Mississippi Corn Promotion Board
2018 Progress Report

Project Title: Determining optimal rainfall duration and rainfall intensity by soil texture based on irrigation nozzle type

PI: Dr. Connor Ferguson and Dr. Jason Krutz

Department: Plant and Soil Sciences

Project Summary (Issue/Response)

Mississippi agricultural soils vary widely in texture, which can make determining an optimal irrigation program difficult. It is well known that soil textures vary in their water infiltration capabilities, and over irrigating a given soil texture is not only costly, but is not a sound water management tool. This project will trial multiple nozzle types used for irrigation to determine nozzle output and water infiltration across a variety of soil textures. A controlled application system equipped with a rainfall simulator that can apply water accurately to 0.1 gallons per acre will be used to screen multiple nozzles used for irrigation, for future projects to utilize this knowledge in a field irrigation study. Results will be presented to growers through Extension publications and meetings to help growers tailor their irrigation system to maximize efficiency.

The objectives of this project have several components. First, we collected soils from the major corn growing regions around the state, ensuring that common soil textures in all corn growing regions are included in the study. Soil profile containers were constructed to be able to view water infiltration into the profile to measure the first objective. The first objective was to determine the optimal rainfall duration for each soil texture resulting in maximum infiltration while minimizing run-off. This objective also examined the optimal rainfall intensities for each of these soils. The second objective is to trial a variety of commercially available irrigation nozzle types for optimal set-up for maximum water infiltration given the optimal rainfall duration and rainfall intensity determined in the first objective.

Irrigation is a positive addition to a corn production system, but can be costly if not properly set-up for a given soil texture. An improper irrigation set-up can result in over or under application of water which is detrimental to corn yield. Furthermore, by over applying water, the grower is spending money to pump water that does not help his or her crop which is costly to the overall bottom-line for the grower. By understanding optimal rainfall duration and rainfall intensity for soil textures across the state, any irrigation system can be tailored using these results to achieve maximum yield and minimize run-off. This project has the opportunity to improve a grower's bottom-line as well as protect necessary water resources for future growing years – especially in drought years.

Project Results/Outcomes

Year 1 data collected determined the optimal rainfall amount for six soil types from across the state (3 from the Delta, and 3 from the Eastern Hills). Soil types tested were: Commerce Silt Loam, Dubbs Silt Loam, Sharkey Clay, Leeper Clay Loam, Brooksville Silty Clay, and Marietta Fine Sandy Loam. Optimal rainfall totals ranged from 7/8 inches with the Dubbs Silt Loam, to 5/8 inches with the Commerce Silt Loam. These results seem quite similar, though statistically they were different. Soils were filled into 15 qt containers that had 50 pre-drilled 5/32 inch holes underneath for consistent design and water infiltration. Each soil was watered for a known amount, and then left to sit for 2 minutes and 30 seconds to drain. After the draining period, soils were dug to a 5 inch depth and tested to see if each inch was at the field saturation level. If the soils were still dry at any layer, additional water was applied. Each soil type was replicated four times over a week period to ensure the data was reflective of the optimal rainfall duration for each soil.

Each soil type was analyzed by the Mississippi State Soil Testing Laboratory to better understand if organic matter, nutrition, and other factors played a role in influencing the optimal rainfall and duration identified in the study. Soil test results found that soil pH ranged from 7.4 for Sharkey Clay down to 5.1 for the Brooksville Silty Clay. Organic matter ranged from 2.6% for both the Brooksville Silty Clay and the Dubbs Silt Loam down to 1.5% for the Marietta Fine Sandy Loam. When data were assessed based on these results we found that organic matter significantly influenced the total rainfall, where soils above 2.0% organic matter were able to hold a greater water volume in order to percolate down through the profile. Soil texture played a significant role too, where soils with greater silt and clay properties took more water to effectively percolate through the soil profile. The Marietta Fine Sandy Loam took greater replications, as a commonly observed phenomenon was a pooling at the soil surface, while the profile beyond 3 inches was still dry. The other soil types were quite consistent, but additional Fine Sandy Loam soils will be collected in year two to better understand if what was observed for the Marietta soil is observed for those soil types as well.

