



Irrigation Research Update

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Michigan State University Extension

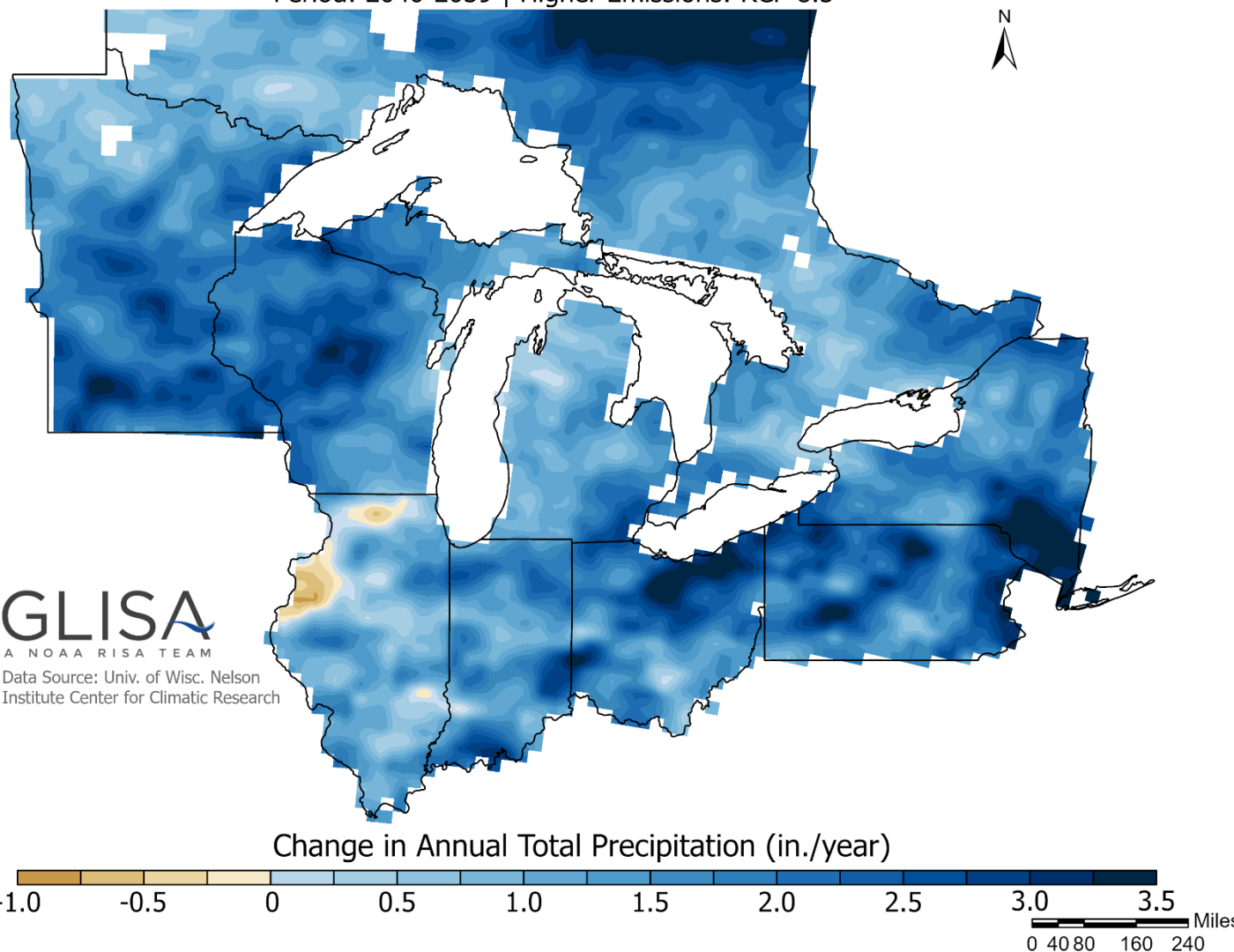
Michiana Irrigated Corn and Soybean Workshop
Feb. 26, 2024



Impacts of Climate Change on Water Management in Agriculture

Projected Change in Annual Total Precipitation by Mid-Century

Period: 2040-2059 | Higher Emissions: RCP 8.5

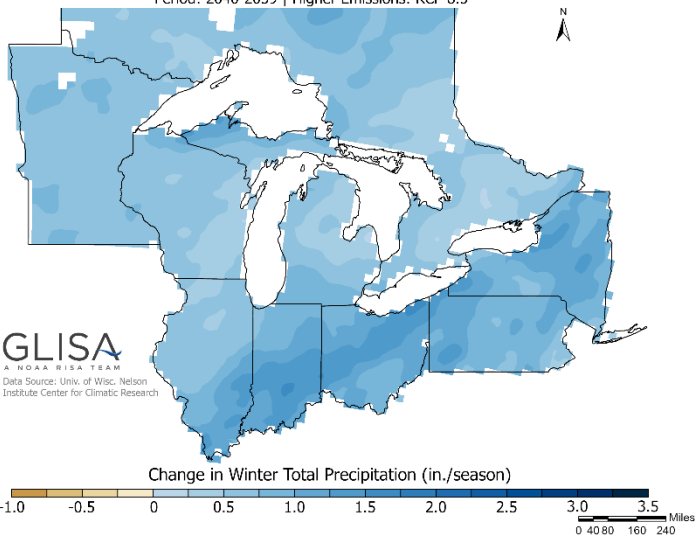




Impacts of Climate Change on Water Management in Agriculture

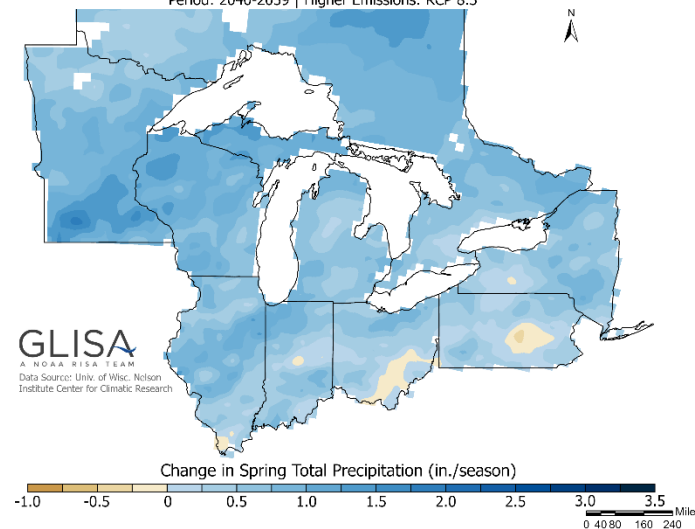
Projected Change in Winter Total Precipitation by Mid-Century

Period: 2040-2059 | Higher Emissions: RCP 8.5



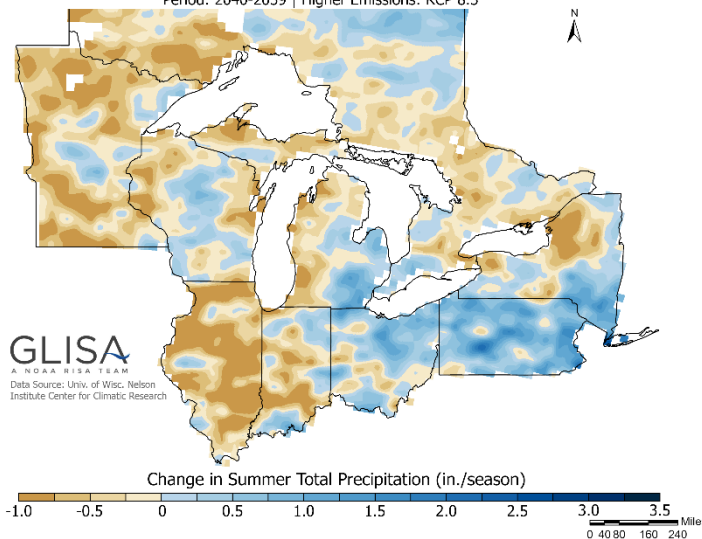
Projected Change in Spring Total Precipitation by Mid-Century

Period: 2040-2059 | Higher Emissions: RCP 8.5



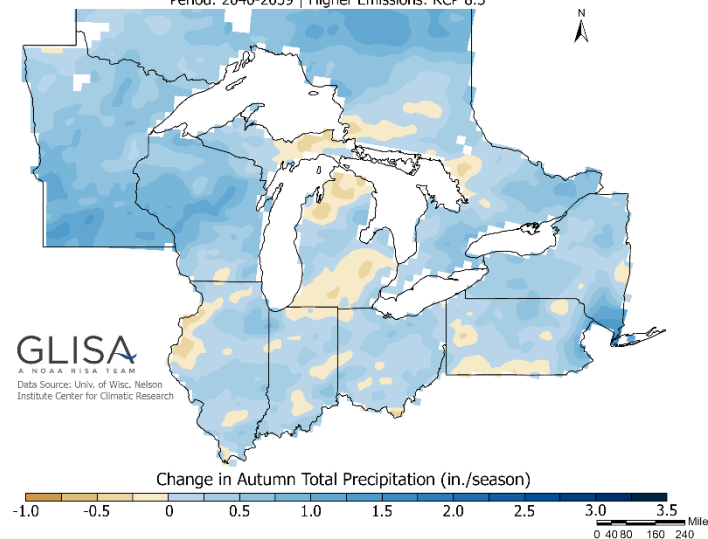
Projected Change in Summer Total Precipitation by Mid-Century

Period: 2040-2059 | Higher Emissions: RCP 8.5

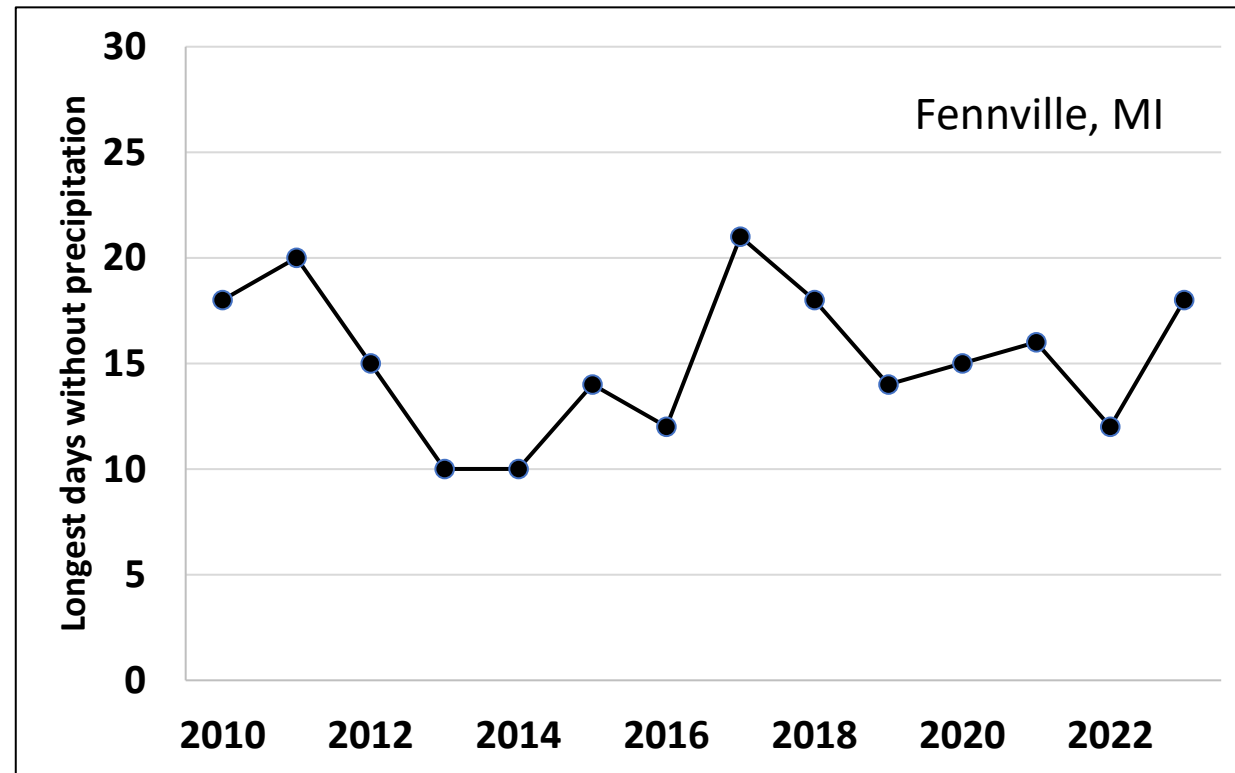
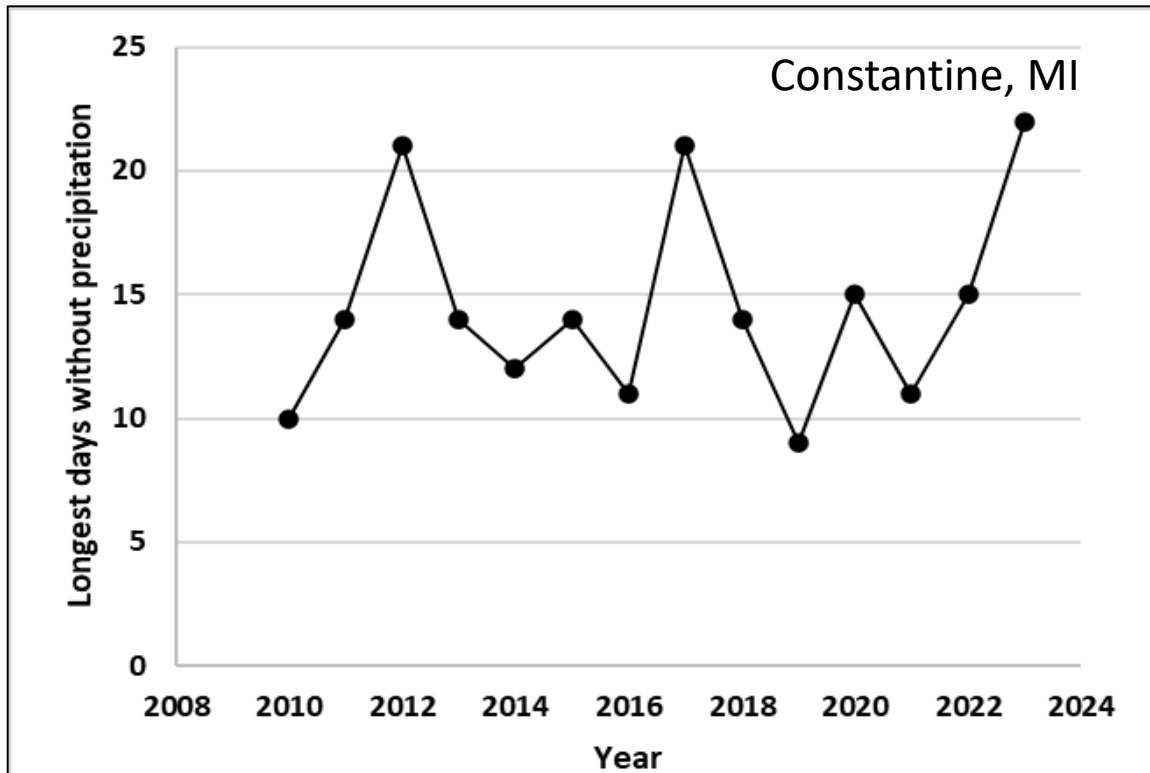


Projected Change in Autumn Total Precipitation by Mid-Century

Period: 2040-2059 | Higher Emissions: RCP 8.5



Impacts of Climate Change on Water Management in Agriculture



Longest period without precipitation during the growing season (May - September).
Most seasons require irrigation to prevent yield loss.



