Mississippi Corn Promotion Board
2013 Progress Report

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

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Project Summary (Issue/Response)

This is the third and final year for the project 'On-farm Validation of the Mississippi Irrigation Scheduler Tool (MIST) for Corn Production Systems.' The project was begun to enhance crop performance with water management that is based on crop needs. Irrigation scheduling is a method of managing water to better match timing and application of water with crop water use. There have been many irrigation methods developed for dry climates, but there are few tools available for humid, high rainfall areas like Mississippi. Additionally, most irrigation scheduling tools require extensive data collection by producers, limiting their practical use during the production season. The original objectives of this project – in pursuit of releasing the Mississippi Irrigation Scheduling Tool (MIST) – were to parameterize MIST with crop-specific soil coefficients based on common Mississippi soils, validate MIST on Mississippi corn fields, test the accuracy of radar-derived rainfall estimations, and deliver the tool and supporting educational materials to users. MIST provides an estimate of crop water use based on a "checkbook" approach that determines the water balance of the soil, plus water from rainfall or irrigation, minus water used by the crop or evaporated from the soil. Daily evaporation is calculated using the modified Penman-Monteith equation. The system automatically notifies the farmer if irrigation is required when the available soil moisture falls below a set threshold. The MIST queries external databases, calculates soil and plant moisture needs, and recommend timing and amount of water application. Automating data collection is more efficient and also simplifies the decision-making process for Mississippi's corn producers who may realize greater yields at lower costs when irrigation more closely matches plant needs based on measurable characteristics. The web-based tool is being designed with producer input to enhance adoption.

Project Results/Outcomes

***Objective #1*:** Complete development and implementation of the user interface and integrate research results into the web-based version of the irrigation decision support tool.

The address for the interface is www.agwater.msucares.com/Irrigation/. The initial work on the interface was done by Joe Crumpton. After he departed, Brandon Rice was hired to work on the project in pursuit of his M.S. degree in Computer Science. Mr. Crumpton and Brandon Rice both made progress on the interface, including basic layout of various pages, creation of the login page, linking the interface to Google maps, and more. They programmed MIST to manually calculate the water balance for one event. When Brandon Rice graduated in May of 2013, the water balance was still not calculating manually for more than one event.

Project Results

While the graphical interface was nearly complete, the interface was not linked to the necessary databases, and calculations were not automated. In May of 2013, we purchased a portion of a full-time MSU programmer's time to complete the needed programming. Since this time, more tasks have been automated, the existing code and databases have been debugged, and MIST has been connected to the weather and other databases. MIST now calculates evapotranspiration and water balance using one weather station over a given time period. The immediate goal was to get all needed connections in place so that the scheduler is calculating. We can now expand the functionality of the web-based version of MIST. The programming component has been much more time consuming than was initially expected, and several personnel changes exacerbated these problems. In summary, this task has been completed to get a web-based version of MIST that will make the needed calculations on a limited level (e.g. with only one weather station). However, a no-cost extension is being requested to continue expanding the functionality of the web-based MIST to include the capabilities that were originally planned.

***Objective #2*:** Incorporate automated spatial rainfall data for use in water balance calculations to replace field-scale rain gauge measurements**.**

Publically available rainfall from CoCoRahs, COOP and DREC stations were compared to the National Weather Service (NWS) spatially gridded radar precipitation estimates. For the analysis, daily precipitation was tabulated from approximately 140 gauge sites, and geographical information systems (GIS) was used to obtain radar estimated amounts from the same 140 sites (by correlating latitude and longitude). The two values were then compared. While there were some discrepancies, it was determined that the convenience, time savings, low cost (free), and reliability of the radar estimates outweigh any inconsistencies.

