Advanced Irrigation Water Management Strategies in Furrow Irrigation

Drew M. Gholson
NCAAR Coordinator & Assistant Professor
Extension Irrigation Specialist
Delta Research and Extension Center

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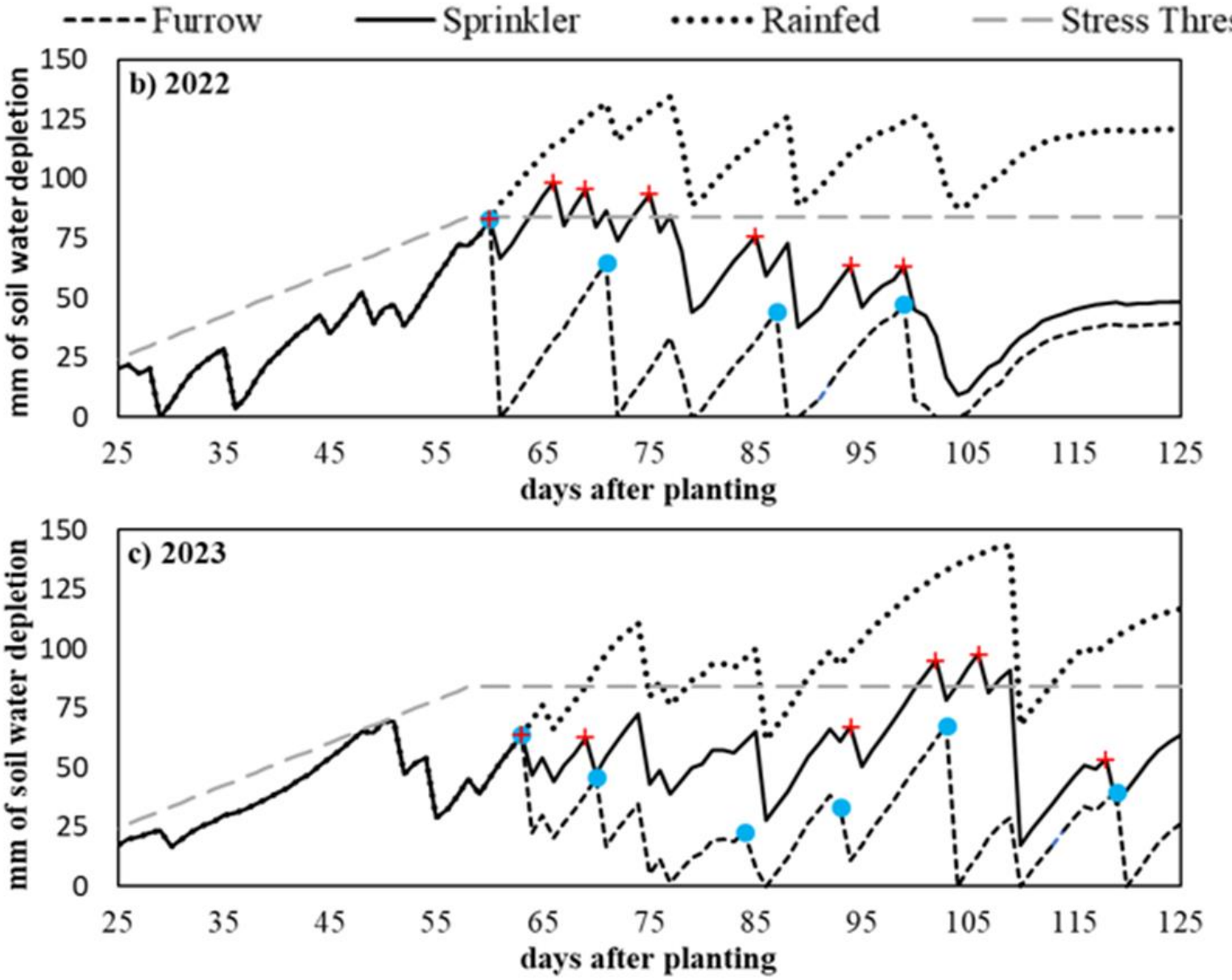
Wide-Skip Furrow Irrigation: A Promising Practice for Managing Sharkey Clay Soil

Problem

- Vertisols (shrink-swell clays) compose roughly half of the furrow-irrigated area in the Yazoo-Mississippi Delta
- Excessive infiltration and subsequent waterlogging are prevalent
- Whenever unexpected rain occurs shortly after furrow irrigation, prolonged waterlogging can result in crop yield loss
- How can furrow irrigation be managed differently to minimize this problem?


Furrow
Sprinkler
Rainfed
Stress Threshold
b) 2022
mm of soil water depletion
150
125
100
75
50
25
0
25
35
45
55
65
75
85
95
105
115
125
days after planting
c) 2023
mm of soil water depletion
150
125
100
75
50
25
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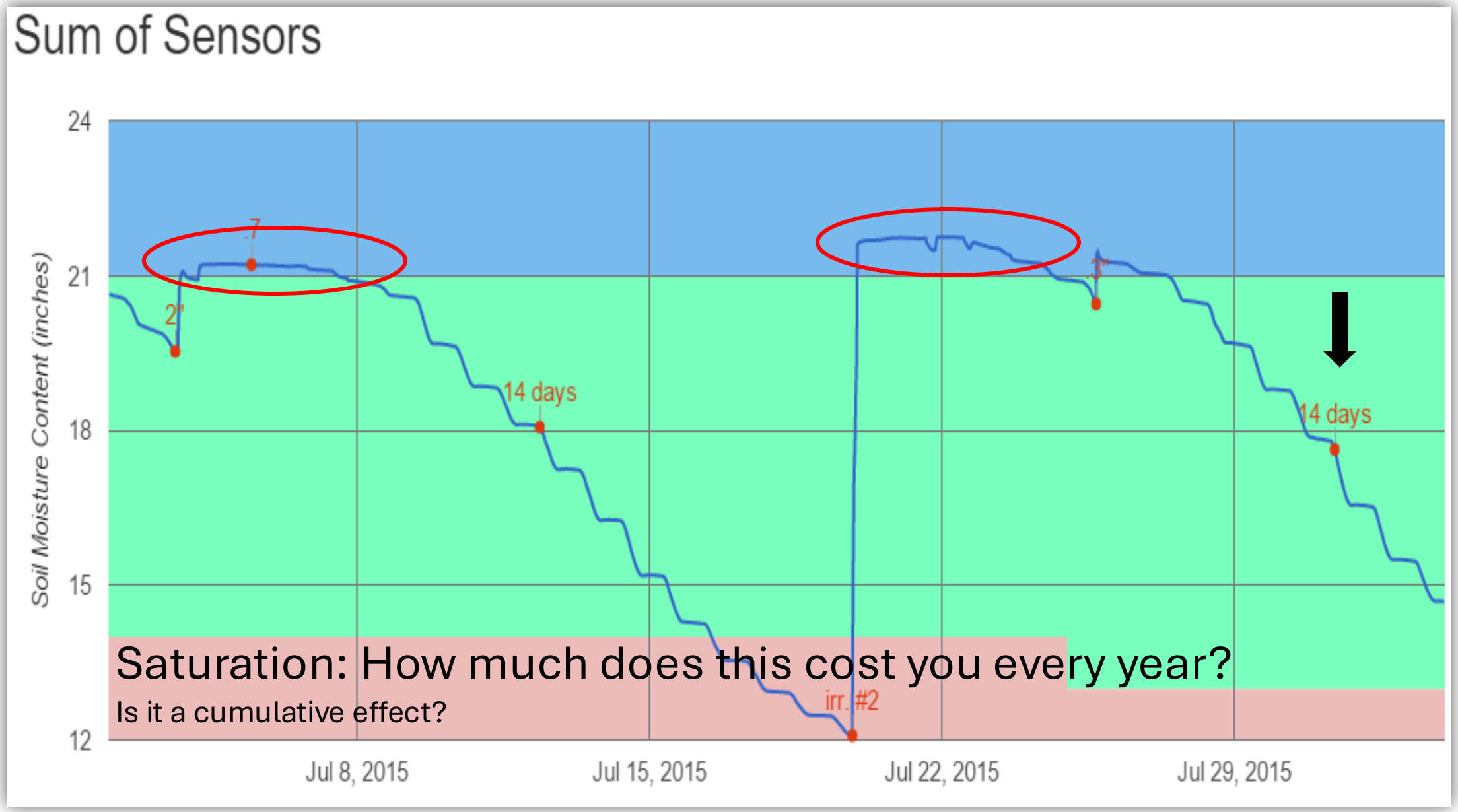
125
days after planting

