

Irrigation Scheduling Workshop

2/20/2026

Practice worksheet:

AWHC of soil (from Web Soil Survey): _____

Crop Selected: _____

Total Available Water: _____

MAD: _____ inches

2025 Time Period selected: _____

Day	Date	ET (from CoAgMet	Rainfall	Irrigation event depth	Deficit (inches)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					



Soil Water Terminology

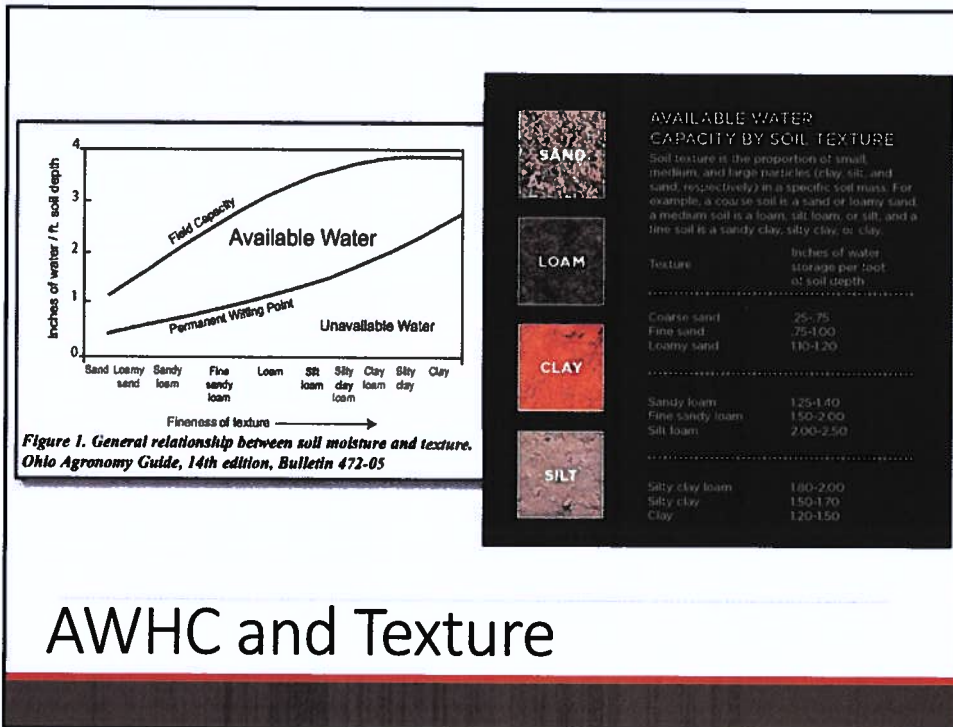
Saturation Water: is the soil water content where all soil pores are filled (Saturation) and is the water that readily percolates or drains out from the root zone by gravity

Field Capacity (FC): is the amount of water that remains in the soil after all the Saturation Water. Reached in roughly 24 hours in sandy soil, and up to 3 days in heavier (higher clay and organic matter). (Measured in the lab at 0.1 to 0.33 bars)

“Permanent Wilting Point” (PWP): When plants take up all the **Available Water** for a given soil, soil cannot supply any water to keep plants from dying. (Lab measure is at -15 bars)

Available Water Holding Capacity (AWHC or AWC): is the water held between field capacity and permanent wilting point.

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AWHC and Texture

The Benefits of Higher Organic Matter

- According to most research, a 0.1% increase in organic matter typically results in a roughly 0.15% increase in available water in soils
- 1% increase in organic matter, you can expect around a 1.5% increase in available water capacity in the soil. <https://csanr.wsu.edu/outline-numbers-to-the-difficult-task-of-increasing-soil-organic-matter/>
- Every 1% increase in organic matter results in as much as 25,000 gallons of available soil water per acre.
- Each pound of soil organic matter (SOM) can hold up to 18 to 20 pounds of water and 1% of SOM can hold up to 1 inch of water in the soil. <https://csanr.wsu.edu/outline-numbers-to-the-difficult-task-of-increasing-soil-organic-matter/>

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Web Soil Survey (WSS)

<https://websoilsurvey.nrcs.usda.gov/app/>

The screenshot shows the Web Soil Survey (WSS) homepage. At the top, there's a navigation bar with 'Home', 'About WSS', 'Help', and 'Contact Us'. Below that, a search bar is visible with the text 'Enter Keyword' and a 'Go' button. A dropdown menu shows 'All NCRS Sites'. To the right of the search bar is a 'START WSS' button. The main content area is titled 'Welcome to Web Soil Survey (WSS)' and includes a paragraph describing the service: '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 50 years of the nation's history.' To the right of this text is 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', and 'Know how to hyperlink from'.

