8.1 PREDICTING WATER DEMAND FOR IRRIGATION BASED ON A CROP SIMULATION MODEL AND LOCAL WEATHER DATA

L. C. Guerra[1*], G. Hoogenboom[1], V. K. Boken[1], D. L. Thomas[2], J. E. Hook[2], and K. A. Harrison[2]
[1]The University of Georgia, Griffin, Georgia
[2]The University of Georgia, Tifton, Georgia

1. INTRODUCTION

Recent issues that affect water use in the state of Georgia are the tri-state water dispute between Georgia, Alabama and Florida, the continuing drought in the southeastern USA, and the rapidly increasing irrigated acreage in agriculture. An understanding of present and future water needs by agriculture is needed to ensure availability of water for current and future users. Unfortunately, *how much water is required* and *how much is actually being used* for irrigation is unknown. In Georgia, most agricultural operators are required to be permitted, but they are not required to report their water use. The Georgia Department of Natural Resources, Environmental Protection Division (EPD), the designated state regulatory agency, therefore has to rely on estimates of current and future water needs by agriculture. The objectives of this study were: 1) to predict the irrigation demand for major crops in Georgia using a crop simulation model, and 2) to assess the impact of local weather and soil conditions on irrigation demand.

2. EXPERIMENTAL DESIGN AND METHODS

Irrigation demand was predicted using the Erosion-Productivity Impact Calculator (EPIC) model version 8120 (Williams, personal communication;ftp://ftp.brc.tamus.edu/pub/meinardu/epic/epic8120/latestepic). EPIC has a single crop model, crop and soil management, and soil and plant water balance components (Meinardus et al., 1998). In EPIC, automatic irrigation is triggered when soil moisture in the root zone is less than a specified value below field capacity.

Input data for the EPIC model were obtained for typical sites that represented the main crop growing regions. Daily weather data from 1997 to 2001 were gathered for several climatic zones in Georgia. The data were recorded by the Georgia Automated Environmental Monitoring Network (Hoogenboom, 2001). Soil profiles for each location were taken from the soil survey reports of the Georgia Agricultural Experiment Stations (Perkins et al., 1978; 1979; 1982; 1986). Crop and soil management practices were taken from the variety trial reports of the Georgia Agricultural Experiment Stations (Day et al., 1997; 1998; 1999; 2000; 2001). Predicted yield and irrigation were evaluated with the same variety trial data.

Corresponding author address: Larry C. Guerra, Dept. of Biological and Agricultural Engineering, The University of Georgia, Griffin, GA 30223

3. RESULTS AND DISCUSSION

As an example the analysis results for cotton and peanut at two sites, i.e., Plains and Midville, are presented. Both crops are planted at about the same time, with peanut harvested earlier. Plains is located in southwest Georgia while Midville is in southeast Georgia. Both sites are in the Coastal Plain region, where most of the irrigated crops such as cotton and peanut are grown.

3.1 Yield Comparison

A comparison between predicted and the actual cotton yield in Plains, Georgia, is shown in Figure 1. The EPIC model predicted a fairly stable yield from 1997 to 2001, which we would normally expect when a crop is irrigated. The actual yield shows a slightly increasing trend from 1997 to 2000, and a sharp increase in 2001. There is close agreement between the predicted and actual yields, except in 2001 when the predicted yield is lower by about 32%. For peanut, the EPIC model again predicted a fairly stable yield from 1997 to 2001 (Fig. 2). There is close agreement between the predicted and actual yields, except in 2000 when the predicted yield is higher by about 22%.

3.2 Irrigation Comparison

Table 1 shows the predicted and actual irrigation during the growing season for cotton and peanut in Midville, Georgia. For cotton, both the predicted and actual irrigation are highest in 1999 and lowest in 1997. For peanut, irrigation is also lowest in 1997.Table 2 compares the predicted and actual irrigation in Plains, Georgia. For both cotton and peanut, irrigation is lowest in 2001.

Overall, predicted irrigation is higher than actual irrigation. On the average, irrigation is higher for cotton compared to peanut. Generally, irrigation is higher in Midville than in Plains.

The prediction of irrigation demand based on a crop simulation model looks promising. This method will be further evaluated using data from the AgWaterPumping (www.AgWaterPumping.net) program of the University of Georgia.

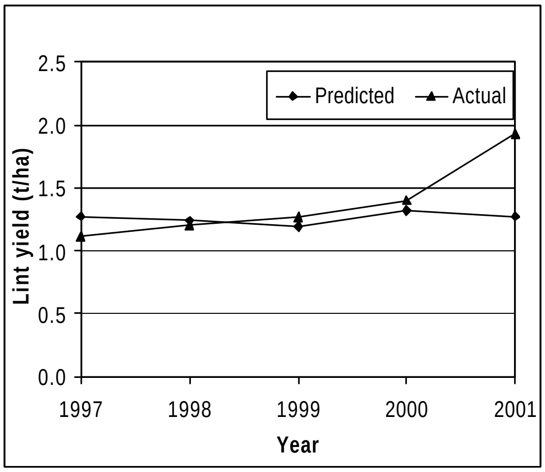

Figure 1. Predicted and actual cotton yield for Plains.

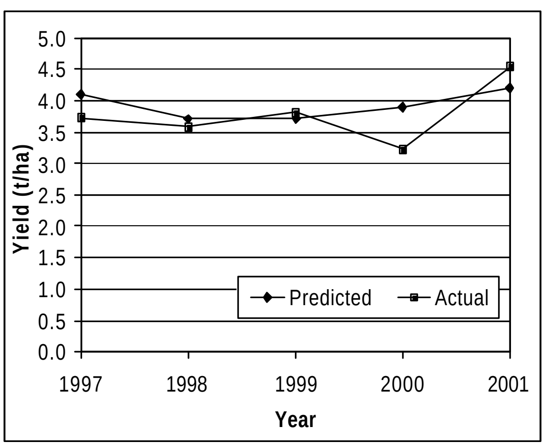

Figure 2. Predicted and actual peanut yield for Plains.

Table 1. Irrigation (mm) during the growing season of cotton and peanut in Midville.

	1997	1998	1999	2000	2001	Avg.
Cotton						
Actual	133	305	324	203	210	235
Predicted	280	385	420	385	385	371
Peanut						
Actual	152	330	325	152	152	223
Predicted	210	315	315	315	315	294

Table 2. Irrigation (mm) during the growing season of cotton and peanut in Plains.

	1997	1998	1999	2000	2001	Avg.
Cotton						
Actual	112	211	193	318	85	184
Predicted	245	350	315	280	175	273
Peanut						
Actual	142	178	203	145	119	157
Predicted	210	280	245	210	175	224

4. REFERENCES

Day, J.LaD., A.E. Coy, W.D. Branch, O.L. May, S.S. LaHue and L.G.Thompson. Field Crops Performance Tests. Research Report Number 648; 658; 664; 671; 677. The Georgia Agricultural Experiment Stations,The University of Georgia.

Hoogenboom, G. 2001. Weather monitoring for management of water resources. p. 778-781. *In* : [K. J. Hatcher, editor] *Proceedings of the 2001 Georgia Water Resources Conference*. Institute of Ecology, The University of Georgia, Athens, Georgia.

Meinardus, A., R.H. Griggs, V. Benson, and J. Williams, 1998: EPIC. http://www.brc.tamus.edu/epic

Perkins, H.F., V. Owen, J.E. Hammel, and E.A. Price. Research Bulletin 217; 245; 271; 346. The Georgia Agricultural Experiment Stations, The University of Georgia.