

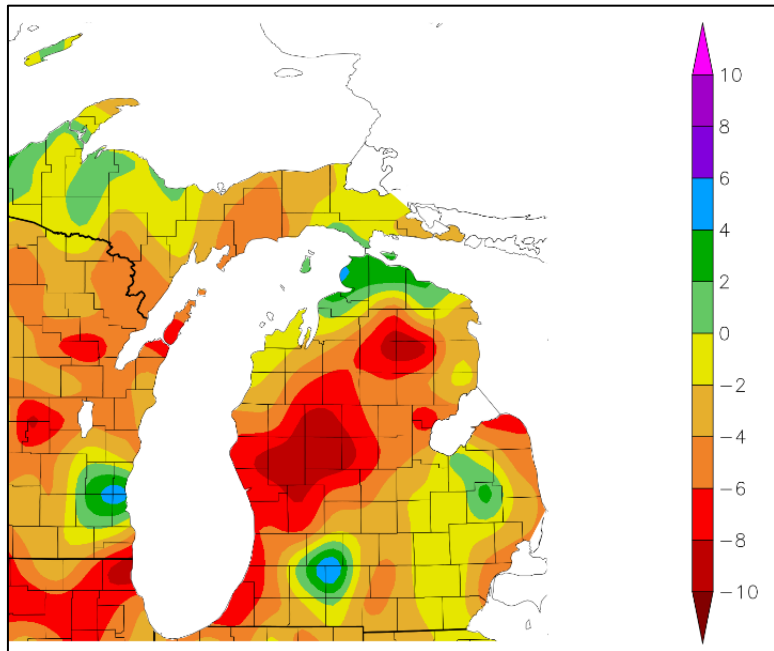
Research updates from 2025 Christmas tree irrigation experiments

Younsuk Dong, Mamata Pandey, Bert Cregg, Riley Johnson, Bill Lindberg

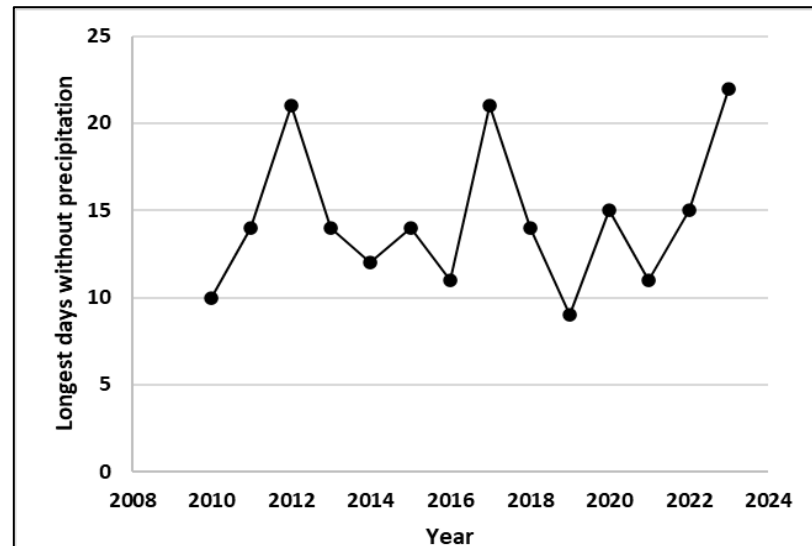
Michigan Christmas Tree Association's Winter Meeting
February 27, 2026



Impacts of Changing Weather Patterns in Michigan



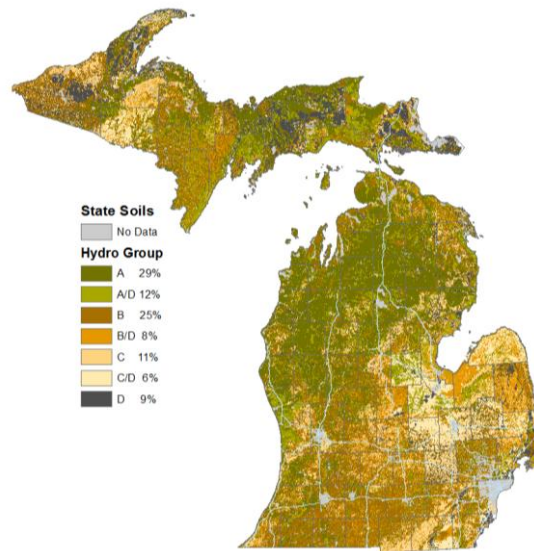
Precipitation in 2025 during the growing season compared to average years (the last 10 years).



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

Importance of Irrigation in Christmas Tree Production

- Lack of moisture on young trees may results in high rates of tree mortality and poor growth for young trees.
- Excessive moisture/irrigation can increase nutrient leaching, soil erosion, and promote suitable environments for *Phytophthora root rot*.



USDA Hydrological
Soil Map

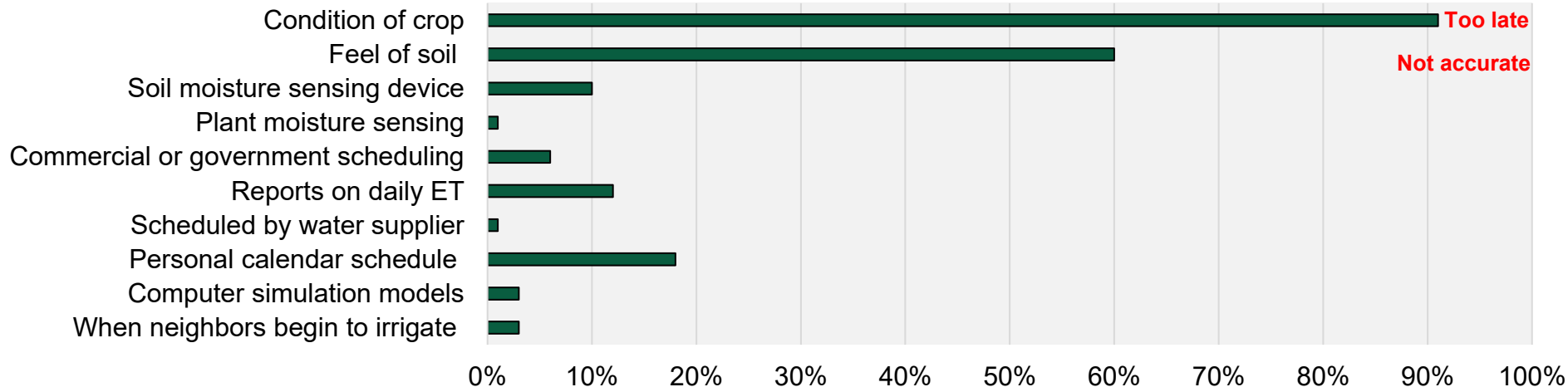
Left: Drought killed tree seedling (photo credit: Bill Lindberg)

Right: *Phytophthora root rot* (photo credit: Gary Chastagner)

How do we manage Irrigation?