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Calculating Available Water for a given crop

$AW = \text{Root Depth (inches)} \times \text{AWHC (in/in)}$

AWHC was just explored through Web Soil Survey

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Management Allowed Deficit-MAD

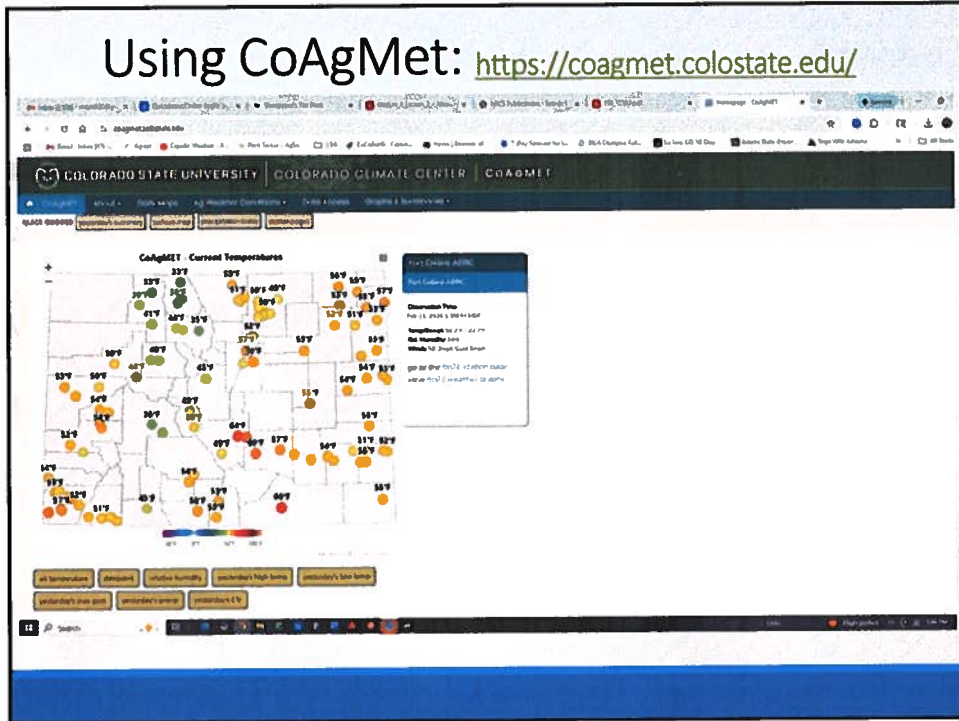
- MAD = The portion of the water that a crop plant can extract from the soil without causing more than acceptable harm (Yield and/or Quality)
- MAD depends on: Soil type, Crop, Stage of growth

