RESEARCH UPDATES: Mobile Drip Irrigation & Soil Moisture Sensors

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Comparing Mobile Drip Irrigation to Low Elevation Spray Application

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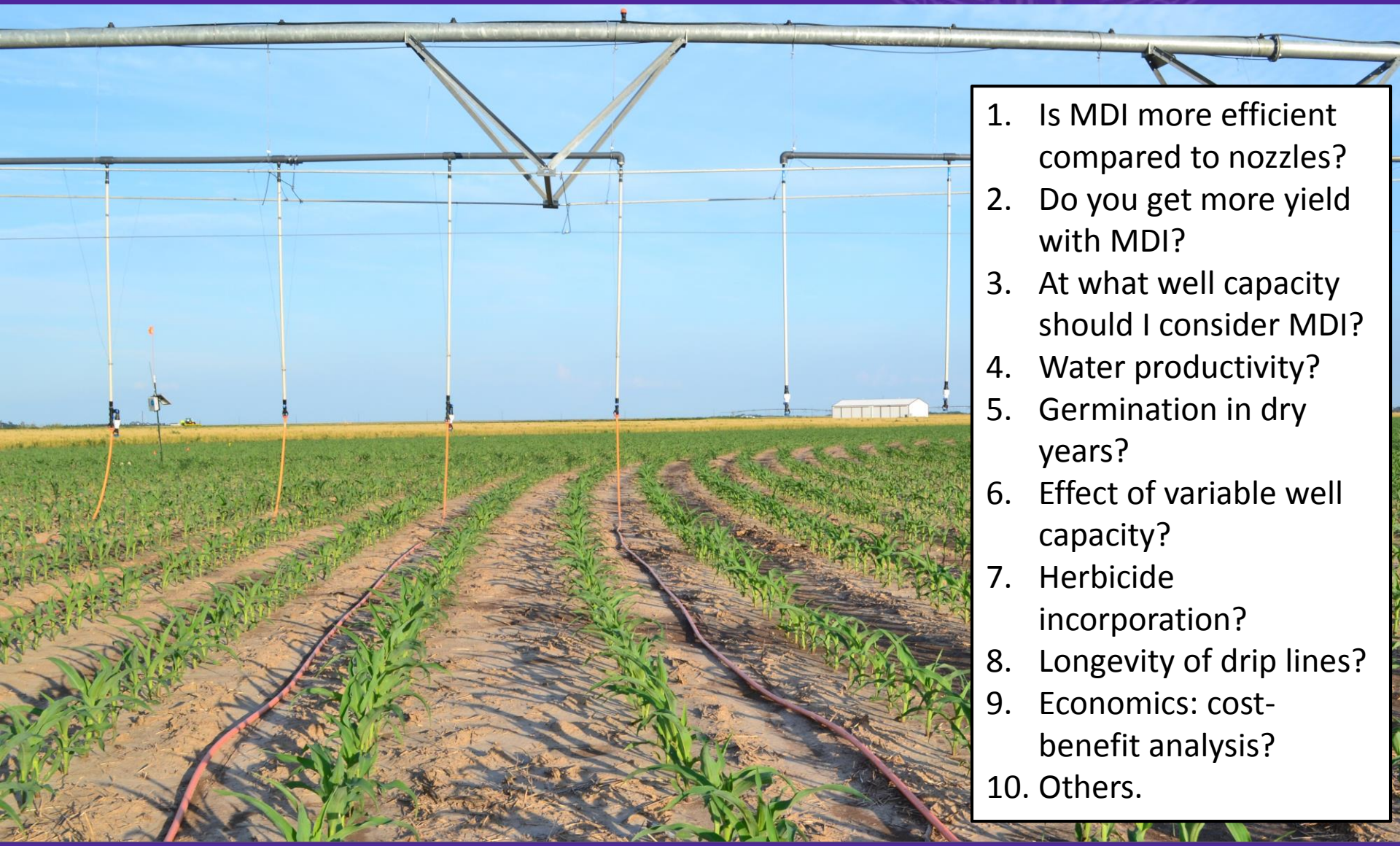
Mobile Drip Irrigation (DragonLine)

Questions about MDI



1. Is MDI more efficient compared to nozzles?
2. Do you get more yield with MDI?
3. At what well capacity should I consider MDI?
4. Water productivity?
5. Germination in dry years?
6. Effect of variable well capacity?
7. Herbicide incorporation?
8. Longevity of drip lines?
9. Economics: cost-benefit analysis?
10. Others.

Managing Irrigation with Limited Water

Goal: Maximize Water Productivity (WP)

$$WP = \frac{Economic\ Yield}{ET_c\ (Crop\ Water\ Use)}$$

Objectives

1. Compare **evaporation water losses** under MDI and LESA (in-canopy spray nozzles).

2. Compare **yield**, **water productivity, irrigation water use efficiency**, and **end of season soil water** under MDI and LESA at two well capacities.

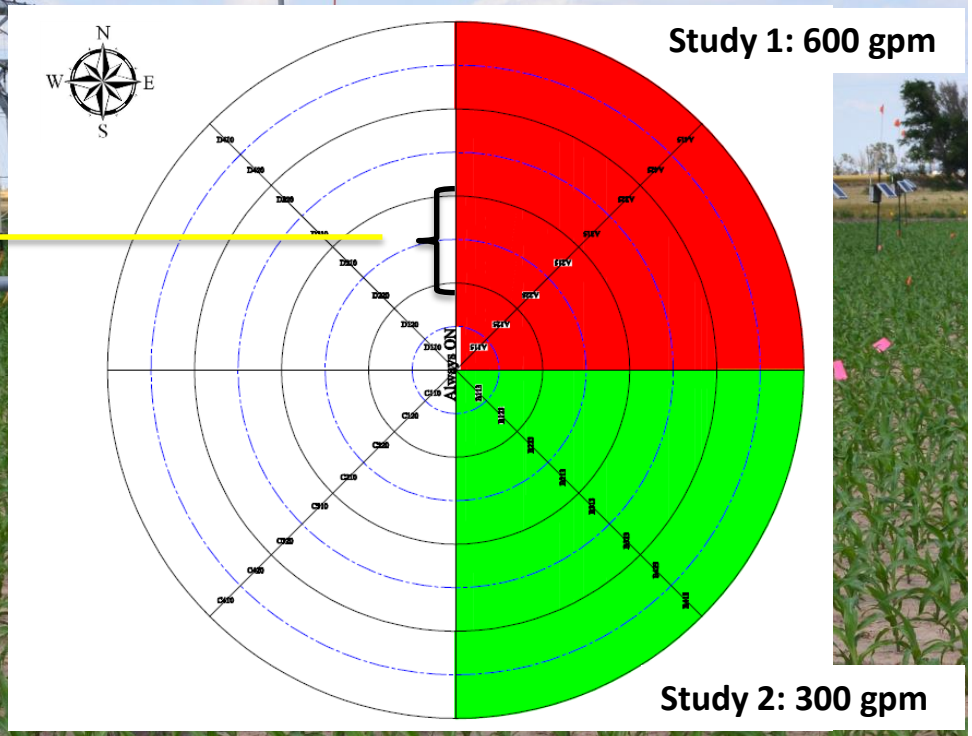
Acknowledgements

- USDA OAP
- Kansas Water Office
- Private industry: Dragon-line, Netafim, Servi-tech, and Monsanto
- Kansas Corn Commission
- K-State Global Food System

