MICHIGAN STATE UNIVERSITY | Extension

MICHIGAN STATE Irrigation Lab

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

NORTH CENTRAL SARE Sustainable Agriculture Research & Education

Michigan Department of AGRICULTURE & Rural Development

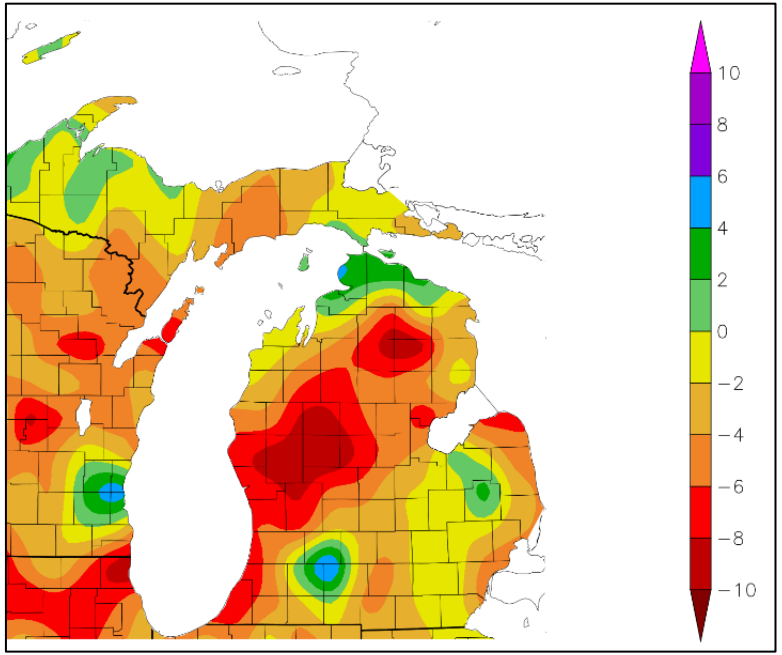
MICHIGAN CHRISTMAS TREE ASSOCIATION

KORSON'S Tree Farms

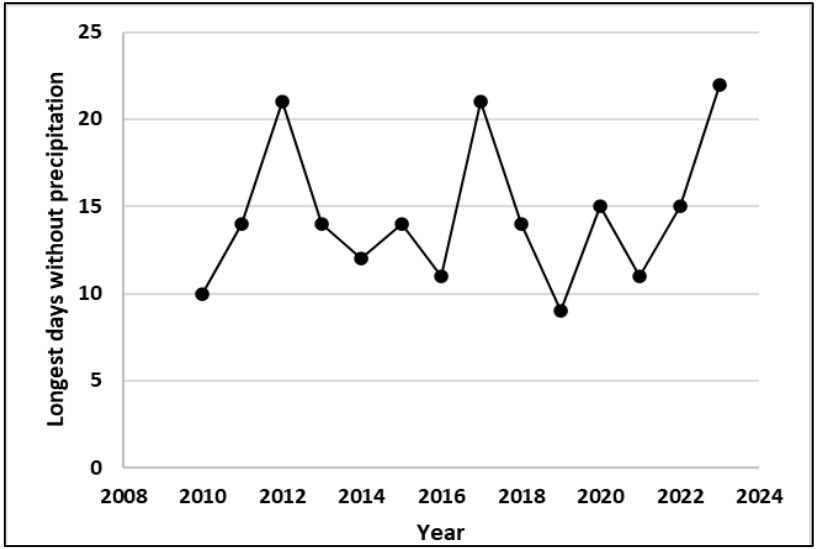
DUTCHMAN TREE FARMS

BADGER Evergreen Nursery, L.L.C.

Impacts of Changing Weather Patterns in Michigan



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

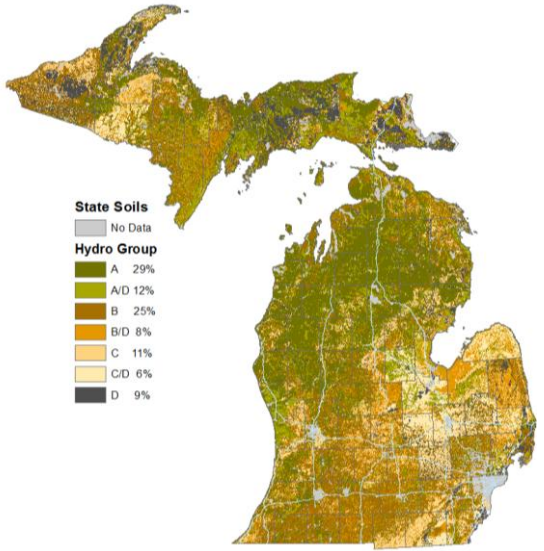


Longest period without precipitation during the growing season (May - September).
Most seasons require irrigation to prevent yield loss.

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.*

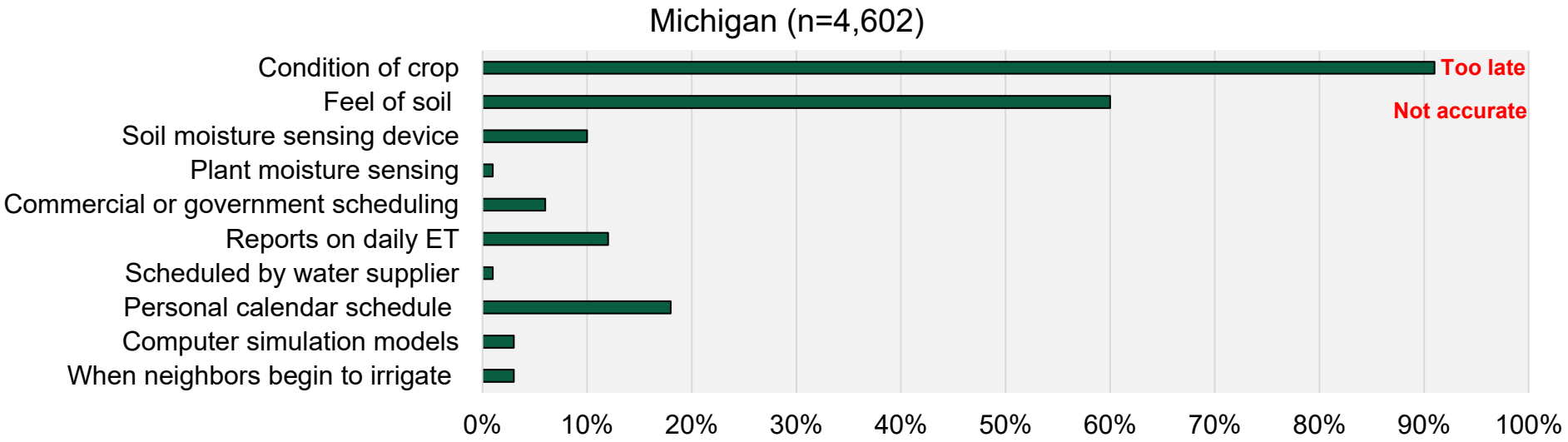
Left: Drought killed tree seedling (photo credit: Bill Lindberg)
Right: *Phytophtora root rot* (photo credit: Gary Chastagner)



USDA Hydrological Soil Map

How do we manage Irrigation?