USDA Hydrological Soil Map - Michigan

Natural Resources Conservation Service (NRCS) classified soils based on texture and water table depth into Hydrologic Soil Groups.

Example Texture of Each Soil Group

A: Sands or gravel

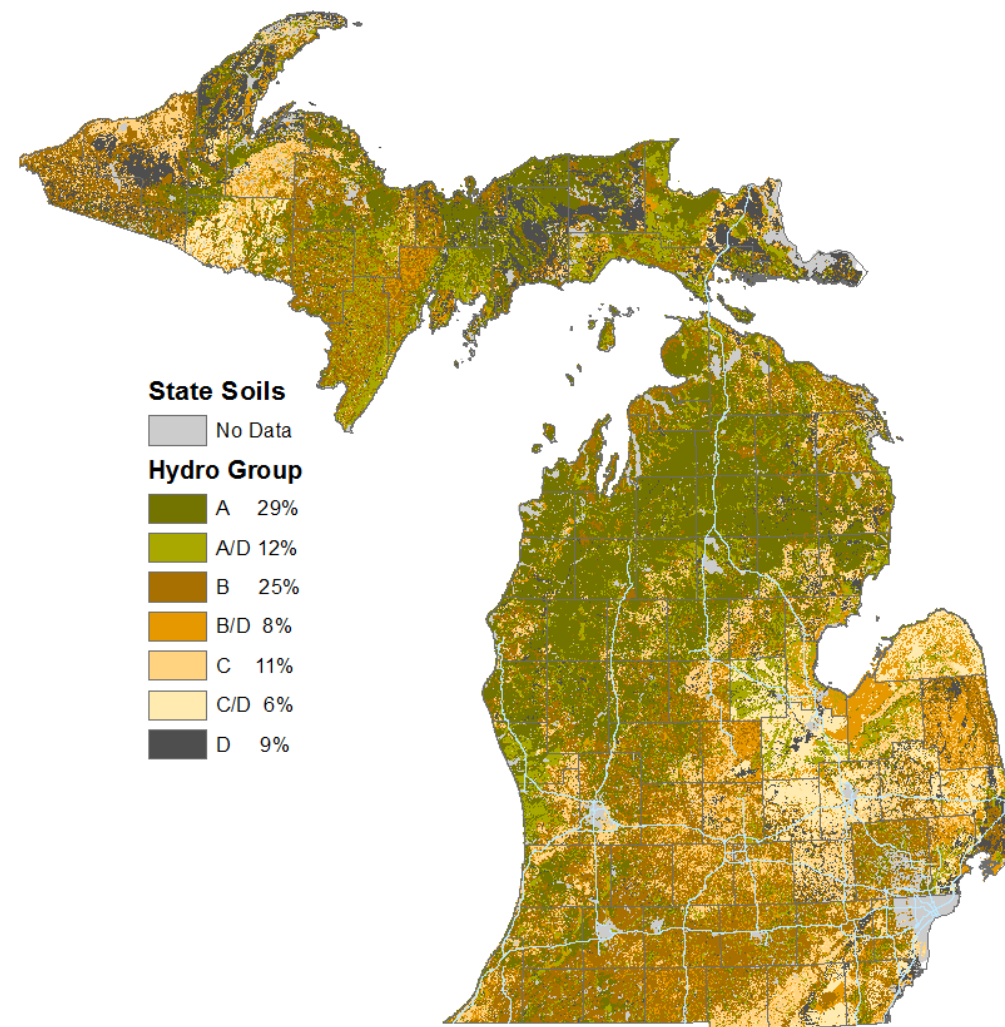
B: Sandy loam, loam, silt loam, and silt

C: Clay loam

D: Clay

Group A/D, B/D, C/D

Soils classified as A/D, B/D and C/D have a high water table, which means low ability to move the water out of the root zone. If it is drained, it is considered as the first letter.



Hydrological Soil Map - Indiana

Natural Resources Conservation Service (NRCS) classified soils based on texture and water table depth into Hydrologic Soil Groups.

Example Texture of Each Soil Group

A: Sands or gravel

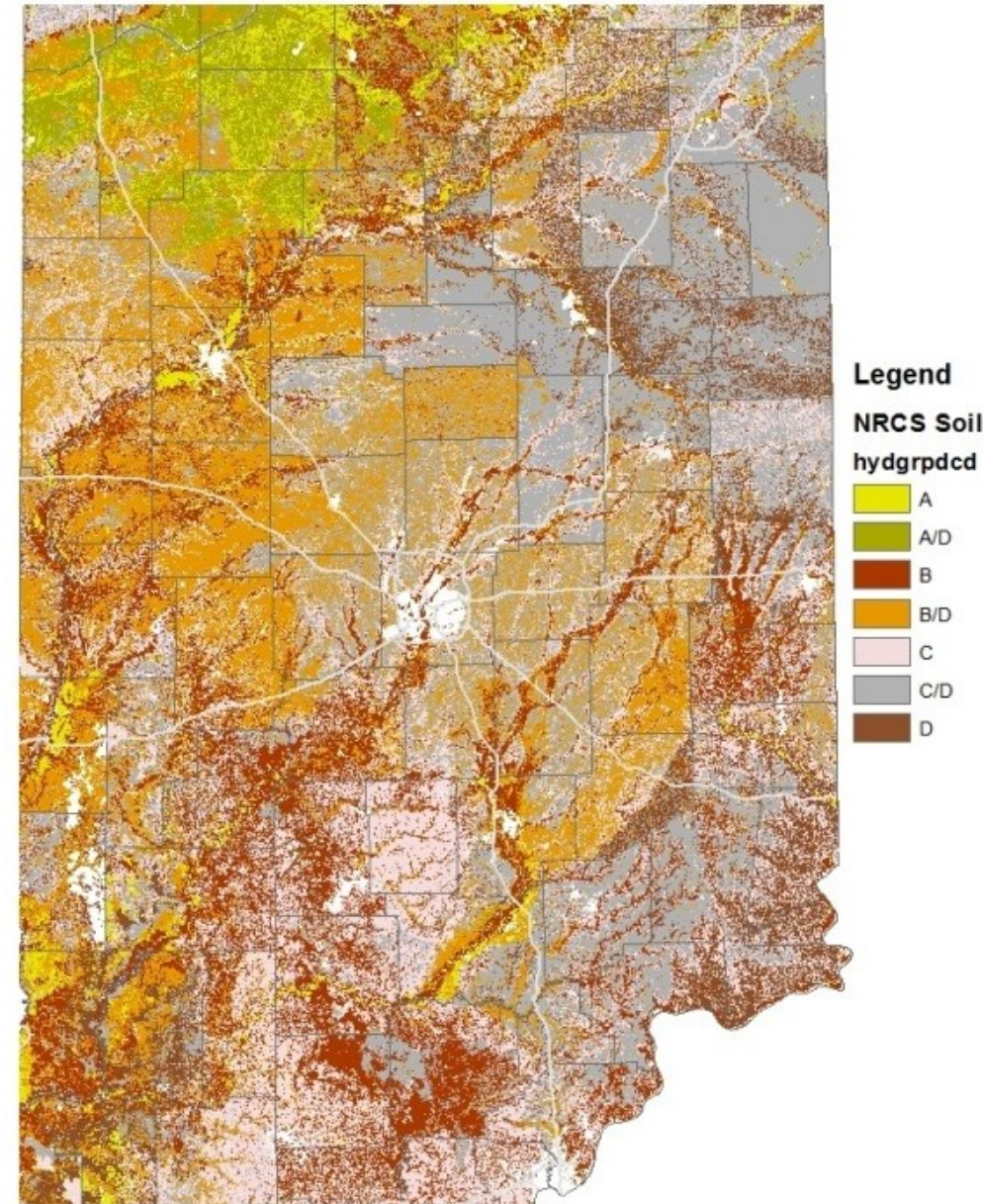
B: Sandy loam, loam, silt loam, and silt

C: Clay loam

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Group A/D, B/D, C/D

Soils classified as A/D, B/D and C/D have a high water table, which means low ability to move the water out of the root zone. If it is drained, it is considered as the first letter.



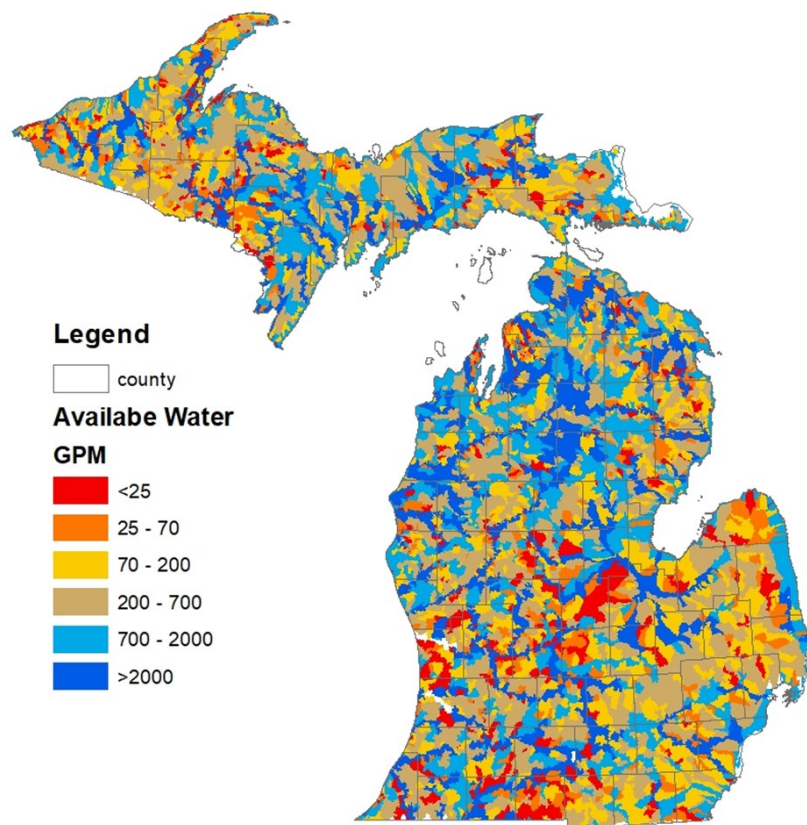
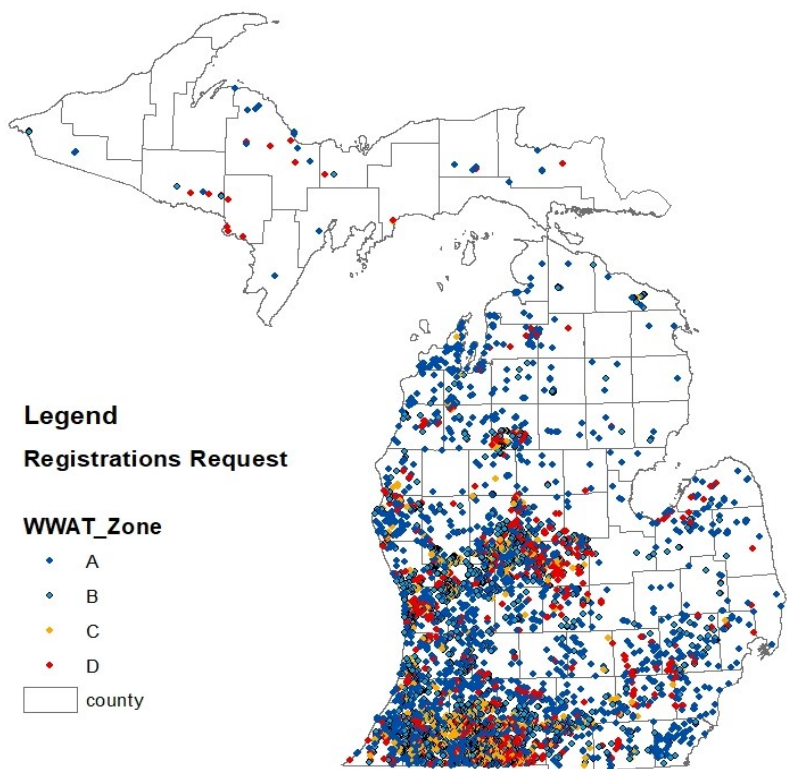


UNCHARTED WATERS

America Is Using Up Its Groundwater Like There's No Tomorrow

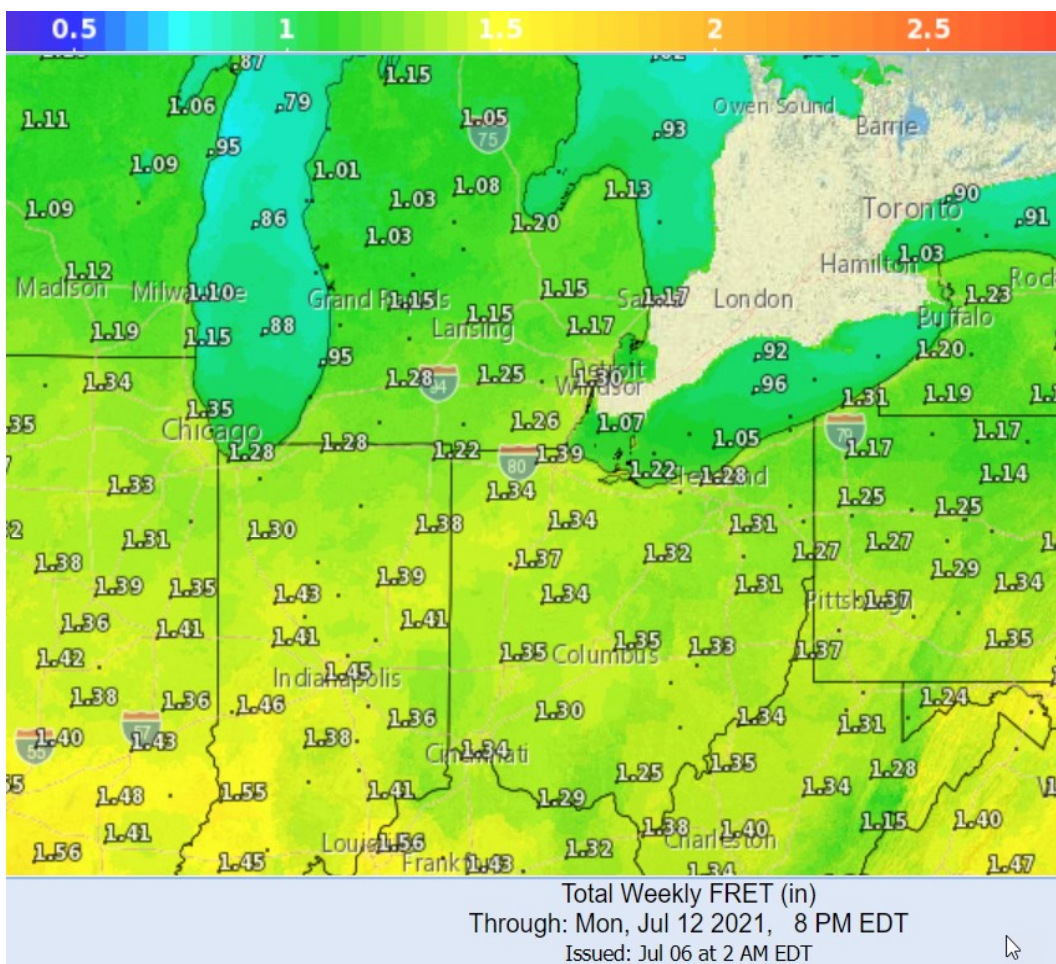
Overuse is draining and damaging aquifers nationwide, a New York Times data investigation revealed.

