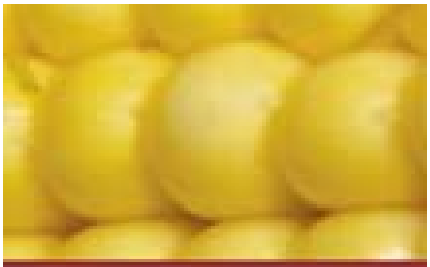
Mississippi Corn Promotion Board
2012 Progress Report

Project Title: On-farm Validation of the Mississippi Irrigation Scheduler Tool (MIST) for Corn Production Systems

PI: A.M. Schmidt, G.F. Sassenrath, J. Pote

Department: Agricultural & Biological Engineering and USDA Agricultural Research Service



Project Summary (Issue/Response)

Corn yield can more than double through good water management. Irrigation scheduling is a method of managing water to better match the timing and application of irrigation with crop water needs. However, to date most irrigation scheduling tools have had only limited applicability and use in Mississippi. Currently available scheduling tools are usually not accurate in humid areas such as Mississippi, are time-consuming to operate, and require users to install, update and run software to make the management decision. The goal of this research is to develop an accurate, easy-to-use, readily accessible irrigation management tool for corn production in Mississippi. The Mississippi Irrigation Scheduling Tool (MIST) allows users to assess the water needs of their crop and schedule irrigation according to crop need, and is based on the latest scientific knowledge of crop growth and water use, soil hydrology, and weather conditions. MIST queries external soil and weather databases, calculates plant water needs, and recommends timing and amount of water application using a water-balance approach. The system will be delivered to producers through the Mississippi State Extension Service's website, MSUCares. To enhance ease of use, data are automatically collected from state and national databases, eliminating the need for farmers to collect weather, soil or crop data, or to install, manage and interpret information from field-based measuring equipment.

Project Results/Outcomes

The specific objectives of the current project are to parameterize MIST with crop-specific coefficients based on common Mississippi soils, validate MIST on Mississippi corn production fields, and deliver the tool and supporting educational materials to users. Automating data collection simplifies the decision-making process for Mississippi's producers who may realize greater yields at lower costs when irrigation more closely matches plant needs. Producers are involved in designing the web-based tool to enhance its ease of use and increase adoption.

The primary outcome of this research is the Mississippi Irrigation Scheduling Tool, MIST. Through collection of data from production and research fields, the research has also developed knowledge of corn crop water use for a range of soil types, planting dates, and management practices in Mississippi. Weather information from the Delta Research & Extension Weather Center is used to calculate daily reference evapotranspiration (ET) rates using standardized equations. Crop coefficients for Mississippi have been developed from plant growth measurements from production and research fields. Corn crop water use calculated from developed crop coefficients and reference ET calculations closely tracks plant growth for a variety of planting dates and production systems, indicating a single crop coefficient is feasible. Water release curves have been measured for soils ranging from rapidly draining Crevasse loamy sand, to several types

Project Results

of well-drained silt loam soils, through slowly draining clay loams such as Forestdale. This information on soil hydrology is used in the scheduling tool to calculate soil available water for various soil types. The MIST was calibrated and validated using measurements of crop water use and soil available water from production and research fields. The MIST was tested in 2011 and 2012 in seven production fields and three research fields for both sprinkler and furrow irrigation. Watermark soil moisture sensors were used to compare soil water changes in the field with crop water use calculated using MIST. Preliminary results indicate that the MIST gives a good estimate of crop water use, and indicates when sufficient water has been lost and irrigation is needed (Figure 1).