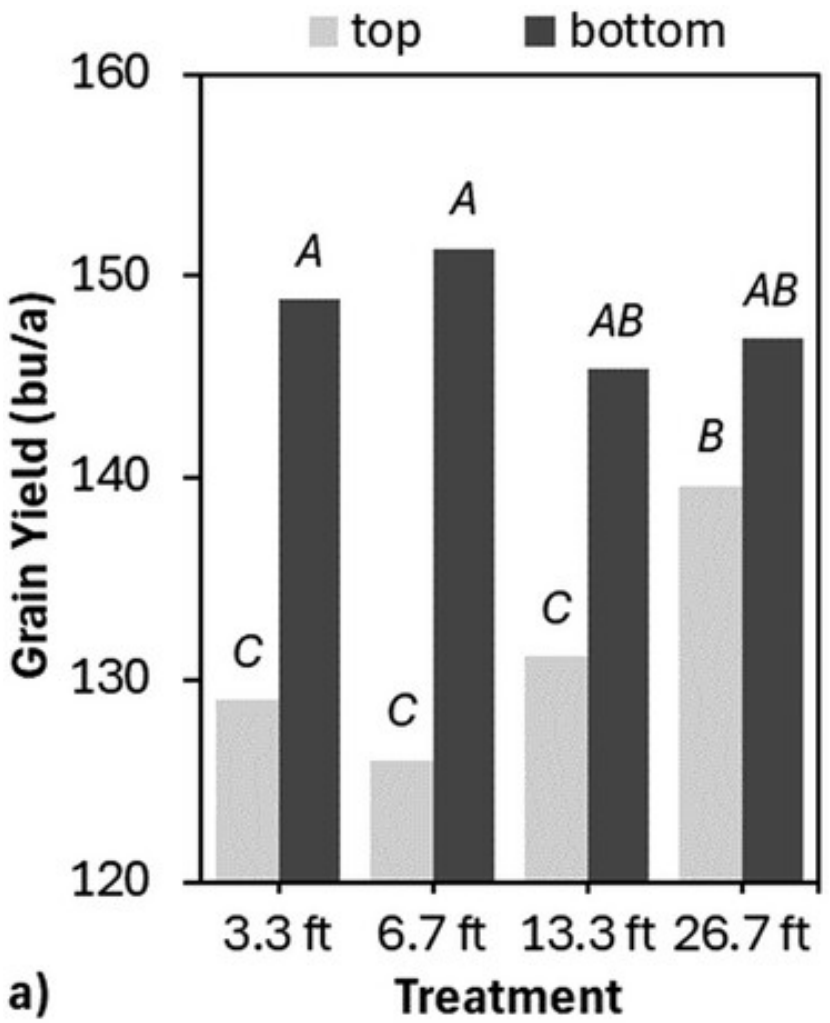

Sum of Sensors
Soil Moisture Content (inches)
24
21
18
15
12
.7
2"
14 days
irr. #2
.3"
14 days
Jul 8, 2015
Jul 15, 2015
Jul 22, 2015
Jul 29, 2015
Saturation: How much does this cost you every year?
Is it a cumulative effect?

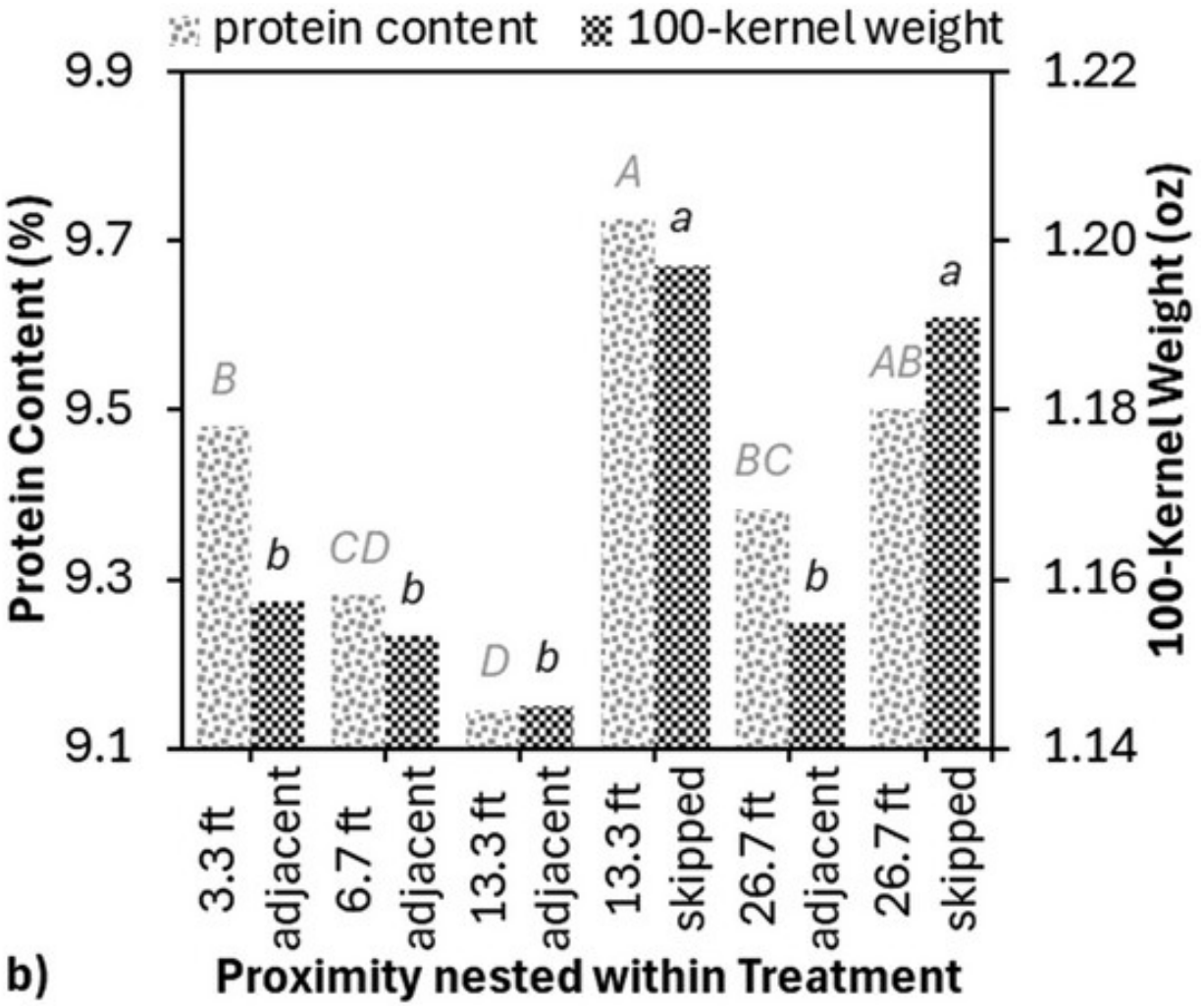
Farmer Innovation: Wide-Skip Furrow Irrigation

Diagram of Treatments

Diagram depicting the middle 16 rows of each plot in one replication for the on-station study. Numbers 1–16 indicate crop rows that were 3.3 ft apart, whereas blue vertical lines represent furrows irrigated. For each plot, corn grain was measured at a topographically higher "top" position and a topographically lower "bottom" position across six rows that are marked by either "A" or "S" to differentiate their proximity to irrigated furrows. "A" denotes rows adjacent to irrigated furrows, and "S" denotes rows situated in the middle of the skip between irrigated furrows.