Registration request (using data Available November 2021)





Irrigation Scheduling

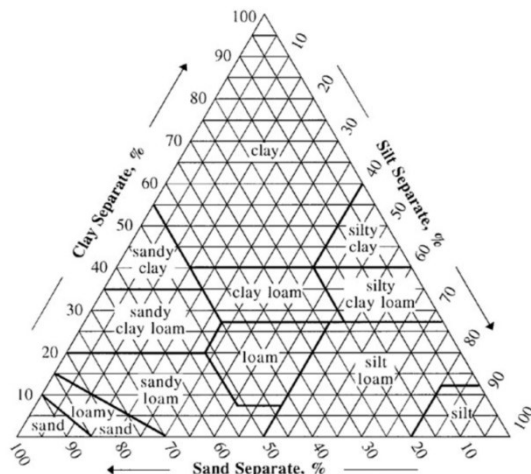


Weather-based Irrigation Scheduling



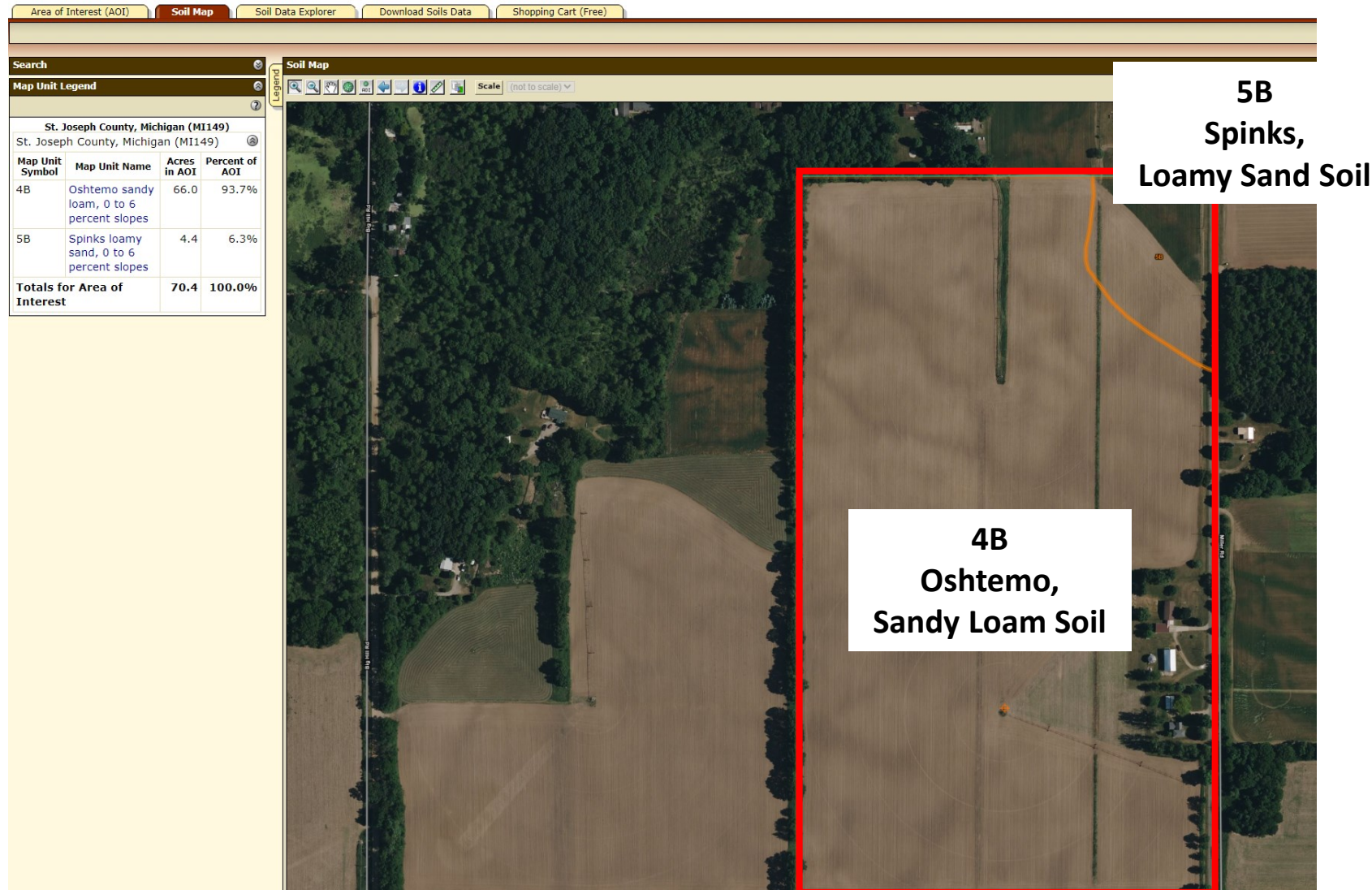
Sensor-based Irrigation Scheduling

Water Holding Capacity - Soil Sampling



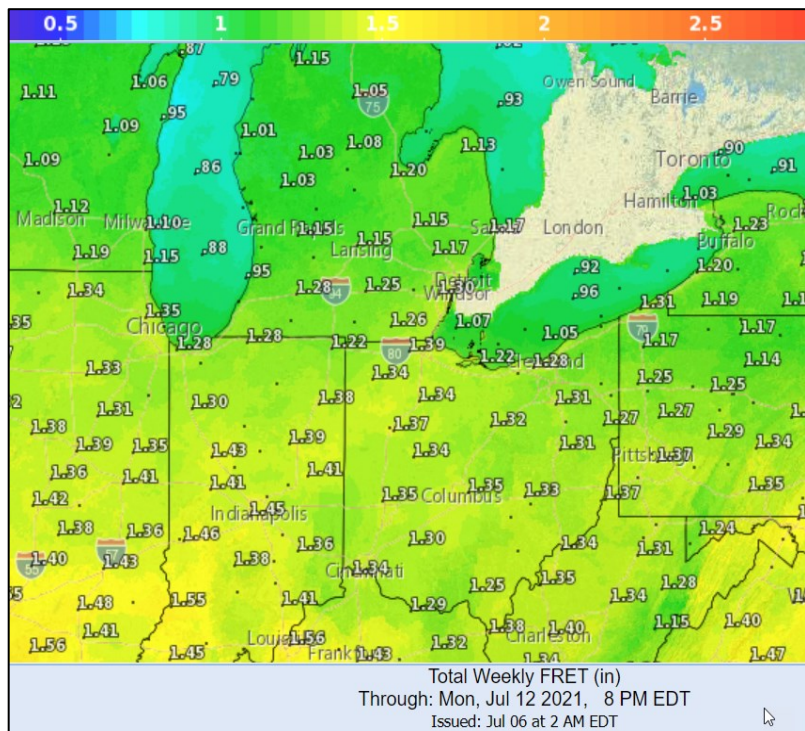
The screenshot shows the USDA Web Soil Survey homepage. At the top, it features the USDA logo and the text "United States Department of Agriculture Natural Resources Conservation Service". The main heading is "Web Soil Survey". Below this, there is a navigation menu with "Home", "About Soils", "Help", and "Contact Us". A search bar is present with the text "Enter Keyword" and a "Go" button. A "START WSS" button is highlighted with a red box and a red arrow pointing to it from the search bar area. The page content includes a "Welcome to Web Soil Survey (WSS)" section with a small image of people in a field and a paragraph of text. To the right, there is a "I Want To..." section with a list of links: "Start Web Soil Survey (WSS)", "Know Web Soil Survey Requirements", "Know Web Soil Survey operation hours", "Find what areas of the U.S. have soil data", "Find information by topic", "Know how to hyperlink from other documents to Web Soil Survey", "Know the SSURGO data structure", and "Use Web Soil Survey on a mobile device". At the bottom right, there is an "Announcements/Events" section with a link: "Web Soil Survey 3.4.0 has been released! View Web Soil Survey".

Water Holding Capacity - USDA Web Soil Survey



Current Irrigation Management Practices

Weather-based Irrigation Scheduling



$$ET_C = K_C * rPET$$

Where,

ET_C = Actual Crop Evapotranspiration (in/day)

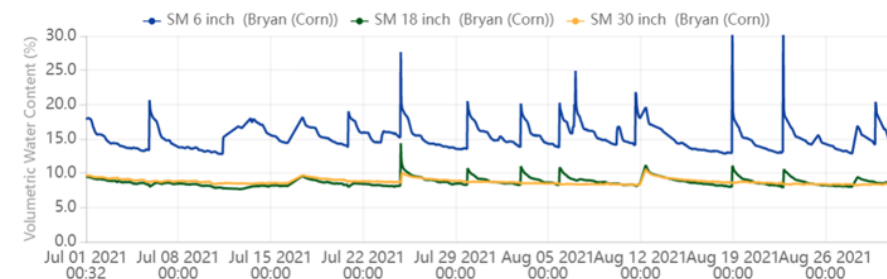
K_C = Crop Coefficient (unitless multiplier)

$rPET$ = Reference Potential Evapotranspiration (in/day)

Sensor-based Irrigation Scheduling



Soil Moisture Levels





Weather-based Irrigation Scheduling - Crop Evapotranspiration

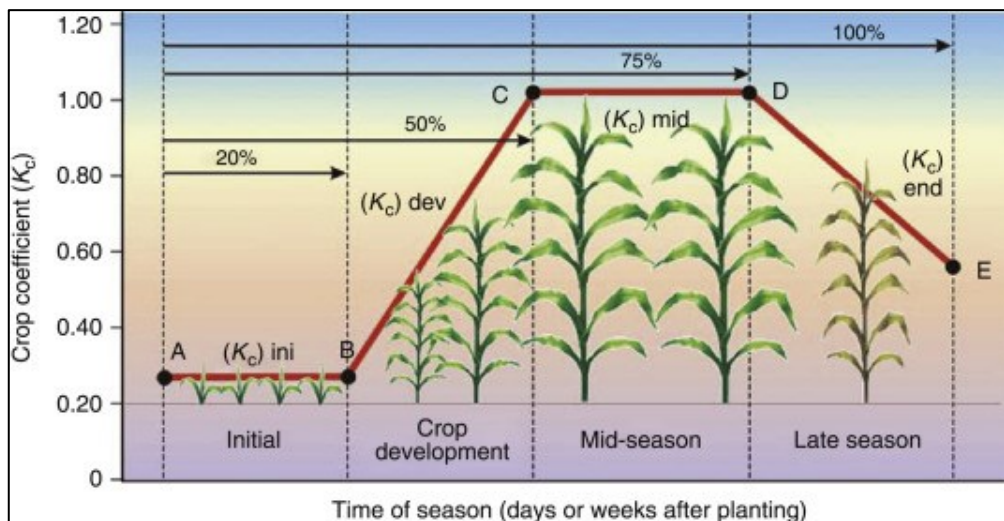
$$ET_C = rPET * K_C$$

Where,

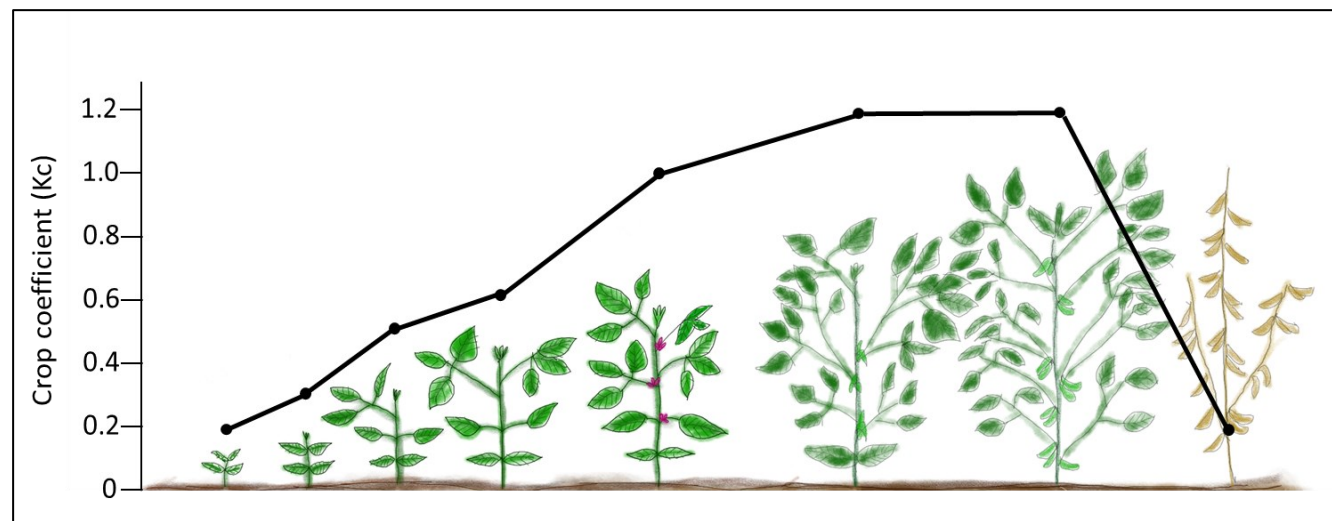
ET_C = Actual Crop Evapotranspiration (in/day)

$rPET$ = Reference Potential Evapotranspiration (in/day)

K_C = Crop Coefficient (unitless multiplier)



Corn Kc (Pokorny, 2019)



Soybean Kc

Reference Potential Evapotranspiration

<https://www.weather.gov/ict/Evapotranspiration>

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER SAFETY INFORMATION EDUCATION NEWS SEARCH ABOUT

Local forecast by "City, St" or ZIP code
Enter location ...
[Location Help](#)

News Headlines

- Seeking comments on the NWS "Advisory" and "Special Weather Statements" headlines being replaced by plain language headlines.
- Latest Kansas Drought Information
- May 2023 Climate Summary and Highlights
- Today in weather history...

Evapotranspiration - Water Management Aid Wichita, Kansas
Weather Forecast Office

[Weather.gov](#) > [Wichita, Kansas](#) > [Evapotranspiration - Water Management Aid](#)

Evapotranspiration (ET)

Evapotranspiration

Process to determine the amount of water evaporated and transpired which can help create an effective water balance or practices to support better water management

[CoCoRaHS Daily Evapotranspiration Reports \(Non-NWS\)](#)

Daily Temperature/Precipitation Summaries

Regional	Regional COOP Observers	CoCoRaHS	State of Kansas
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Interactive Forecast Tool
(daily (inches), daily departure from normal (inches), total weekly (inches))
Daily (FRET) is amount of evapotranspiration.

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME FORECAST PAST WEATHER WEATHER SAFETY INFORMATION CENTER NEWS

Graphical Forecasts
Weather.gov - National Digital Forecast Database Graphical Forecasts
This graphical forecast page is planned to be replaced by the map viewer now experimentally available at [digital.mdl.nws.noaa.gov](#)

National Digital Forecast Database Display

National (CONUS) Total Weekly FRET (in) Ending Jun 21, 8 PM EDT



Reference Potential Evapotranspiration

The screenshot shows the Enviroweather website with a dark green header and a grid of navigation links. The links are organized into four columns:

- Summary:** Temperature, Rainfall and Degree day summary; Meteogram; Overnight Temperatures; Soil Conditions.
- Degree Day Tools:** Regional Degree Day Summary; Degree Day Summary last 5 yr; Precipitation; Rainfall summary, historical; Regional Rainfall Comparison.
- Maps:** Growing Degree-Days (50); Latest Observations; NOAA NWS Radar - Great Lakes; Temperature Inversion Potential; More Information; Data on Demand (in development).
- Irrigation Tools:** Sign up for RPET Text Alerts; MSU Irrigation Scheduler; MSU Irrigation Resources; Soil Water Balance Sheet (download pdf); Potential Evapotranspiration Daily Summary.