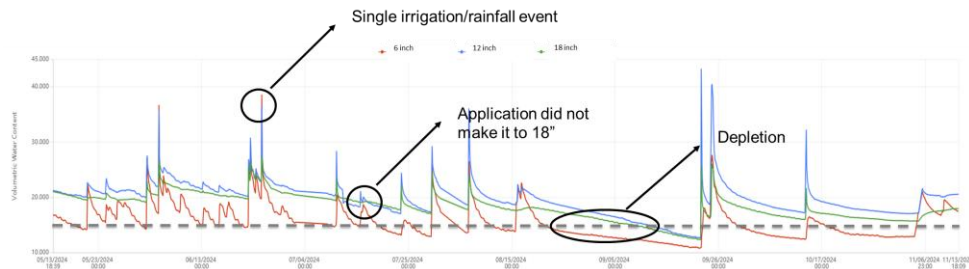
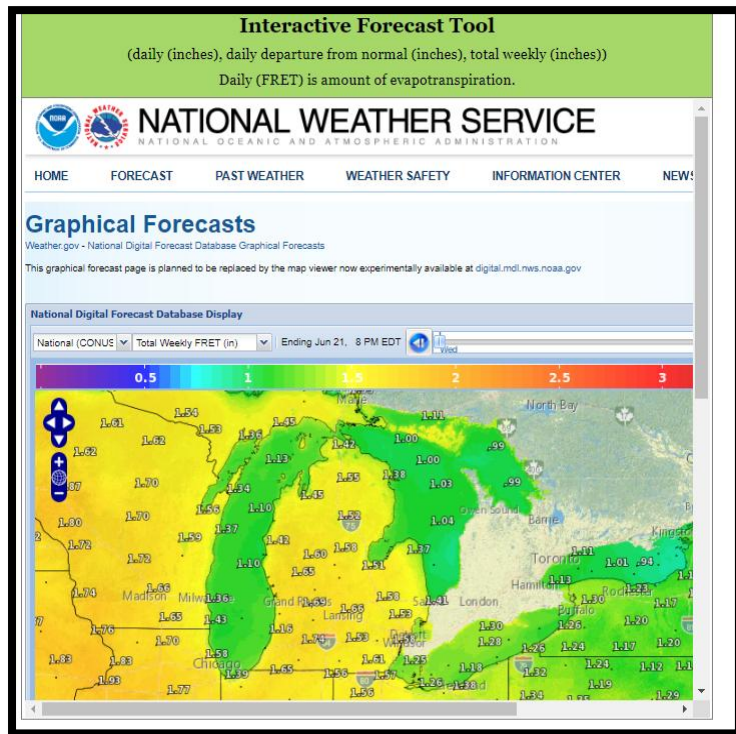
ACCORDING TO THE 2023 IRRIGATION AND WATER MANAGEMENT SURVEY

Michigan (n=4,602)



Only ~33% rely on data-driven methods

Irrigation Scheduling Methods



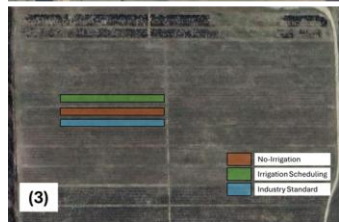
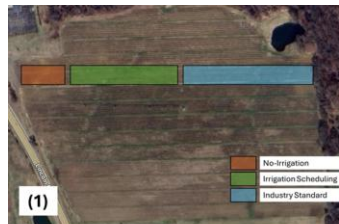
Ongoing Christmas Tree Irrigation Project

Treatments

1. Rainfed
2. Grower's Standard
(e.g., rule of thumb, 1-inch per week)
3. ET-based Irrigation Scheduling

Monitoring

1. Soil moisture monitoring
2. Weather
3. Growth and survivability



Ongoing Christmas Tree Irrigation Project

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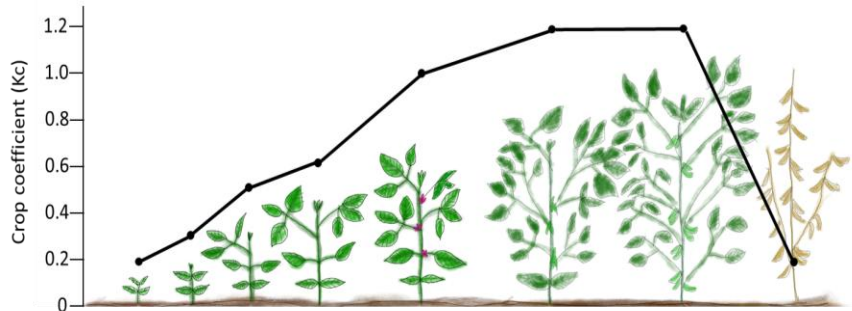
$$ET_C = K_C * rPET$$

Where,

ET_C = Crop Evapotranspiration (in/day)

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

K_C = Crop Coefficient (unitless multiplier)