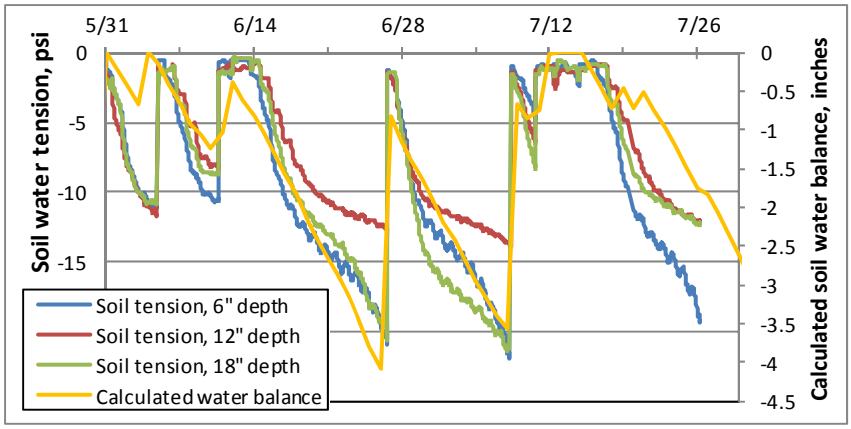


Figure 1. Comparison of changes in measured soil available water (soil water tension, psi) at 6, 12 and 18" depths in the soil with soil water balance calculated with MIST, throughout the growing season.

Significant progress has been made in implementing the MIST into the web-based user interface. Delineation of fields is carried out through a Google mapping interface using a polygon tool that allows users to outline the field area directly on a map. Field and well locations are saved and crop information can be updated yearly. We are working to import field information from Farm Service records, simplifying setup. Field water status is indicated on a calendar. The user can update information on irrigations (applied water) or rainfall directly. Alternatively, rainfall data from the National Weather Service gridded radar product can be used.

Project Impacts/Benefits

The primary beneficiaries of this research are Mississippi corn producers. Understanding soil and crop water relations, irrigation scheduling, and crop water management will enable crop producers to make water use decisions based on crop needs. Water management tools and the web-based irrigation scheduler will improve timing and amount of water applications, improve crop yield and quality, and reduce excess water use in corn production.

Over the past 20 years, Mississippi corn acreage has more than tripled to just under a million acres per year. While yield has increased steadily, the state's average corn yield per acre over that twenty year period (110 bu/ac) is 28 bu/ac below the US average. Although corn yield can be substantially increased with irrigation (178 vs 119 bu/ac for Mississippi in 2007), much of Mississippi corn acreage remains non-irrigated. Implementing timely and accurate irrigation scheduling on all corn acres could yield a net increase of 30M bushels of corn produced in Mississippi. At a corn price of $4.35/bu (five year average) and an irrigation cost of ~ $150/ac, a yield increase of 59 bu/ac of irrigated over rain fed production could generate an additional $257 in return per acre at an input cost of around $150/ac. If the MIST reduces the volume of irrigation water pumped, farmers will realize additional reductions in fuel expenses for operating pumping equipment. Further, new state water permits require implementation of water conservation measures. The MIST, developed for state-specific soils and climate, is an acceptable method as established by NRCS.

Knowledge of agricultural water needs will be beneficial in developing water management policies that are economically realistic and environmentally sustainable. All Mississippians will benefit from this research through the improved management of our water resources.

Project Deliverables

Delta Ag Expo, Jan. 17-18, 2012, Cleveland, MS
Precision Ag meeting, Jan. 31 – Feb. 1, 2012, Tunica, MS
Farm and Gin Show, March 2-3, 2012, Memphis, MS
Mississippi Water Resources Conference, April 3-4, 2012, Mississippi Water Resource Research Institute, Jackson, MS
2012 WDC018 Meteorological and Climate Data to Support ET-Based Irrigation Scheduling, June 4 – 7, 2012, Water Conservation, and Water Resources Management, St. Louis, MO
2012 American Society of Agricultural Biological Engineering Annual International Meeting, July 28 – Aug. 2, 2012, Dallas, TX

Mississippi Irrigation Scheduling Tool:
http://www.agwater.msucares.com/Irrigation

Water management web site and educational information:
http://www.agwater.msucares.com

MISSISSIPPI MAFES AGRICULTURAL & FORESTRY EXPERIMENT STATION

MISSISSIPPI STATE UNIVERSITY EXTENSION SERVICE