The screenshot shows the Purdue Mesonet Data Hub website. It features a blue header with the Purdue University logo and 'Indiana State Climate Office'. A navigation menu includes Home, About, Data, Climate Maps, Tools, and Publications. Below the menu is a secondary navigation bar with About, Get Involved, Data Hub, and Station Information. The main content area has a large heading 'PURDUE MESONET Data Hub' and a welcome message: 'Welcome to the Purdue Mesonet Data Hub'. A paragraph explains that users can access real-time weather data via map view or search for historical data. A 'Need help?' link points to 'Data Hub Instructions'. At the bottom, there are three data tables:

Recent Conditions at CCCS (as of 12월 14 at 10:00 오후 IST)		Past 24 Hours at CCCS		Station ID
Air Temperature (°F)	33.44	Avg. Air Temperature (°F)	36.9	cccs
Wind Speed (mph)	0.00	Maximum Air Temperature (°F)	57.0	Go to Data Selector
Wind Gust (MPH)	0.67	Minimum Air Temperature (°F)	21.6	Go to Map View
Wind Direction (°)	95	Total Precipitation (in.)	0.00	
Dewpoint Temperature (°F)	21.07	평균 4" Soil Temp (°F)	40.3	
4" Soil Temperature (°F)	41.36	Avg. Dewpoint Temperature (°F)	19.9	



MSU Enviroweather Program

$$ET_C = K_C * rPET$$

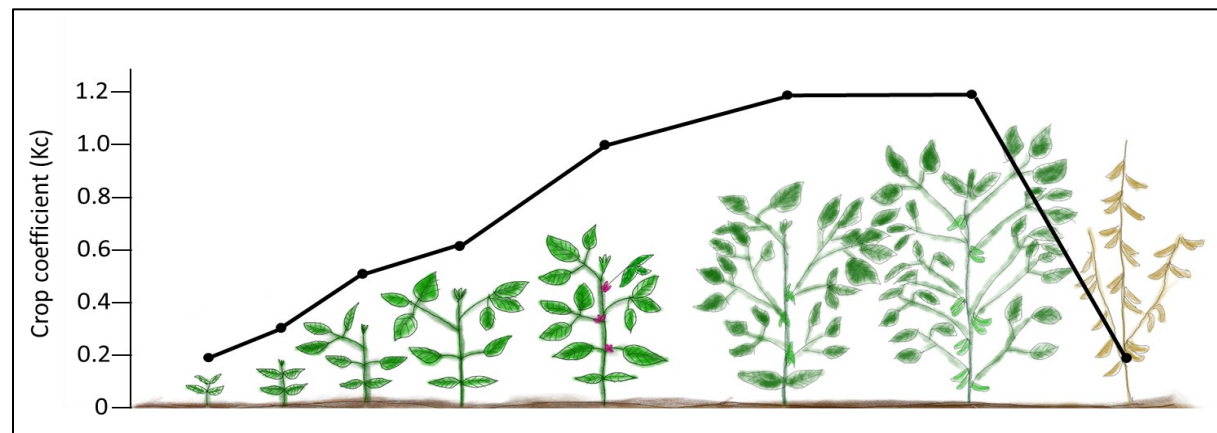
$$ET_C = 1.1 * 0.83 \text{ in} = 0.91 \text{ in}$$

Where,

ET_C = Actual Crop Evapotranspiration (in/day)

K_C = Crop Coefficient (unitless multiplier)

$rPET$ = Reference Potential Evapotranspiration (in/day)



MSU Irrigation Scheduler Program

MSU Irrigation Scheduler Program -- Michigan State University Extension
(Version 4.0 - May 1, 2018) For Excel 2007-2016 & Office 365

- Set Up This Irrigation Schedule (Field ID, Crop, Soil Type, Etc.)
- View Plant Available Water By Plant Growth Stage in This Field
- Download Weather Data From Enviroweather Station
- Print Soil Moisture Graph For This Schedule
- Enter Your Irrigation and Rainfall Data
- Generate a Water Use Report for This Field
- Generate Detailed Soil Moisture Report for Last 7 Days and 5 Day Forecast ET Outlook
- Enter Your Irrigation and Rainfall Data-Easy System

Biosystems & Agricultural Engineering - Irrigation

HOME IRRIGATION SYSTEM EFFICIENCY IRRIGATION SCHEDULING IRRIGATION WATER LAW CONTACT US

BAE - Irrigation

Welcome to Biosystems & Agricultural Engineering Irrigation Research Group

Irrigation Scheduling

- Process of maintaining an optimum water balance in the soil profile for crop growth and production

Center Pivot Sprinkler Irrigation System

Quick Links

- SENSOR
- MSU Irrigation Scheduler**

Quick Links

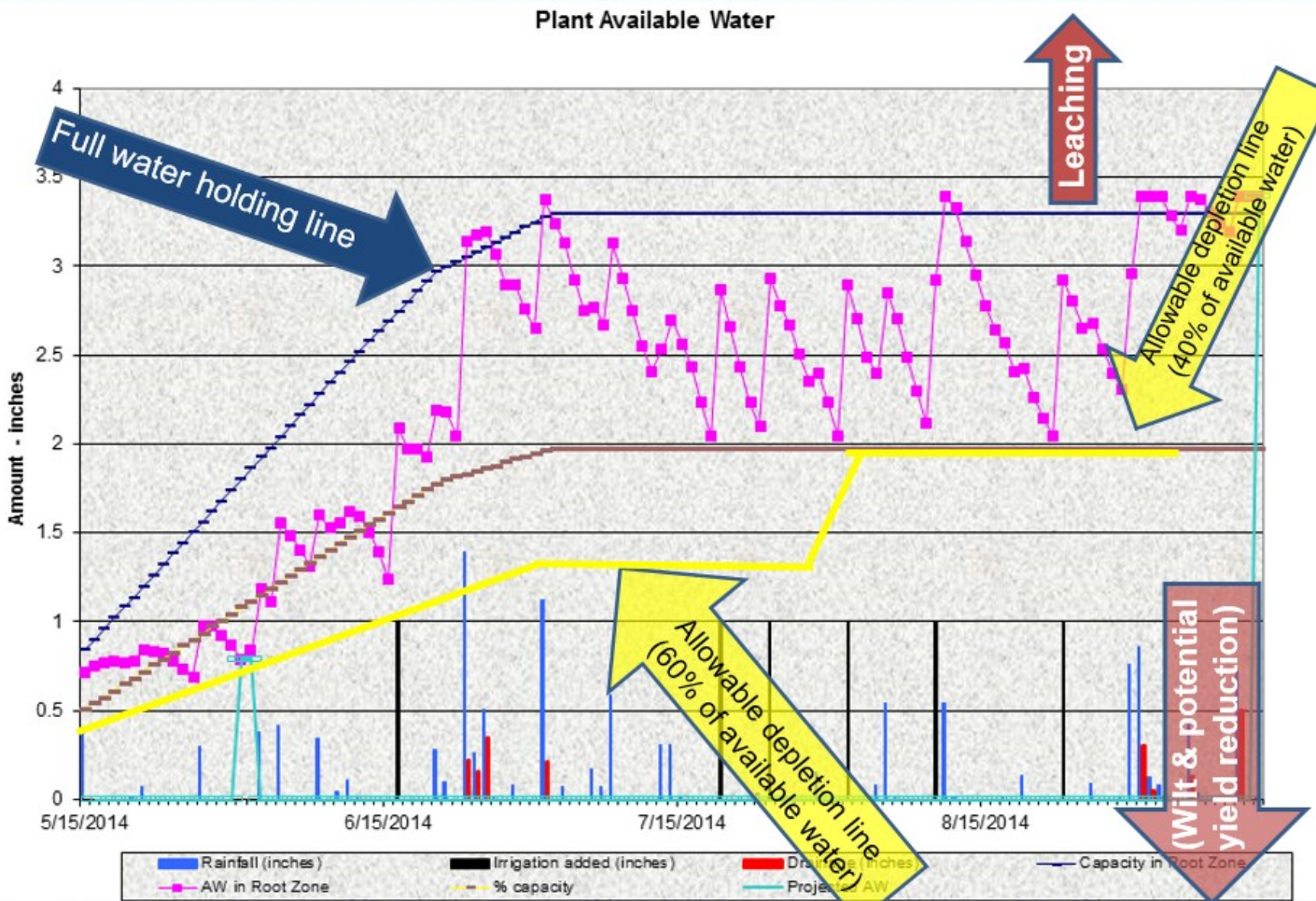
- SENSOR
- MSU Irrigation Scheduler

www.egr.msu.edu/bae/water/irrigation



MSU Irrigation Scheduler Program

MSU Excel Irrigation Schedule Checkbook Method - Mendon 2014



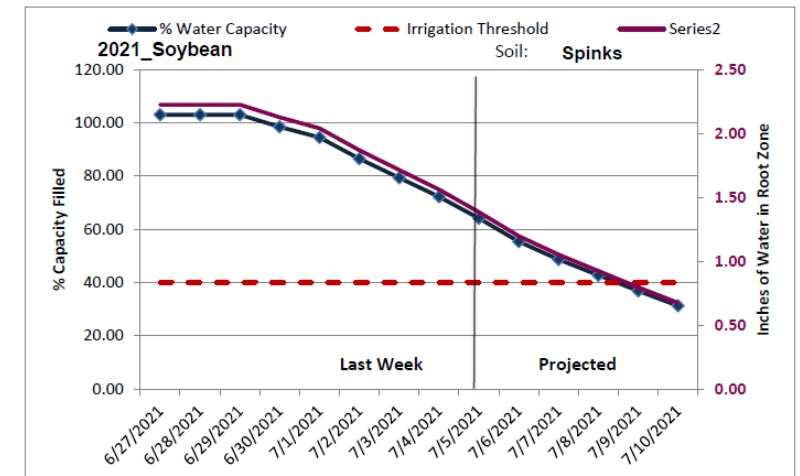
St. Joseph County Soil and Water Conservation District Irrigation Scheduling Service
Weekly Water Balance Report and Et Outlook for Next 5 Days

Generated: 07/06/21

MSU Irrigation Scheduler

Field Name	2021_Soybean	
Crop:	Soybeans24	Emergence Date: 5/16/2021

Date	Rainfall	Irrigation	Crop Et	Forecasted Et	Drainage	AW Above Threshold	Additional Capacity
6/27/2021	0.16		0.06		0.02	1.30	0.00
6/28/2021	0.32		0.11		0.21	1.30	0.00
6/29/2021	1.18		0.11		1.07	1.30	0.00
6/30/2021	0.02		0.12		0.00	1.26	0.03
7/1/2021	0		0.09		0.00	1.18	0.12
7/2/2021	0		0.17		0.00	1.00	0.29
7/3/2021	0		0.15		0.00	0.85	0.45
7/4/2021	0		0.15		0.00	0.70	0.60
7/5/2021	0		0.18		0.00	0.52	0.77
7/6/2021		0.1888			0.00	0.33	0.96
7/7/2021				0.15	0.00	0.19	1.11
7/8/2021				0.13	0.00	0.06	1.24
7/9/2021				0.13	0.00	-0.07	1.36
7/10/2021				0.12	0.00	-0.19	1.49
Totals	1.68	0	1.14	0.52	1.30		



Please note: projected values do not include forecasted rainfall, only the outlook Et values.
Irrigation Threshold: Dropping below this level may cause yield loss. To avoid, initiate irrigation.
Enviroweather Station Selected: Constantine

Updating MSU Irrigation Scheduler – (In-progress)

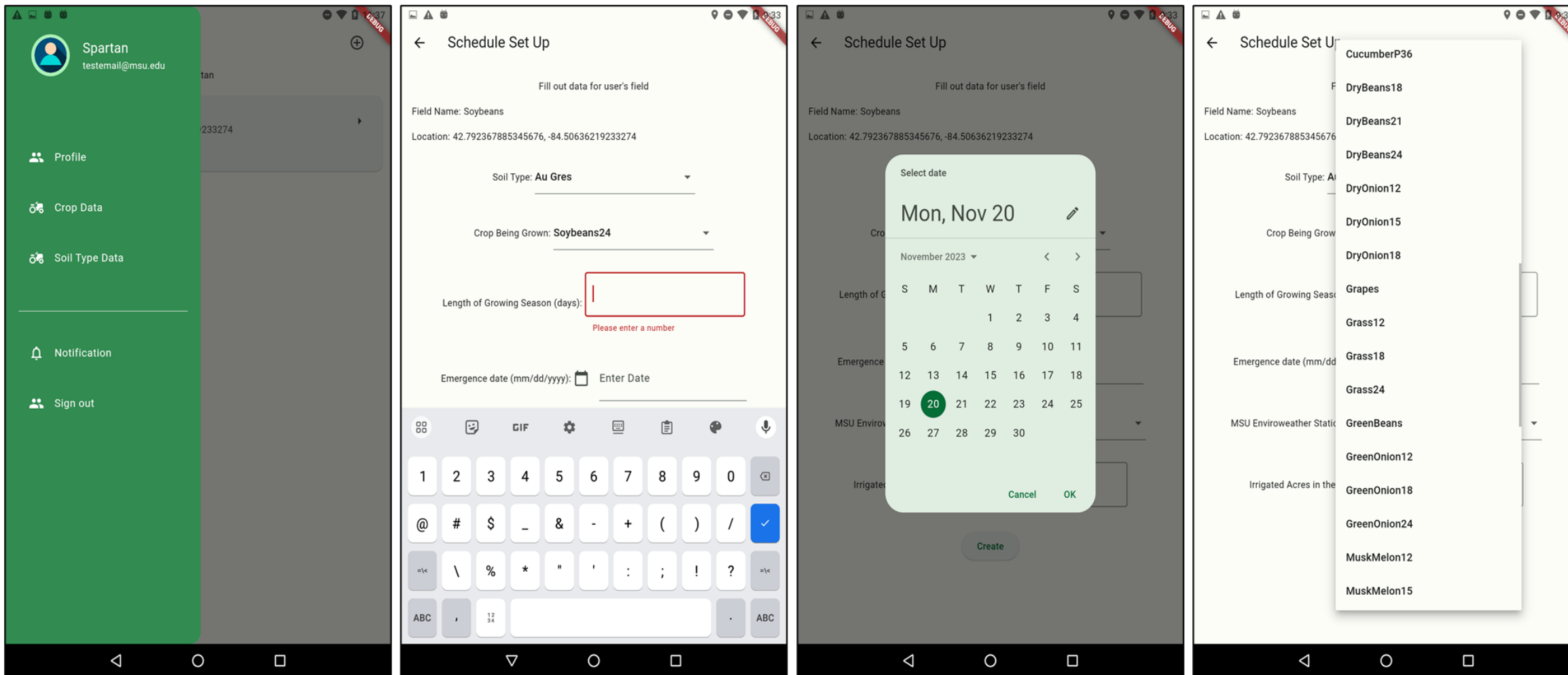
Excel-based MSU Irrigation Scheduler



Mobile App-based MSU Irrigation Scheduler

Date	Rainfall	Irrigation applied	% capacity filled
2023-08-09	0.00	0.0	0.85
2023-08-10	0.00	0.0	0.75
2023-08-11	0.00	0.0	0.67
2023-08-12	0.33	0.0	1.00
2023-08-13	0.00	0.0	0.91
2023-08-14	0.74	0.0	1.03
2023-08-15	0.53	0.0	1.03
2023-08-16	0.00	0.0	0.93
2023-08-17	0.29	0.0	1.03
2023-08-18	0.00	0.0	0.95
2023-08-19	0.00	0.0	0.86
2023-08-20	0.00	0.0	0.80
2023-08-21	0.00	0.0	0.74
2023-08-22	0.00	0.0	0.69
2023-08-23	0.00	0.0	0.63
2023-08-24	0.00	0.0	0.51
2023-08-25	0.00	0.0	0.47
2023-08-26	0.00	0.0	0.42
2023-08-27	0.00	0.0	0.33
2023-08-28	0.00	0.0	0.25

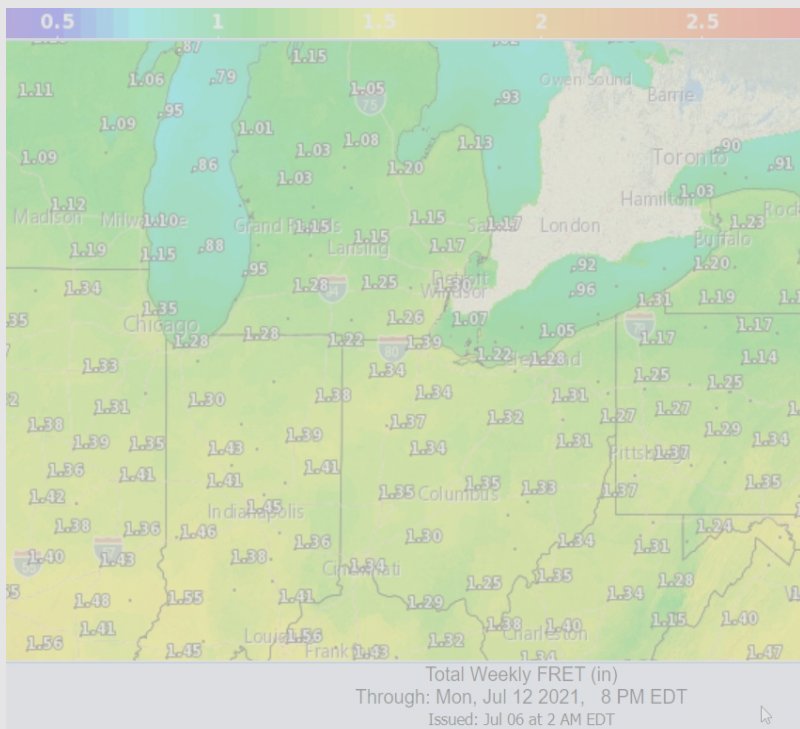
MSU Irrigation Scheduling Mobile App (In-progress)



If you are interested in trying Beta version, please leave a note it in the survey.