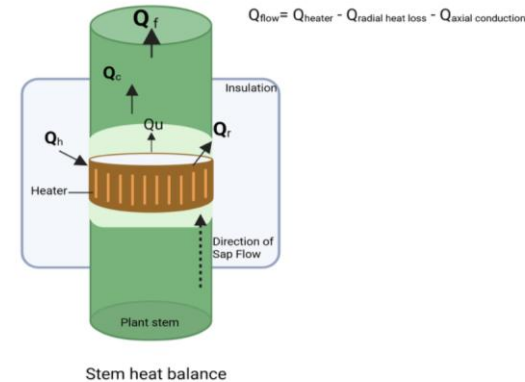
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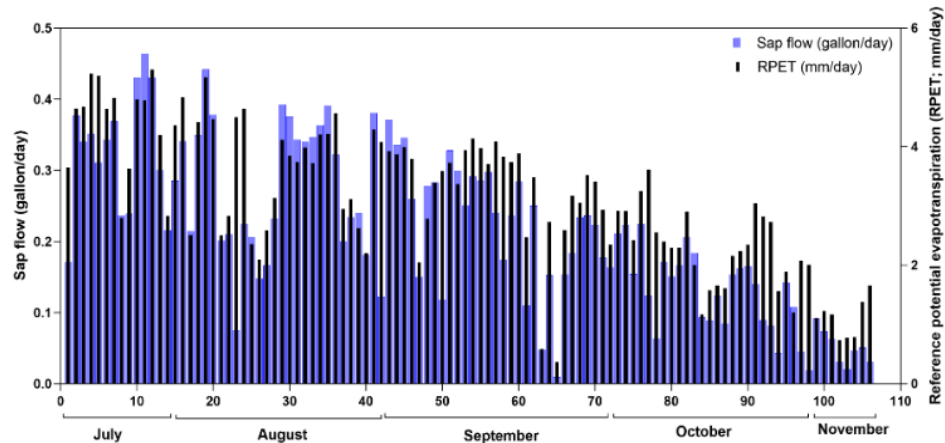
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Month	Average SAP Flow (gal/tree/day)
Jul	0.33
Aug	0.27
Sep	0.22
Oct	0.13
Nov	0.05

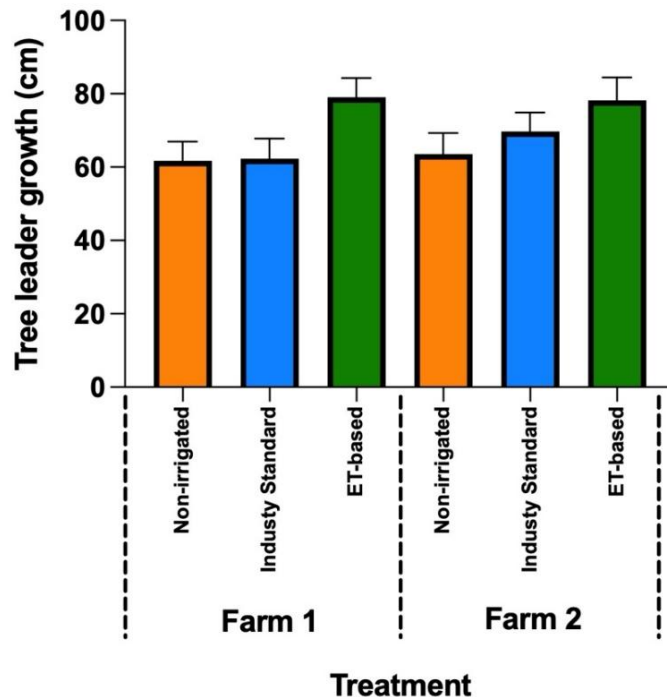
Ongoing Christmas Tree Irrigation Project

2024–2025 Result:

ET-based irrigation **increased** cumulative leader growth **by 10–30%** compared to both the grower's standard practice and non-irrigated treatments.

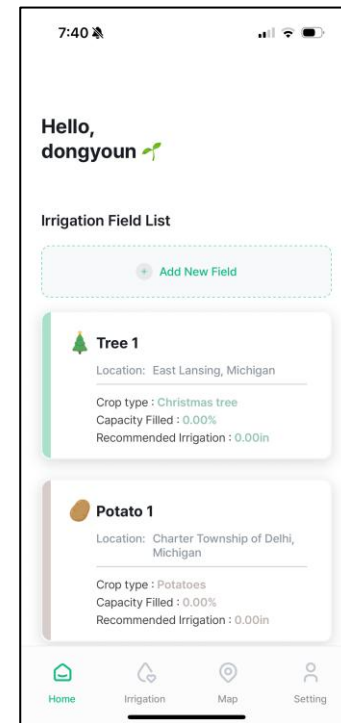
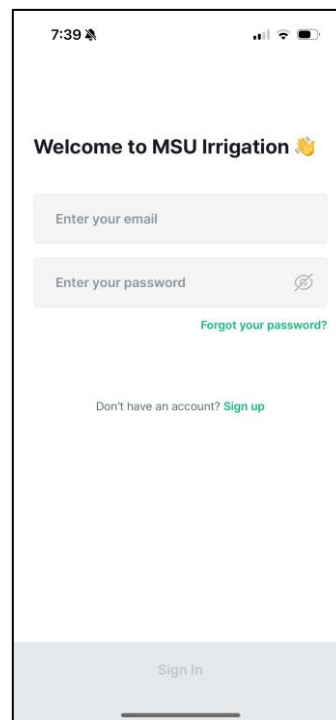
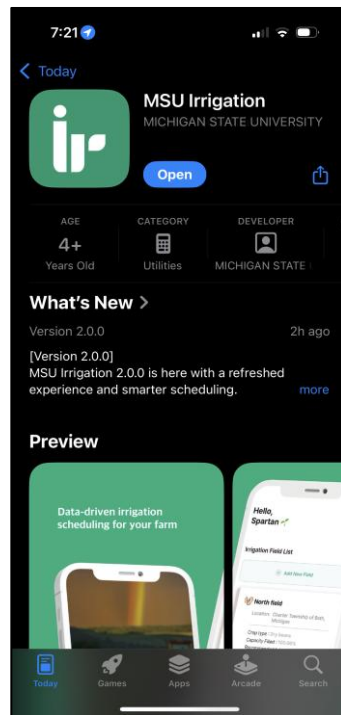
Other monitoring:

- Soil moisture levels
- Survivability
- Trunk diameter
- Leaf nutrient content





MSU Irrigation Scheduler APP V 2.0





MSU Irrigation Scheduler APP - Setup

7:42

← 370 s van buren

370 S Van Buren St
Shipshewana, IN, United States

370 S Van Buren St
Bay City, MI, United States

370 S Van Buren Rd
Reese, MI, United States

370 S Van Buren St
Amarillo, TX, United States

370 S Van Buren St
Placencia, CA, United States

370 S Van Buren St
Henderson, TX, United States

q w e r t y u i o p
a s d f g h j k l
z x c v b n m
123 space search

7:42

← Search for an address or place

Standard View

My Location

Latitude -90° to 90°
41.671802

Longitude -180° to 180°
-85.582728

Next

7:43

←

Field Size

17.56

Auto-calculated: 17.56 acres (you can edit this value)