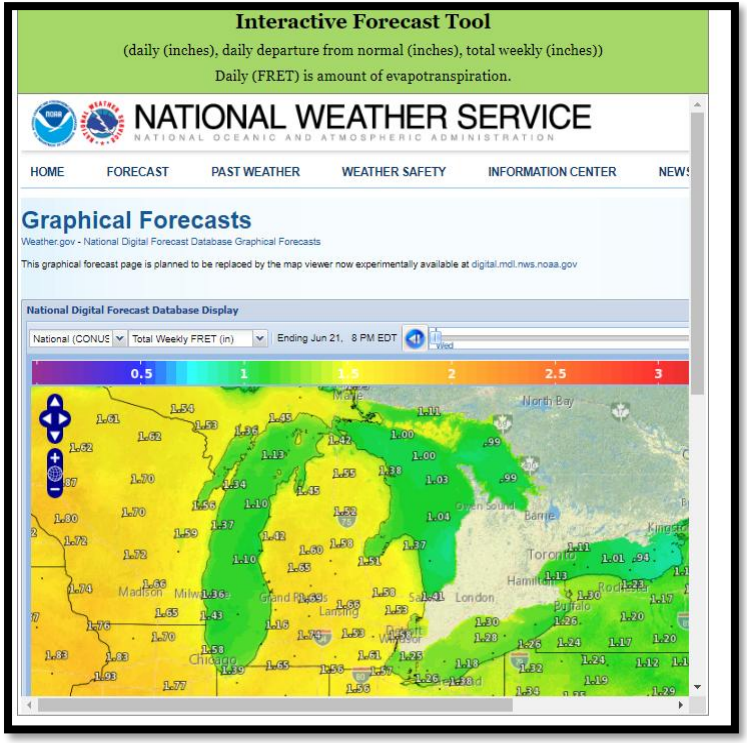
ACCORDING TO THE 2023 IRRIGATION AND WATER MANAGEMENT SURVEY



Only ~33% rely on data-driven methods

https://www.nass.usda.gov/Publications/AgCensus/2022/Online_Resources/Farm_and_Ranch_Irrigation_Survey/index.php

Irrigation Scheduling Methods



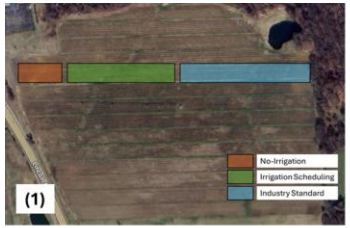
Ongoing Christmas Tree Irrigation Project

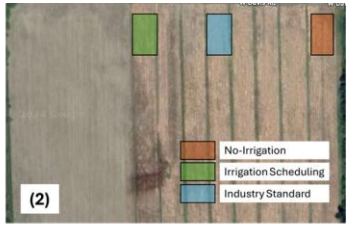
Treatments

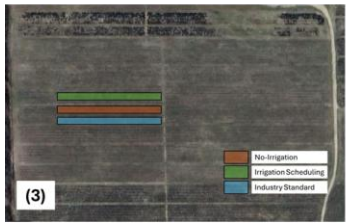
1. Rainfed
2. Grower's Standard
   (e.g., rule of thumb, 1-inch per week)
3. ET-based Irrigation Scheduling

Monitoring

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







Ongoing Christmas Tree Irrigation Project

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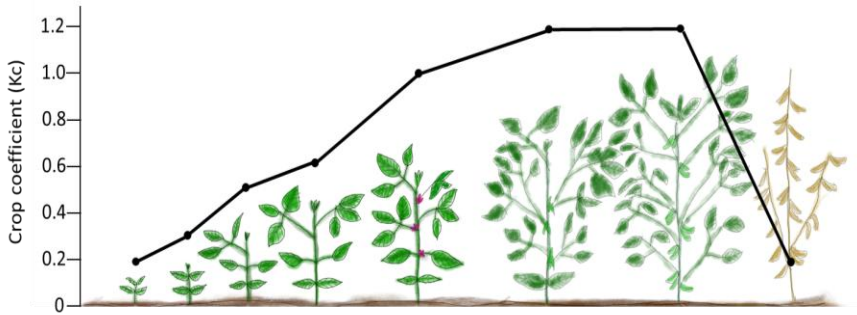
   (e.g., rule of thumb, 1-inch per week)
3. ET-based Irrigation Scheduling

$$ET_C = K_C * rPET$$

Where,
ET_C = Crop Evapotranspiration (in/day)
$rPET$ = Reference Potential Evapotranspiration (in/day)
K_C = Crop Coefficient (unitless multiplier)

Monitoring

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



Ongoing Christmas Tree Irrigation Project

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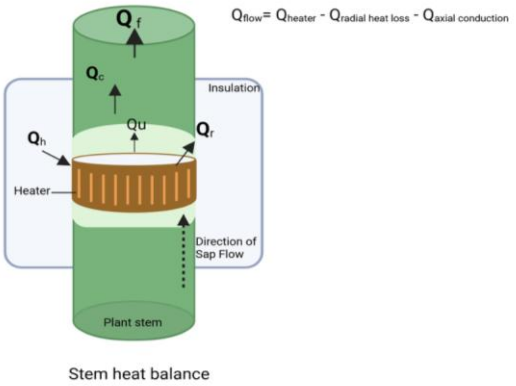

Stem heat balance

Monitoring

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

Ongoing Christmas Tree Irrigation Project

Treatments

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Monitoring

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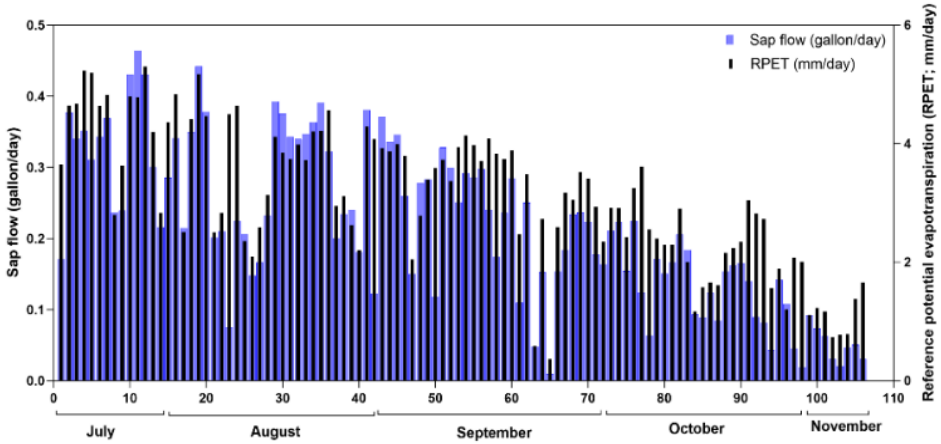
2. Weather
3. Growth and survivability

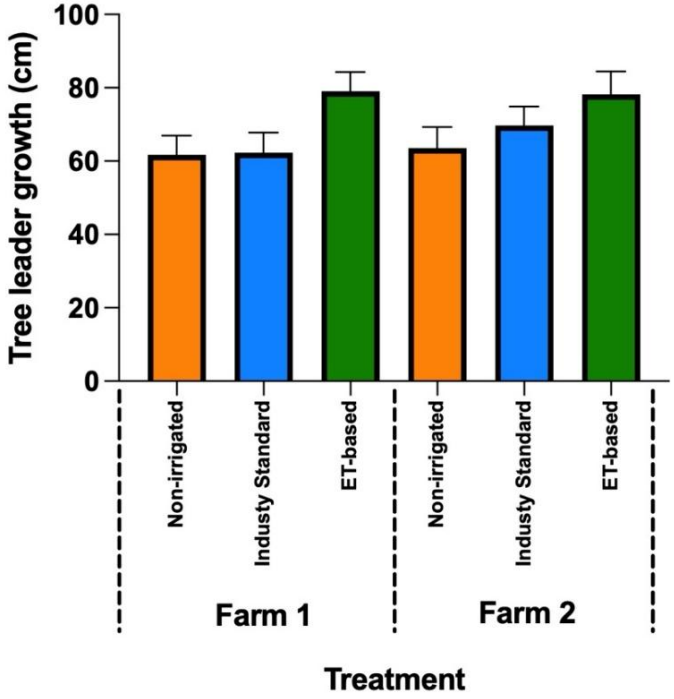


Month	Average SAP Flow (gal/tree/day)
Jul	0.33
Aug	0.27
Sep	0.22
Oct	0.13
Nov	0.05