Available Water(AW) = AVAILABLE WATER CAPACITY x ROOTING DEPTH

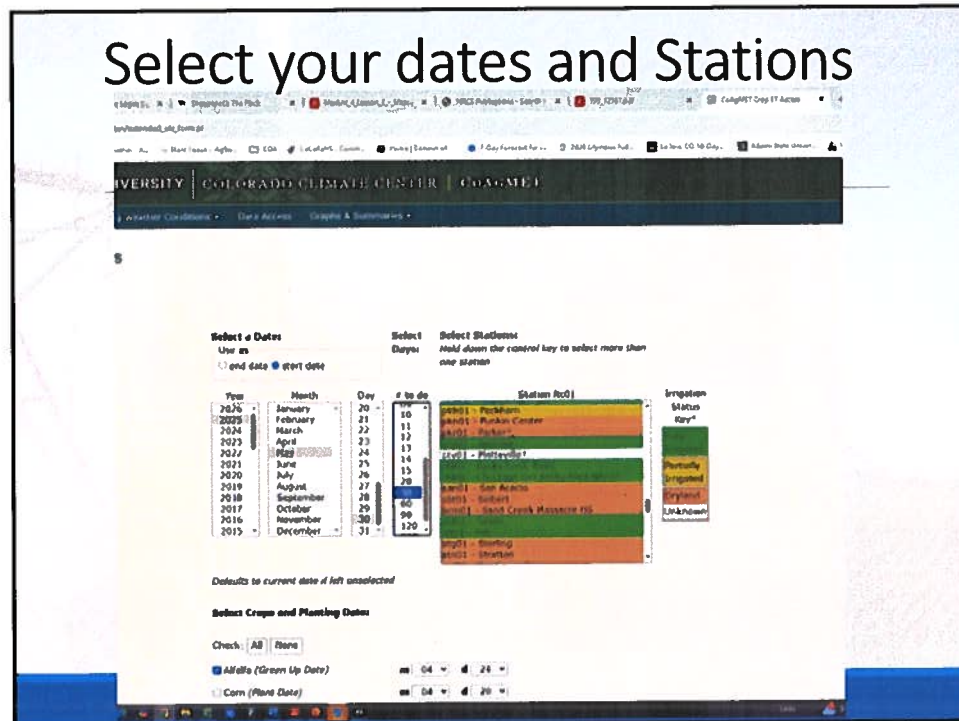
MAD = % allowable deficit x AW

- Alfalfa: 50%
- Potatoes and vegetable crops: 25-35%
- Small grains: Early boot to flag: 50%, flag to early fill: 40%, Late: 60%
- Sorghum, Millet, Sorghum Sudan and C4 Grasses: 50-60%
- Corn: 50% except 40% during tasseling
- Soybeans, Dry Beans: 40 to 50% except 35-40% during flowering
- Irrigated pasture: 50-60%

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Select your crops and enter plant and green-up dates

Select Crops and Planting Date:

Check: All None

<input checked="" type="checkbox"/> Alfalfa (Green Up Date)	m: 04 d: 24
<input type="checkbox"/> Corn (Plant Date)	m: 04 d: 20
<input type="checkbox"/> Drybeans (Plant Date)	m: 05 d: 31
<input checked="" type="checkbox"/> GrassHay (Green Up Date)	m: 04 d: 15
<input checked="" type="checkbox"/> Smallgrn (Plant Date)	m: 04 d: 06
<input type="checkbox"/> Sgrbeets (Plant Date)	m: 04 d: 08
<input type="checkbox"/> Potatoes (Plant Date)	m: 06 d: 03
<input type="checkbox"/> Onion/ed (Plant Date)	m: 03 d: 22
<input type="checkbox"/> WntzWheat (Green Up Date)	m: 03 d: 01
<input type="checkbox"/> Tomato (Plant Date)	m: 05 d: 15
<input type="checkbox"/> Peach (Green Up Date)	m: 04 d: 01
<input type="checkbox"/> Apple (Green Up Date)	m: 04 d: 10
<input type="checkbox"/> Cherry (Green Up Date)	m: 04 d: 03
<input type="checkbox"/> Grape (Green Up Date)	m: 05 d: 01
<input type="checkbox"/> Cool Season Turf	

Reference ET Model:

Penman-Kimberly

ASCE Standardized Daily

ASCE Standardized Hourly

Format

Web page (HTML)

Comma-Separated Values (CSV)

The crop coefficients used to generate crop ET reports were developed for the Penman-Kimberly model. Selection of another model is only

Submit Reset

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Crop Growth Stage

Built in to CoAgMet somewhat = "Crop Coefficients"

Field verification involves estimating the percent cover

Percent cover X Potential ET = Actual ET for that growth stage

Many crops, particularly corn, beans, and small grains DO NOT LIKE early overwatering!

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What factors affect ET

1. Solar Radiation: Energy from the sun
2. Temperature
3. Wind
4. Humidity
5. Crop
6. Stage of Growth: Crop Coefficients
7. Soil moisture and salinity
8. Stand density, plant nutrition, crop variety etc.