Field area selected with 7 points

Reset

Next

7:44

← Field Details

Field Information

Latitude: 41.669236
Longitude: -85.583326
Area: 17.56 acres

Field Name

Corn field A

Crop Type

Corn

Soil Type

Spinks

Irrigation Type

☒ Sprinkler ☐ Drip

Length of Growing Season(days)

150

Emergence Date (mm/dd/yyyy)

01/01/2026

Field Sharing

Personal
Manage this field by yourself

Team
Share this field with team members

Save Field

7:44

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☒ Sprinkler ☐ Drip

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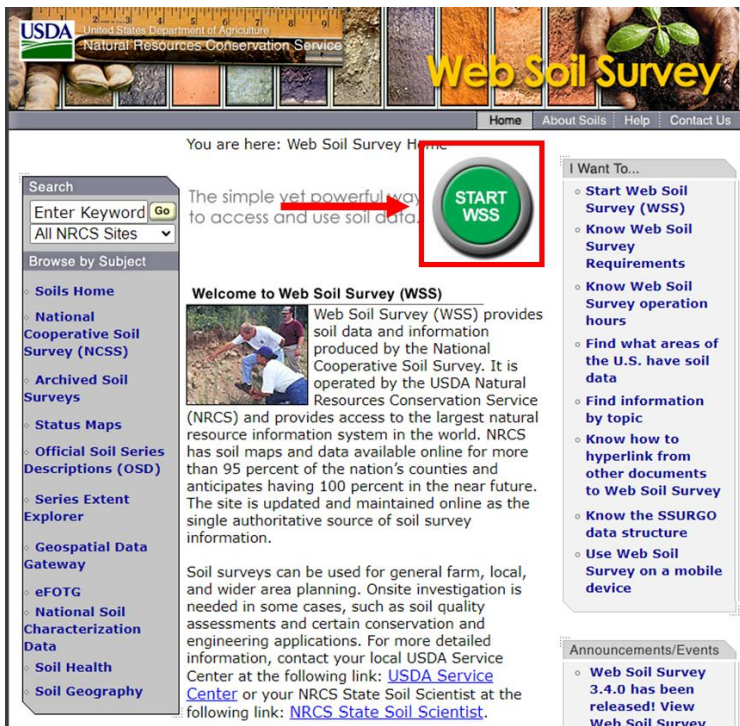
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USDA Web Soil Survey



USDA
United States Department of Agriculture
Natural Resources Conservation Service

Web Soil Survey

Home About Soils Help Contact Us

You are here: Web Soil Survey Home

The simple yet powerful way to access and use soil data.

START WSS

Welcome to Web Soil Survey (WSS)

Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

Soil surveys can be used for general farm, local, and wider area planning. Onsite investigation is needed in some cases, such as soil quality assessments and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center at the following link: [USDA Service Center](#) or your NRCS State Soil Scientist at the following link: [NRCS State Soil Scientist](#).

I Want To...

- 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
- Use Web Soil Survey on a mobile device

Announcements/Events

- Web Soil Survey 3.4.0 has been released! [View Web Soil Survey](#)

<https://websoilsurvey.sc.egov.usda.gov/>

USDA Web Soil Survey

Area of Interest (AOI)

Soil Map

Soil Data Explorer

Download Soils Data

Shopping Cart (Free)

Search

Area of Interest

Import AOI

Quick Navigation

Address

View

Address

Show location marker ☒

View

State and County

Soil Survey Area

Latitude and Longitude or Current Location

PLSS (Section, Township, Range)