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:

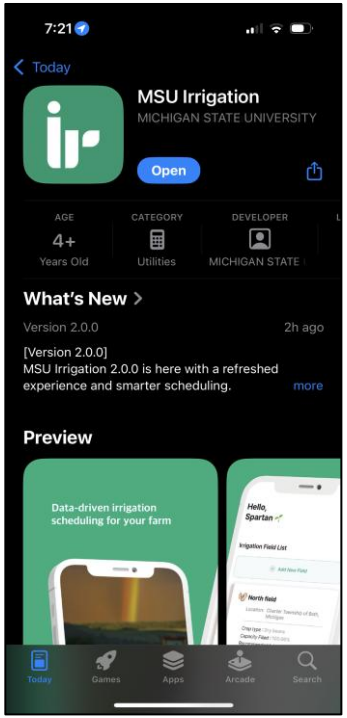
- Soil moisture levels
- Survivability
- Trunk diameter
- Leaf nutrient content

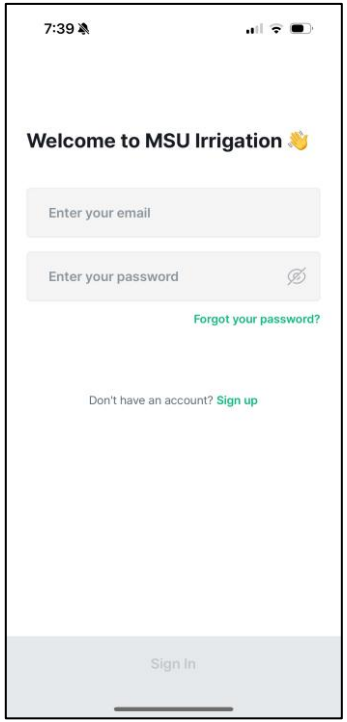
MSU Irrigation Scheduler APP V 2.0

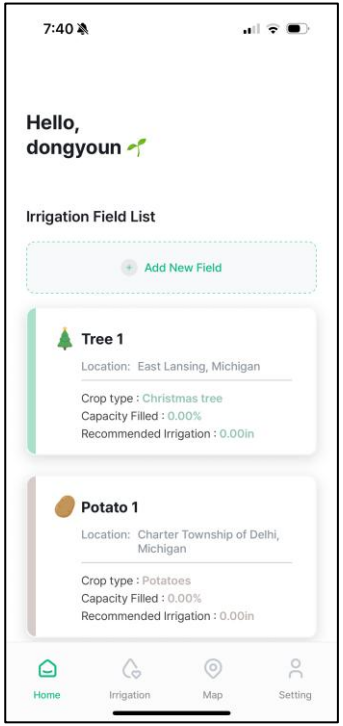
Download on the App Store

ANDROID APP ON Google play

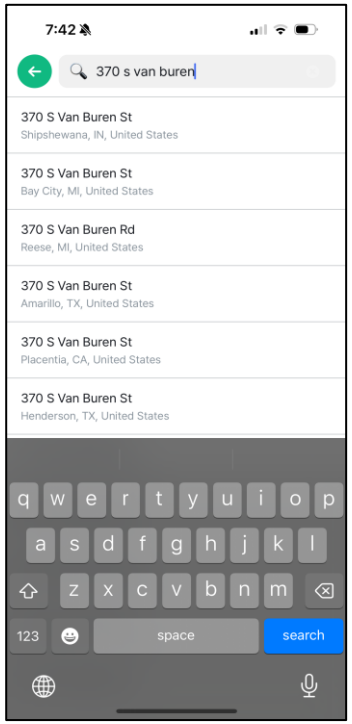
Coming Soon

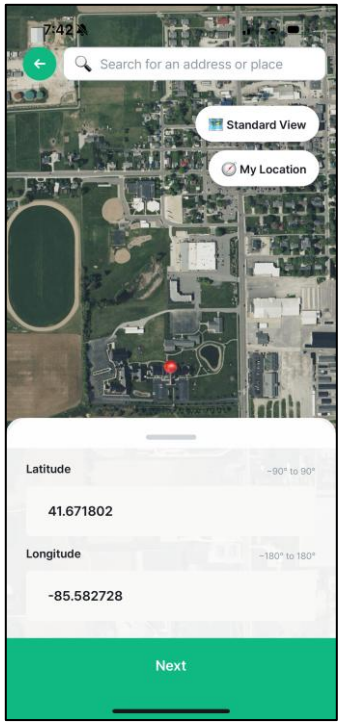


