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ARKANSAS IRRIGATION SCHEDULING COMPUTER PROGRAM--A DECISION AID

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Abstract

Data from the National Agricultural Statistics Service (2002) indicates that irrigation has increased over the last several years in Arkansas. Arkansas now ranks 4th among states in irrigated acreage at approximately 4.5 million acres. During this time of increase in irrigated acreage there has been much work done by the University of Arkansas in the area of irrigation scheduling. This work has led to the development of the Arkansas Irrigation Scheduling Computer Program (Cahoon, J. etal, 1990). The program is designed to be practical and require minimum data. It is used extensively in research and extension demonstrations and there have been approximately 350 different requests for the program in the last 3 years. The program is also being used in Mississippi, Louisiana, Missouri, Tennessee and Kentucky. Users of the program indicate that it is a helpful decision aid on determining when to irrigate. University of Arkansas researchers and extension personnel continue to evaluate the program and make revisions to improve its usefulness and effectiveness.

Introduction

Arkansas has approximately 4.5 million irrigated acres with about 1.5 million being in flood irrigated rice. Flood irrigated rice does not require the same type of irrigation scheduling approach that is needed on the 3 million acres of irrigated row crop. Approximately 1 million acres of cotton is grown in Arkansas and about 75 % (750,000 acres) is irrigated. The proper timing of irrigation is especially critical for cotton to reach its yield potential. Research and extension work with irrigation scheduling over the last several years in Arkansas has resulted in a water balance approach being the method most recommended for producers. The water balance method has been incorporated into an Arkansas Irrigation Scheduling Computer Program that is available to producers. The program is downloadable from the internet (www.uaex.edu) or it is available on CD. An Arkansas Checkbook Method that guides users through the water balance calculations in a paper version in the same way as the program is also available. Irrigators need a practical and effective method for irrigation scheduling and results indicate that the Arkansas Irrigation Scheduling Computer Program and Checkbook Method are helpful as decision aids.

Objective

Develop and maintain irrigation scheduling methods for Arkansas irrigators that are practical and effective.

Methods and Materials

Tensiometers and other soil or crop monitoring methods have been researched and used as irrigation scheduling decision aids in Arkansas. Experience has shown that most growers need a method that is effective but doesn't require a lot of time, labor or data collection. The approach taken was to develop a simple water balance method that didn't require a lot of field measurements but could provide good information with a very limited amount of data. It was also determined that having a user friendly computer program would make the process less time consuming for the producer. The program would also make it easier to include a predictive aspect that would tell in advance when irrigation would be needed. This led to the development of the Arkansas Irrigation Scheduling Computer Program over the last 20 years.

A method for calculating the crop water use, evapotranspiration (ET), was developed using daily maximum temperature as the only data that had to be recorded daily during the season. Other data needed during the season are rainfall and irrigation events. The program requires the one time entry of some other information like emergence date, irrigation method and acres that are readily known. By using ET, rainfall and irrigation data the program can calculate the moisture change in the soil. It was determined to tie several components of soil moisture status into one value described as the Soil Moisture Deficit (SMD). The initial SMD is used to start the programs calculation and guidelines are included in the program on suggested Allowable SMD. The Allowable SMD is then set as the amount of moisture the crop is allowed to use before irrigation is recommended. Once the program calculations approach the Allowable SMD a message appears with a recommendation on which field needs irrigation first and when. The suggested Allowable SMD is determined by the crop, soil type and irrigation method and it is based on research and extension studies. In order for this simple water balance approach to work, the program has to include the following assumptions; 1) Good surface drainage exists so that there is minimum standing water 24 hours after a rain or irrigation. 2) The crop uses water at the rate of a non-stressed plant. 3) The SMD returns to zero when a field is surface irrigated.

The program was initially set up for center pivot sprinkler irrigation systems but it now includes flood, furrow and border irrigation methods. It also can schedule irrigation for corn, soybean and grain sorghum crops in addition to cotton. Initially the program was designed for Arkansas but through its development it has become more applicable to use by other states in the Mississippi River Delta.

Results and Discussion

Records indicate that over 350 requests for the program have been made in the last few years. It is now being used in Mississippi, Louisiana, Tennessee, Missouri and Kentucky and has even been used in a couple of other countries. The program's accuracy for determining the water balance appears to be very acceptable even with the limited amount of data that it requires. Program users indicate that it helps them better prepare for irrigation, especially the first irrigation which can be needed before most growers think it would be necessary. Table 1 shows the results of a field demonstration of the effect of delaying the first irrigation on cotton. The program was used to determine when to irrigate and then part of the field that wasn't irrigated when the program recommended was irrigated about 5 days later with the exception of 1999 when it was delayed 10 days by mistake. The program has been used extensively in the Crop Verification Trials conducted on Arkansas farms. The common remark from participants in this program is that they learned how important irrigation timing is and that the program was a better and more successful method than what they had used previously. Most of the participants now use the program as a part of their decision aid package in their operation. Many users have several irrigation wells that serve various crops including rice and they feel that the program helps them better manage the distribution of the water to the fields as well as schedule their labor.

Summary

The Arkansas Irrigation Scheduling Program has shown to be a practical decision aid for helping the grower to irrigate timely enough to satisfy the crop's water needs during the season while better managing his irrigation water and labor.

References

Cahoon, J., J. Ferguson, D. Edwards, and P. Tacker. 1990. A microcomputer-based irrigation scheduler for the humid mid-south region. Appl. Eng. Agric. 6:289-295.

National Agricultural Statistics Service. 2002. Agricultural statistics database. Available on-line at http://www.nass.usda.gov:81/ipedb/.

Table 1. Effect of Delaying Initial Irrigation on Cotton, Clay County On-Farm Demonstration Results, 1999-2003

YEAR	Delayed Irrigation* (lbs seed/cotton/ac)	Scheduled Irrigation (lbs seed cotton/ac)	Yield Difference
1999	2877	3129	+252
2000	2547	2886	+339
2001**	3094	3151	+56
2002	1831	2112	+281
2003	2810	3060	+250
Average	2632	2868	+236

*Irrigation delayed 5 days except in 1999 and it was delayed 10 days by mistake.

**In 2001 the delayed irrigation treatment received 1" of rainfall two days after the scheduled irrigation treatment was irrigated.