Treatment Effects on Corn Grain Results





Volumetric Water Content (ft of water per ft of soil)

11:00 AM

9:00	distance from water			
depth	20	60	100	140
2	0.00	0.00	0.00	0.00
6	0.03	0.03	0.00	0.00
10	0.12	0.15	0.01	0.00
14	0.13	0.21	0.09	0.00
18	0.14	0.18	0.09	0.00
22	0.11	0.15	0.06	0.00
26	0.06	0.12	0.04	0.00

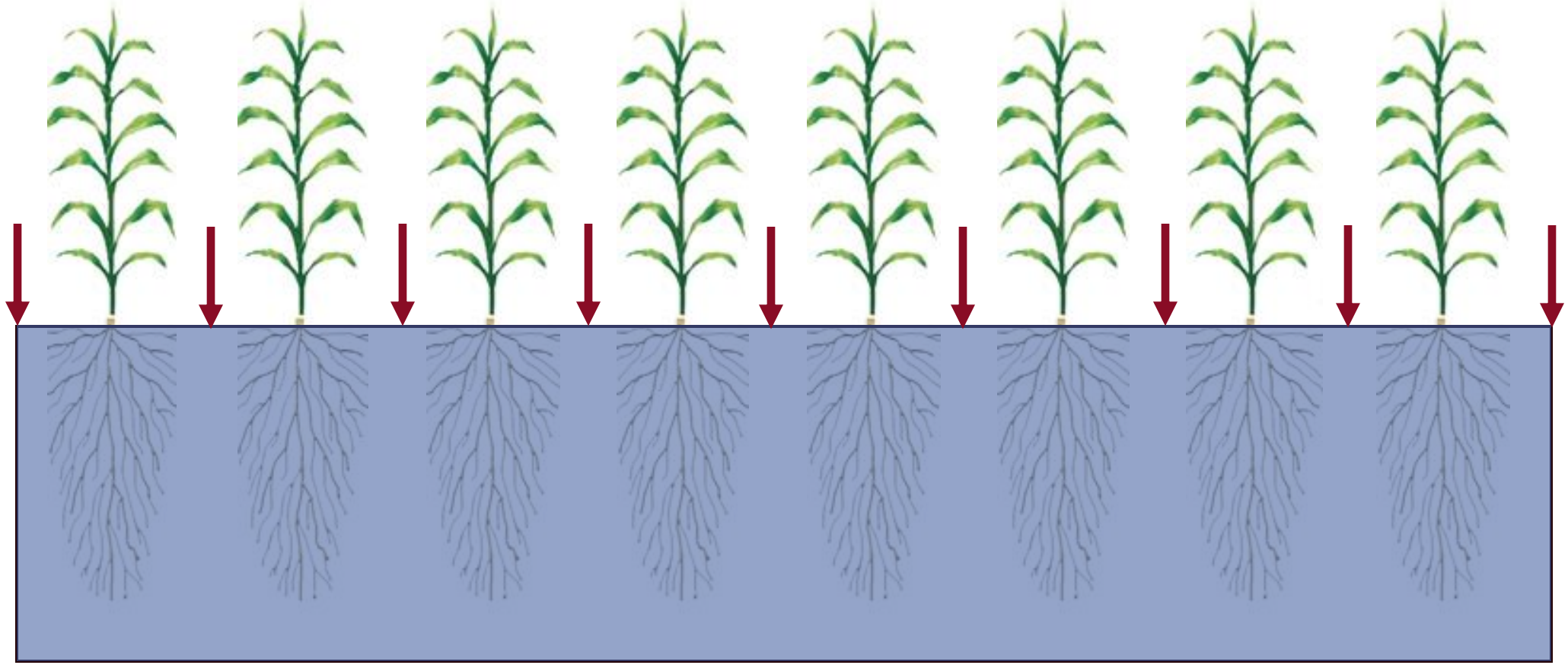
11:00 AM

11:00	distance from water			
depth	20	60	100	140
2	0.28	0.13	0.01	0.00
6	0.38	0.29	0.13	-0.02
10	0.38	0.43	0.27	0.15
14	0.38	0.49	0.32	0.27
18	0.35	0.45	0.35	0.38
22	0.26	0.37	0.28	0.27
26	0.15	0.18	0.17	0.19

