the water need. They were able to shut the system when soil water was recharged.

Figure. 3: Rainfall, irrigation, and ETa



The corn yield data for 1998 is shown in Fig: 4. The average yield for the demonstration plots was above 205 bushels per acre.

Figure 4: Corn Yield of 1998



The ET data from Kansas State University Southwest Research Center was posted on web page manually in 1998. This will be automated in 1999, which will help the producers to download the data automatically using the web browser in the early morning hours. The spreadsheet has been developed to link for data acquisition via web browser from the web page. The producer or the consultant will have the ET scheduling spreadsheet updated in the morning. This will help in making an irrigation decision quicker and easier.

The web address for Kansas State University weather station at Garden City is:
www.oznet.ksu.edu/wkarc/swrec/weather1.htm
The web address for Groundwater Management District weather stations is:
www.ink.org/public/ksgm

CONCLUSION

Reference ET within a county may not differ irrespective of source of data as evidenced from the data obtained from weather station and ET gauge. 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 softwares are now available making data retrieval faster for quick decisions.

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