Materials and methods

Experimental layout

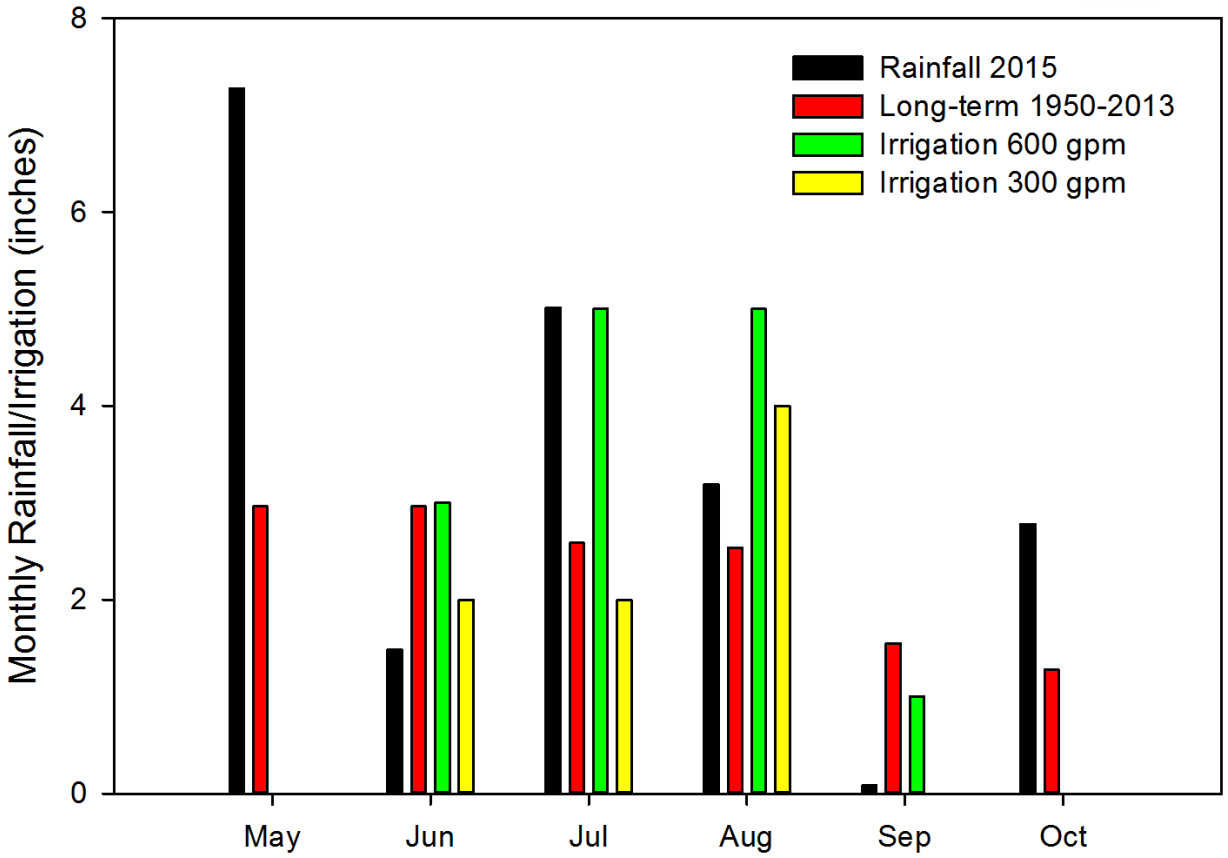
4 Replications



Soil water evaporation measurement

Mini-lysimeter

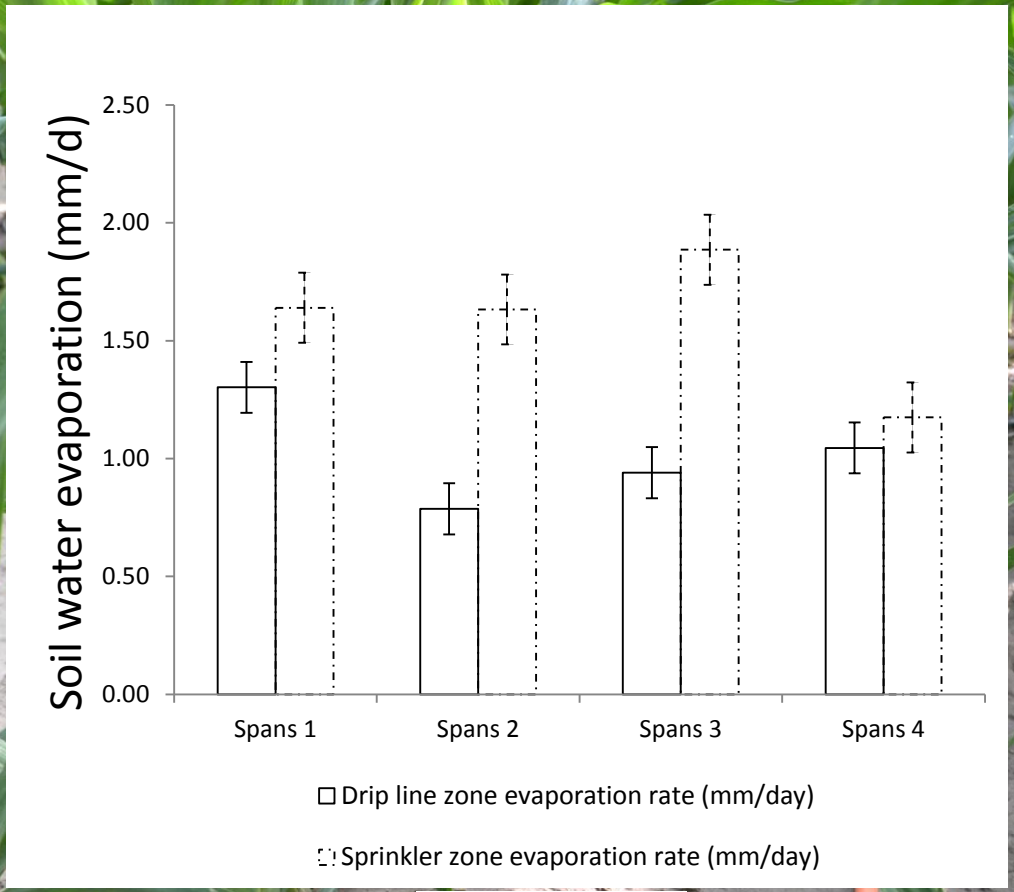
Rainfall and Irrigation



Total irrigation under 600 gpm: 14 inches
Total irrigation under 300 gpm: 8 inches
Total seasonal rainfall 18.3 inches (May to September)

2015 Results

Soil Water evaporation under sprinkler and dripline (mm/day)



Dry

Wet

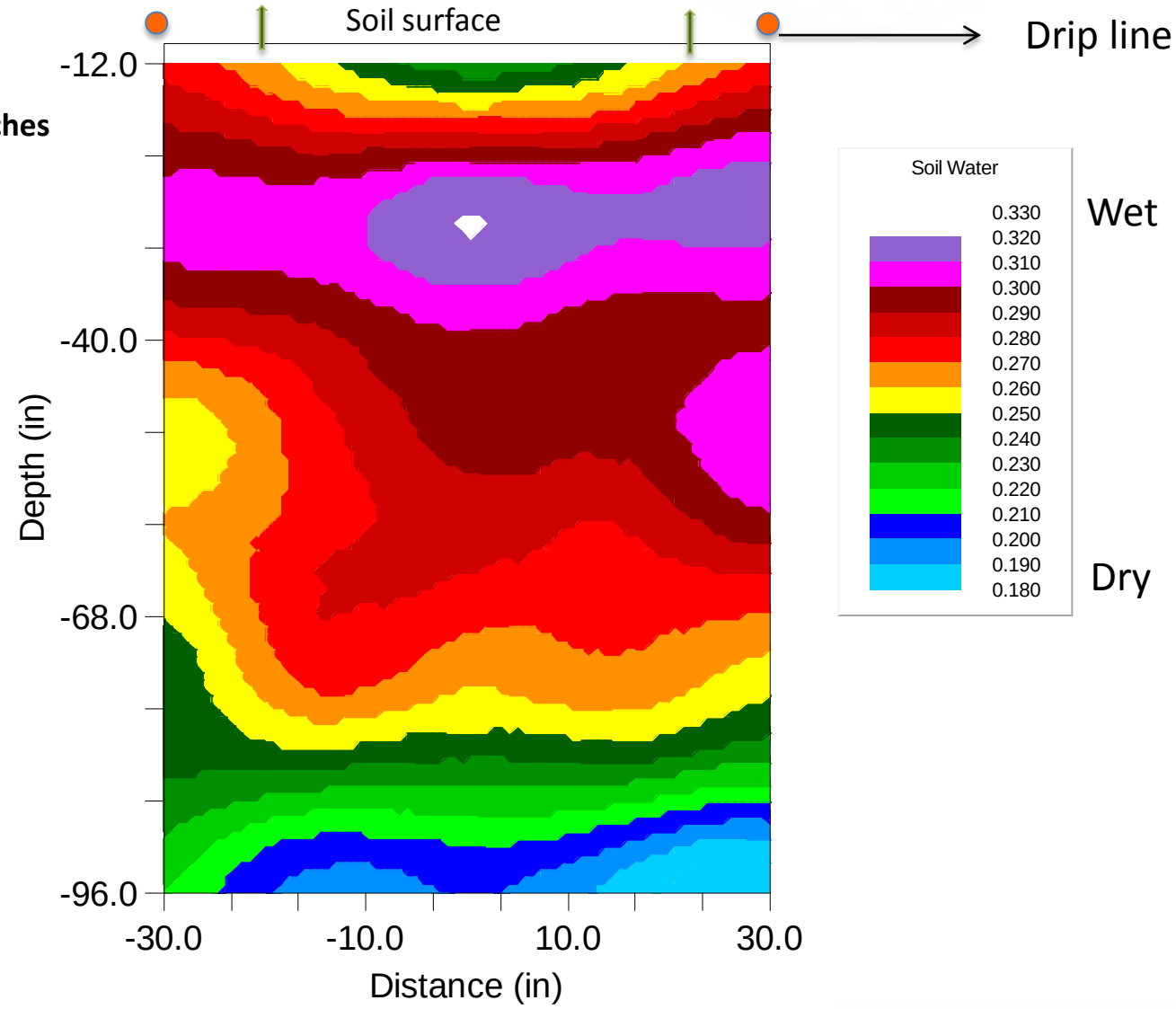
4/100 in/d

6/100 in/d

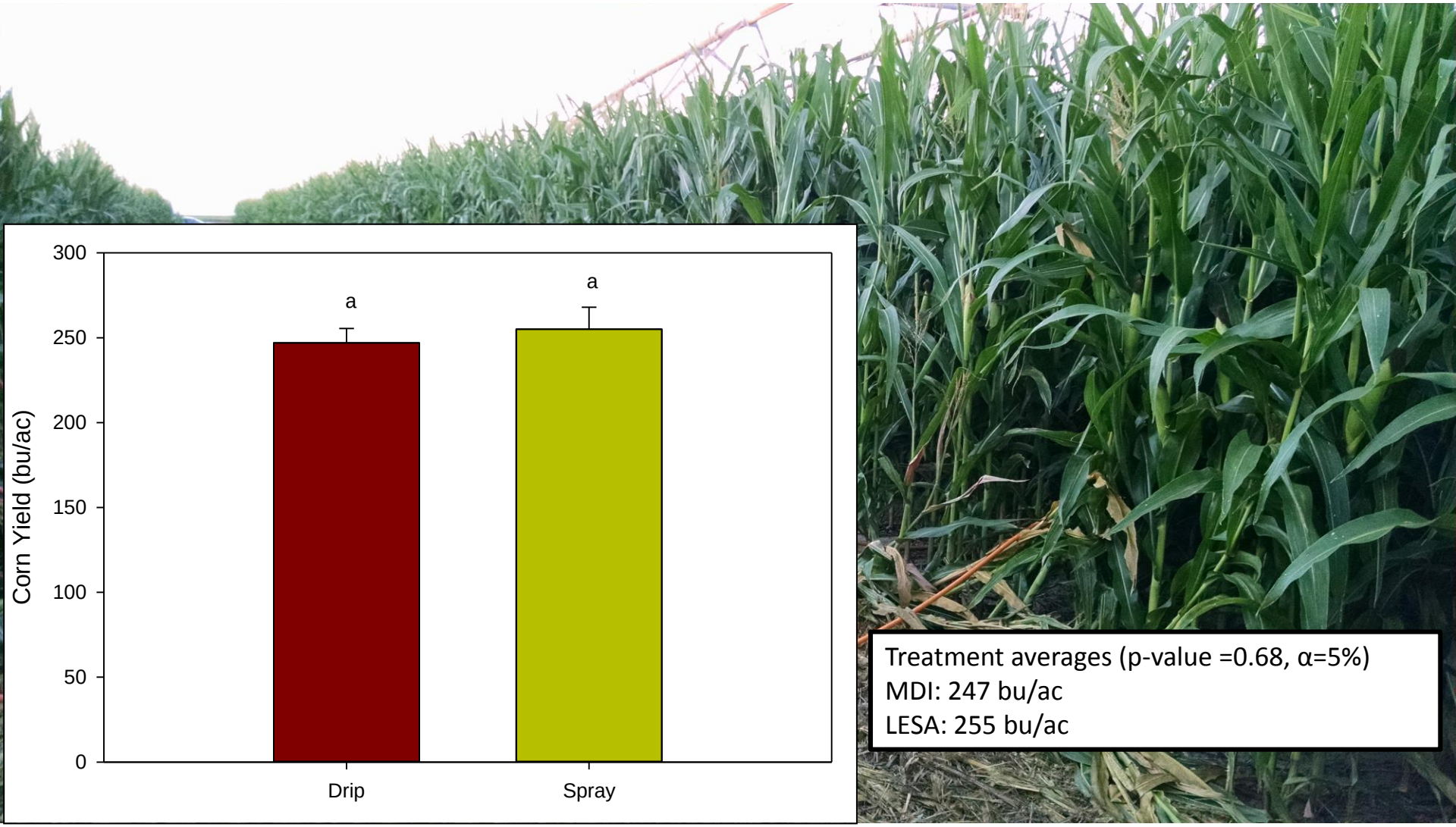
Average daily soil water evaporation: Drip 1.0 mm/day; Sprinkler 1.6 mm/day p-value<0.05