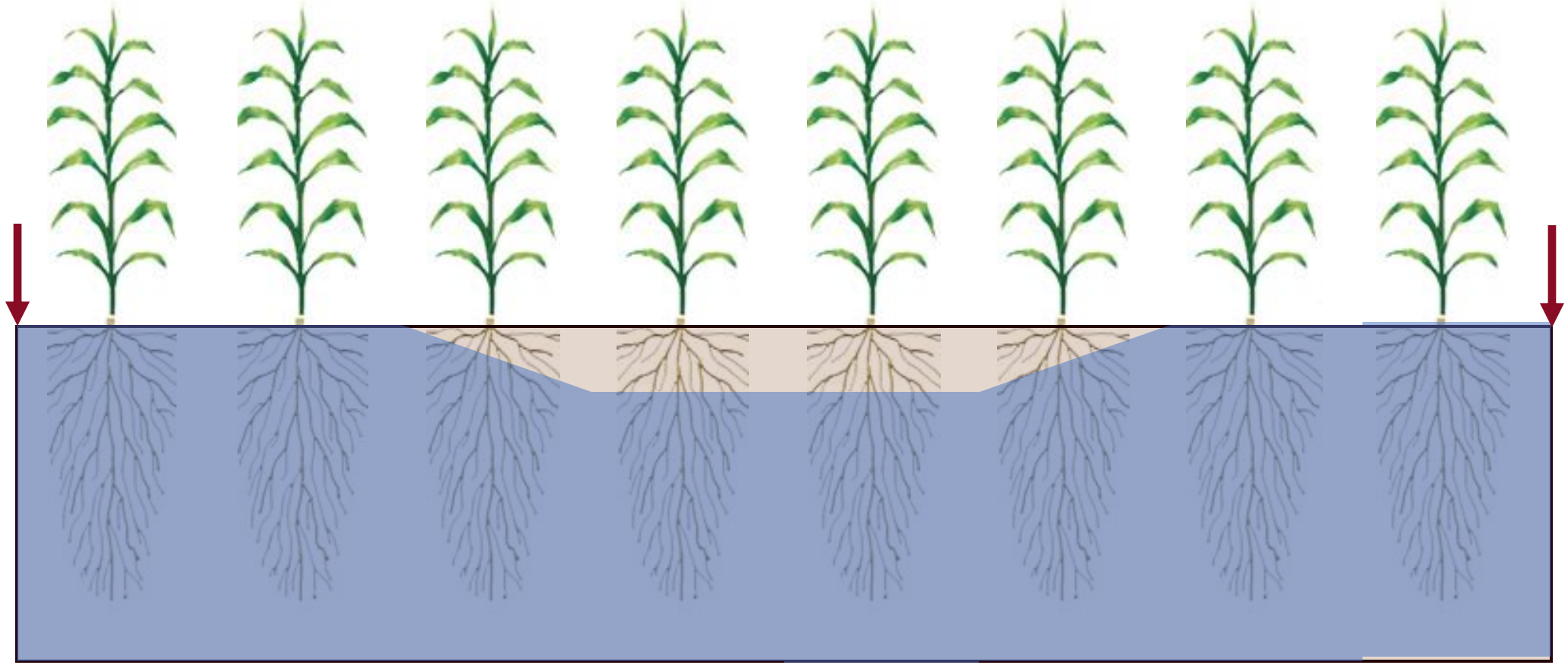
8:00 PM

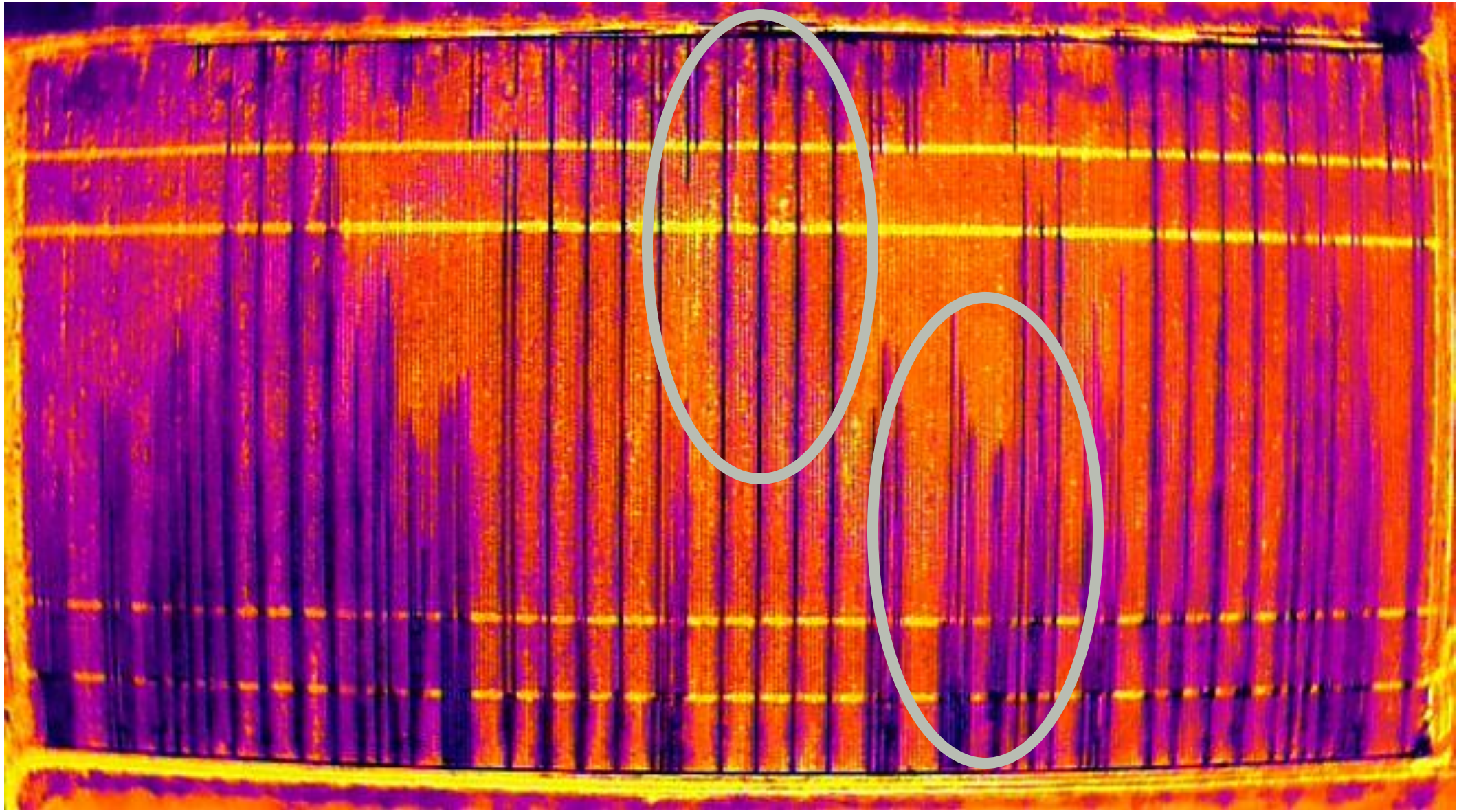
20:00	distance from water			
depth	20	60	100	140
2	0.37	0.33	0.13	0.09
6	0.38	0.45	0.34	0.24
10	0.38	0.49	0.39	0.30
14	0.38	0.49	0.36	0.33
18	0.35	0.46	0.35	0.38
22	0.27	0.36	0.28	0.26
26	0.16	0.18	0.17	0.17

3.3-ft Skip



26.7-ft Skip





Conclusions and Next Steps

- Reduced waterlogging was confirmed to be associated with higher corn grain yield and grain quality in this study
- Furrow spacing could be widened to 26.7 ft without decreasing corn grain yield under the conditions of the three-year study

- How wide could you go?
- What happens in a dry year?
- Expand testing to more crops and more on-farm field sites

2024 Research on Wide-Skip Furrow Irrigation

On-Station

- Effects of furrow inflow and irrigation frequency on wide-skip
  - 12-row (40-foot) skip in corn
  - 6-row (20-foot) skip in soybean

On-Farm

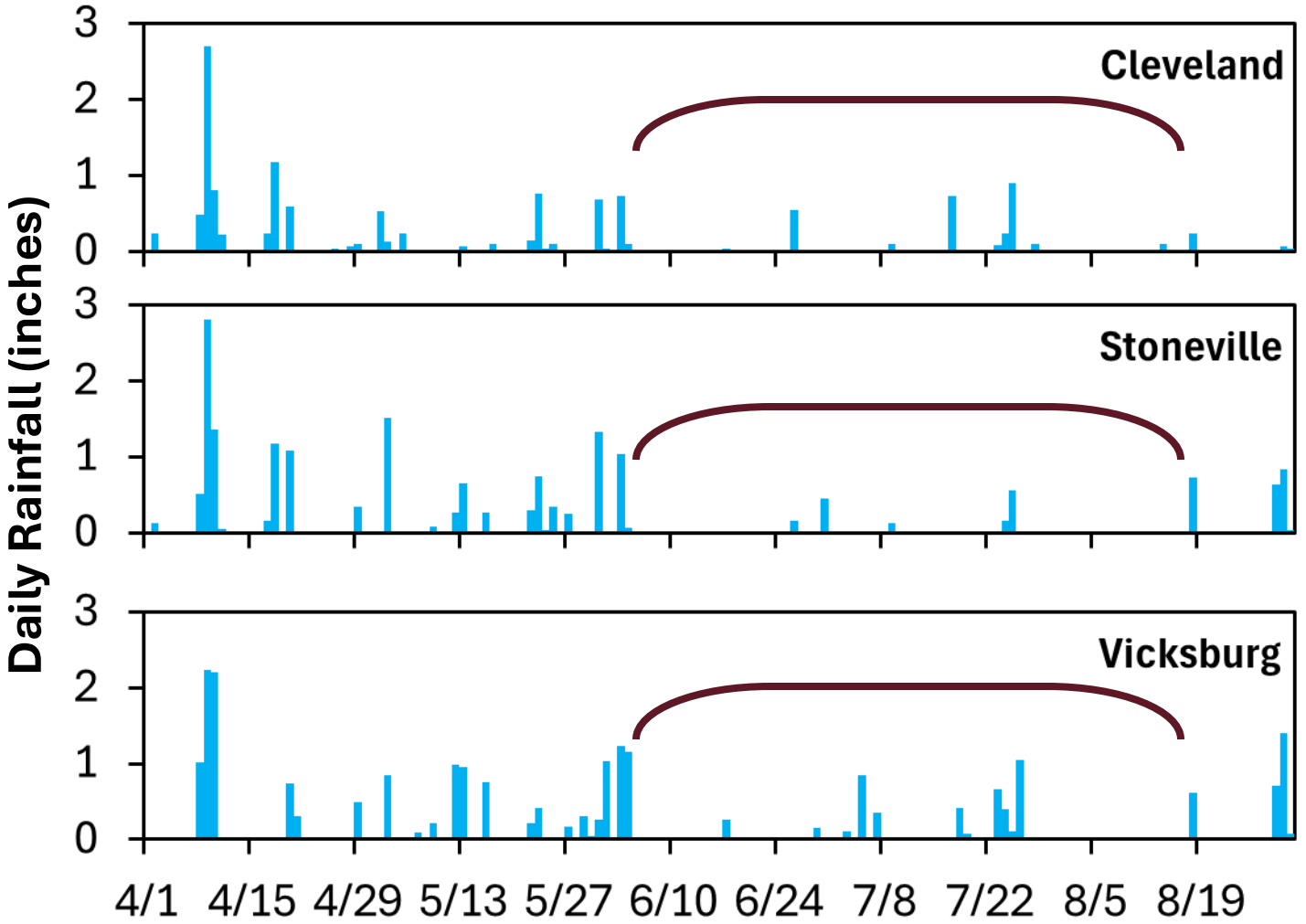
- Comparison of 20-foot-skip furrow irrigation against farmers' conventional practices
  - Corn and soybean
  - Coordinated by Mark Henry, Alex Deason, and Dillon Russell at three farms