Bureau of Land Management

Department of Defense

Forest Service

National Park Service

Hydrologic Unit

Area of Interest Interactive Map

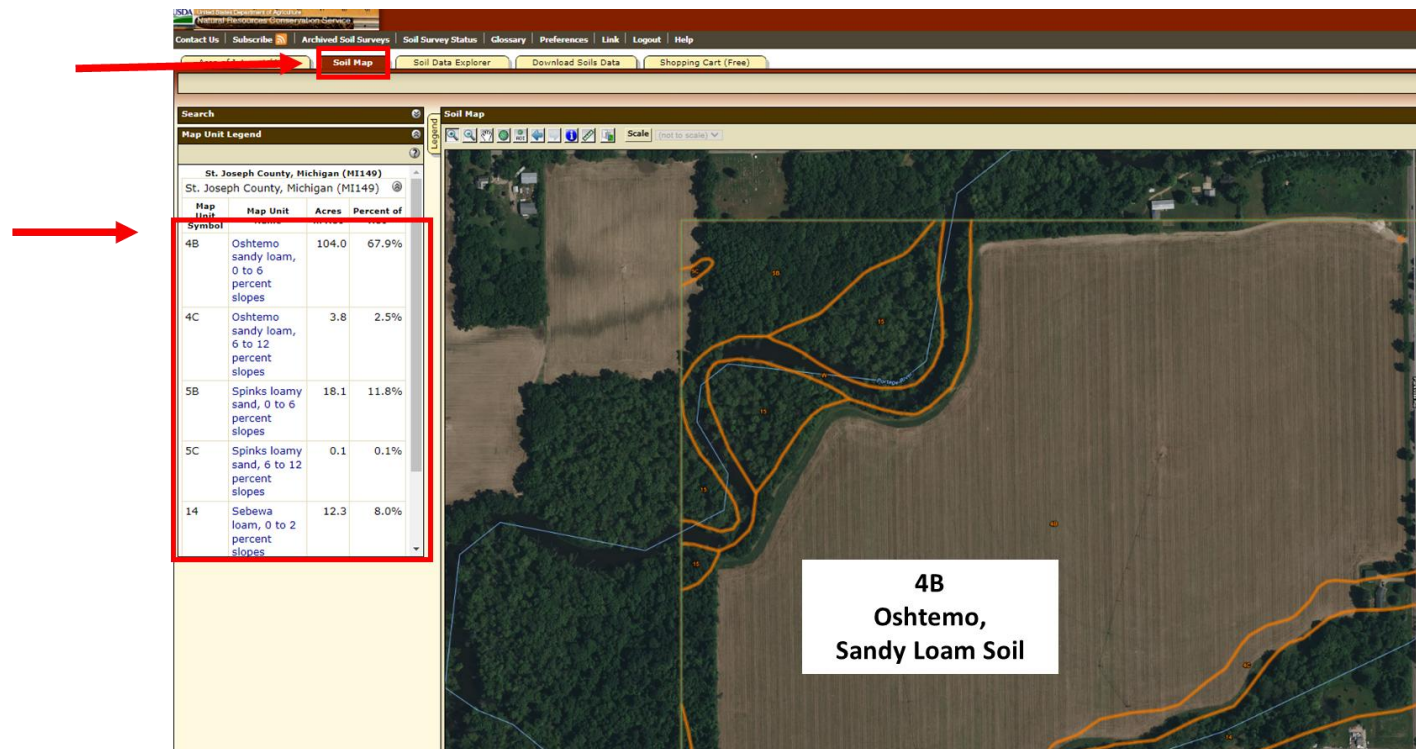
View Extent

Contiguous U.S.

Scale

(not to scale)

USDA Web Soil Survey



USDA Web Soil Survey

[illegible]

MSU Irrigation Scheduler APP - Setup



7:42

← 370 s van buren

370 S Van Buren St
Shipshewana, IN, United States

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Amarillo, TX, United States

370 S Van Buren St
Placencia, CA, United States

370 S Van Buren St
Henderson, TX, United States

q w e r t y u i o p
a s d f g h j k l
z x c v b n m
123 space search

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Length of Growing Season(days)

150

Emergence Date (mm/dd/yyyy)

01/01/2026

Field Sharing

Personal ☒
Manage this field by yourself

Team ☐
Share this field with team members

Save Field

7:44

← Field Details

Soil Type

Spinks

Irrigation Type

☒ Sprinkler ☐ Drip

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150

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01/01/2026

Field Sharing

Personal ☒
Manage this field by yourself

Team ☐
Share this field with team members

Save Field



MSU Irrigation Scheduler APP – Team sharing

7:51

< **Activate Field**

Team ✓
Share this field with team members

Field Password
Team members will need this password to join the field

Confirm Password

Your Role

Manager ✓
Full access to manage all aspects of the field

- ✓ Edit and delete fields
- ✓ Create and modify irrigation logs
- ✓ Invite and remove members
- ✓ Change member roles

Operator

Activate

8:36

Invite Team Members

Enter email addresses to invite team members.

Email Address:
dongyoun@msu.edu Add

Added Emails (1)
dongyoun@msu.edu ✕

Cancel Invite

8:36

< **Field c**

01/02/26	0.00	0.00	84.9
01/03/26	0.04	0.00	85.5
01/04/26	0.00	0.00	85.3
01/05/26	0.00	0.00	85.1

Invite Team Member ✕

Share this invitation link with team members.

Invitation Link:
<https://irrigationschedulermdu-414119.web.app/invite/19c92703b5a256709d6d1d404> Share

Done

Field Members (1)

dongyoun
Manager • Field Creator
Joined 2/24/2026

You

+ Invite Team Member

8:37

New Message Cancel

To:

Join Field - MSU Irrigation ✕
irrigationschedulermdu-414119.w...

I'd like to invite you to join my irrigation field "Field c" on MSU Irrigation!

<https://irrigationschedulermdu-414119.web.app/invite/19c92703b5a256709d6d1d404>

Please reach out to me for the field password.

7:48

< **Pass**

01/05/26	0.00	0.00	85.1
01/06/26	0.35	0.00	97.6
01/07/26	0.00	0.00	97.5

Cumulative Totals

Precipitation (in)	Irrigation (in)
1.59	0.00

Field Members (2)

dongyoun
Manager • Field Creator
Joined 2/24/2026

You

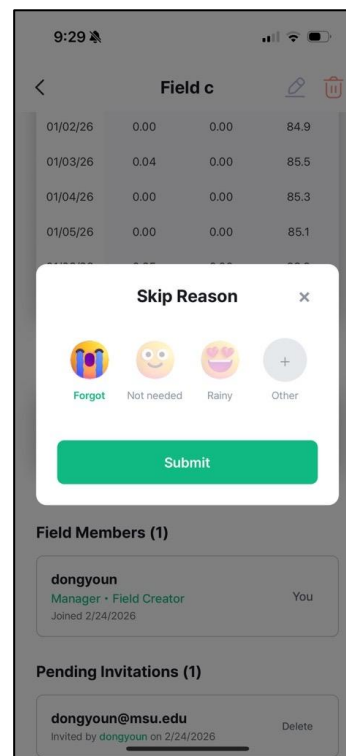
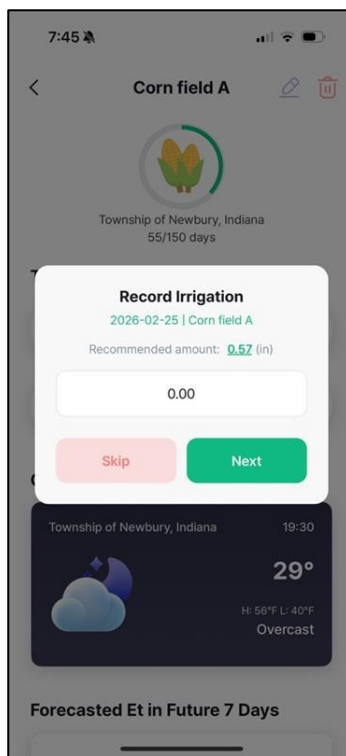
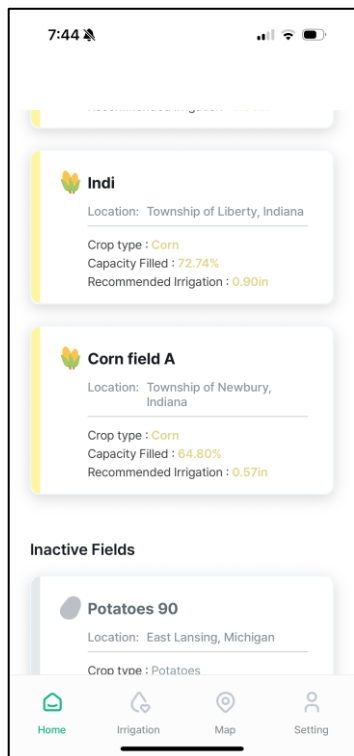
angiegradiz2
Operator
Joined 2/24/2026