Soil water redistribution under MDI

- **Drip line spacing 60 inches**
- **Corn spacing 30 inches**

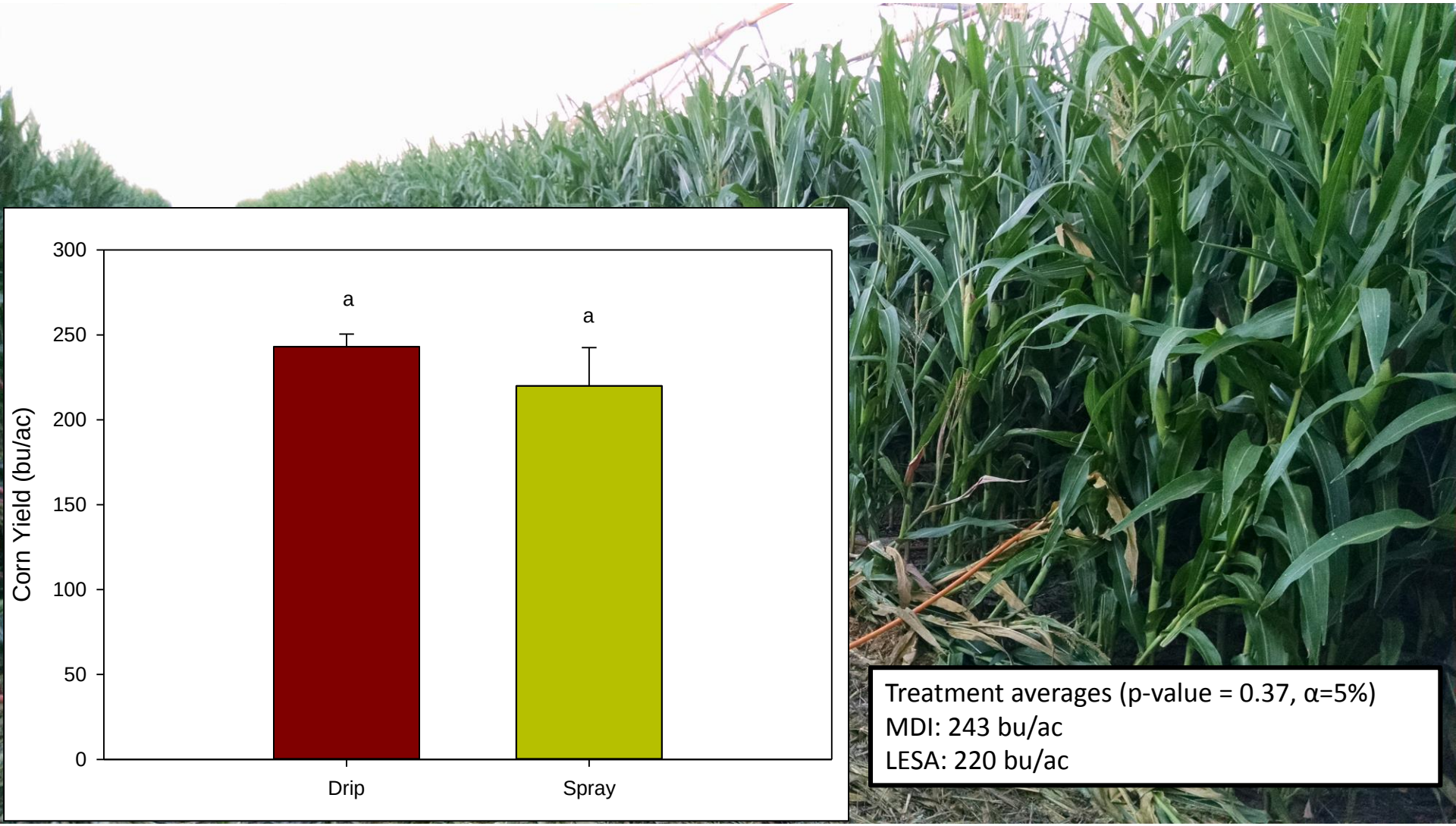


Corn yield under 600 gpm 2015



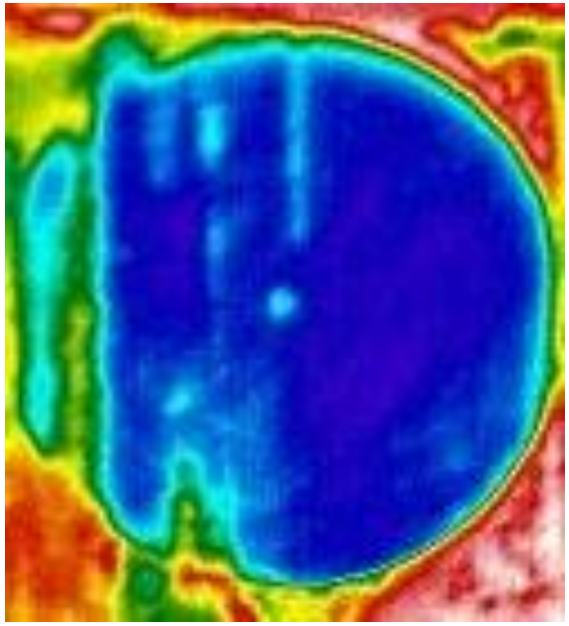
Treatment averages (p-value =0.68, α=5%)
MDI: 247 bu/ac
LESA: 255 bu/ac