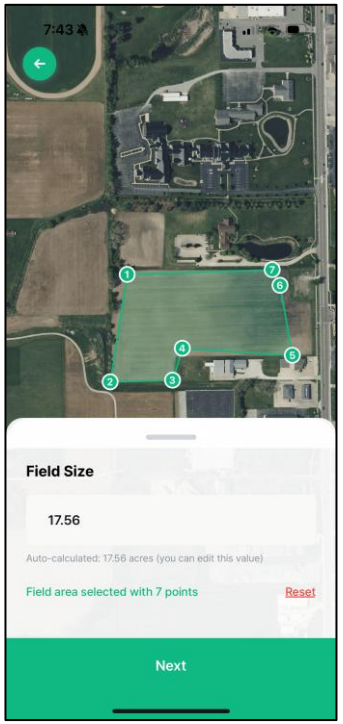


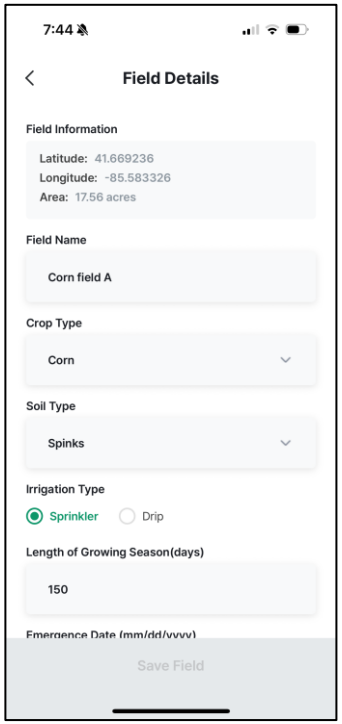


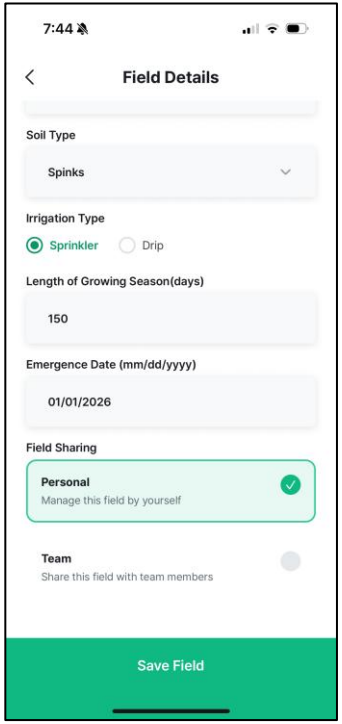
MSU Irrigation Scheduler APP - Setup



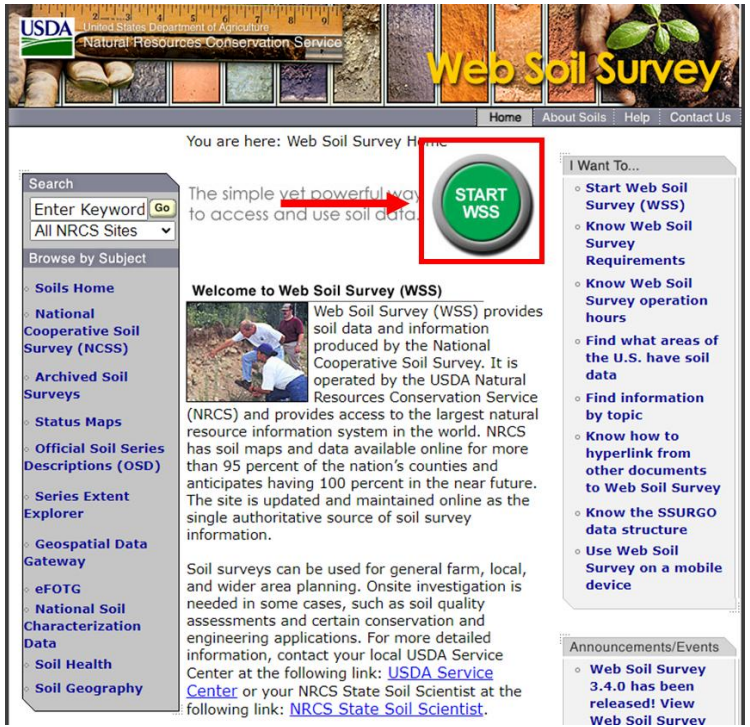








USDA Web Soil Survey



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

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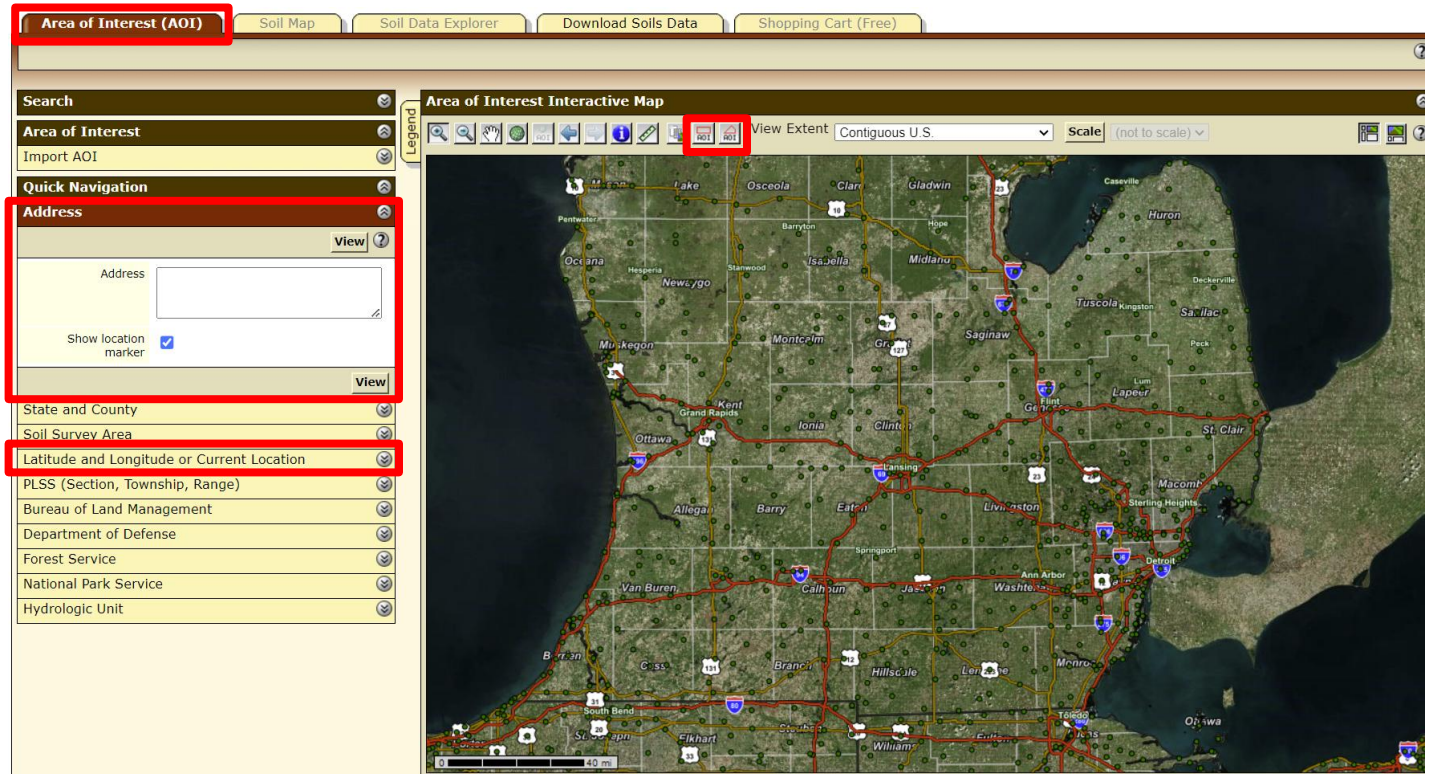

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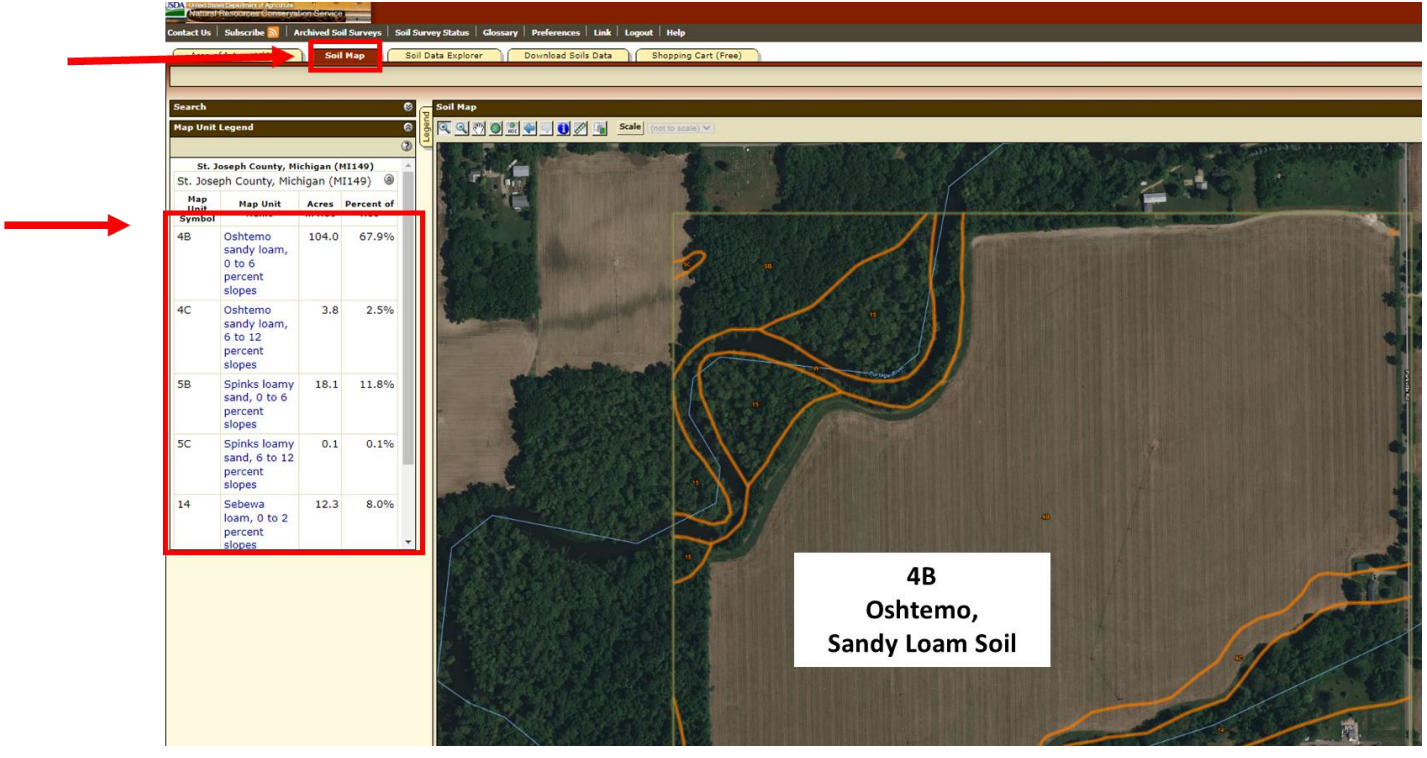