Make Manager Remove

+ Invite Team Member

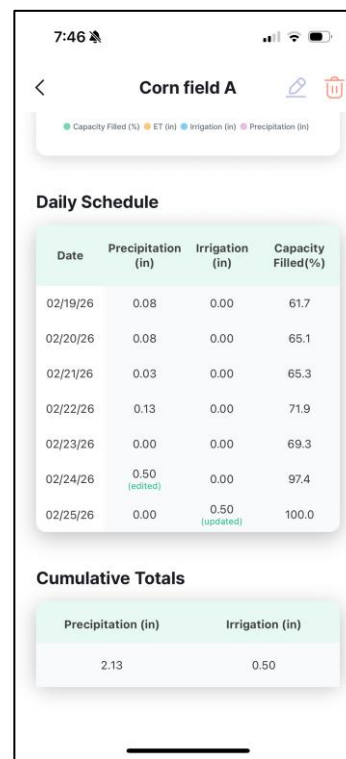
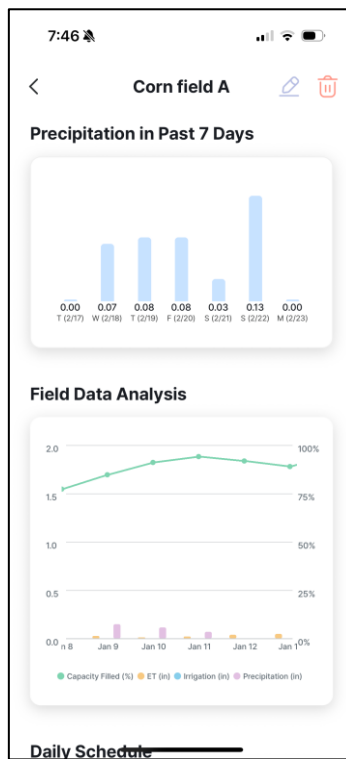
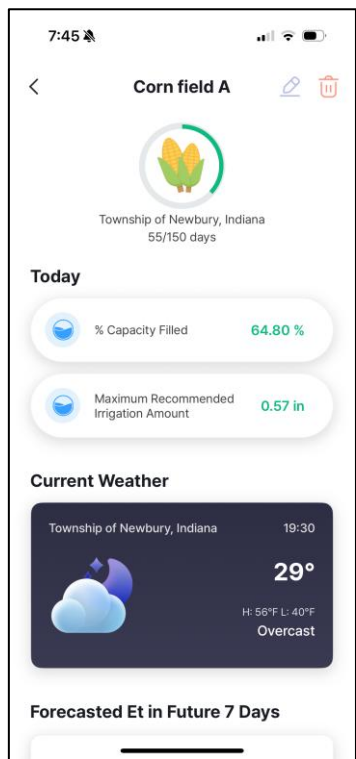


MSU Irrigation Scheduler APP - Operation



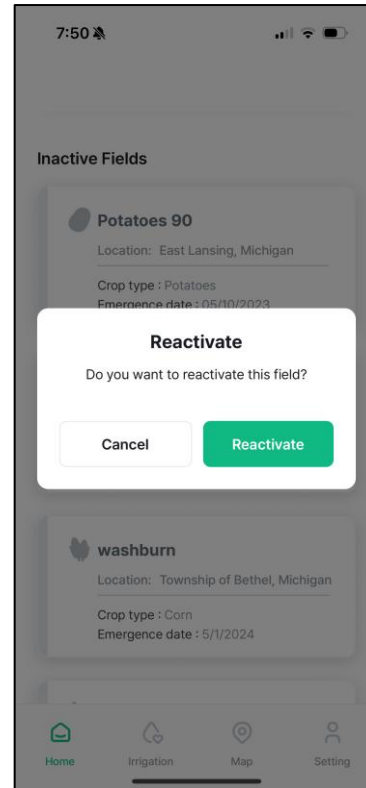
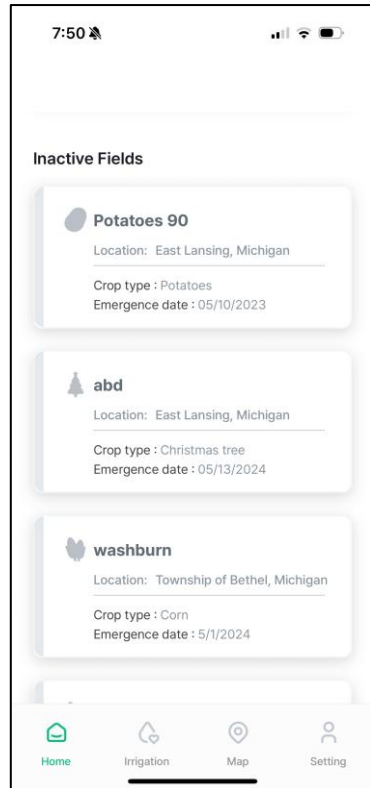