Current Irrigation Management Practices

Weather-based Irrigation Scheduling



$$ET_C = K_C * rPET$$

Where,

ET_C = Actual Crop Evapotranspiration (in/day)

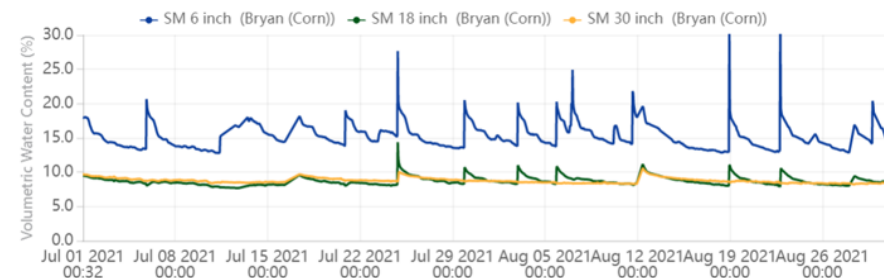
K_C = Crop Coefficient (unitless multiplier)

$rPET$ = Reference Potential Evapotranspiration (in/day)

Sensor-based Irrigation Scheduling



Soil Moisture Levels



Soil Moisture Sensor-based Irrigation Scheduling Method



EC-5



10HS



Soil Watch 10



Teros 12



SoilVUE10



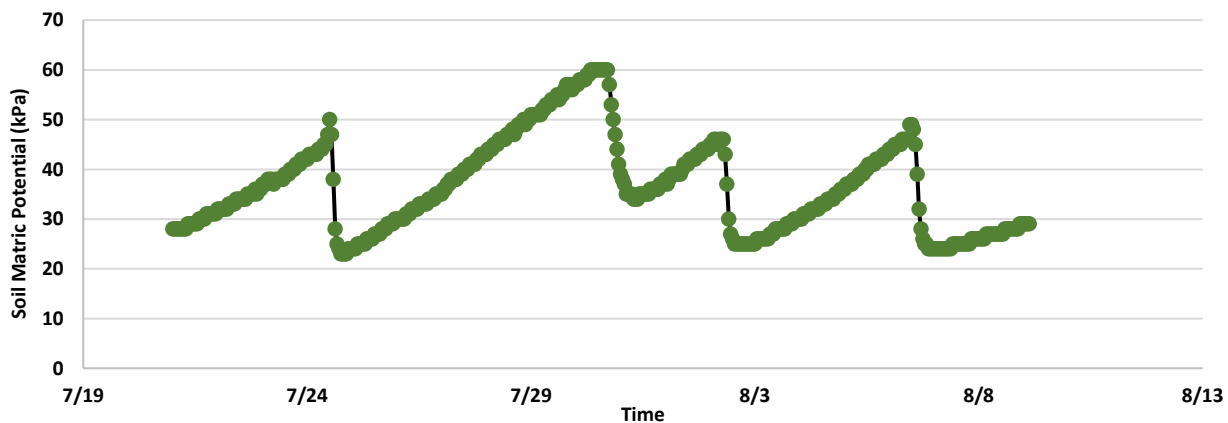
WATERMARK





Soil Tension – WATERMARK Sensor

Measures the actual soil water tension, which indicates the effort required by root system to extract water from the soil.



Soil Matric Potential for 30%, 50%, and 70% of soil water depletion for different soil types (Irmak et al., 2014)

Soil texture	Depletion in water holding capacity (kPa)		
	30%	50%	70%
Sand	20	30	60
Loamy sand	25	40	67
Sandy loam	28	50	80
Silt loam	80	150	250



Frequency Domain Reflectometry – Volumetric Water Content

Frequency Domain Reflectometry (FDR) sensors measure soil water content using the dielectric properties of soil which are highly dependent on moisture content.

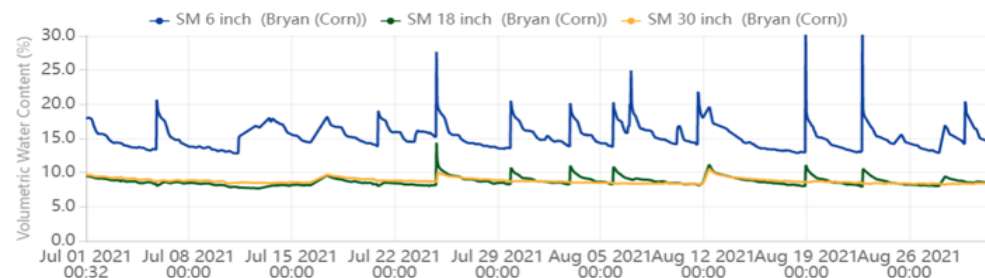


Material	Dielectric permittivity
Air	1
Soil Minerals	3~7
Organic Matter	2~5
Ice	5
Water	80

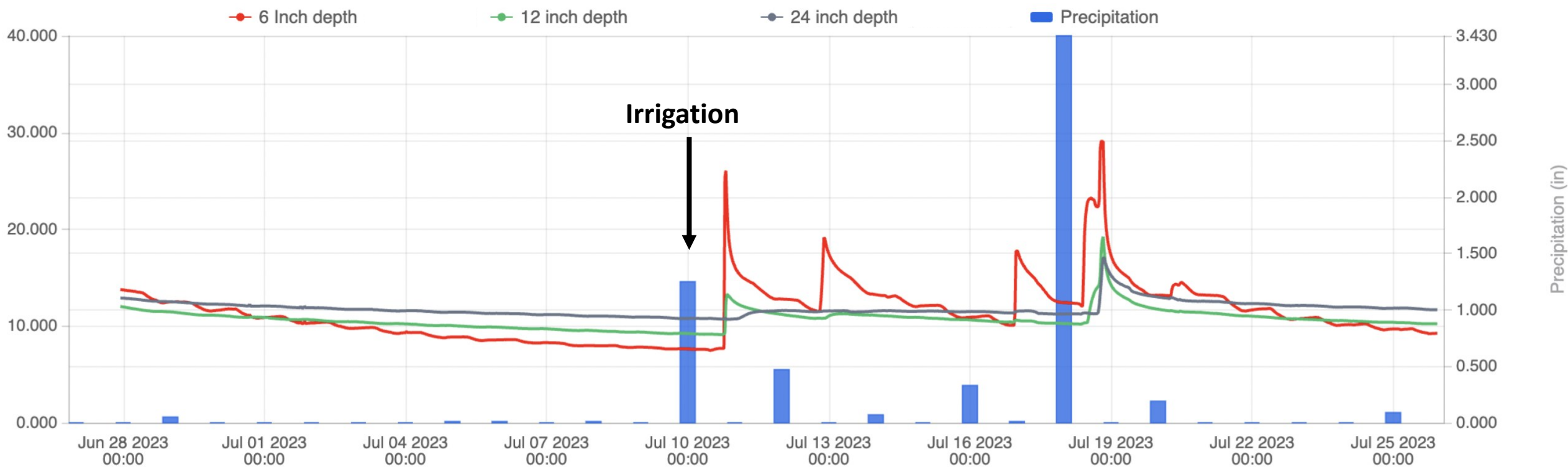
Recommended irrigation trigger point for different soil types

Soil Texture	Trigger Point Range (Irrigate when VWC falls below these values)
Sand	7 - 8 %
Loamy Sand	8 -10 %
Sandy Loam	12 - 15 %
Loam	20 - 26 %

Soil Moisture Levels

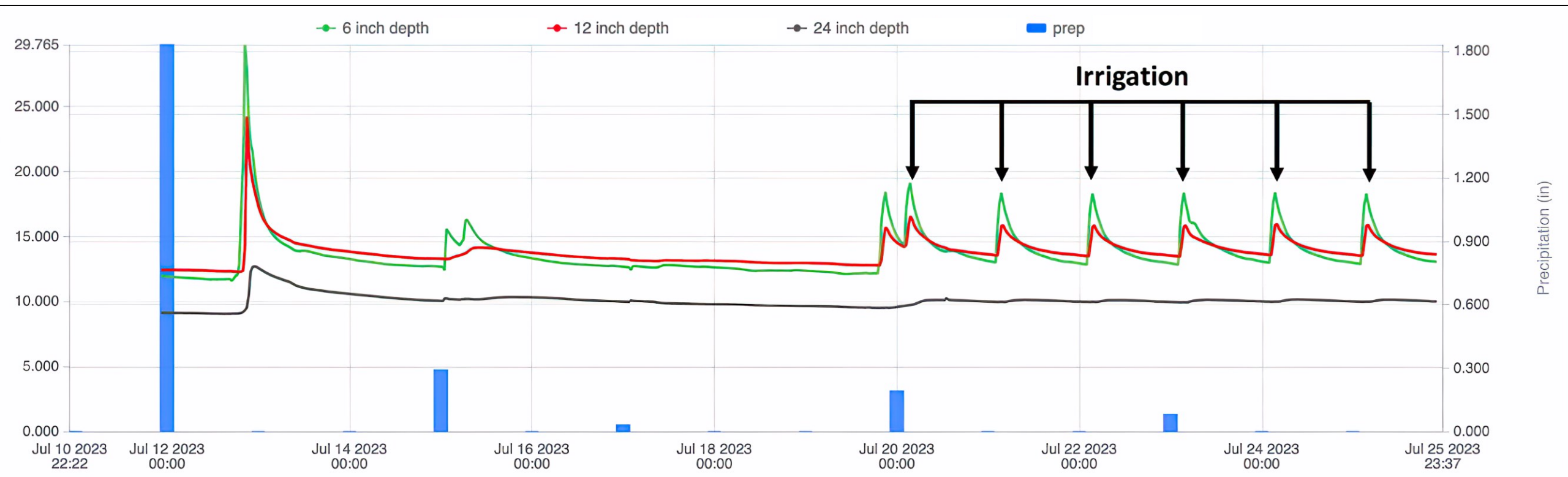


Center Pivot Irrigation - 2023



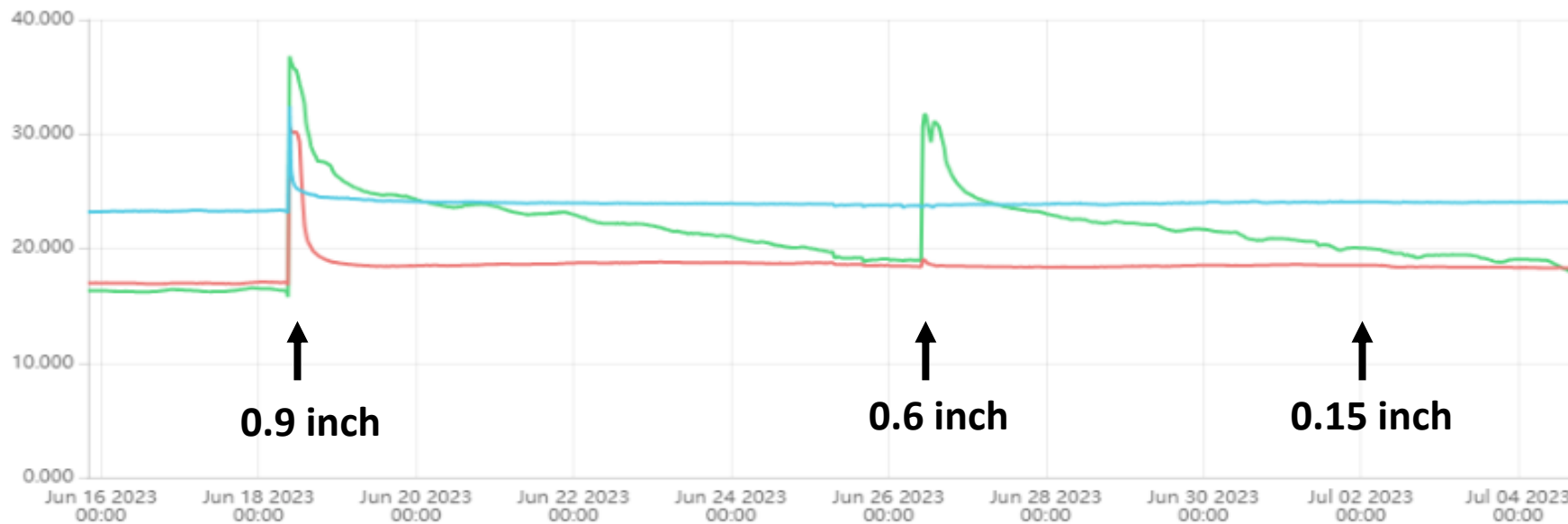


Drip Irrigation - 2023





Tekonsha, MI



Green – 1 FT.
Blue – 2 FT.
Red – 3 FT.

Crop type: Commercial Corn
Stage (7/4/23): V5
Soil: Oshtemo Sandy Loam Soil

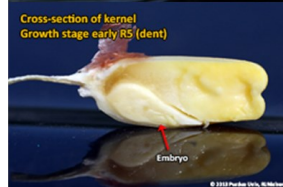
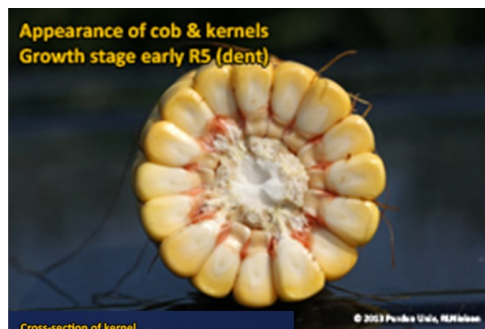


Recommended Irrigation Management - Corn

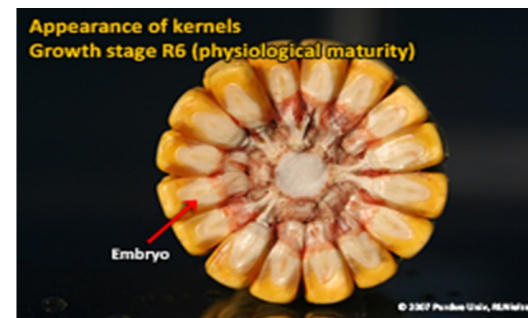
Most critical time for Corn plants to have adequate water is from VT until R6.