2024 Growing-Season Weather

6/5-8/17 cumulative rainfall (74 days)

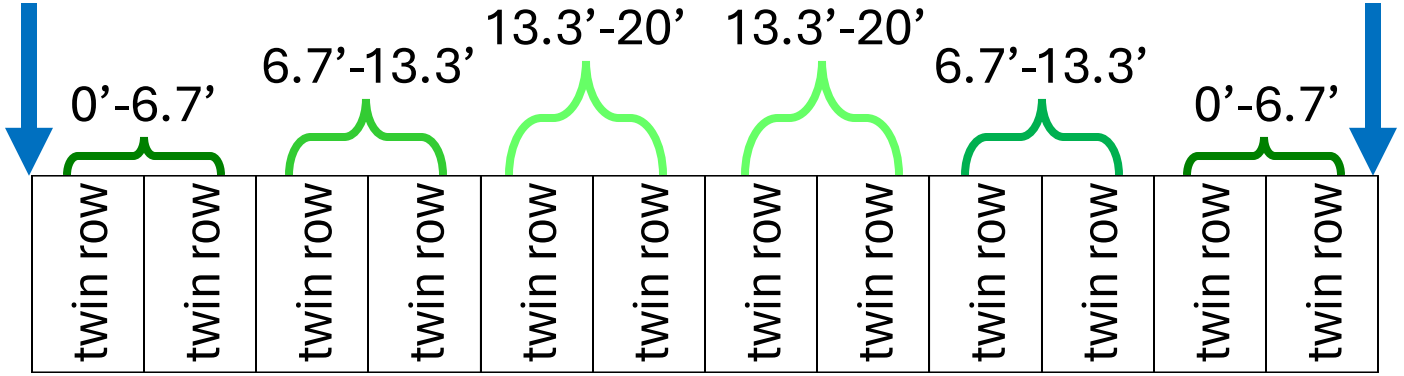
- 2.8 inches in Cleveland
- 1.5 inches in Stoneville
- 4.5 inches in Vicksburg

- Dry periods of such long duration were absent in previous study years (2021-2023)



Effects of furrow inflow and irrigation frequency

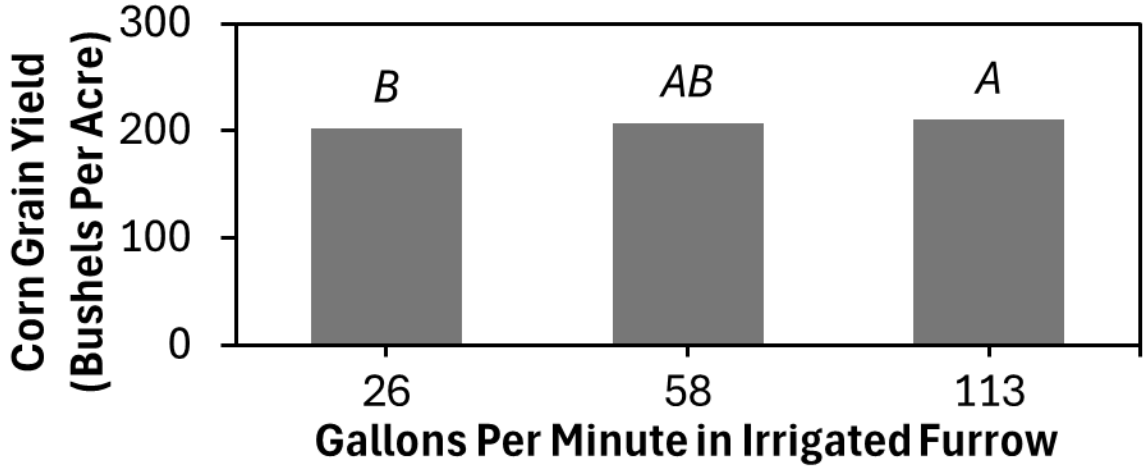
- Corn planted April 4th on 40-inch twin rows
- 40-foot-skip furrow irrigation from mid-June to mid-July at three furrow inflows and two irrigation frequencies

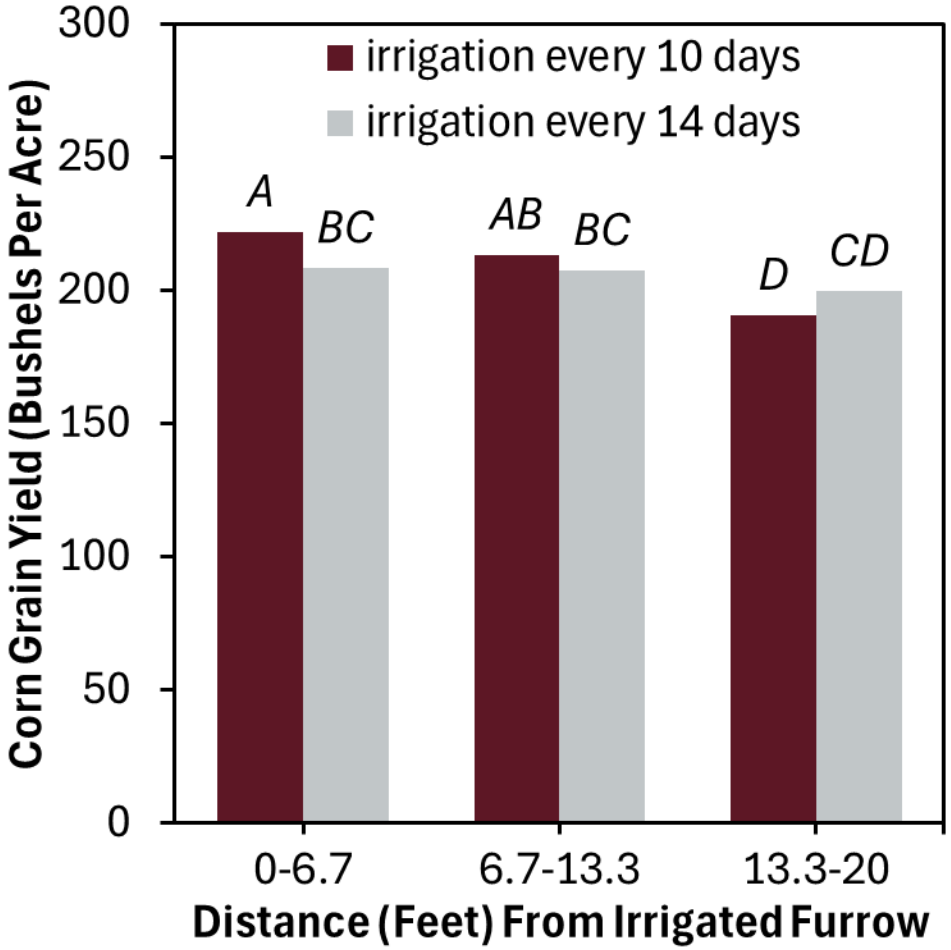


- 26, 58, and 113 gallons per minute in each irrigated furrow
  - Equivalent to roughly 2, 5, and 9 gallons per minute if every furrow instead
- Every 10 days (4 applications) versus every 14 days (2 applications)

Effects of furrow inflow and irrigation frequency

- Yield increased with higher inflows (bottom figure) but not with more opportunity time (data not shown)
- Yield decreased at 13.3-20 feet from the irrigated furrow with higher irrigation frequency (right figure)

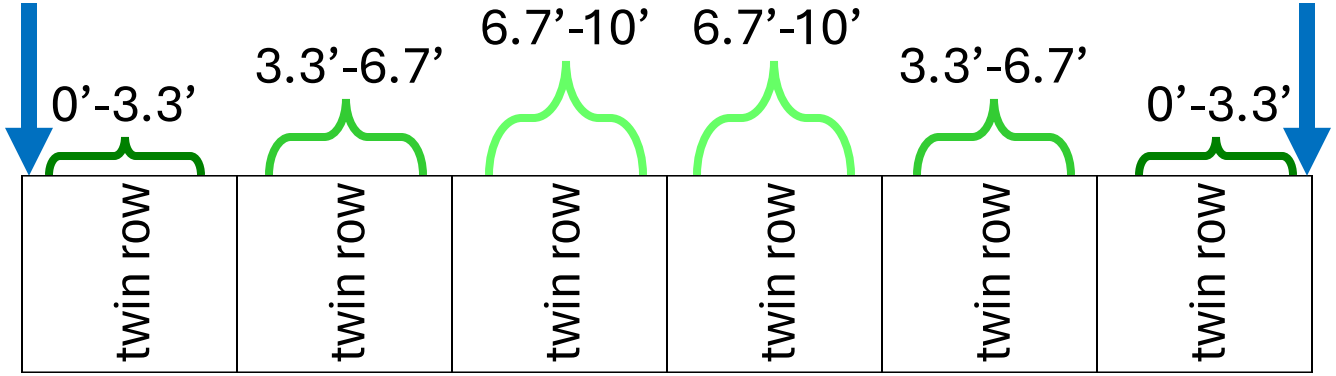




Treatments sharing a grouping letter are not significantly different at α = 0.05 according to Tukey's post-hoc test.