MSU Irrigation Scheduler APP - Operation



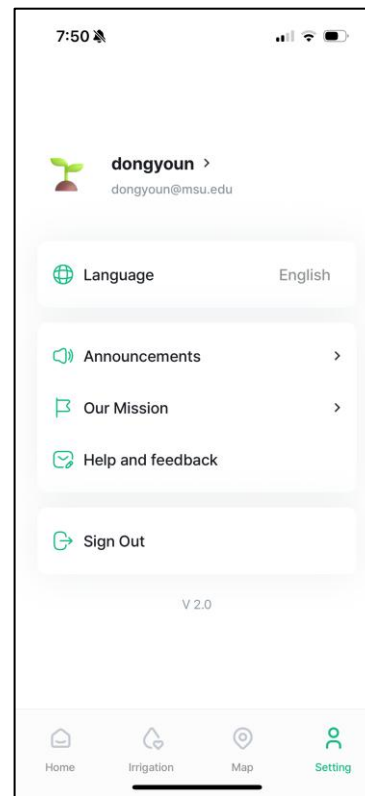
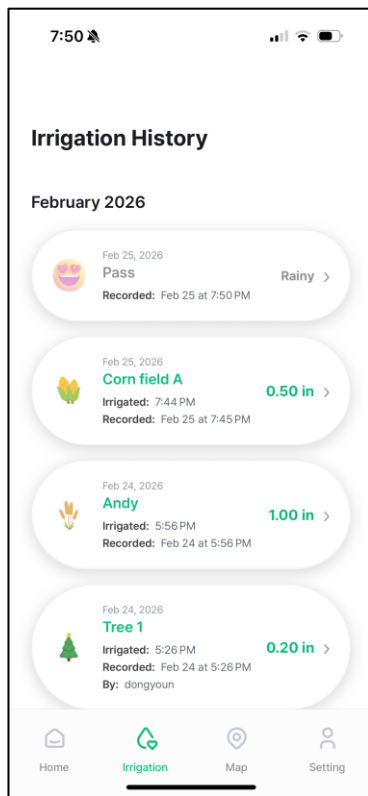


MSU Irrigation Scheduler APP – Previous fields





MSU Irrigation Scheduler APP

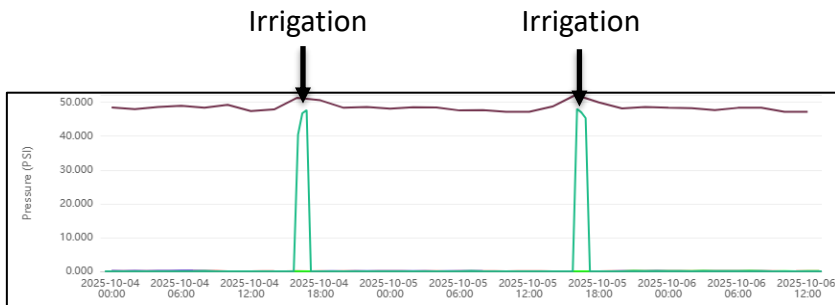


MSU Irrigation Scheduler APP

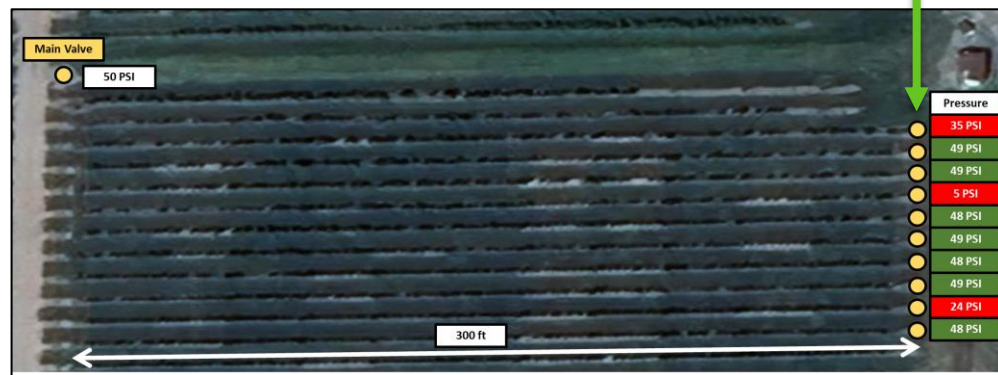


Irrigation System Monitoring

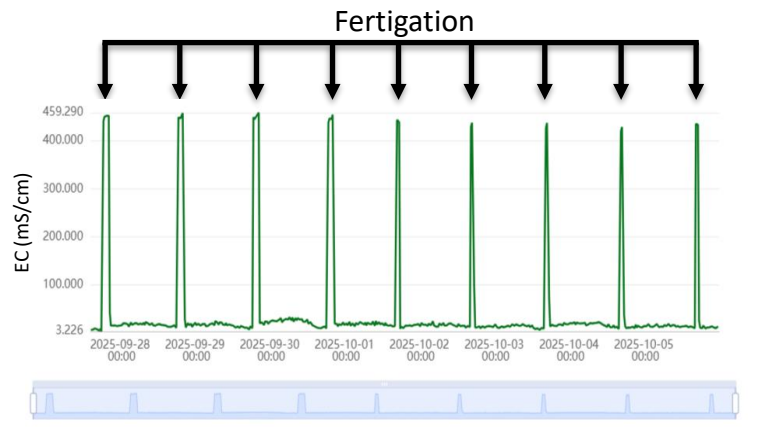
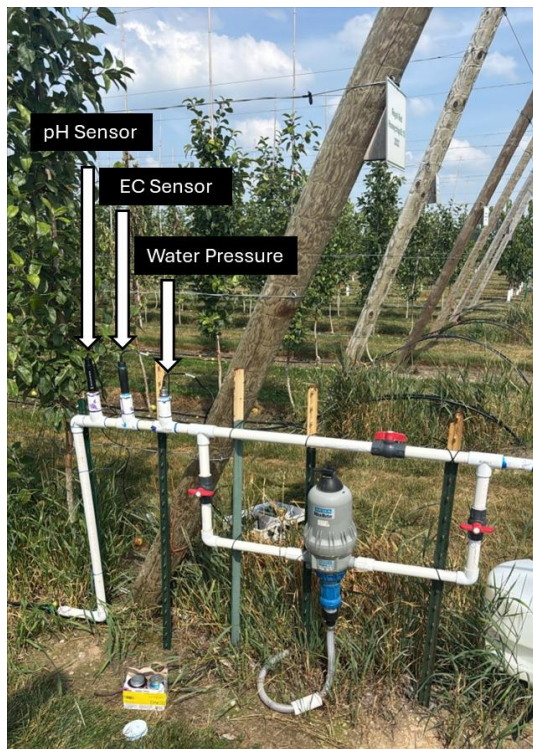
- Operation status.
- Detect under- or over- water pressure.
 - Under-pressure; leaks, pump malfunction.
 - Over-pressure; faulty or clogged or missing pressure regulator.