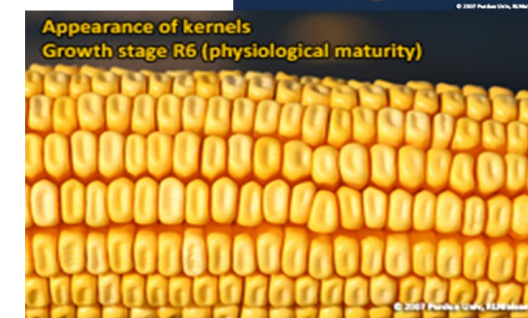
VT



Dent stage-
Maintain soil
moisture
> 50%



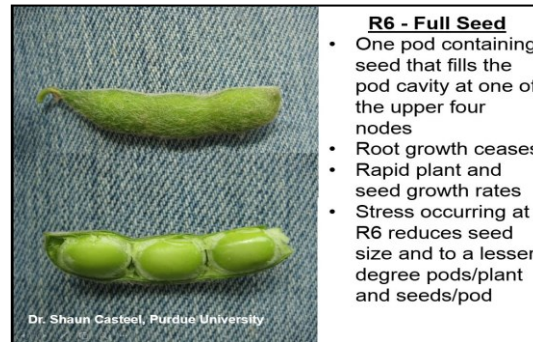
Black layer- No
benefit from
additional
irrigation





Recommended Irrigation Management - Soybean

- Most critical times for Soybean plants to have adequate water are during **pod development (R3 - R4) and seed fill (R5 - R6)**.
- Not enough moisture during the critical stages (R3-R6) in sandy soil field can reduce yield up to 28 bu/acre.



Stages	Average numbers of days	Range in number of days
Planting to VE	10	5 to 15
VE to VC	5	3 to 10
VC to V1	5	3 to 10
V1 to V2	5	3 to 10
V2 to V3	5	3 to 10
V3 to V4	5	3 to 8
V4 to V5	5	3 to 8
Beyond V5	3	2 to 5
R1 to R2	3	0 to 7
R2 to R3	10	5 to 15
R3 to R4	9	5 to 15
R4 to R5	9	4 to 26
R5 to R6	15	11 to 20
R6 to R7	18	9 to 30
R7 to R8	9	7 to 18

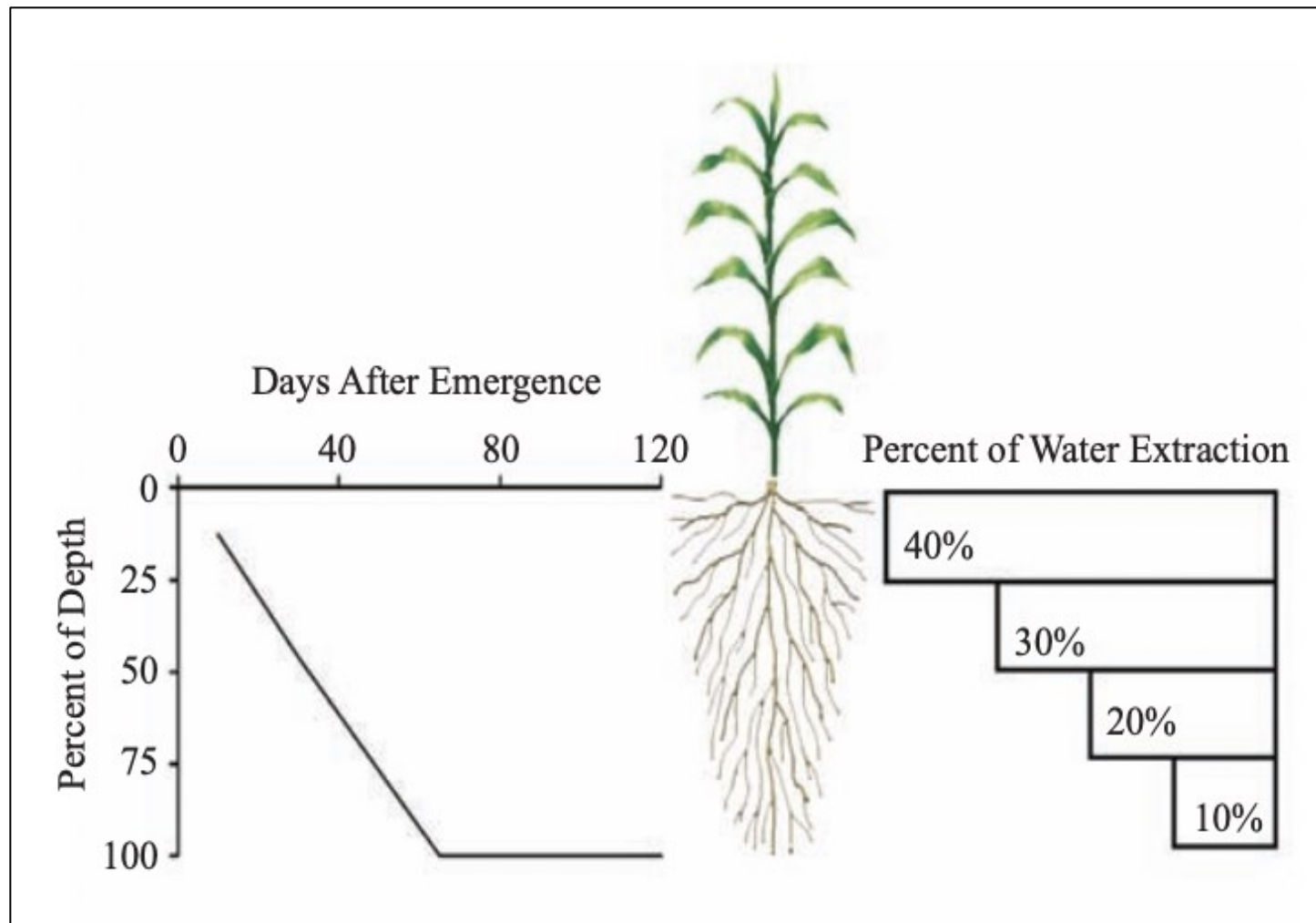
Source: Shaun Casteel, Purdue University.

Source: University of Minnesota



Sensor Installation Considerations

- Root depth.
- Representative area.
 - Soil type
 - Slope
 - Crop type
- Installation technique
(No air gap)

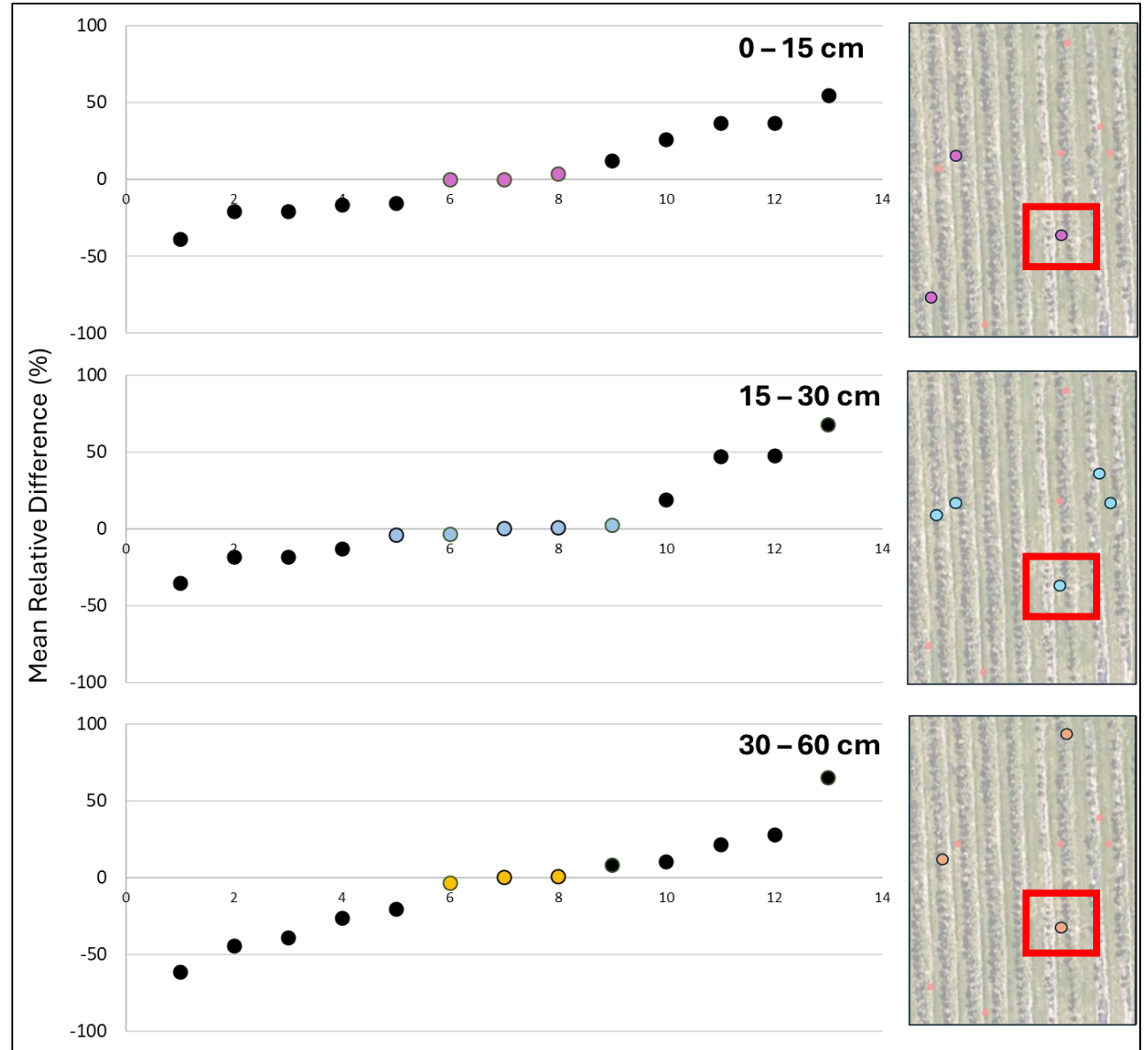
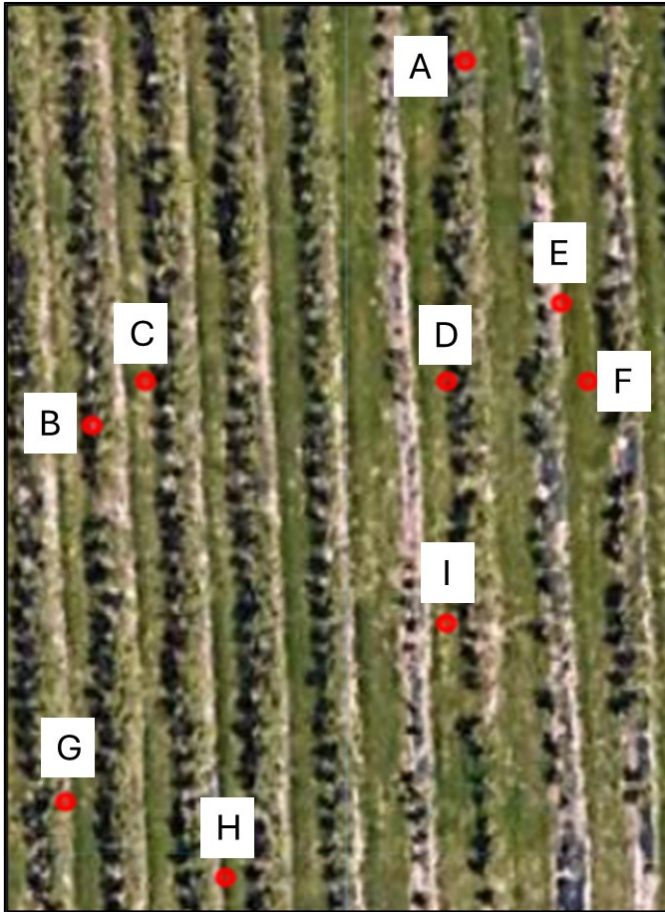


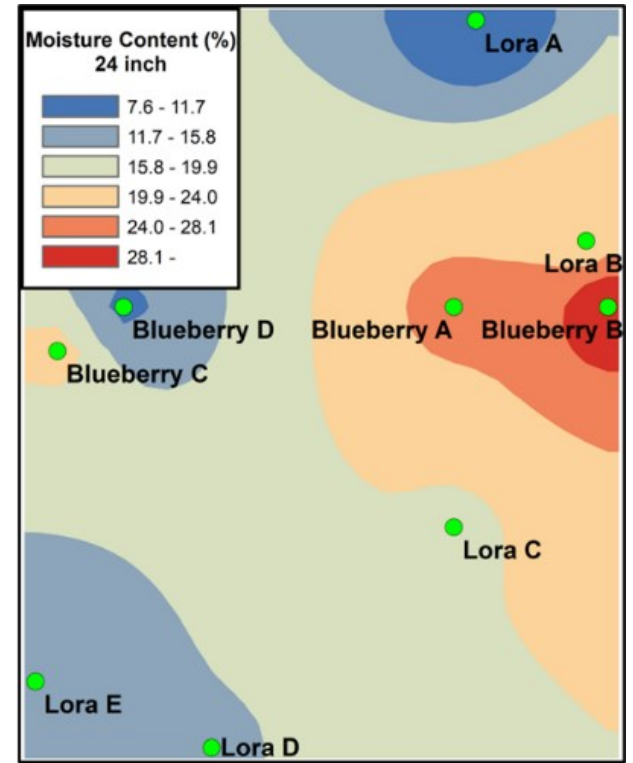
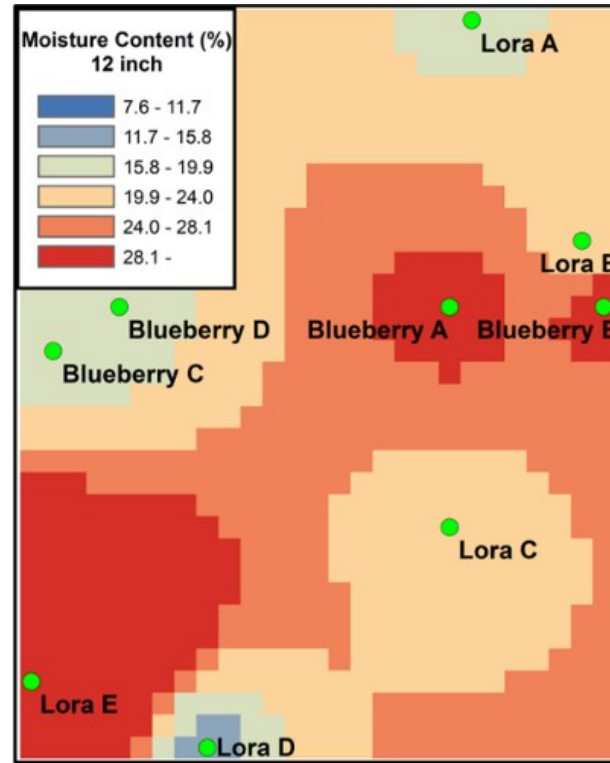
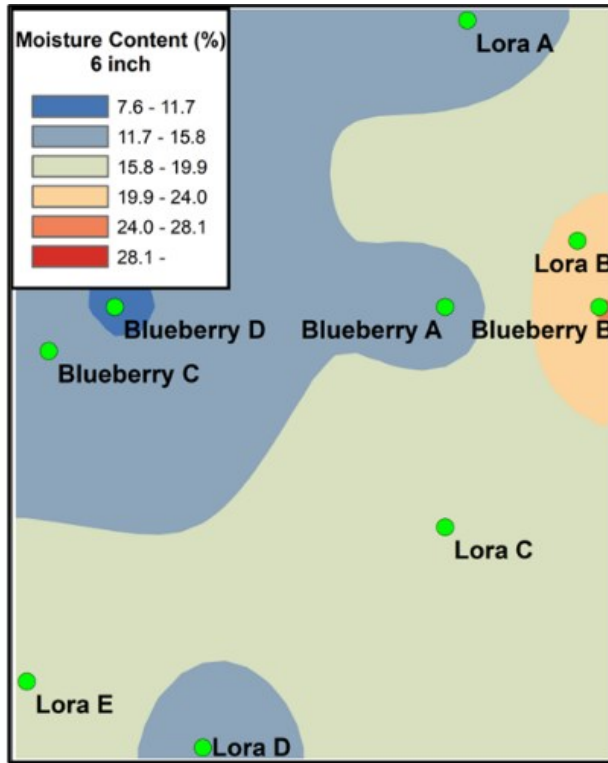