Corn yield under 300 gpm 2015



Treatment averages (p-value = 0.37, α=5%)
MDI: 243 bu/ac
LESA: 220 bu/ac

Visual and thermal imagery

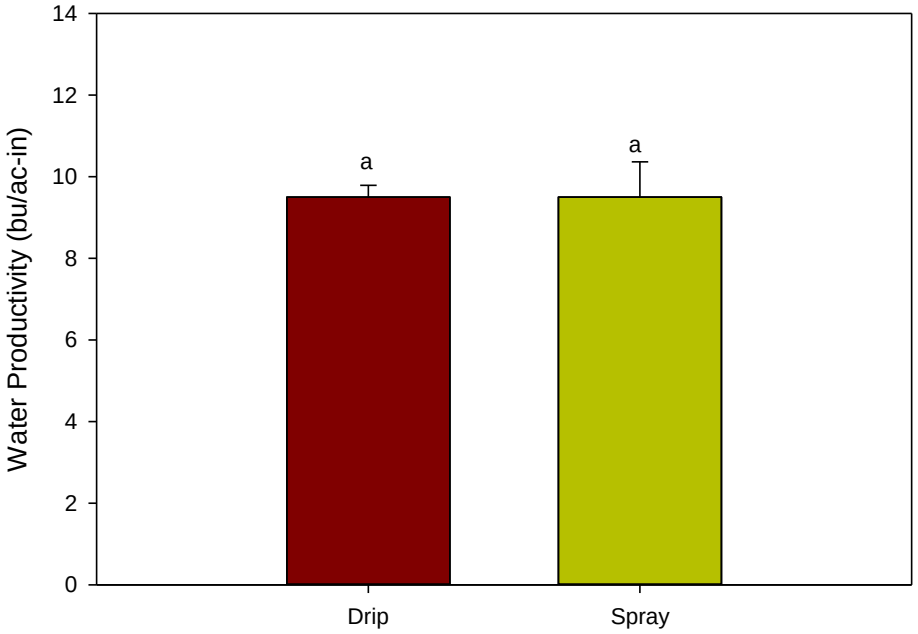


Canopy Temperature

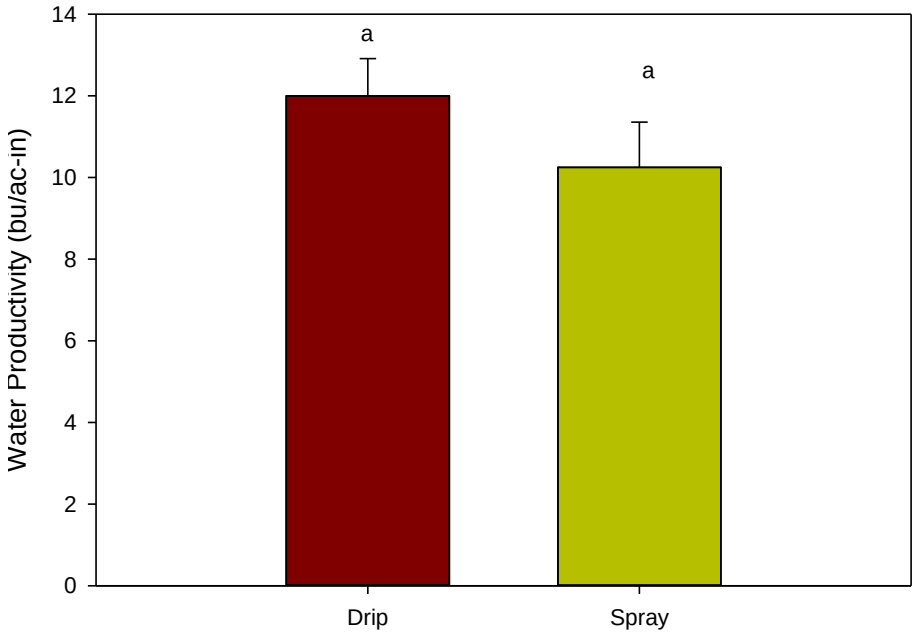
Coolest ⟷ Warmest

Water productivity

Study 1: 600 gpm



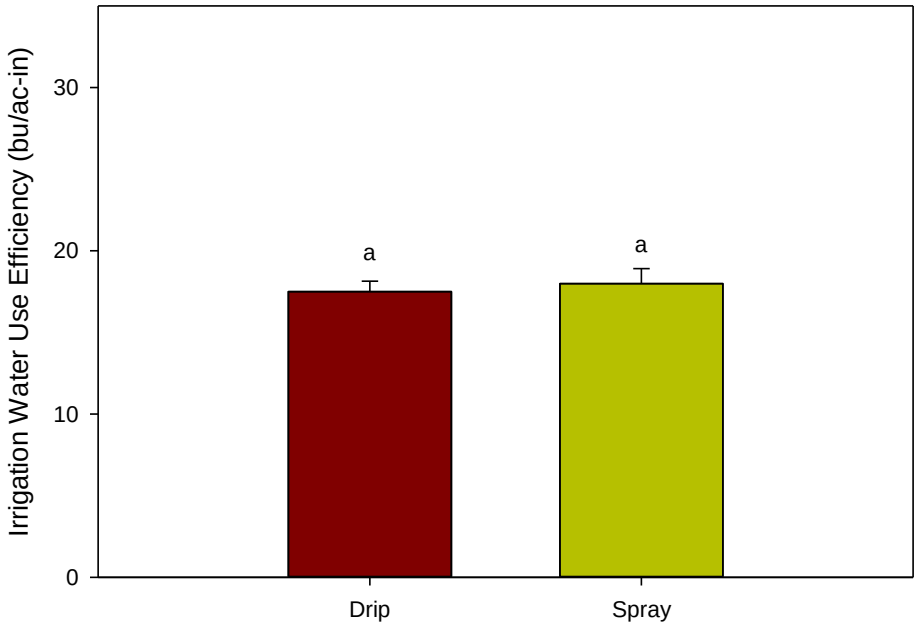
Study 2: 300 gpm



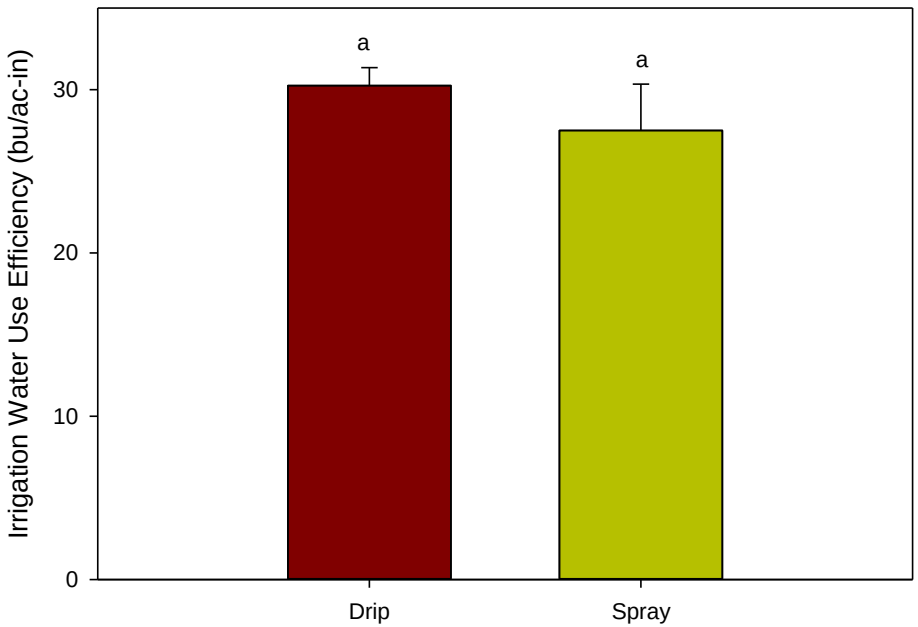
$$WP = \frac{Economic\ \ Yield}{ET_c\ (Crop\ Water\ Use)}$$