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Adjustments

Hot and Windy—Use Max ET numbers

Cloudy afternoon: Use 2/3 of Max ET

Cloudy all day: Use ½ of Max ET

But remember you can always get info off the web for ET from CoAgMet stations

And always check you soils: Auger, shovel, sensors

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Verifying Moisture

- Shovel, Auger, field check
 - Using the "Feel Method"
- Moisture Sensors
 - Tensiometers or Gypsum Blocks
 - Capacitance probes
 - Autonomous Pivot

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	Clayey Texture - Fine Sand and Loamy Fine Sand	Moderately Coarse Texture - Sandy Loam and Fine Sandy Loam	Medium Texture - Sandy Clay Loam, Loam and Silty Loam	Fine Texture - Clay, Clay Loam, or Silty Clay Loam
Available Water Capacity (inches/foot)				
	0.6-1.2	1.3-1.7	1.5-2.1	1.6-2.4
Available Soil Moisture Percent	Soil Moisture Deficit (SMD) in inches per foot when the feel and appearance of the soil are as described			
0-25	Dry. Loose, will hold together if not disturbed, loose sand grains on fingers with applied pressure. SMD 12-05	Dry. Forms a very weak ball; aggregates fall apart readily from ball. SMD 17-10	Dry, soil aggregates break apart readily, no moisture sticking on fingers; clods crumble with applied pressure. SMD 21-11	Dry, soil aggregates easily separate, clods are hard to crumble with applied pressure. SMD 24-12
25-50	Slightly moist, forms a very weak ball with well-defined finger marks, light coating of loose and aggregated sand grains visible on fingers. SMD 09-03	Slightly moist, forms a weak ball with defined finger marks, darkened sides, no water sticking on fingers, grain break sharp. SMD 13-07	Slightly moist, forms a weak ball with slight coating on fingers, few aggregates of soil grains break sharp. SMD 16-08	Slightly moist, forms a weak ball, very few soil aggregates form with applied pressure. SMD 18-08
50-75	Moist, forms a weak ball with loose and aggregated sand grains on fingers, darkened sides, moderate to wet sticking on fingers, will not stick. SMD 06-02	Moist, forms a ball with defined finger marks, very light coating of water sticking on fingers, darkened color, will not stick. SMD 09-03	Moist, forms a ball, very light water sticking on fingers, darkened sides, plastic, forms a weak ribbon between thumb and forefinger. SMD 11-04	Moist, forms a smooth ball with defined finger marks, light soil water sticking on fingers, ribbon between thumb and forefinger. SMD 12-04
75-100	Wet, forms a weak ball, loose and aggregated sand grains on fingers, wet coating on fingers, will not ribbon. SMD 03-00	Wet, forms a ball with wet soil that is on hand, light to moderate water sticking on fingers, makes a weak ribbon between thumb and forefinger. SMD 04-00	Wet, forms a ball with well-defined finger marks, light to heavy soil water coating on fingers, ribbon between thumb and forefinger. SMD 05-00	Wet, forms a ball, more moisture to heavy soil water coating on fingers, ribbon only between thumb and forefinger. SMD 06-00
Field Capacity (100 percent)	Wet, forms a weak ball, moderate to heavy soil water coating on fingers, wet coating of soil ball remains on hand. SMD 00-00	Wet, forms a soil ball, free water appears briefly on soil surface after squeezing or shaking, soil surface to be dry soil water coating on fingers. SMD 00-00	Wet, forms a soil ball, free water appears on soil surface after squeezing or shaking, medium to heavy soil water coating on fingers. SMD 00-00	Wet, forms a soil ball, free water appears on soil surface after squeezing or shaking, thick soil water coating on fingers, slick and shiny. SMD 00-00

Feel Method

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Irrigation Scheduling, February 20 2026

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So... where do I check?

At the Start Position

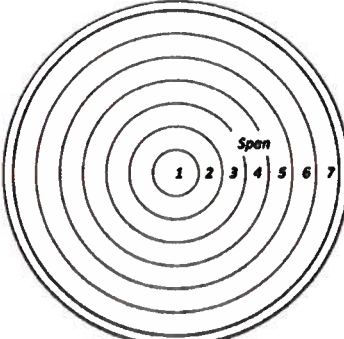
In Front of the sprinkler

If you have concerns, at the stop position

On a sprinkler: Outer 2, maybe 3 spans

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So... where do I check?