Sensor Installation Considerations

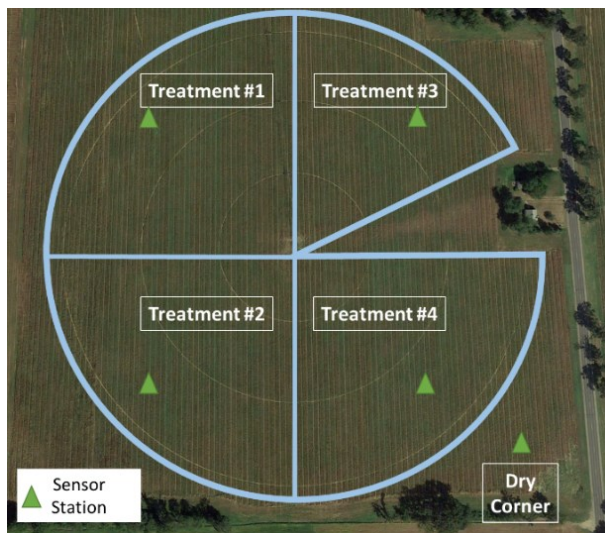
- Root depth.
- Representative area.
 - Soil type
 - Slope
 - Crop type
- Installation technique
(No air gap)



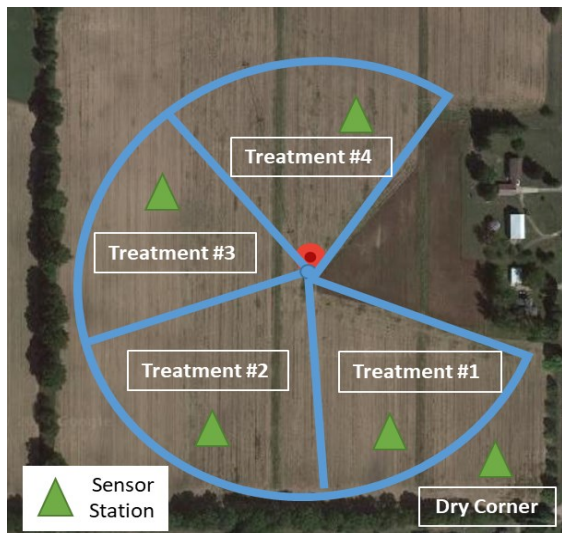




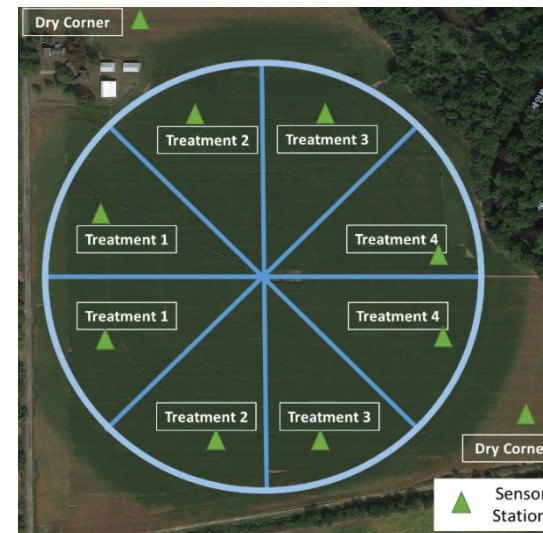
Irrigation Management with IoT Technology – Corn & Soybean & Potato



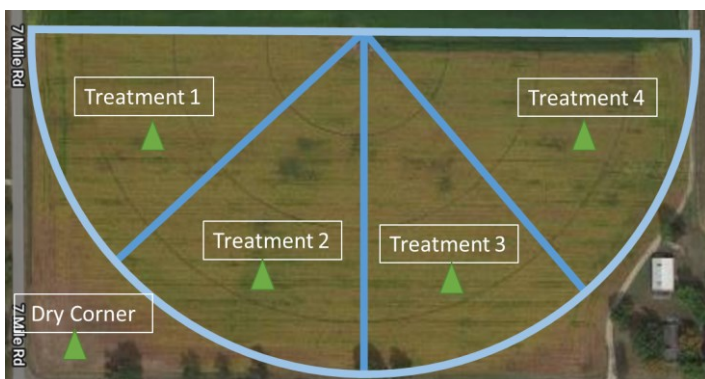
Constantine, MI (40 acres)



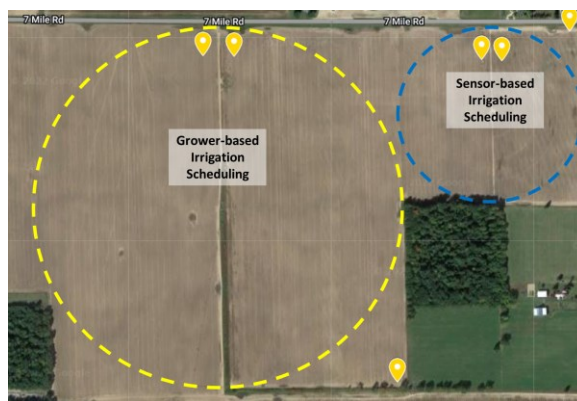
Sturgis, MI (40 acres)



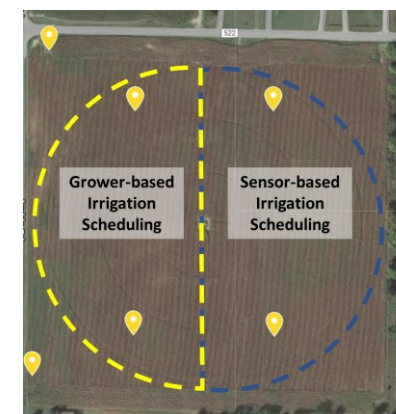
Tekonsha, MI (70 acres)



Union City, MI (40 acres)



Mecosta, MI (80 acres)



Lakeview, MI (40 acres)

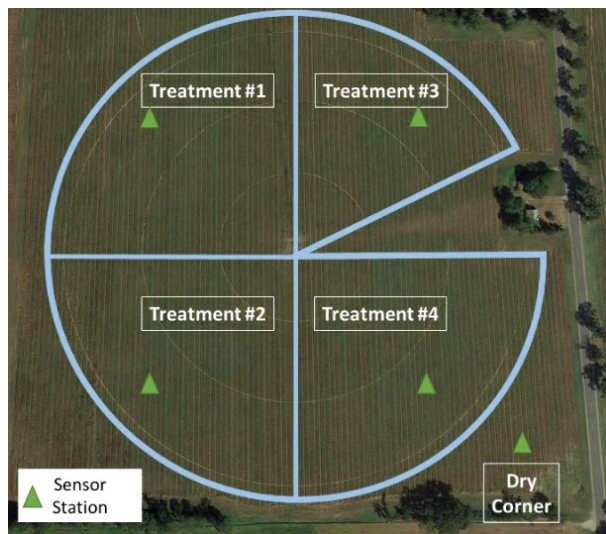
Corn Irrigation On-Farm Demonstration Project Updates



Irrigation Treatment	Yield (bu/acre)	Irrigation Water Use Efficiency (bu/acre-inch)	Value (\$/acre-inch)*
Producer's Irrigation Management	305	19.5	132
100% Irrigation Scheduling	319	22.4	152
130% Irrigation Scheduling	319	19.3	131
70% Irrigation Scheduling	309	20.3	137
Dry Corner	218		

*Assumed that corn price is \$6.77/Bushel (1/20/23)

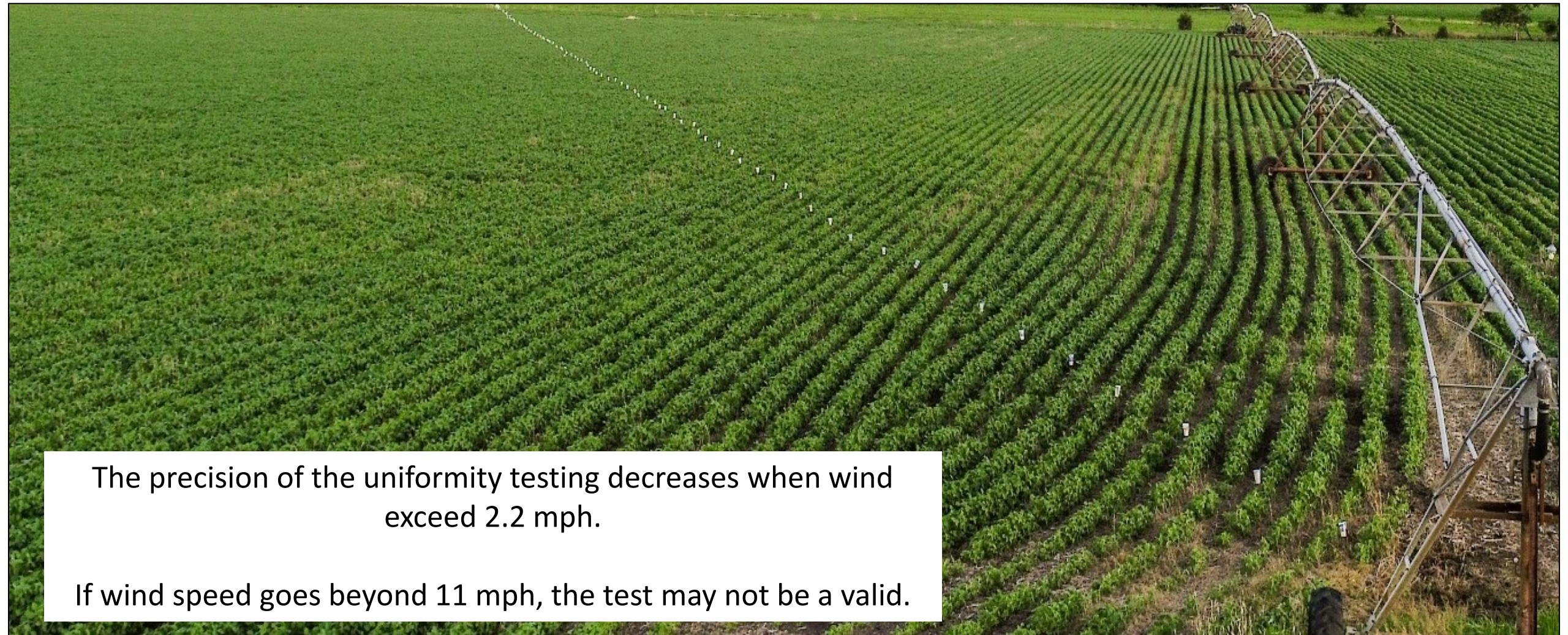
Soybean Irrigation On-Farm Demonstration Project Updates



Irrigation Treatment	Yield (bu/acre)	Irrigation Water Use Efficiency (bu/acre-inch)	Value (\$/acre-inch)
Producer's Irrigation Management	64	6.3	9
100% Irrigation Scheduling	66	8	122
130% Irrigation Scheduling	66	6	92
70% Irrigation Scheduling	58	4.5	69
Dry Corner	54		

**Assumed that soybean price is \$15.3/Bushel (1/19/23)

Irrigation System Uniformity Evaluation

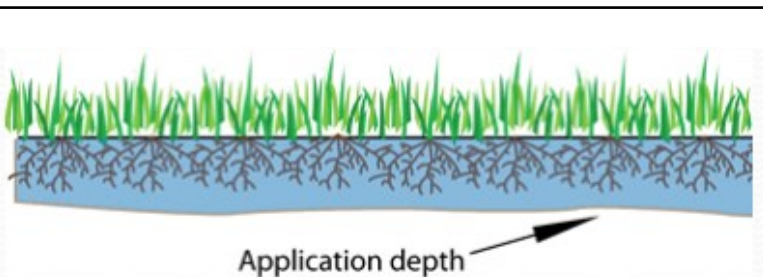


The precision of the uniformity testing decreases when wind exceed 2.2 mph.

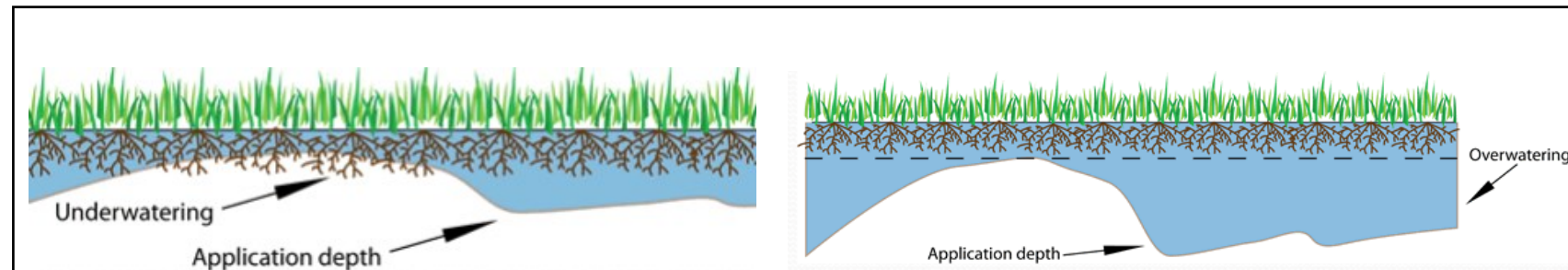
If wind speed goes beyond 11 mph, the test may not be a valid.

Importance of Checking Irrigation System Uniformity

- Poor water distribution can result in over- and under-irrigated areas.
- Under-irrigation can reduce crop yield and grain quality.
- Over-irrigation can cause runoff and leaching water and nutrients below the root zone.
- Low uniformity can negatively impact on a farm's net return and environmental impacts.



Good Distribution Uniformity



Poor Distribution Uniformity

(MJC Irrigation Technology, n.d.)