Irrigation water use efficiency under

Study 1: 600 gpm



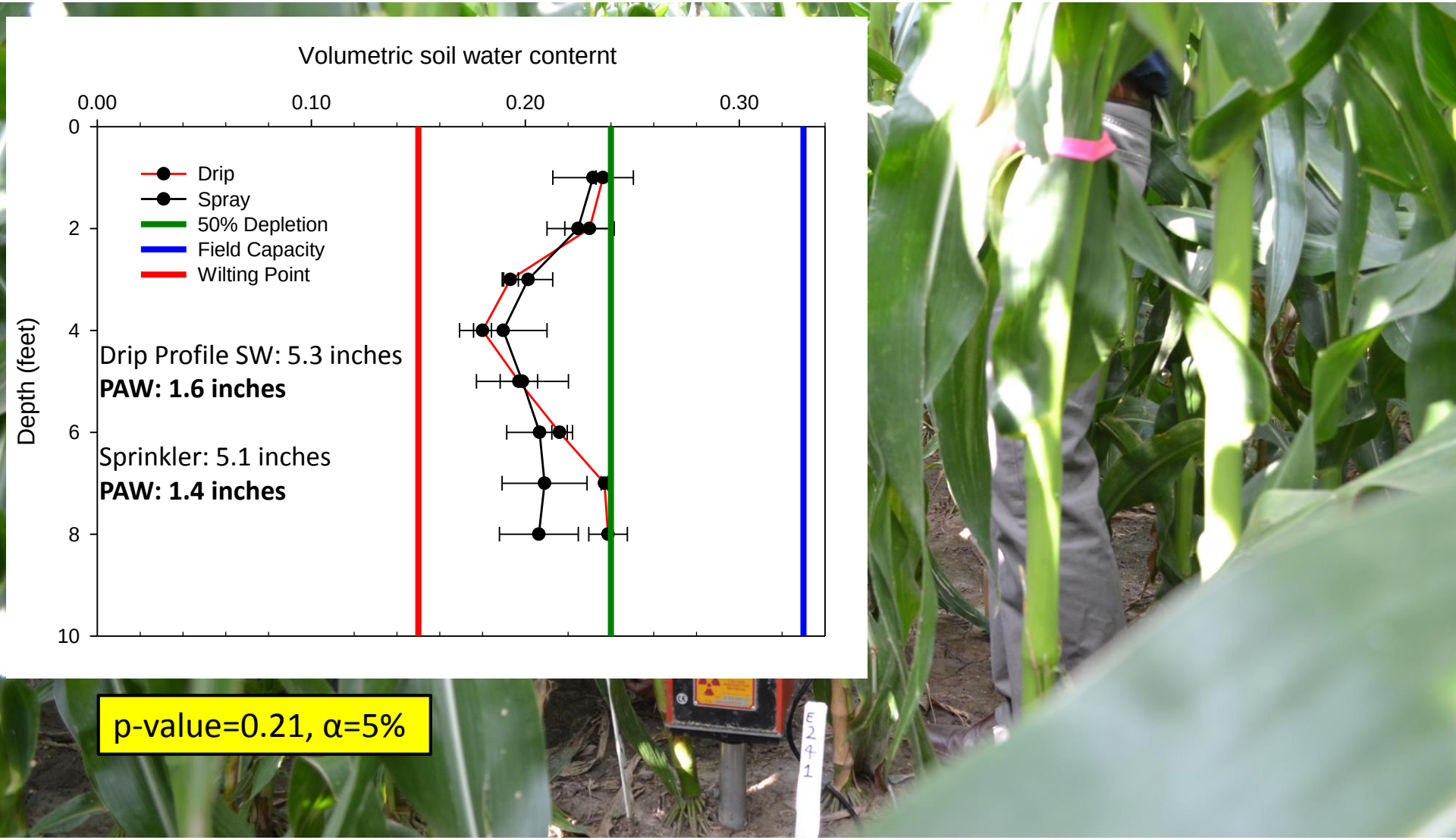
Study 2: 300 gpm



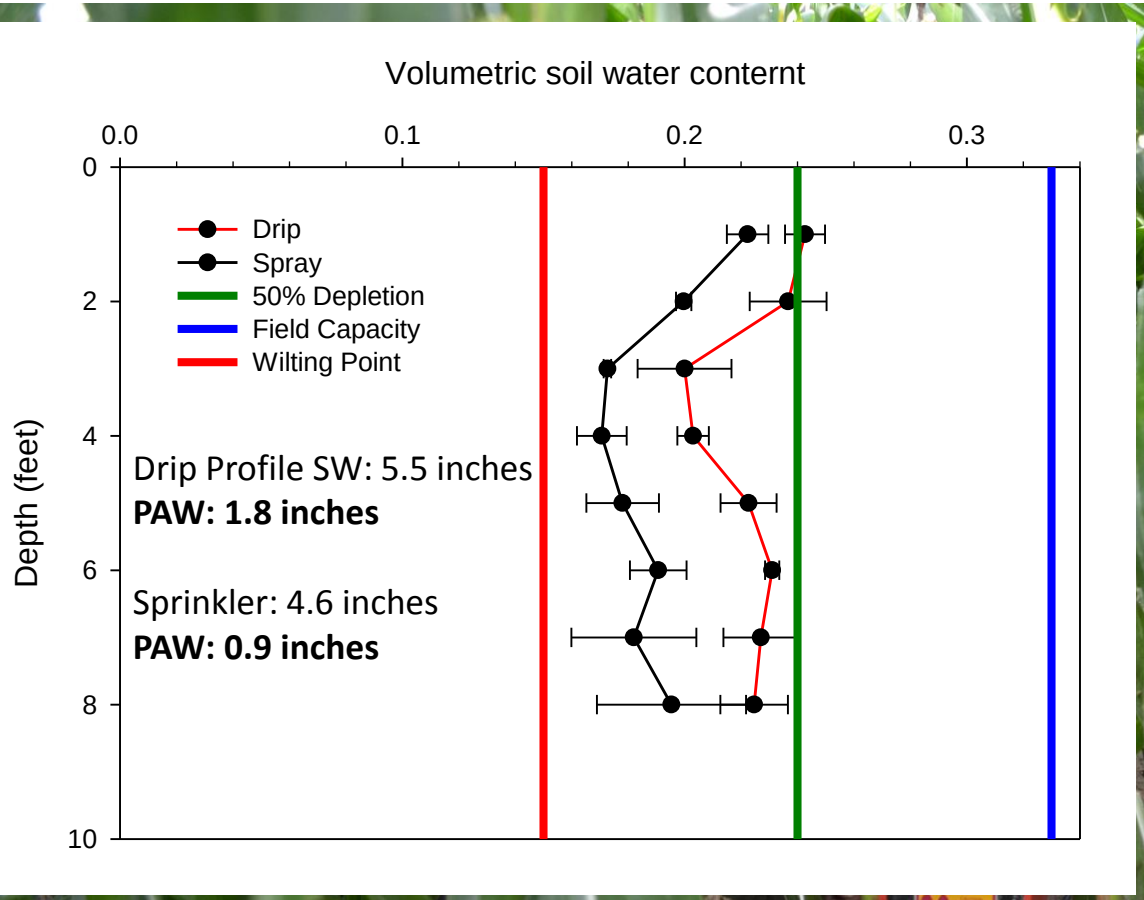
$$IWUE = \frac{Yi - Yd}{I}$$

Potential sources of water loss: Deep drainage and soil water evaporation

End of season soil water under 600 gpm

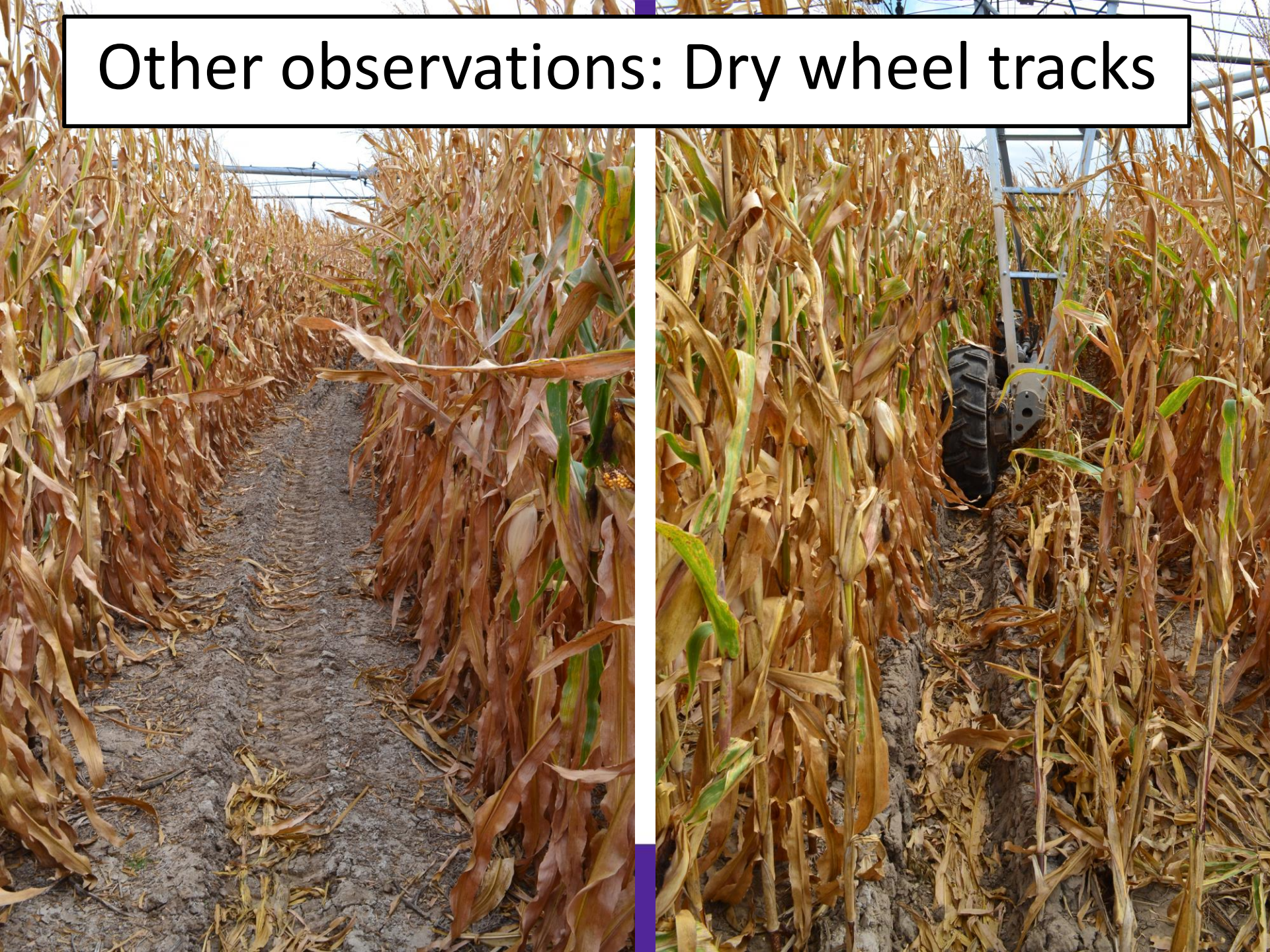


End of season soil water under 300 gpm



P-value<0.05, α=5%

Other observations: Dry wheel tracks



Challenges

Summary and Conclusion

- Lower soil water evaporation under Drip.
- No significant difference in yield in 2015 due to high rainfall.
- End of season soil water significantly higher under Drip for low well capacity.
- Dripline spacing of 60 inches with emitters of 1 gal/hr spaced 6 inches appears adequate on silt loam soils.
- More research needed to confirm the benefits of MDI.

On-Farm Soil Moisture Sensor Demonstration

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Rationale

1. **Demonstrate** management tools which have been successful in research environments
2. **Encourage** neighbors and other producers try new practices which can be viewed and tested by their peers
3. **Evaluate** the effectiveness of soil moisture sensors as a cost effective irrigation water management tool

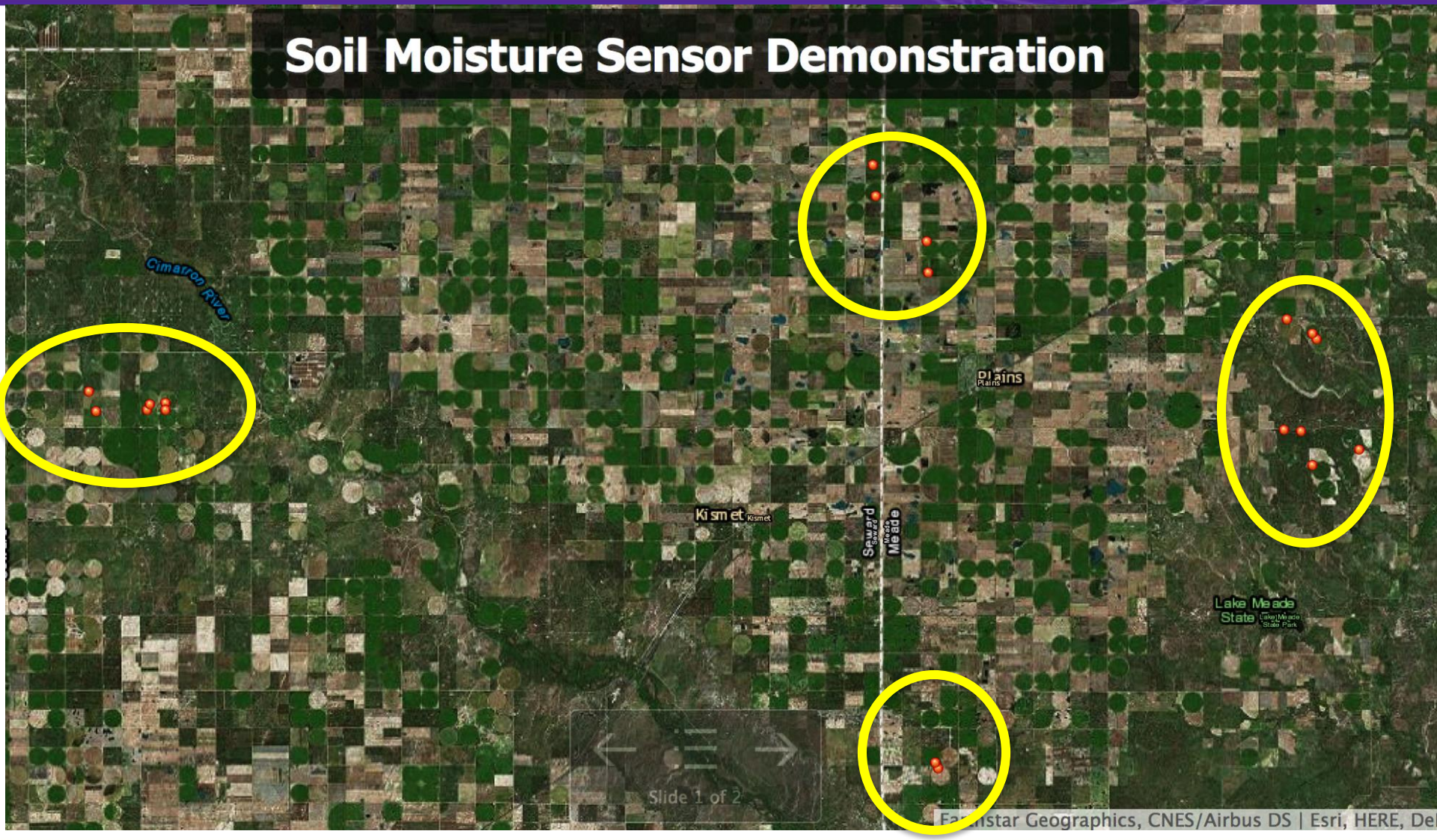
Approach

- Cost share with the Producer and KDA-Division of Conservation
- Servi-Tech Laboratories (STEPSPro) will provide the sensors and make recommendations
- Verification and validation of data by K-State
- Coordinate well measurements with Div. of Water Resources