Cloud website for real-time remote monitoring

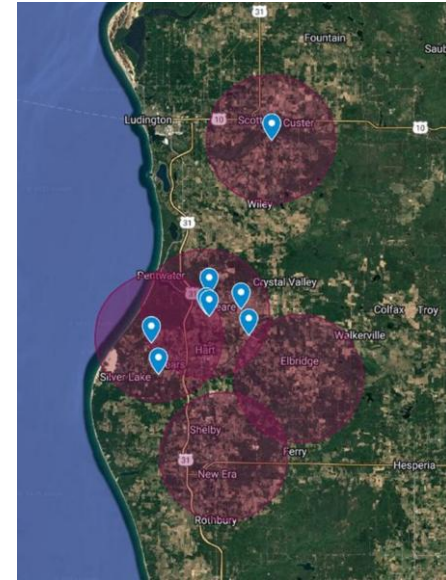


Fertigation Monitoring



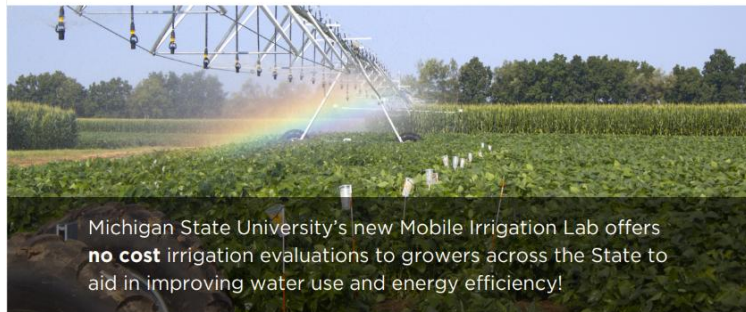
Sensor Communication Methods

Pros and cons?



The Mobile Irrigation Lab is rolling out for 2026!

MSU MOBILE IRRIGATION LAB



Michigan State University's new Mobile Irrigation Lab offers **no cost** irrigation evaluations to growers across the State to aid in improving water use and energy efficiency!



NO COST EVALUATION
FOR CENTER PIVOT
IRRIGATION SYSTEMS



COST-SHARE FUNDS
AVAILABLE FOR
IRRIGATION SYSTEM
RETROFITS

WHAT TO EXPECT FROM THE MOBILE IRRIGATION LAB:

- Evaluation of center pivot system including uniformity, pressure, and flow rate test
- Management plan to repair and/or upgrade the current irrigation system
- Estimated water and energy cost savings
- Customized irrigation scheduling guide

Contact: **Riley Johnson** rouseril@msu.edu 517-432-8751

MI Ag Ideas to Grow With

March 5 – Water Day

Time	Speaker	Title
9:00 -9:50	Kevin Greer, Tehama County RCD's Mobile Irrigation Lab	Considerations and practical tips when starting, operating, and sustaining a Mobile Irrigation Lab program
10:00 -10:50	Jon LaPorte, Lyndon Kelley and Brenden Kelley, MSU Extension	Why we need irrigation?
11:00 -11:50	Angie Gradiz- MSUE Irrigation Efficiency Dr. Abia Katimbo, UNL	What can we learn from Nebraska's irrigation- focused extension and outreach programs in supporting improved water use efficiency on farms and regional water conservation?
12:00 – 12:50	Dr. Keith Cherkauer, Purdue ABE/ Indiana Water Resource Center Michigan Farm Bureau	Understanding the competition for water and how it may change water policy Overview of Riparian Rights and the impact on regional water policy
1:00 – 1:50	Lena Pappas- EGLE Todd Feenstra- Midwest Water Stewards	Michigan Large Volume Water Use: Site Specific Review and Water Users Committee
2:00 – 2:50	Brenden Kelley and Ben Philips, MSU Extension	Rolling out a new type of irrigation

CEU CCA's credits
Crop Management: 1
Soil&Water Management: 5

Register for free:



Do you want to learn more?

MICHIGAN STATE
UNIVERSITY Extension

For additional information, visit extension.msu.edu

Utilizing Soil Moisture Sensors for Efficient Irrigation Management

Angie Gradiz¹ and Younsuk Dong^{1,2}

¹Michigan State University Extension

²Biosystems and Agricultural Engineering Department, Michigan State University

Effective irrigation management is essential for sustainable agriculture and improving yields, water efficiency, and returns on investment. Advanced technologies such as soil moisture sensors help inform irrigation decisions by measuring soil water content so that the right amount of water is applied at the right time. Choosing the right sensor depends on factors like cost, reliability, durability, and ease of use. This fact sheet outlines key types of soil moisture sensors, costs, and best-use recommendations.

Soil water content basics

Soil moisture sensors provide indirect measurements of soil water content, typically through volumetric water content (θ_v) or matric potential (ψ_m). Volumetric water content represents the ratio of water volume to the total volume of soil, while matric potential indicates the pressure a plant must exert to extract water from the soil. Key soil moisture terms include **saturation**, where the soil pores are saturated with water, **field capacity (FC)**, the maximum amount of water retained in the soil after drainage, and **permanent wilting point (PWP)**, where plants can no longer extract water. The difference between field capacity and the wilting point is **available water (AW)**, and **maximum allowable depletion (MAD)** refers to

the portion of available water that can be depleted without causing stress to the plants, which varies depending on the crop. For further details, please refer to the article "[Basics of Irrigation Scheduling](#)".

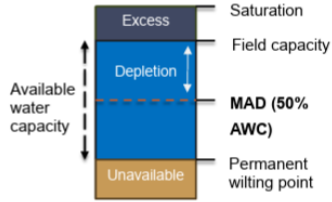


Figure 1. Soil water storage concepts.

Types of soil moisture sensors

As you evaluate different types of soil moisture sensors, it is essential to determine which option best aligns with your specific needs and objectives. Table 1 summarizes the various sensor types and associated costs. This table is adapted from the works of Sample et al. (2016) and Peters et al. (2013).



SCAN ME

New monthly water use digest!



MICHIGAN STATE University

Extension News | Water Use & Irrigation Digest



Join here:



<https://lp.constantcontactpages.com/sl/1dAwbyl/irrigationdiges>

f



Thank you

Younsuk Dong, Ph.D

Assistant Professor

Department of Biosystems & Agricultural Engineering

Michigan State University

dongyoun@msu.edu