Irrigation System Uniformity Evaluation

MSU Extension Irrigation System Evaluation Tool, 1-23-07											
Farm Name		[Redacted]									
System Identification		Cornering Arm System on [Redacted] Farm-Behind House		System Uniformity Coefficient = 79			Good System uniformity coefficient are 85 or greater				
System Settings		Cornering Arm Extended		Deviation from desired application = -0.04							
Application rate (in)		0.5		Wind speed (mph)		4 mph					
Percent timer Setting (%)		19		Wind Condition (variable or steady)		steady					
Operating Pressue (psi)											
Rate of application calculator											
Time from start to end of application at highest rate section of system (min.)				22		Inches/Hour		1.25			
Rate of application for the highest rate section of system (minute /one inch)				48.00							
				Average Application (cm)		1.164					
Length of evaluation area (ft)		1340		Average Application (in)		0.46					
Catch Can Spacing Distance (ft)		10									
				Average catch, collected only (ml)		88.95					
number of cans data collected from		129		70% average catch can (ml)		59.94					
number of cans set		134		Evaluation area, full circle (acres)		122.82					
				catch can opening area (sq cm)		76.977					
Diameter of catch can (cm)		9.9		catch can opening area (sq in)		11.767					
Page 1											
catch can number	Distance from center point	catch volume in ml	Data adjustment	Comments	Water volume (cm)	Water volume (in)	% applied of average	Deviation from average (%)	Area covered per catch can (acres)	Area covered per catch can (% of total)	Weighted Deviation
1	10	88.95			1.156	0.455	99.26%	-0.74%	0.01623	0.01%	0.0001
2	20	88.95			1.156	0.455	99.26%	-0.74%	0.02885	0.02%	0.0002
3	30	88.95			1.156	0.455	99.26%	-0.74%	0.04327	0.04%	0.0003
4	40	88.95			1.156	0.455	99.26%	-0.74%	0.05770	0.05%	0.0005
5	50	88.95			1.156	0.455	99.26%	-0.74%	0.07212	0.06%	0.0006
6	60	88.95			1.156	0.455	99.26%	-0.74%	0.08655	0.07%	0.0007
7	70	125	0.00		1.624	0.639	139.48%	39.48%	0.10097	0.08%	0.0011
8	80	75	0.00		0.974	0.384	83.69%	-16.31%	0.11539	0.09%	0.0008
9	90	115	0.00		1.494	0.588	128.32%	28.32%	0.12982	0.11%	0.0014
10	100	105	0.00		1.364	0.537	117.16%	17.16%	0.14424	0.12%	0.0014

Application is 4% under expectation

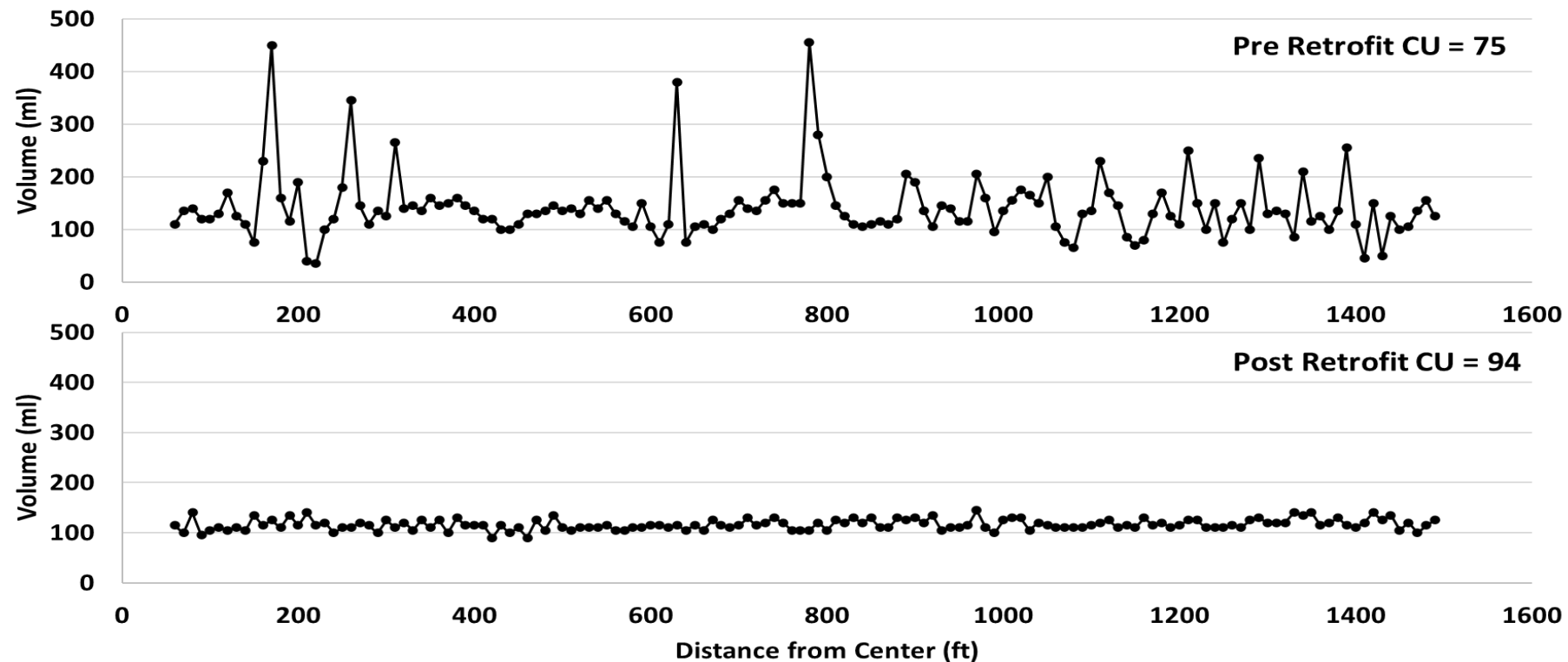
If the CU is 85% or greater, the irrigation system is not likely to need major adjustments to the sprinkler package,

A CU of 80 to 85% may need further analysis of the sprinkler package, and individual sections of the irrigator would benefit from corrections.

A CU of less than 80% requires an adjustment to the sprinkler package design and correction of individual sections of the sprinkler package.

Irrigation System Evaluation – Case study

- Material and labor costs for replacing sprinkler package were \$4,360 and \$2,220, respectively. Total cost was **\$6,580**.
- With \$1,617 in energy savings per year, the payback period of updating the sprinkler system is approximately **4 years**.





Looking for Collaborators!!

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(269) 467-5511

Support \$1,000 for the cost of the retrofit.



USDA NRCS EQIP (Environmental Quality Incentives Program)



United States Department of Agriculture

441-CPS-1

Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD
IRRIGATION SYSTEM, MICROIRRIGATION
CODE 441
(Ac.)

DEFINITION

An irrigation system for frequent application of small quantities of water on or below the soil surface: as drops, tiny streams, or miniature spray through emitters or applicators placed along a water delivery line.

PURPOSE

This practice is applied to achieve the following purpose:

- Efficiently and uniformly apply irrigation water and maintain soil moisture for plant growth.
- Prevent contamination of ground and surface water by efficiently and uniformly applying chemicals.
- Establish desired vegetation (e.g., windbreaks).

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on sites where soils and topography are suitable for irrigation of crops or other desirable vegetation and an adequate supply of suitable quality water is available for the intended purpose(s).

Microirrigation is suited to virtually all agricultural crops, and residential and commercial landscape systems. Microirrigation is also suited to steep slopes where other methods would cause excessive erosion, and areas where other application devices interfere with cultural operations.

Microirrigation is suited for use in providing irrigation water in limited amounts to establish desired vegetation such as windbreaks, living snow fences, riparian forest buffers, and wildlife plantings.

This practice standard applies to systems that wet only a specific area (e.g., an individual plant or tree) and typically have design discharge rates less than 60 gal/hr at individual application discharge points.

Use NRCS Conservation Practice Standard (CPS) Code 442, Sprinkler System, for systems that uniformly wet the entire field and typically have design discharge rates of 60 gal/hr or greater at individual application discharge points.



United States Department of Agriculture

442-CPS-1

Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD
SPRINKLER SYSTEM
Code 442
(Ac.)

DEFINITION

A distribution system that applies water by means of nozzles operated under pressure.

PURPOSE

This practice is applied as part of a conservation management system to accomplish one or more of the following:

- Efficient and uniform application of water on irrigated lands
- Improve plant condition, productivity, health and vigor
- Prevent the entry of excessive nutrients, organics, and other chemicals in surface and groundwater
- Improve condition of soil contaminated with salts and other chemicals
- Reduce particulate matter emissions to improve air quality
- Reduce energy use

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to the planning and functional design of all sprinkler system components (e.g., laterals, risers, nozzles, heads, and pressure regulators).

Individual sprinkler design discharge rates covered by this standard typically have design nozzle discharge rates exceeding 1 gallon per minute and wet the entire field surface uniformly.

Areas must be suitable for sprinkler water application, and have a water supply of adequate quantity and quality for intended purpose(s).

This standard applies to planning and design of sprinkler application systems for:

- meeting crop water demands
- crop cooling, frost protection, or bloom delay
- leaching or reclamation of saline or sodic soils, or soils contaminated by other chemicals that can be controlled by leaching
- application of chemicals, nutrients, and/or waste water



United States Department of Agriculture

449-CPS-1

Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD
IRRIGATION WATER MANAGEMENT
CODE 449
(ac)

Notice of Proposed Changes to the National Handbook of Conservation Practices for the Natural Resources Conservation Service

[Docket No. NRCS-2020-0001]

[PROPOSED FULL TEXT FOR PRACTICE STANDARD CODE 449](#)

DEFINITION

The process of determining and controlling the volume, frequency, and application rate of irrigation water.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve irrigation water use efficiency
- Minimize irrigation-induced soil erosion
- Protect surface and ground water quality
- Manage salts in the crop root zone
- Manage air, soil, or plant microclimate
- Reduce energy use

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable to all currently irrigated lands.

CRITERIA

General Criteria Applicable to All Purposes

Develop an irrigation water management (IWM) plan that defines when irrigation is needed (timing) and the amount and rate of water to apply for each irrigation event.

Base the timing of irrigation on one or more of the following methods:

- Evapotranspiration of the crop, using appropriate crop coefficients and reference evapotranspiration data,
- Soil moisture monitoring,
- Computerized irrigation scheduling, utilizing local real-time climate data, soil, and crop growth characteristics (e.g., remote telemetry data systems coupled with cloud-based irrigation scheduling using the soil-water balance method),
- Plant monitoring (e.g., leaf water potential or leaf/canopy temperature measurements).

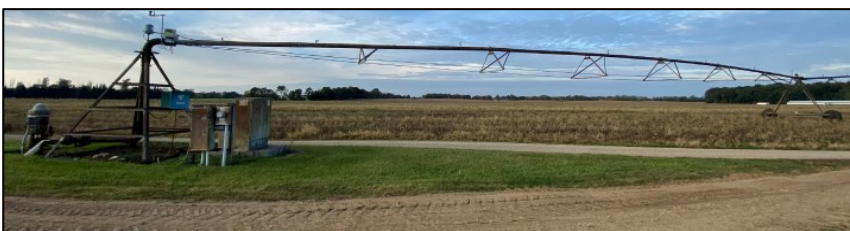


Resources

MSU Extension – Irrigation

<https://www.canr.msu.edu/irrigation>

<https://engineering.purdue.edu/ABE/extension/H2OQual/Irrigation>



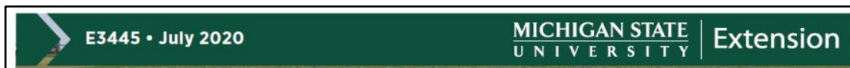
Considerations for Planning and Selecting Pumping Plants for Sprinkler Irrigation

Younsuk Dong and Lyndon Kelley



Efficient Irrigation Management With Center Pivot Systems

Younsuk Dong, Lyndon Kelley, Steve A. Miller



Improving Irrigation Water Use Efficiency: Using Soil Moisture Sensors

Younsuk Dong, Steve A. Miller, Lyndon Kelley



RISK OF IRRIGATION WATER ON THE ROAD

PUBLISHED ON AUGUST 25, 2023

The risk associated with irrigation water on the road depends on the pressure and volume of water hitting the road and amount of traffic encountering it.



THE IMPORTANCE OF CHECKING IRRIGATION SYSTEM UNIFORMITY

PUBLISHED ON AUGUST 18, 2023

Evaluating and retrofitting your irrigation system can help to improve irrigation water use efficiency.



ADEQUATE WATER SUPPLY IS THE HEART OF AN IRRIGATION SYSTEM

PUBLISHED ON AUGUST 16, 2023

Irrigation investments start with securing an adequate water supply that meets the state legal requirements for large-scale water use and minimal potential for conflict with neighbors or adverse resource impacts.



MSU EXTENSION HOSTS SECOND ANNUAL BLUEBERRY RESEARCH FIELD DAY

PUBLISHED ON JULY 18, 2023

Join Michigan State University Extension for this blueberry-focused event on Sept. 6 in Fennville.



JUNE CROP WATER NEEDS

PUBLISHED ON JUNE 15, 2023

If soils are depleted of moisture beneath the developing plants, irrigators need to supply enough water to help establishing roots grow down into natural soil moisture.



Future Irrigation-Related Events



Feb 27. 2024

Zoom

- Irrigation Scheduling
- Value of Irrigation Uniformity and Sprinkler Choice
- Irrigation Electrical Safety
- Pivot Control System



MSU WATER USE EFFICIENCY EXTENSION EDUCATOR

POSITION SUMMARY

MSU Extension is searching for educators to fill two Water Use Efficiency positions. One position will be located in West Michigan in Mason County. The other position will be located in Southern Michigan in Branch County.

MICHIGAN STATE UNIVERSITY | Extension | Agriculture & Agribusiness



MSU EXTENSION
AGRICULTURE AND
AGRIBUSINESS INSTITUTE

Position Information

Position Title

Extension Educator

Salary

\$55,000 or Commensurate with education and experience

Benefits

Comprehensive benefits package:
<https://www.hr.msu.edu/benefits/index.html>

Location

Coldwater (Branch County) or
Scottville (Mason County)

To Apply

Current MSU Employees:
Access the EBS portal. Under the My Career and Training section, select the Careers @ MSU tile to view Internal Job Postings.

External Applicants:
Visit <http://careers.msu.edu>

Posting Number:
875065

Application Deadline:
August 21, 2023

Contact for Questions

msue.hr@msu.edu

Water Use Efficiency Extension Educator (2 positions available)

Position Overview

These positions will provide leadership and programming expertise in water efficiency, water use, and conservation practices related to sustainable irrigation. With an emphasis on best management practices to improve water use conservation and efficiency, these positions help farmers improve water and energy use efficiency in their production systems through education programs, resource development, and individual consultation to reduce water use while maintaining profitable and viable production systems.

West Michigan Water Use Efficiency Educator

The focus of this position will be to emphasize best management practices to improve water use conservation and efficiency in irrigation systems for specialty crop production. Provide support for efficient use of irrigation and other water use systems in sustainable production of agricultural products.

Although negotiable, there will be space available for this position to work from the Mason County MSU Extension office located in Scottville, Michigan.

Southern Michigan Water Use Efficiency Educator

The focus of this position will be to emphasize best management practices to improve water use conservation and efficiency in irrigation systems for annual field crop production and provide education regarding large volume water withdrawal for persons operating animal agricultural facilities. Provide support for efficient use of water in annual crop and livestock production systems for the sustainable production of agricultural products.

Although negotiable, there will be space available for this position to work from the Branch County MSU Extension office located in Coldwater, Michigan.

These positions may be eligible to utilize a flexible work environment.

Qualifications

Minimum Qualifications (see full description for complete list of requirements)

- Master's degree from an accredited institution in a field of study related to agronomy, agriculture engineering, animal science, biosystems, hydrology, or related field must be earned by date of hire.

Application Process

View full description and apply through the [MSU careers](#) page. Search for posting 875065 using the Job Search field. Candidates can indicate their preference for location within their cover letter.

Younsuk Dong

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Lyndon Kelley

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MSU Extension – Irrigation

<https://www.canr.msu.edu/irrigation>