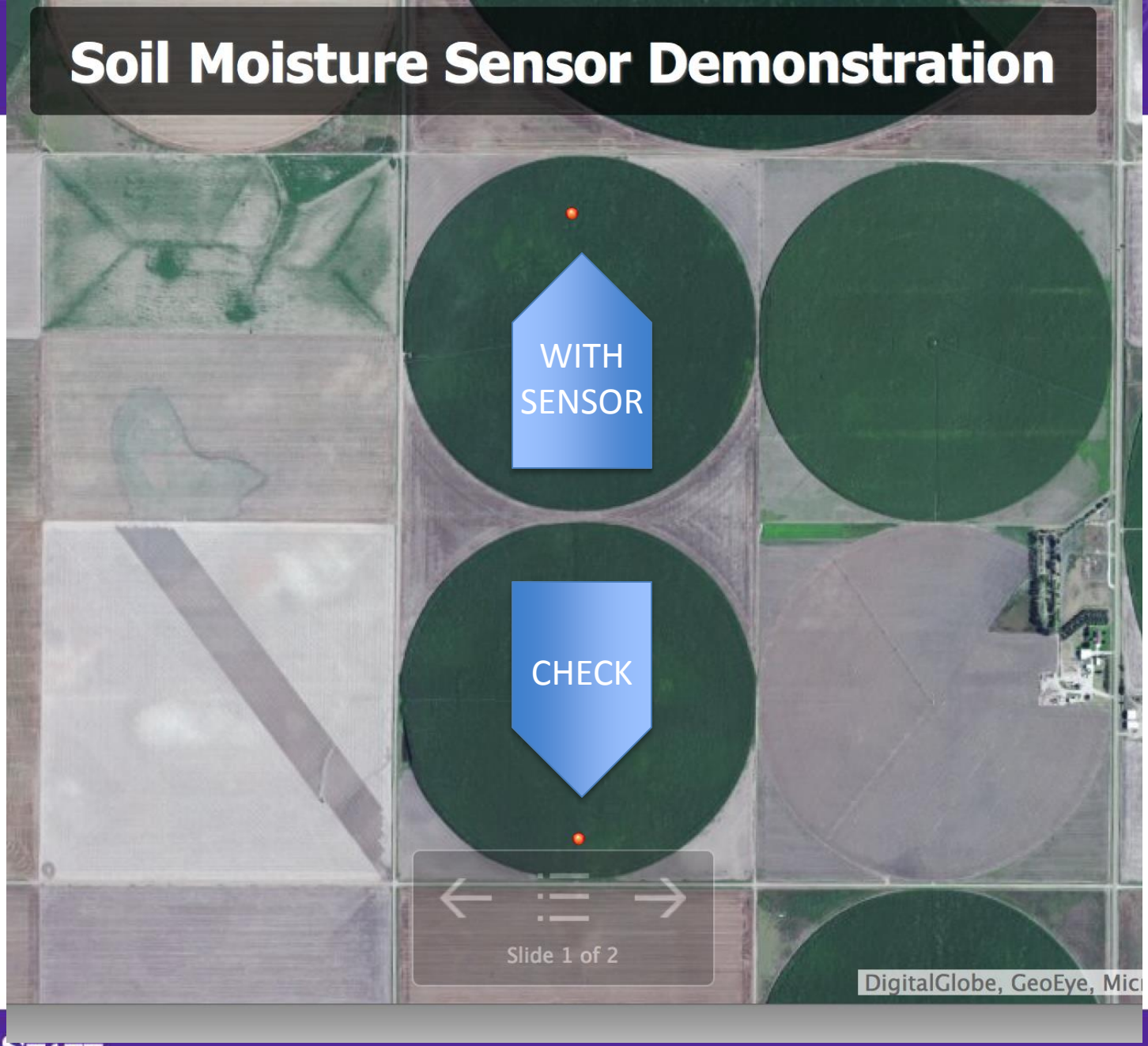
Approach

- 10 monitored center pivot (CP) circles paired with 10 adjacent “check” circles
- Irrigation management of monitored CP is based on soil moisture data
- Three different soil types (clay loam, loam, and sandy)
- Planted to corn

Soil Moisture Sensor Demonstration



Soil Moisture Sensor Demonstration

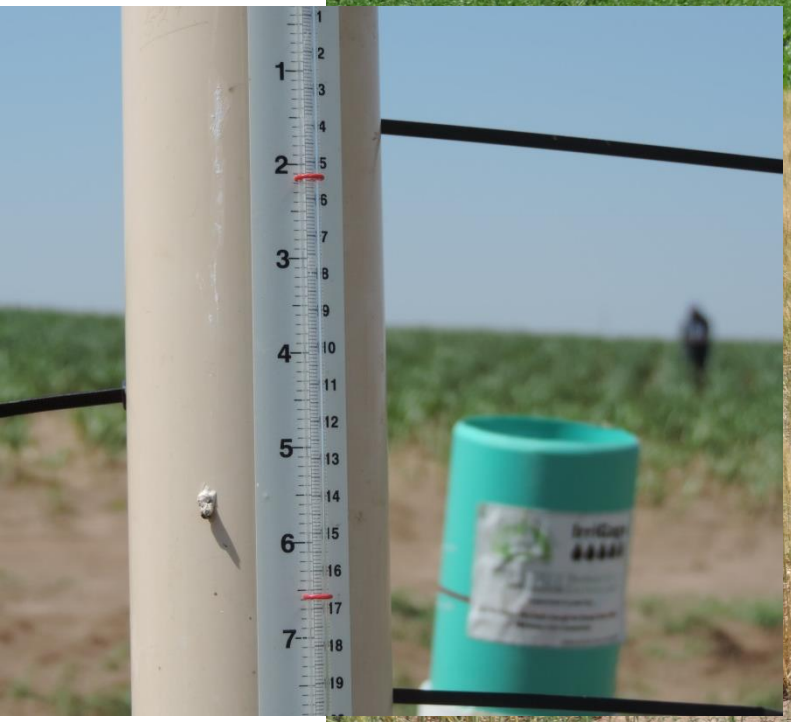


Instrumentation

- The Profiler Soil Monitoring System – **STEPSPRO**
  - Online monitoring
- ET gage, IrriGage, Neutron Probe – **K-State**
  - Weekly manual monitoring
- Yield and Water Use – **Producer**
  - End of season