Effects of furrow inflow and irrigation frequency

- Soybean planted April 26th on 40-inch twin rows
- 20-foot-skip furrow irrigation from late June to mid-August at three furrow inflows



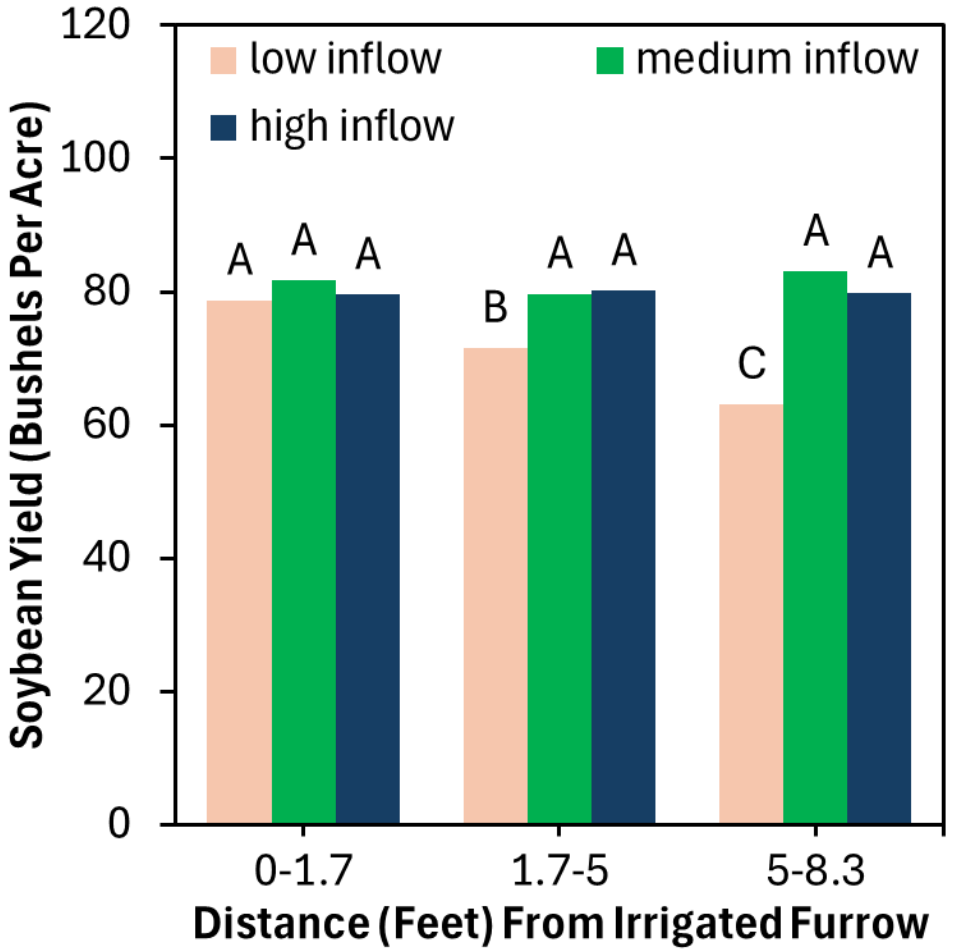
- 15, 36, and 70 gallons per minute in each irrigated furrow
  - Equivalent to roughly 3, 6, and 12 gallons per minute if every furrow instead
- 5 irrigation applications averaging 14 days apart

Effects of furrow inflow and irrigation frequency

- Yield decreased with increasing distance from the irrigated furrow at low furrow inflow only

<u>Some possible contributing factors</u>

- less extensive cracking at this study site, whose soil contained less clay than typical Delta “buckshot”
- declining furrow inflow throughout the season because of a problem with the groundwater well



Treatments sharing a grouping letter are not significantly different at α = 0.05 according to Tukey’s post-hoc test.

On-Farm Tests of 20-Foot-Skip Furrow Irrigation

Yield Impact

Issaquena corn (6 reps)

- skip: 221 bushels per acre
- conventional: 221 bushels per acre

Issaquena soybean (3 reps)

- skip: 63 bushels per acre
- conventional: 65 bushels per acre

Bolivar soybean (1 rep)

- skip: 90 bushels per acre
- conventional: 89 bushels per acre

Water Conservation

For each treatment, farm personnel cut off irrigation when furrow advance was complete

Issaquena soybean (1 rep)

- 12% less irrigation

Bolivar soybean (1 rep)

- 27% less irrigation

Preliminary Takeaways

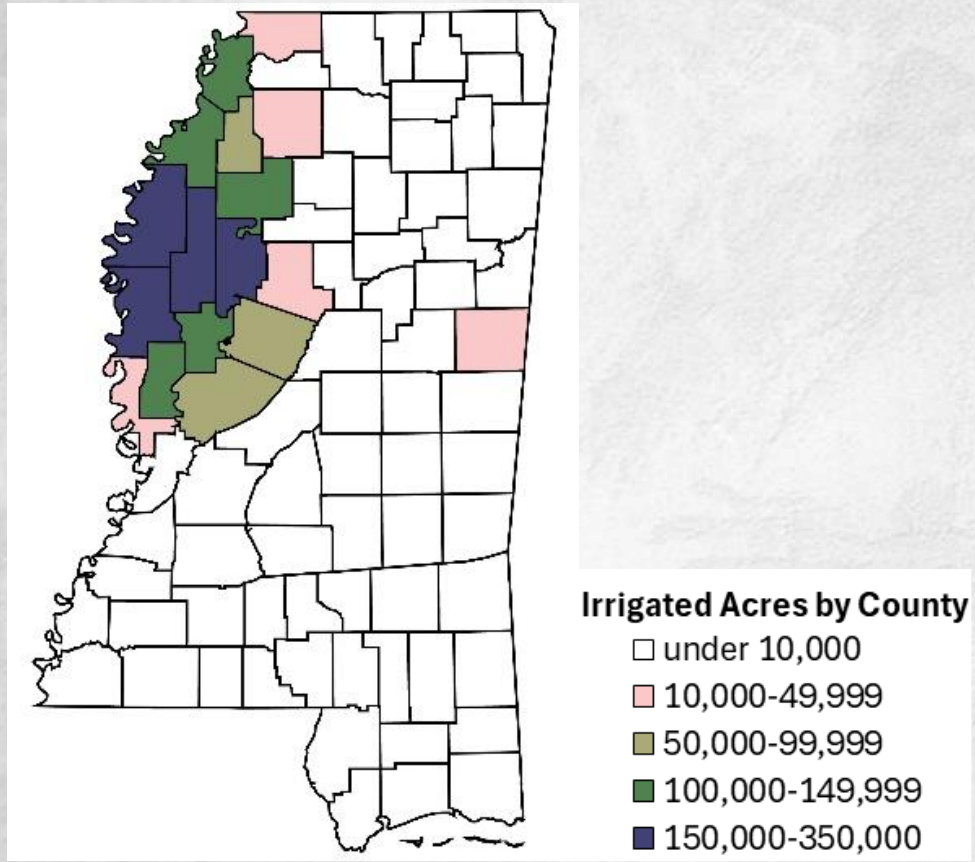
- Four consecutive years of on-farm research support the claim that 20-foot spacing of irrigated furrows does not decrease crop yield relative to conventional practices on “buckshot” soils
- Even with the drier weather of 2024 and the inclusion of soybean (which typically requires more irrigation than corn in the Delta), yield loss was not observed farthest from the irrigated furrow unless furrow inflow is very low
- By reducing infiltration and accelerating advance, wide-skip can shorten irrigation sets, decrease irrigation pumping, reduce waterlogging, and increase rainfall capture on “buckshot” soils