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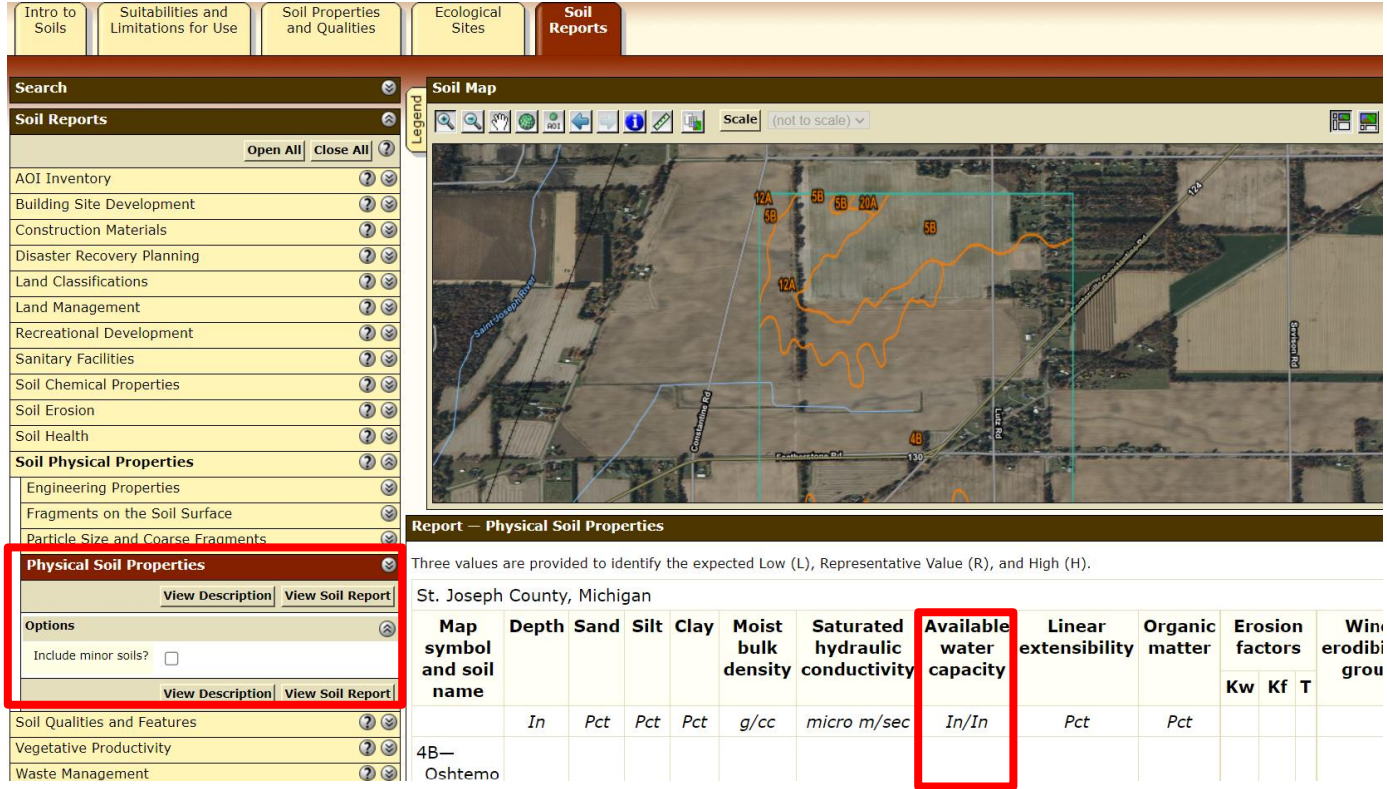
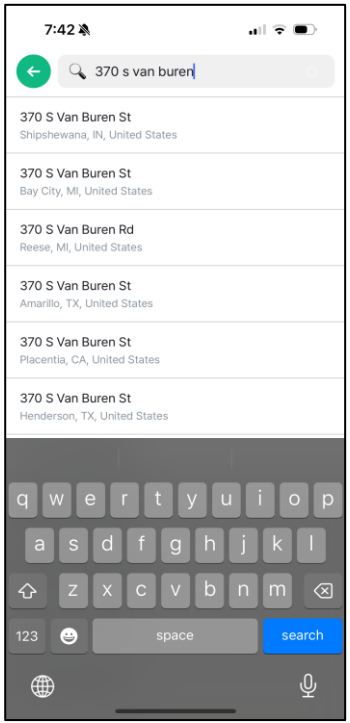
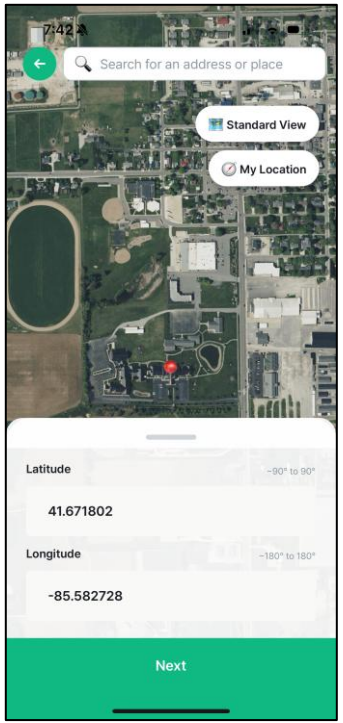
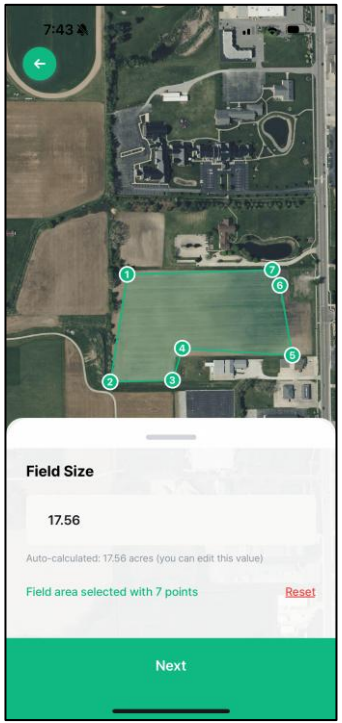
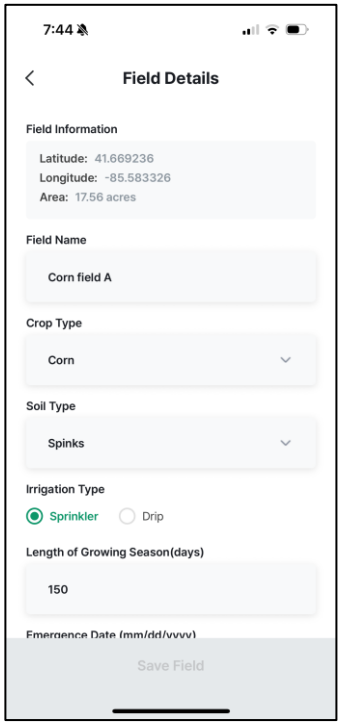