***Objective #3*:** Improve runoff estimation and soil water balance for high-rainfall events.

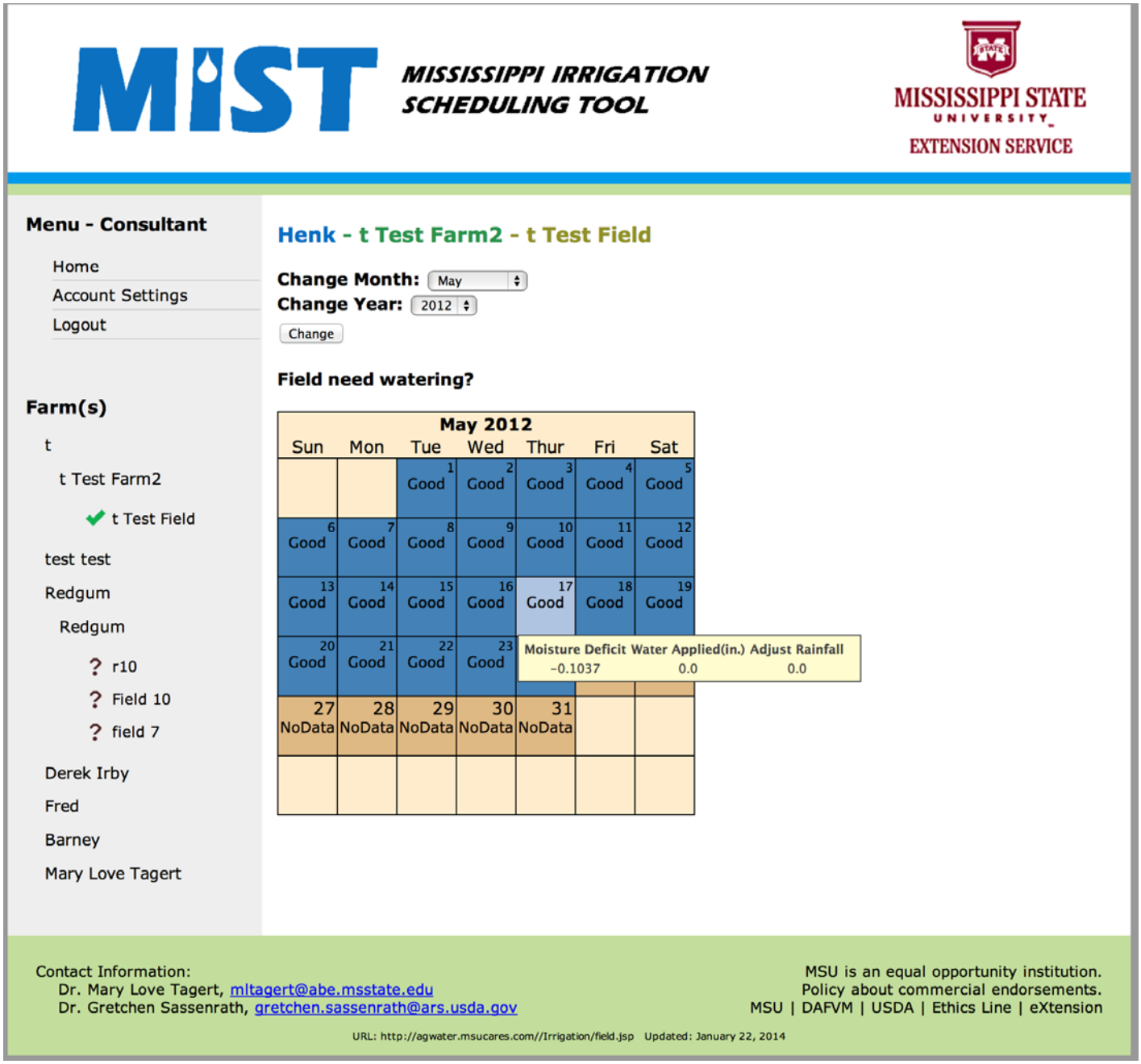
In 2012, there were several events with high rainfall over multiple days. The high rainfall events during the 2012 growing season indicated that the NRCS runoff equation being used may not give an accurate calculation of soil water balance during high rainfall events. It was originally planned for these methods to be further tested on-farm during the 2013 growing season. However, Dr. Gretchen Sassenrath, the primary cooperator on this project, left USDA in May 2013 to take a new position in another state. With her departure, her technician was allowed to work on this project on a limited basis only. This, combined with the heavy rainfall in late May and early June, reduced the number of study sites for monitoring. However, if granted a no-cost extension, we have a new graduate student who will be working on this objective during the summer of 2014.

***Objective #4*:** Test MIST scheduling irrigation recommendations for a range of corn production practices and soil types.

We were able to work with producers in the Northern Delta during the summer of 2013. With additional manpower for the summer of 2014 and recent progress in programming of the interface and software, we anticipate working with our cooperating farmers again in 2014 to verify accuracy of the MIST calculations for crop water use and need for irrigation.