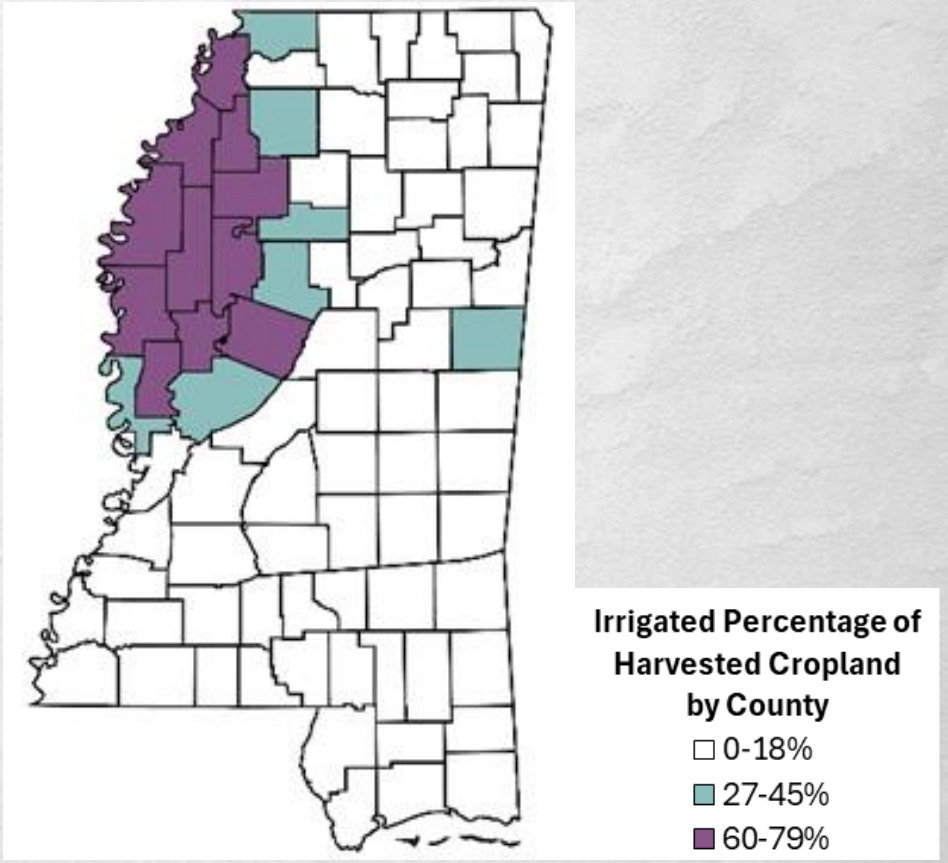
We gratefully acknowledge your generous support of MCPB project 30-2024 and MSPB project 55-2024!

2023 Irrigation and Water Management Survey

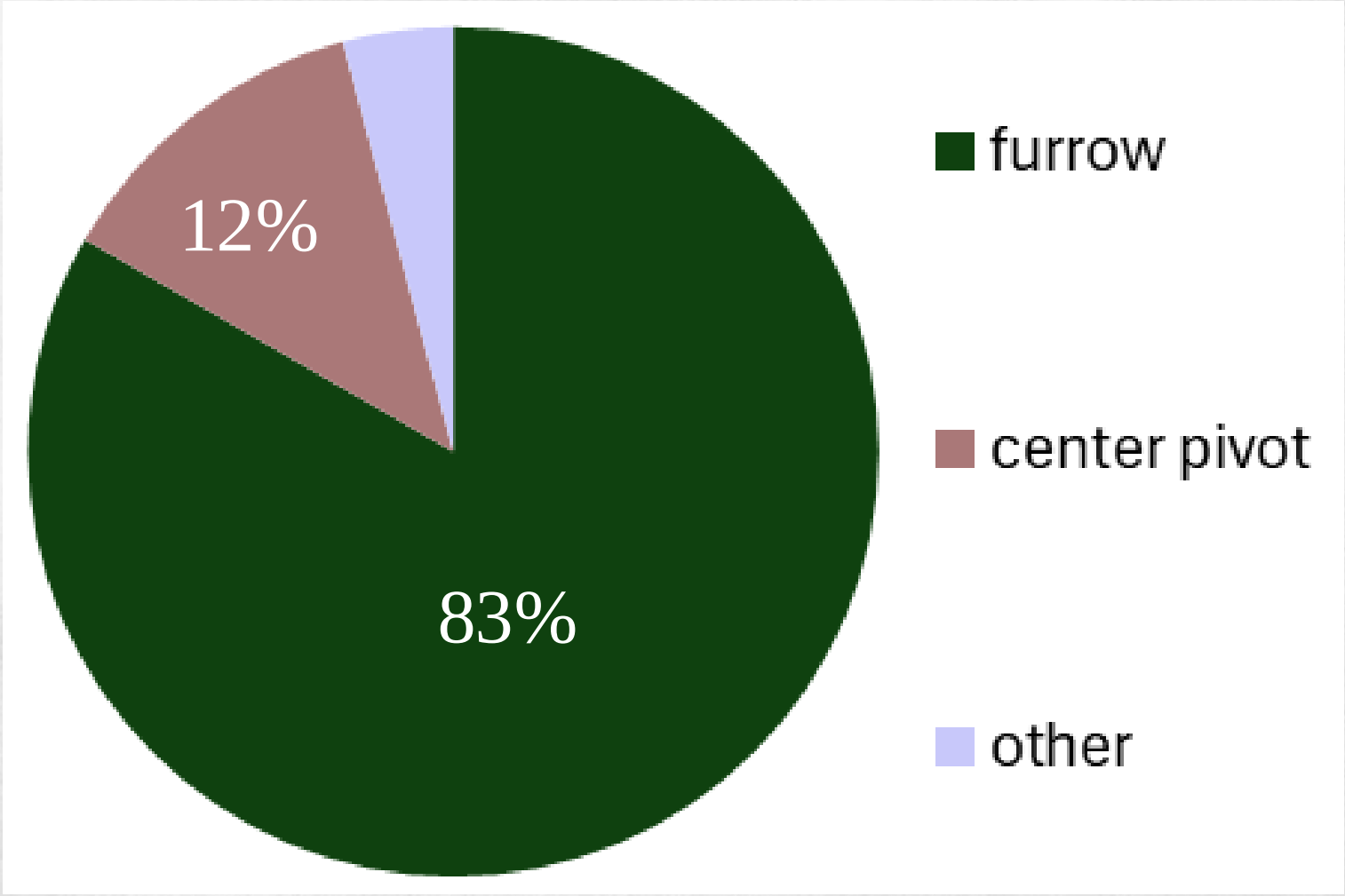
- The primary purpose of the Irrigation and Water Management Survey (IWMS) is to provide data relating to on-farm irrigation activities for use in preparing a wide variety of water-related local programs, economic models, legislative initiatives, market analyses, and feasibility studies.