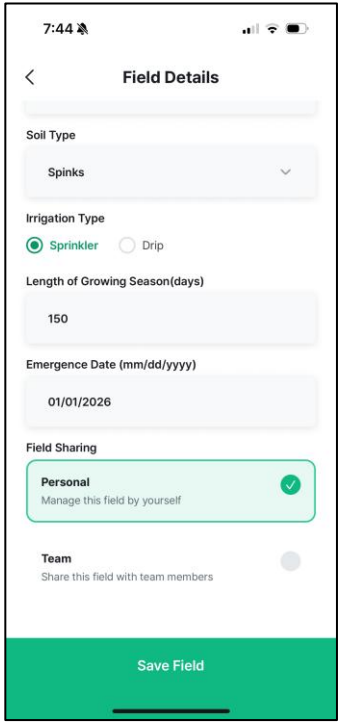
MSU Irrigation Scheduler APP - Setup



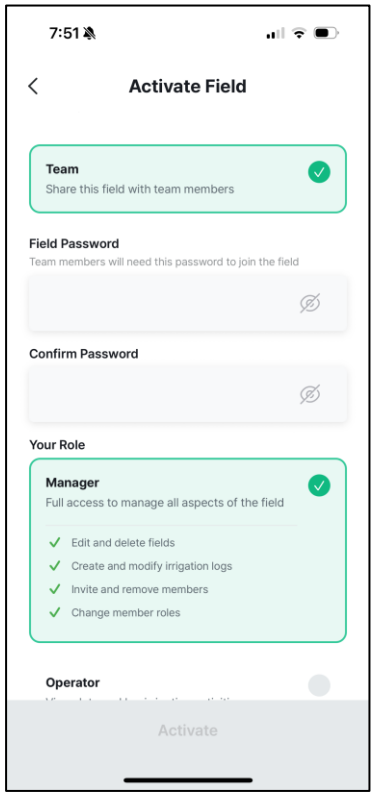


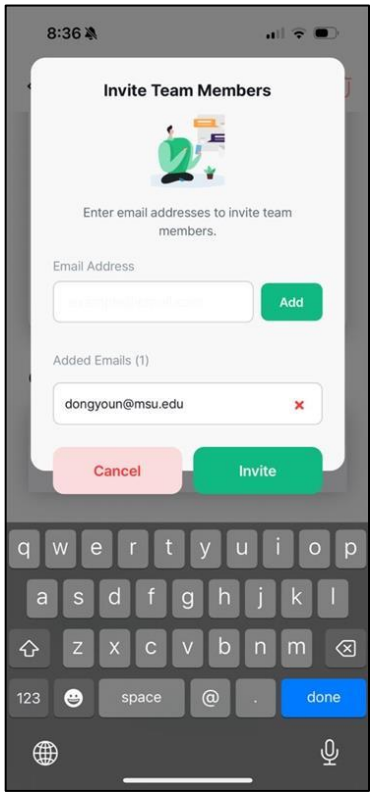


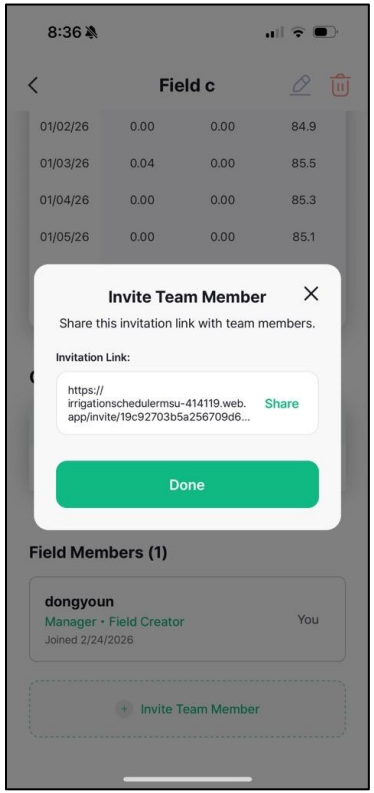


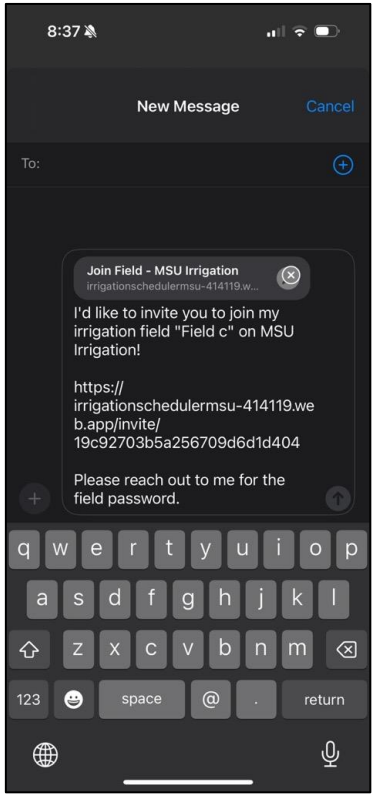


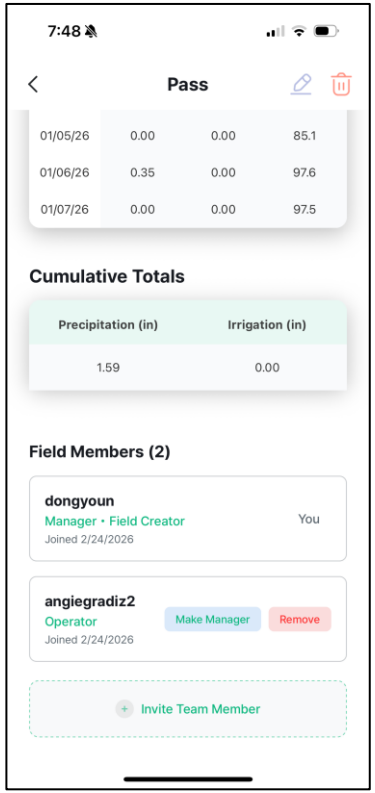
MSU Irrigation Scheduler APP – Team sharing