Span	Span end, ft	Area within the span, acres	Discharge from span gpm
1	180	2	14
2	360	7	42
3	549	12	71
4	720	16	99
5	900	21	127
6	1080	26	156
7	1269	39	184
O. Hang	1310	9	56
Total		124	750

Figure L-1. Characteristics of a typical center pivot. (Note that 45% of the land area is under the outer two spans while only about 7% of the land is under the first two spans.)

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Irrigation Efficiencies

Defined as the Percent of the water applied in an irrigation that goes to crop evapotranspiration

Sprinklers: 80% to 95%

- Depends on nozzling, height, runoff

Sideroll: 60 to 85%

Surface/Flood: 35% to 60%

Wild Flood/Meadows: Depends on water distribution

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For Sprinklers and Sideroll: Current Percent vs. Depth Chart?

- **Correct Flow?**
 - Design Flow is often NOT the actual
 - Nozzle charts are often based on un-tested flow and pressure
- **Correct Pressure?**
 - Well Problems/declining water will manifest here!!!
 - Pattern problems
 - Biggest impact will be on the outer 2 to 3 spans
- **Center Drive Changes?**
 - Gearbox went out, center drive replaced with something off an old sprinkle or the shelf in the shop?
 - Ground was rented out (carrots and lettuce growers will put in super fast gearboxes)

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On the fly adjustments

1. MEMORIZE THIS!!!

$$Q \text{ (GPM)} T \text{ (hrs)} = 453 A \text{ (acres)} D \text{ (In.)}$$

This is the basis for all percent charts

2. Adjusting for Pressure change:

$$\sqrt{\frac{\text{Pressure}}{\text{New} \div \text{Old}}} * \text{Old Flow (GPM)} = \text{APPROX NEW FLOW}$$

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The Math

$$\sqrt{\frac{\text{Pressure}}{\text{New} \div \text{Old}}} * \text{Old Flow (GPM)} = \text{APPROX NEW FLOW}$$

$$Q \text{ (GPM)} T \text{ (HRS)} = 453 A \text{ (ACRES)} D \text{ (IN.)}$$

1. ADJUST FLOW

$$22 \div 32 = 0.875$$

$$\sqrt{0.6875} = 0.83$$

$$0.83 \times 900 = 746 \text{ GPM}$$

2. Adjust irrigation depth

You need to apply 0.7"

$$T \text{ (hrs)} = (453 \times A \times D) \div Q$$

$$T \text{ (hrs)} = (453 \times 117 \times 0.7) \div 746$$

$$T = 49.7 \text{ Hrs}$$

3. ADJUST PERCENT TIMER:

Cheat and look up the time on the old chart, 21% Or
Adjust your 100% depth using the above Equation:

$$D = Q \times T / 453 \times A \quad D = (746 \times 10.7) \div 453 \times 117 \quad D = 0.15$$

$$\% \text{ SETTING} = 0.15 / 0.7 \times 100 = 21\%$$

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Putting it all together: How do I ACTUALLY Schedule

What is my MAD? What irrigation depth will I use?

MAD = Root Depth X AWHC X Percent MAD

- **MAD / Irrigation Efficiency = Irrigation Depth**

How long since I last irrigated: in days

What is ET for those days

What is the rainfall over 0.1 inches

Calculate (and do a field check): **Deficit = ET x days – precip**

When I hit my MAD: Irrigate

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Typical Irrigation depth (Sprinklers)

Alfalfa and irrigated pasture:

- New stand after planting: .4 inches
- Established stand:
 - 0.8 inches to 1.8 inches

Potatoes, soybeans, dry beans, peas and some vegetables:

- First irrigation or Pre-Water: Wet entire profile
- Rest of irrigations: .5 to 1.0 inches

Small grains and small seeded vegetables:

- Early: keep seed wet for germination, Break Crust, incorporate fertilizer
- Later: 0.5 to 1.2 depending on soil type

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Contact Information

Maya ter Kuile-Miller
Cactus Hill Ag Consulting, LLC
20758 County Road 10
La Jara, CO 81140
Cell: (719) 580-1976
mayatk30@gmail.com
cactushillag@gmail.com

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