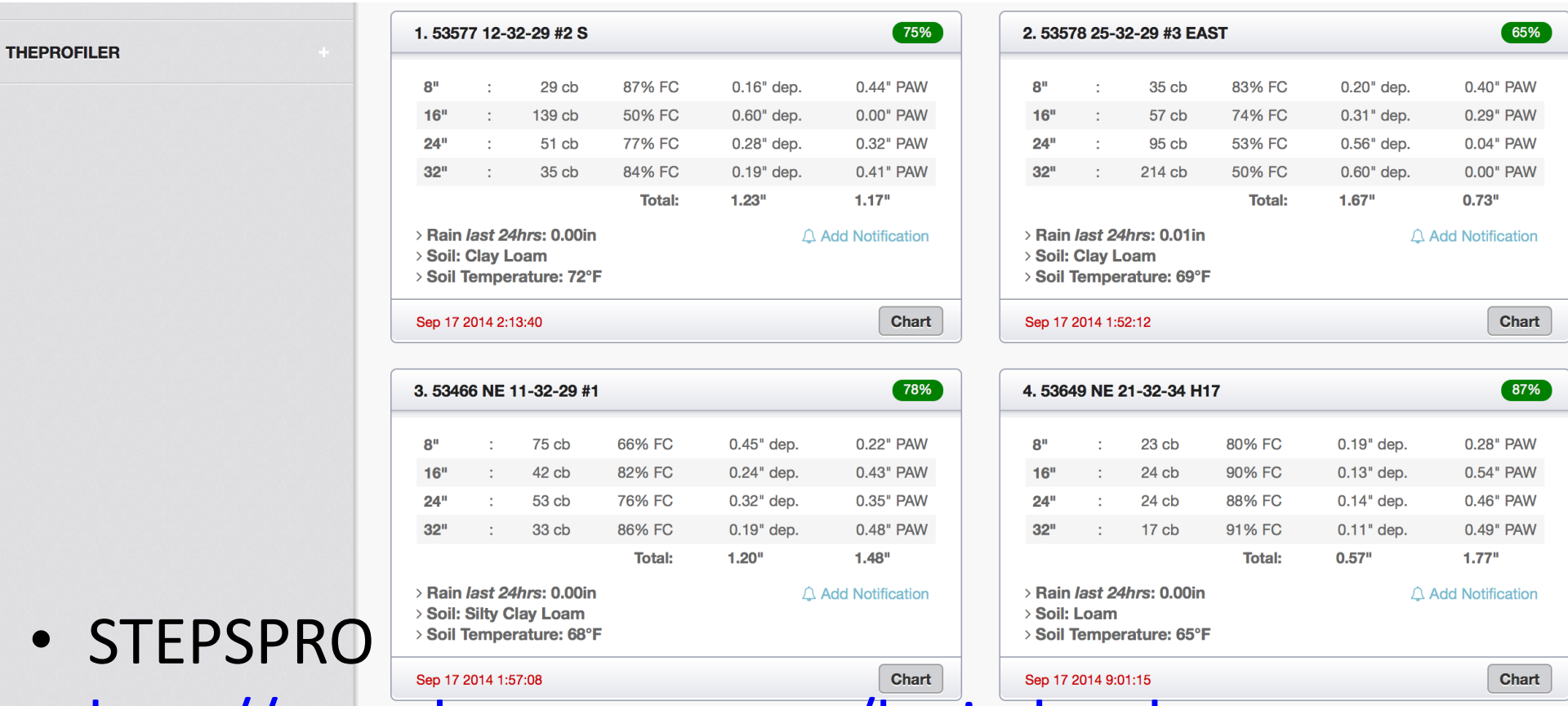
Instrumentation

Instrumentation



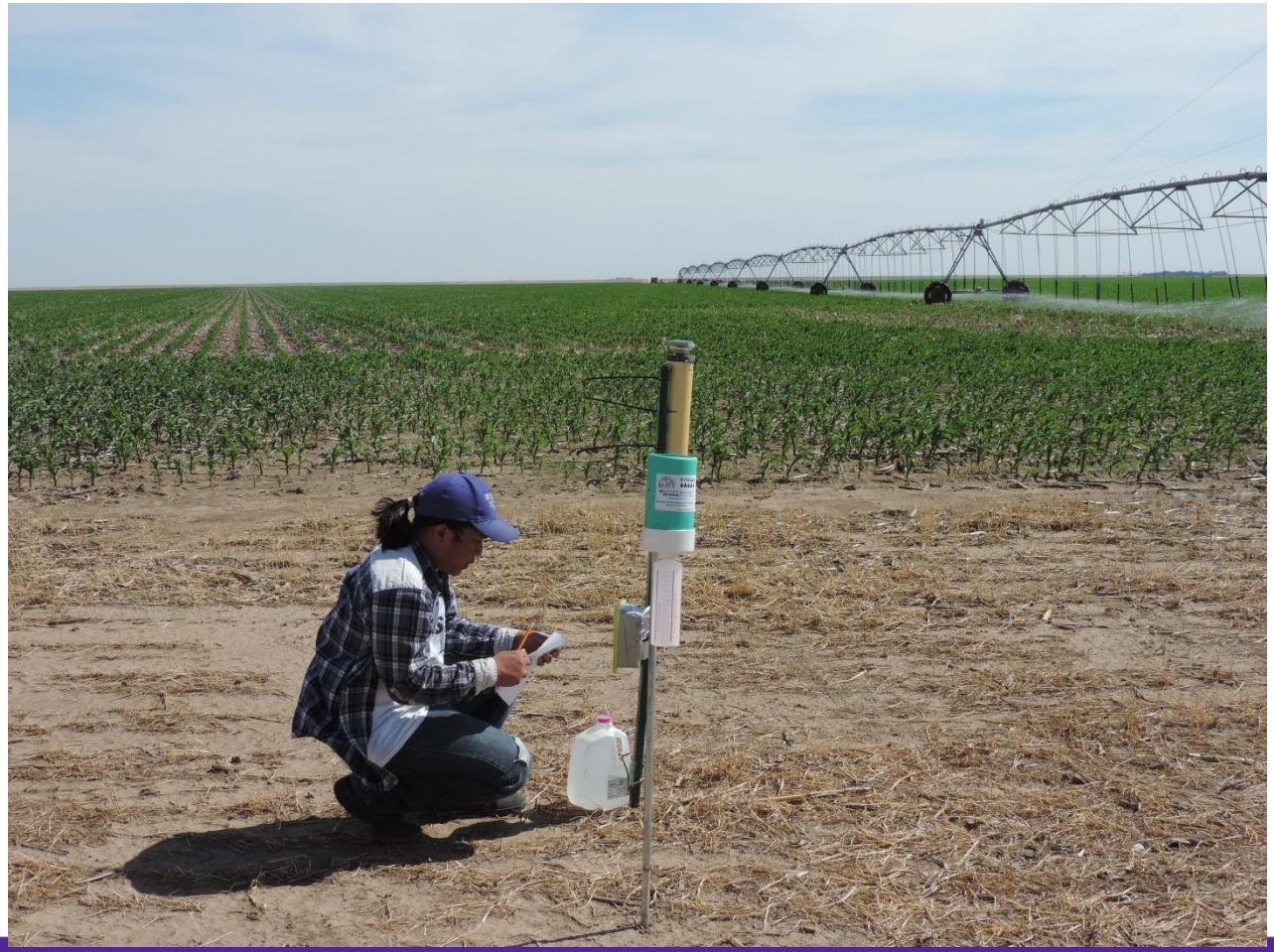
Instrumentation

Monitoring



- STEPSPRO
  http://portal.stepspro.com/login.html

Monitoring



Preliminary Results (2014)

Parameter	Highest	Lowest
Total Rainfall (in)	12.10	9.18
Measured ET (in)	27.65	21.85
Total Irrigation (in) full yr. with sensors	23.82	16.40
Total Irrigation (in) full yr. without sensors	23.82	18.11

First Year Results

- In 8 of 10 weekly visits, the measured soil profile is at 80% or higher field capacity
- The soil moisture sensors corroborates closely with neutron probe readings except at some readings in the fields with sandy soil
- Though the advisor is recommending shutting off the irrigation system for several days, the producer seldom follows the recommendations

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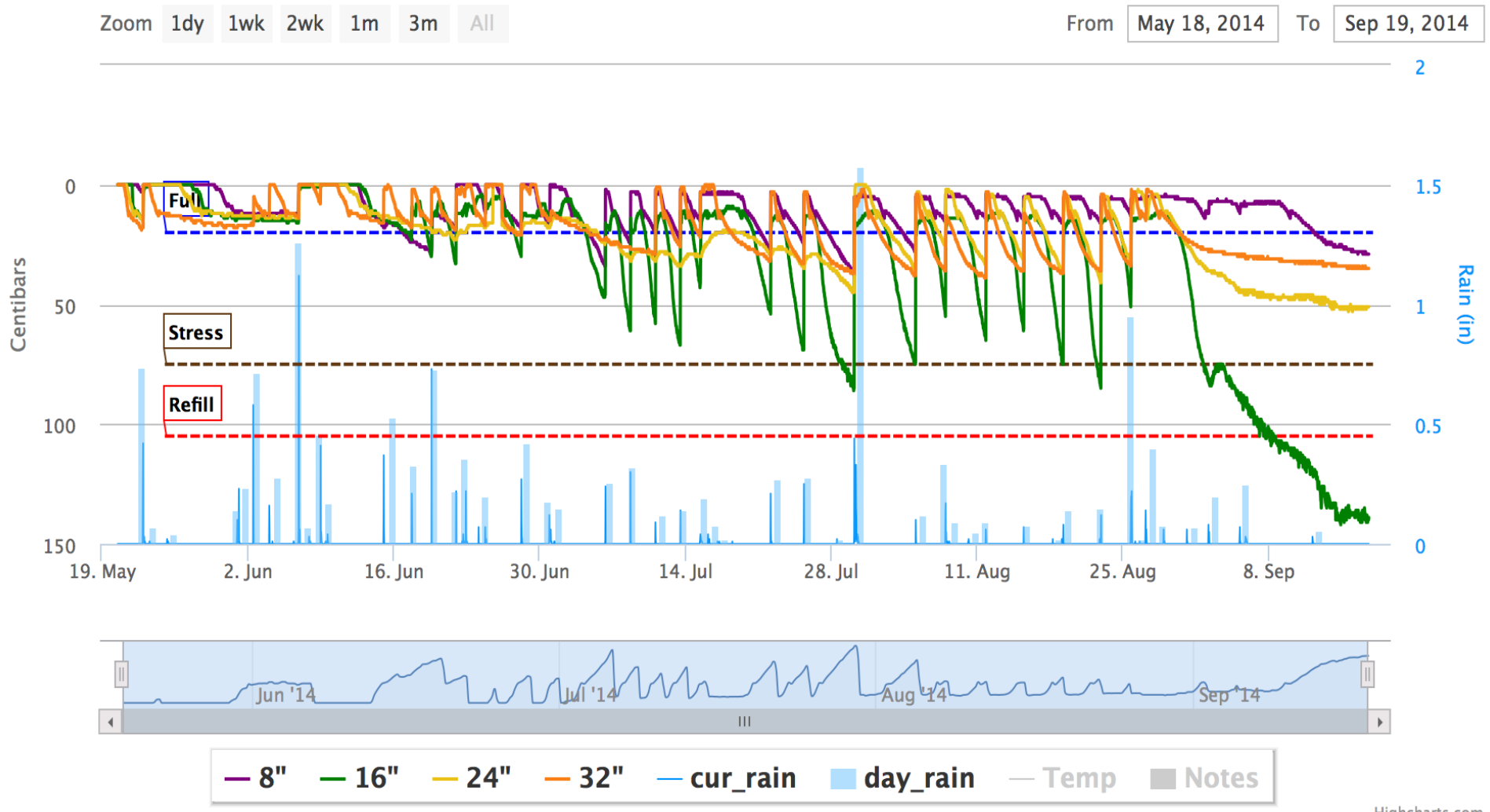
Crop: Corn, Device Soil Type: Clay Loam