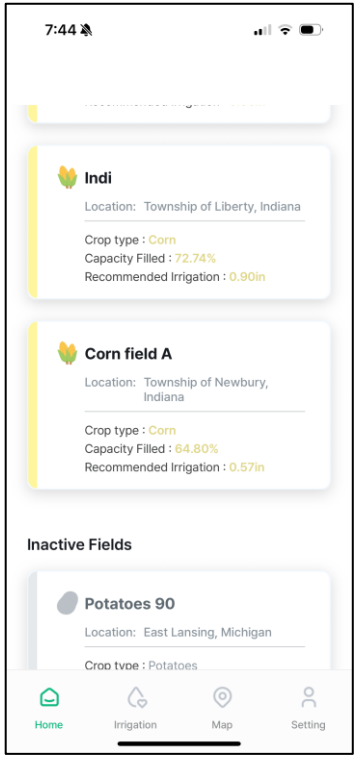


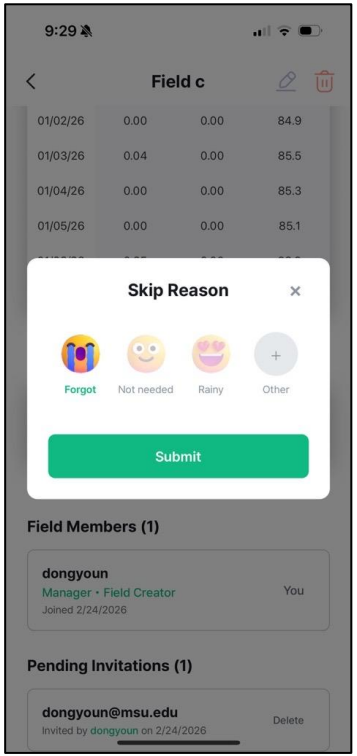




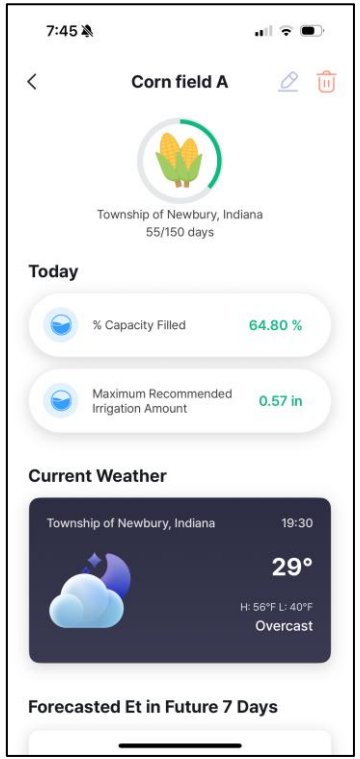


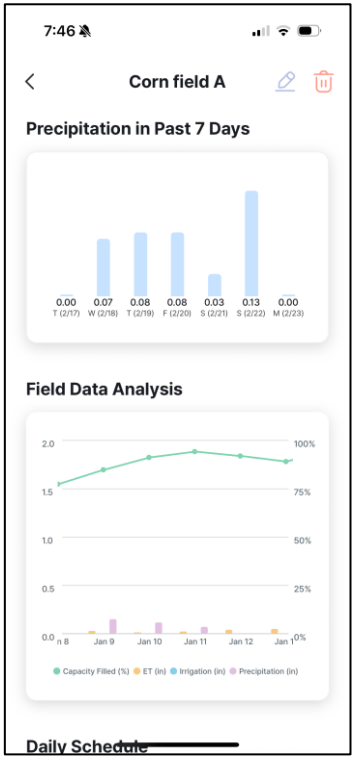
MSU Irrigation Scheduler APP - Operation

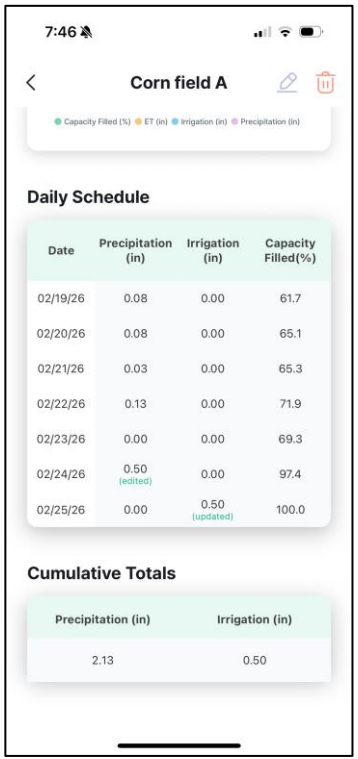




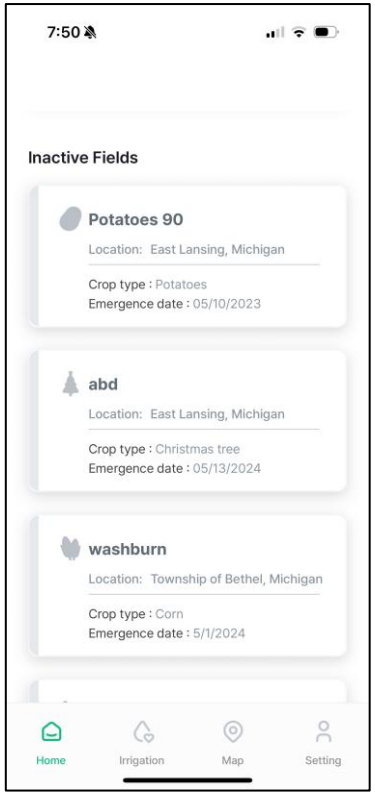
MSU Irrigation Scheduler APP - Operation

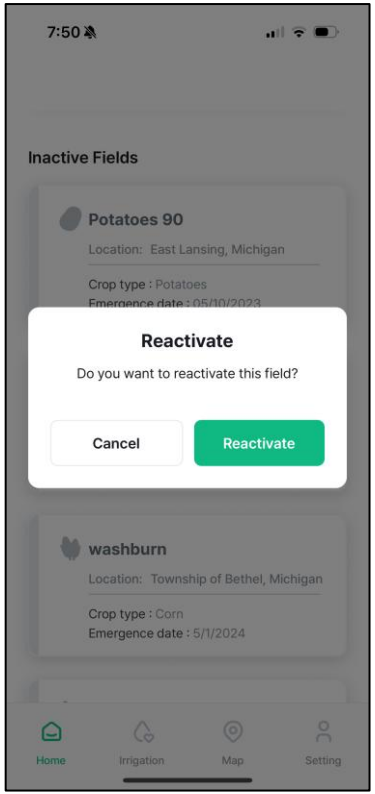




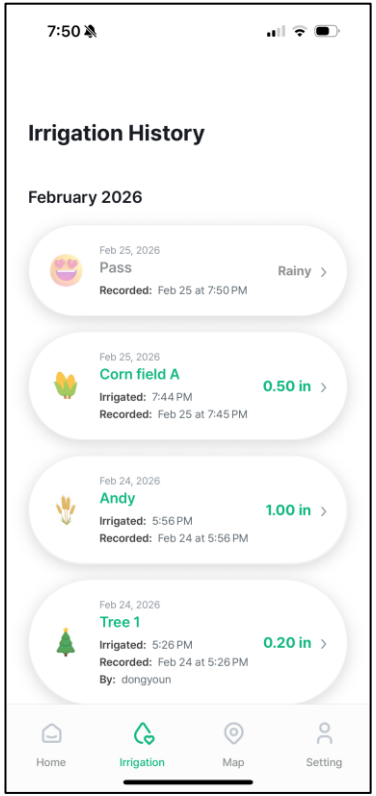


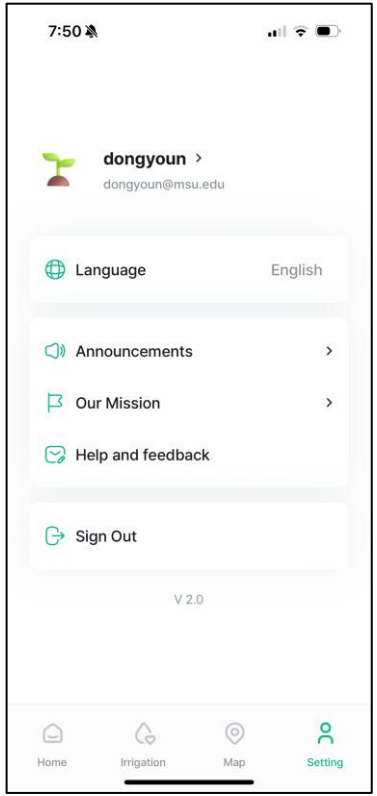
MSU Irrigation Scheduler APP – Previous fields