Based on the data achieved in the first year of the project, the next phase of the project will be to trial various irrigation nozzles that deliver the most effective rainfall intensity and duration for each of the six soil types tested. Each irrigation nozzle type will also be characterized for droplet size and distribution using a newly acquired image analysis system that can measure droplet size and droplet velocity. This kind of data is not available in the literature, but can help to better characterize the results found from the second objective. This will also allow for other nozzles not tested to possibly be recommended for each of the soil types, as long as they achieve a similar droplet size and distribution to the ones selected for the second year of the study.

Project Impacts/Benefits

Optimal rainfall totals ranged from 7/8 inches with the Dubbs Silt Loam, to 5/8 inches with the Commerce Silt Loam. These results seem quite similar, though statistically they were different. The rainfall intensity ranged from 134 to 152 seconds to reach successful infiltration of 1/8 inches, where the Commerce Silt Loam resulted in the longest infiltration time, and the Sharkey Clay resulted in the shortest infiltration rate. These data will be crucial to move the data forward to better work with growers with these soil types to result in optimal irrigation system set-up.

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Project Deliverables

None to report in 2018.

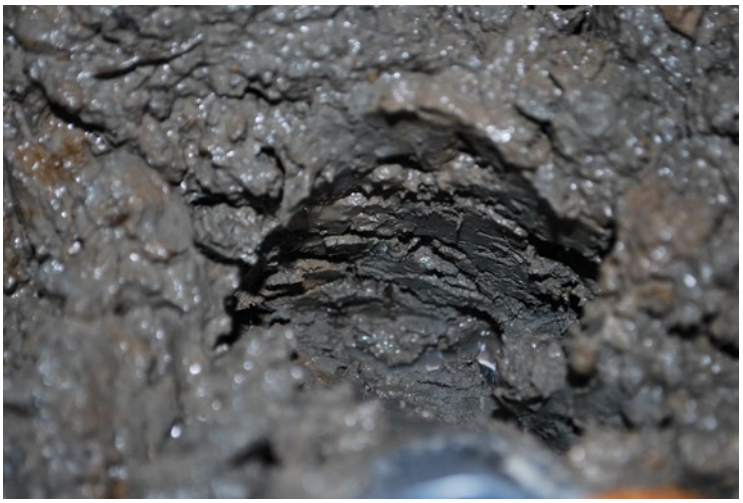

Figure 1: Sharkey Clay after receiving 0.8125 inches (13/16 inches) in 800 seconds (13 minutes and 20 seconds) showing saturation down to

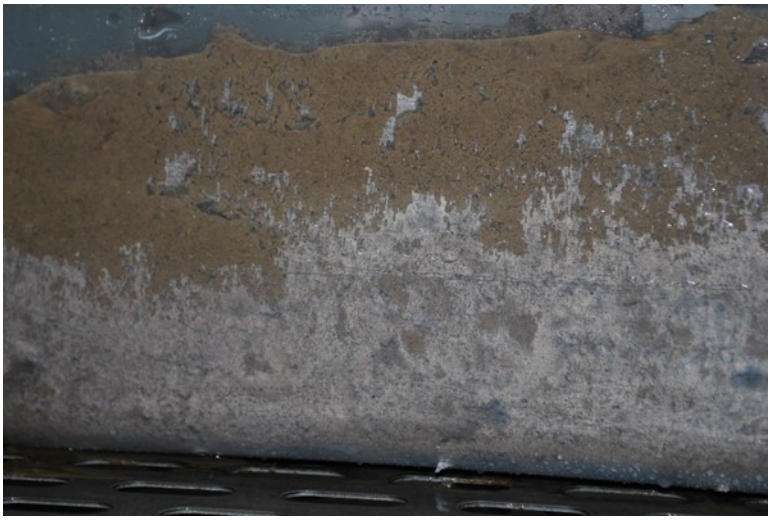

Figure 2: Marietta Fine Sandy Loam after receiving its first ¼ inch showing the water infiltration observed percolating through the soil profile.