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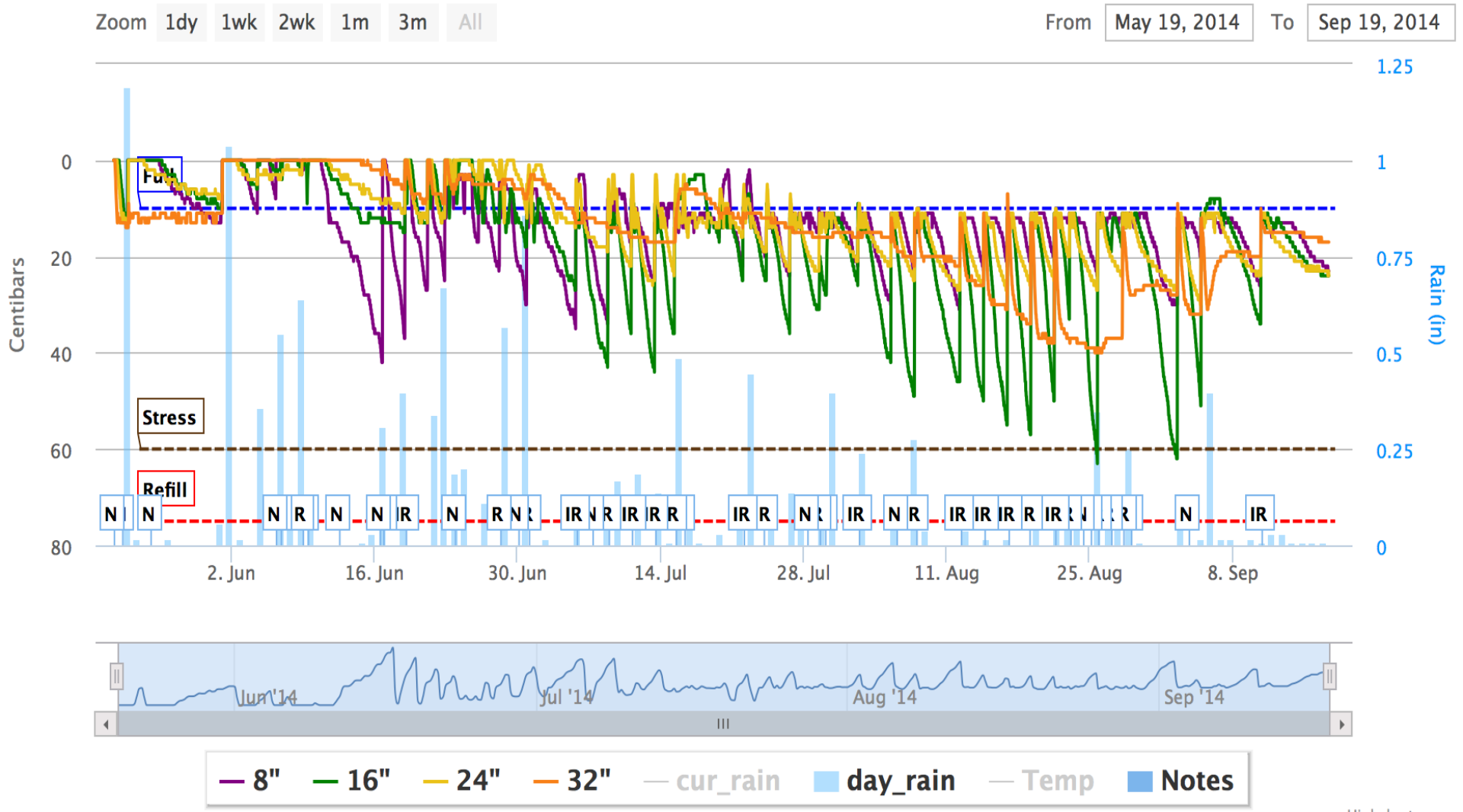
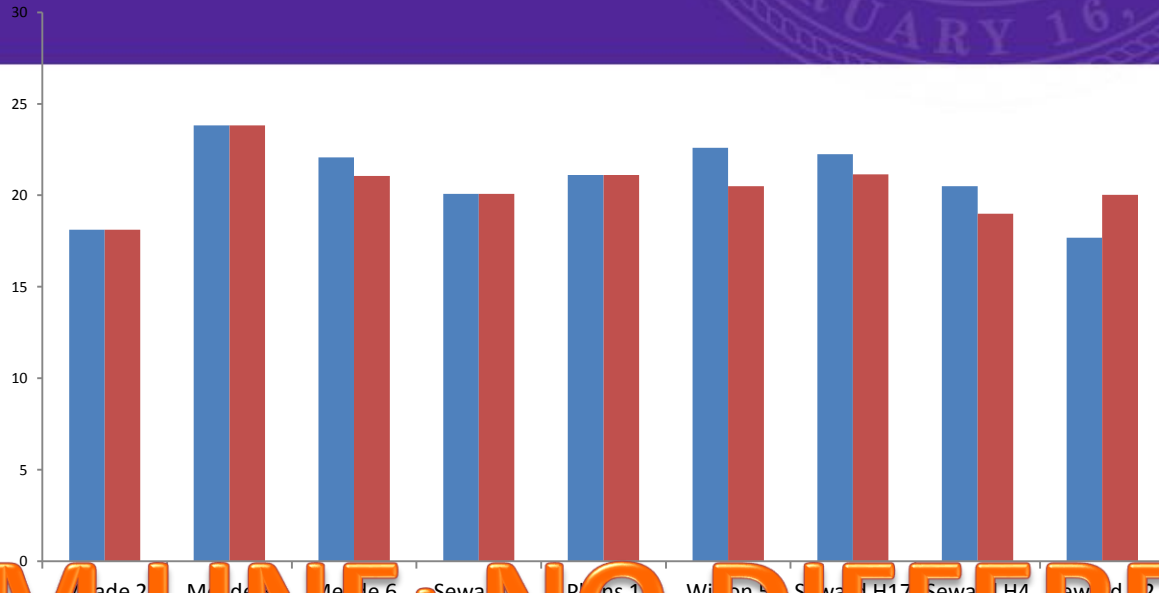
Crop: Corn, Device Soil Type: Loam



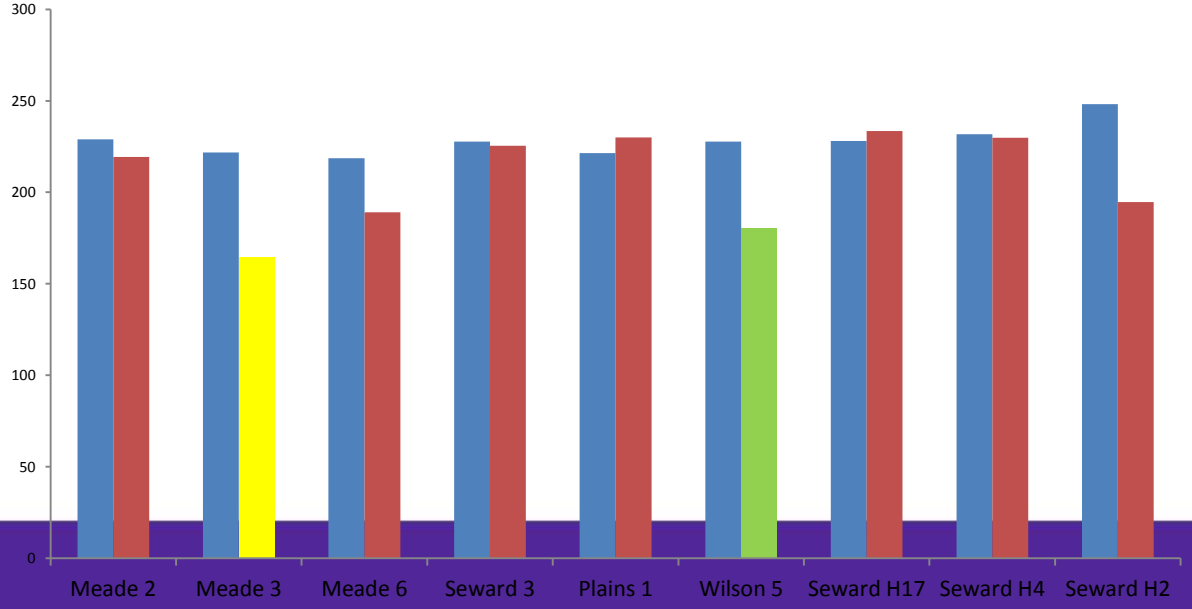
Highcharts.com

Total Irrigation Applied for 2014



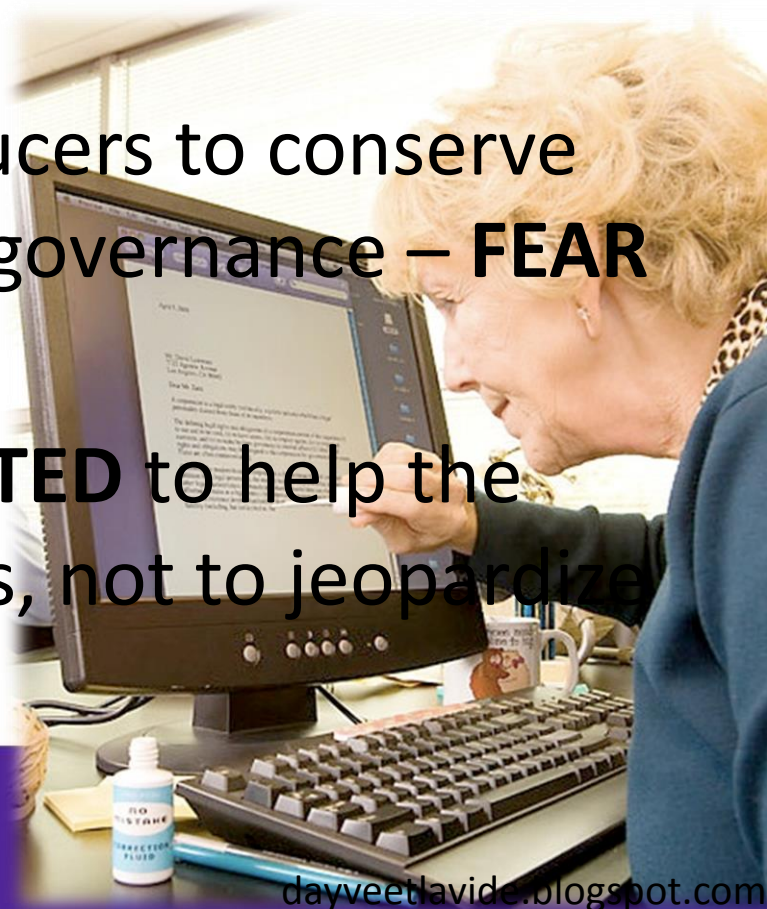
BOTTOM LINE: NO DIFFERENCE

Yield



WHY?

- Producer does not immediately **TRUST** the numbers from the moisture sensors to make irrigation decisions.
- Another challenge for producers to conserve water was related to water governance – **FEAR** of a sweeping policy
- Crop consultants are **EXPECTED** to help the producer achieve yield goals, not to jeopardize them



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Moving Forward

- Producer promised to try to trust the number and the recommendation of the advisor

- It is a challenge for the producer not be influenced in making split decisions in the paired fields

ON ANOTHER ACCOUNT

- A producer in NW Kansas have a soil sensor on his field last year
- He was able to turn off his irrigation system for 30 days around July without yield loss
- His crop advisor got worried
- His neighbors were starting to be concerned
- SECRET: soil sensor readings were used in conjunction with an **ET-based scheduler**

Take Home Message

- Soil moisture sensors are great tools in irrigation management **IF**:
  - Installed properly (location, insertion, calibration)
  - Working in conjunction with ET-Schedule and/or similar independent feedback
  - You take advantage of the information

Thank You