***Objective #5*:** Deliver the MIST and water management educational materials to end-users

We are meeting with all of our cooperating producers to discuss plans for 2014. We plan to work more closely with them this summer so that they can see how MIST is functioning and compare the MIST results and predictions with soil moisture readings on their fields, as well as to their irrigation schedule. We plan on hosting one or more field days towards the end of the 2014 growing season to demonstrate MIST to potential end-users, and we will offer more demonstrations as the programming is completed.



Project Impacts/Benefits

This project has multiple benefits, which include reducing potential water use from the Mississippi Alluvial Aquifer (while maintaining yields), money savings from reduced water use, and more efficient use of time in scheduling irrigation events. As producers begin to use soil moisture sensors to time irrigation, this may not be a sustainable practice for large production operations. A web-based irrigation scheduling tool such as MIST, based on Mississippi's climate, is the best long-term solution to help farmers manage and schedule irrigation based on crop needs.

Project Deliverables

Publications:
Gretchen F. Sassenrath1, J. M. Schneider, A. M. Schmidt, J. Q. Corbitt, J. M. Halloran, R. Prabhu. 2013. Testing gridded NWS 1-day observed precipitation analysis in a daily irrigation scheduler. *Agricultural Sciences*, 4(12):621-27.

Presentations:
Robert Thornton, presenter. Can National Weather Service spatially gridded radar precipitation estimates be used to overcome spatial variability in Mississippi precipitation measurements? Session #10: Irrigation Practices and Management, Mississippi Water Resources Conference, Jackson, MS. April 3, 2013.

Gretchen Sassenrath, presenter. Development of the Mississippi Irrigation Scheduling Tool – MIST. Session #10: Irrigation Practices and Management, Mississippi Water Resources Conference, Jackson, MS. April 3, 2013.

Brandon Rice, presenter. Implementation of the Mississippi Irrigation Scheduling Tool in a dynamic web-based format. Session #10: Irrigation Practices and Management, Mississippi Water Resources Conference, Jackson, MS. April 3, 2013.

Rajkumar Prabhu, presenter. Uncertainty, calibration and validation of the Mississippi Irrigation Scheduling Tool model. Session #10: Irrigation Practices and Management, Mississippi Water Resources Conference, Jackson, MS. April 3, 2013.

The following presentations were made in Session 326: Irrigation Scheduling Tools and Mobile Applications at the ASABE 2013 Annual International Meeting, Kansas City, Missouri, July 21-24, 2013:

Gretchen F. Sassenrath, presenter. Co-authors A.M. Schmidt, J.M. Schneider, M.L. Tagert, J. Corbitt, H. van Riessen, J. Crumpton, B. Rice, R. Thornton, R. Prabhu, J. Pote, C. Wax. Development of the Mississippi Irrigation Scheduling Tool – MIST.

Hendrik van Riessen, presenter. Co-authors D. Irby, G.F. Sassenrath, B. Rice, J.Crumpton, A.M. Schmidt, M.L. Tagert. Implementation of the Mississippi Irrigation Scheduling Tool in a dynamic web-based format.

Rajkumar Prabhu, presenter. Co-authors G.F. Sassenrath, A.M. Schmidt, M.L. Tagert, B. Rice, H. van Riessen, R. Thornton, J. Corbitt, J. Pote, C. Wax. Uncertainty, calibration and validation of the Mississippi Irrigation Scheduling Tool model.

Gretchen F. Sassenrath, presenter. Co-authors J.M. Schneider, J. Corbitt, A.M. Schmidt, M.L. Tagert. Testing the variability of field-level rainfall amounts and the potential impact on error in soil water balance calculations.

Gretchen F. Sassenrath, presenter. Co-authors A.M. Schmidt, J. Corbitt, M.L. Tagert, J.M. Schneider, J. Crumpton, B. Rice, H. van Riessen, R. Thornton, R. Prabhu, J. Pote, C. Wax. On-farm testing and potential improvements in water management using the MIST.

Amy M. Schmidt, presenter. Co-authors G.F. Sassenrath, J. Crumpton, J. Corbitt, B. Rice, H. van Riessen, R. Thornton, R. Prabhu, J. Pote, C. Wax, M.L. Tagert. Development and delivery of educational tools for irrigation water management and on-farm implementation of the MIST.