MSU Irrigation Scheduler APP

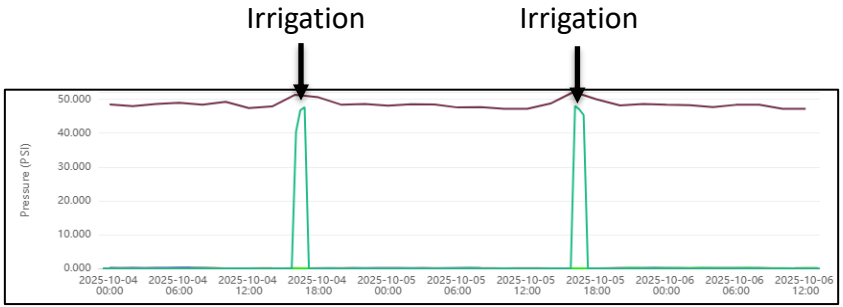




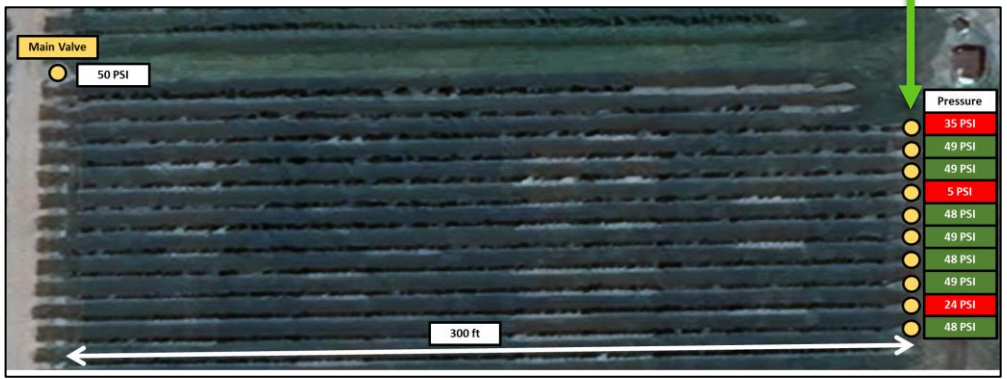
MSU Irrigation Scheduler APP

Irrigation System Monitoring

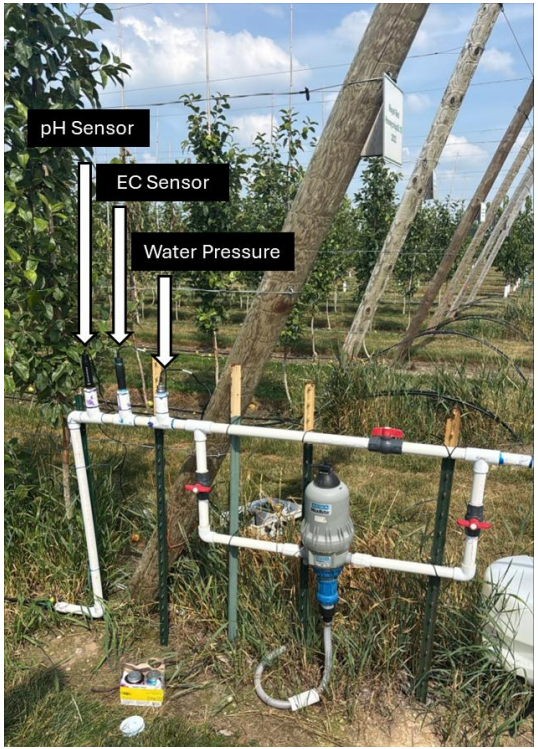
- Operation status.
- Detect under- or over- water pressure.
  - Under-pressure; leaks, pump malfunction.
  - Over-pressure; faulty or clogged or missing pressure regulator.

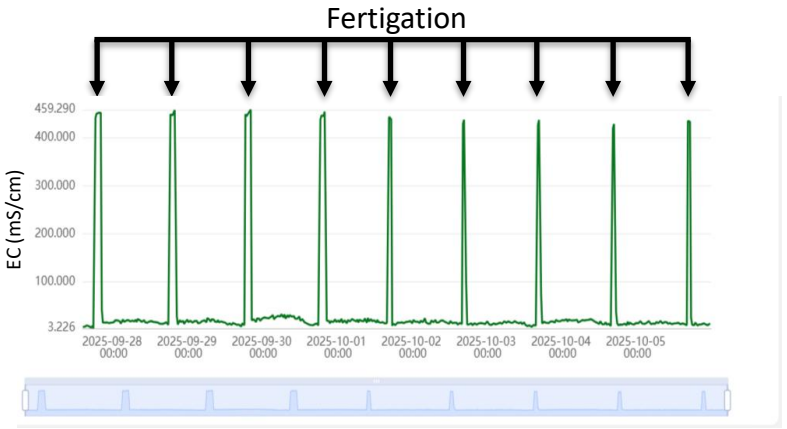


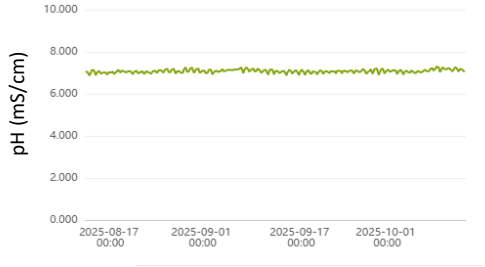
Cloud website for real-time remote monitoring



Fertigation Monitoring

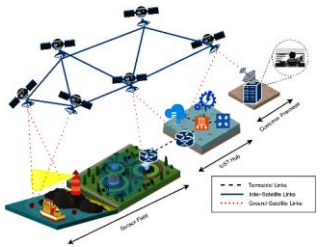


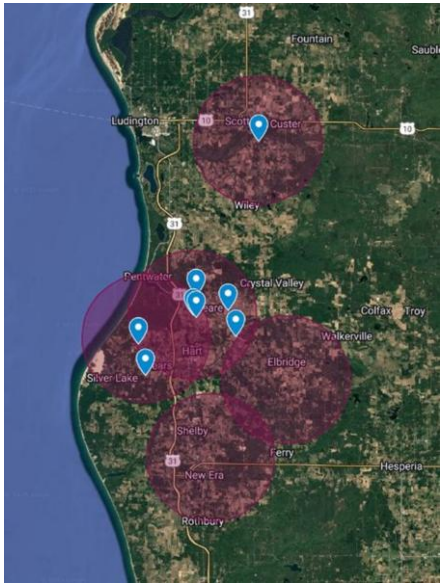




Sensor Communication Methods

Pros and cons?





The **Mobile Irrigation Lab** is rolling out for 2026!

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:

https://www.canr.msu.edu/miagideas/

Do you want to learn more?

Utilizing Soil Moisture Sensors for Efficient Irrigation Management

Angie Gradiz[1] and Younsuk Dong[1,2]
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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".

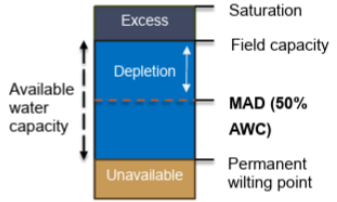

Figure 1. Soil water storage concepts.

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).

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Thank you

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