Geographical Distribution

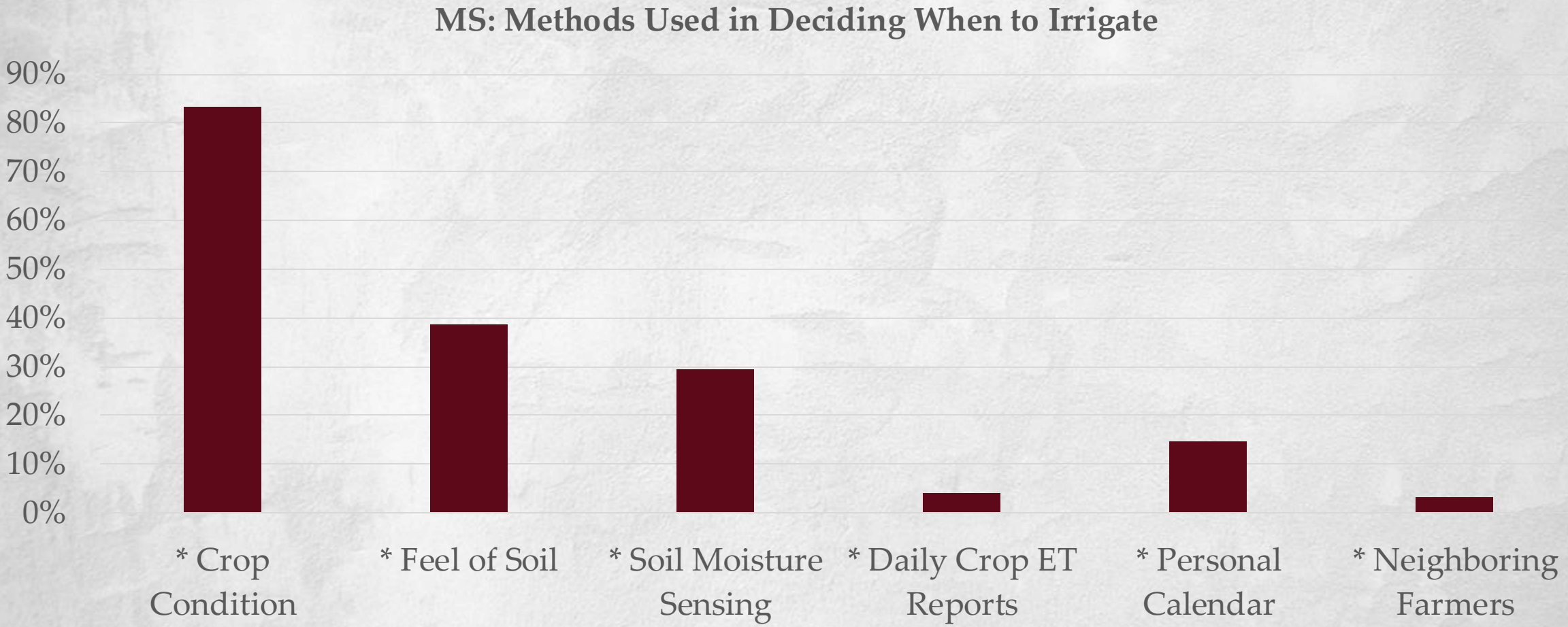




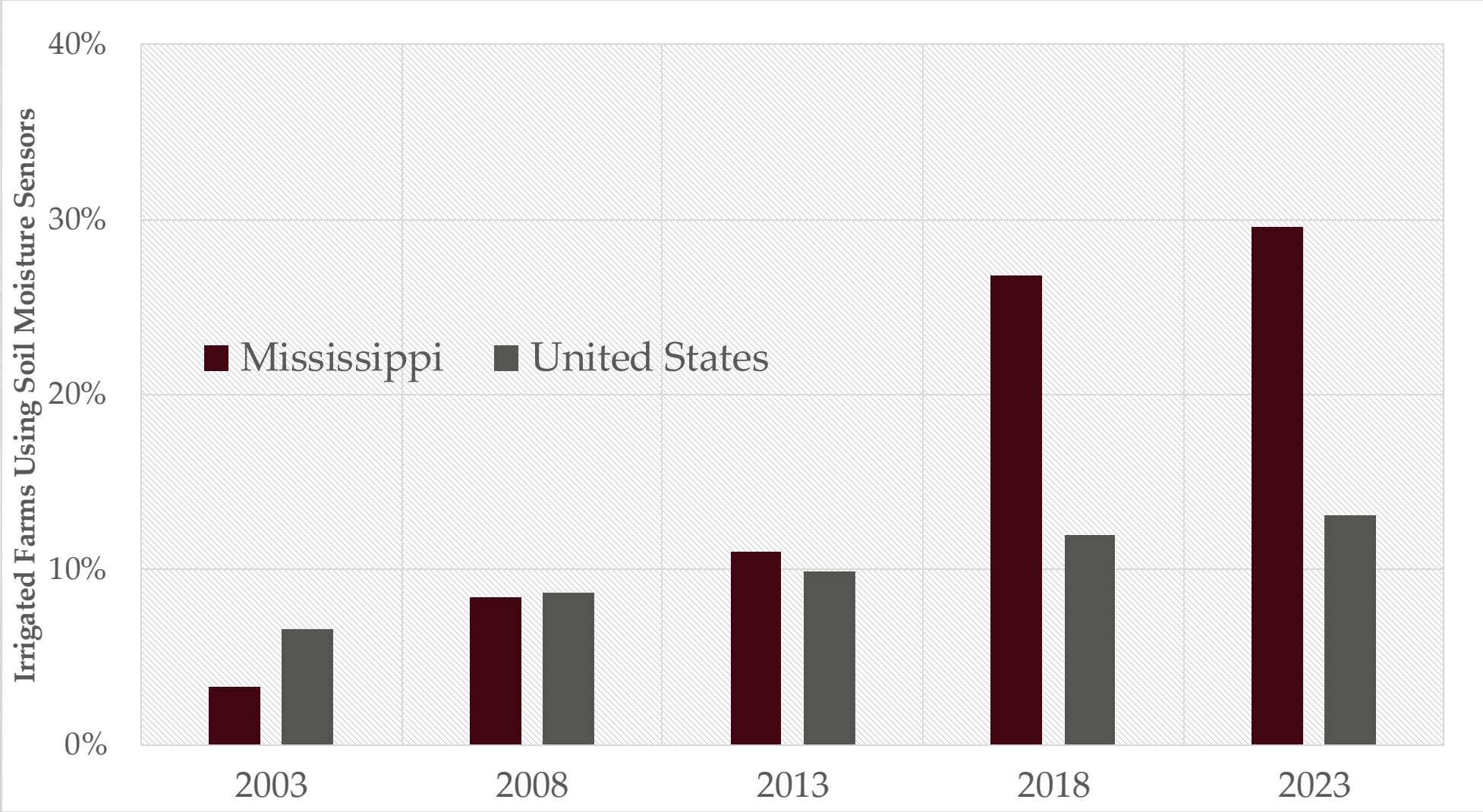
Application Methods



2023 Irrigation and Water Management Survey



Soil Moisture Sensors



Mississippi Master Irrigator

Advanced Training Course

MISSISSIPPI MASTER IRRIGATOR

- Soil health
- Agronomics
- Irrigation water management practices
- Irrigation systems and equipment maintenance
- Policy and management
- Self-paced, hybrid model class

A free program from the National Center for Alluvial Aquifer Research

MISSISSIPPI STATE UNIVERSITY™

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What is Mississippi Master Irrigator?

A 24-hour formal education course designed to educate producers on topics such as:

- Irrigation Water Management Practices (IWM)
- Soil Water Dynamics
- Agronomics
- Irrigation Scheduling
- Irrigation Systems and Equipment Maintenance
- Economics of Irrigated Agriculture
- Policy and Management

How is the course offered?

- The course is designed as a hybrid system with online modules and in-person training/demonstration activities
- Enrollment is currently ongoing, and participants have until January 31, 2025, to sign-up
- In-person meetings will take place on February 12th and 13th at the Delta Research and Extension Center in Stoneville, MS

Course Delivery	Hours
Online Modules (via Canvas) due by Jan. 31, 2025	8
In-person training (Feb. 12th)	8
In-person training (Feb. 13th)	8
Total	24

FOR MORE INFORMATION

www.ncaar.msstate.edu/outreach/master

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USDA United States Department of Agriculture

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Thank You !

Project numbers 30-2024 (MCPB) and 55-2024 (MSPB)

Agricultural Research Service

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