

Strategies for Addressing Extreme Weather and Climate Change: Estimating water needs during dry periods

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The Agroecology Lab



How do you use water on a farm?

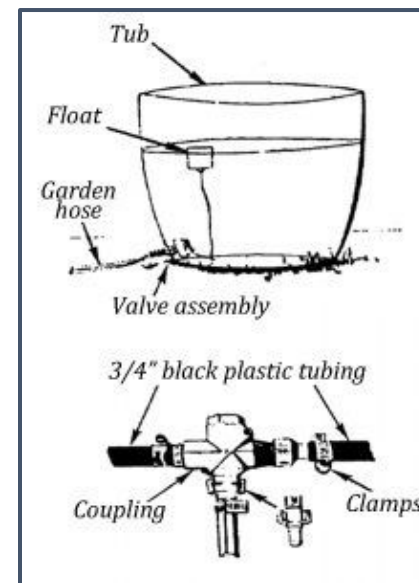
Greenhouse or high tunnel irrigation



Field irrigation



Livestock watering



Frost protection

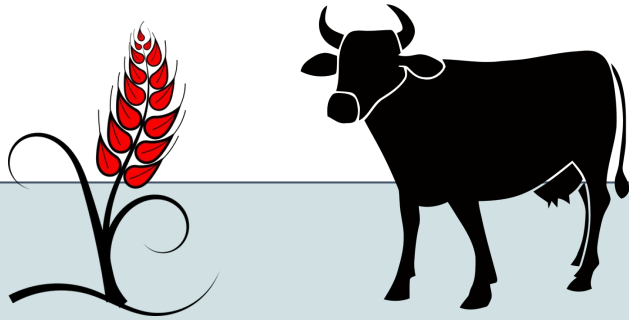


- + Washing equipment
- + Washing product
- + Household uses
- + Anything else?

I have too much water!



Why make a water management plan?



Grow crops and livestock more effectively and efficiently, in a changing climate



Balancing agriculture with conservation



Changes in supply and availability



Potential for future increased competition



Regulatory enforcement & access to funding programs

Ingredients of a water management plan

Step 1: What are your needs?

- How much water do your crops need and when?
- How much water do your animals need, and where?

Step 2: What are your sources?

- Surface options: Rivers, streams, ponds, lakes
- Ground options: Shallow or deep wells
- Municipal or delivery

Step 3: What's your delivery system?

- Pumps, backflow preventers, pipes
- Drip or overhead
- Small scale or large scale
- Permanent set or temporary

Step 4: What regulations apply?

- Federal, state, and local



Step 1: What are your water needs?



Differs by crop...

- Development needs
- Fruiting habit
- Root depth
- Stress resistance
- Amount of time in the ground

...and based on environmental conditions

- Precipitation
- Temperature
- Evapotranspiration
- Soil characteristics and conditions

Crop water requirement = Evapotranspiration (ET_c)

↳ ET_c includes evaporation of water from the ground *and* loss of water through the plant itself

↳ Irrigation is needed when $ET_c > \text{soil water} + \text{precipitation}$



What do you need to know (and keep track of)?

- Soil water content
- Rainfall in the past week
- Rainfall forecasts for the coming week

Need a shortcut?

CSF Water Deficit Calculator

Climate

Tools

Team

Resources

Videos

Programs

Current Location:

Cornell University, Ithaca, NY

[Change Location](#)

Soil Water Capacity

Medium (Loam, med text)

Crop Type

Vegetables (Small) - Sho

Planting/Budbreak

05/30/2024

Last Irrigation Date

NONE

[Season to Date](#)

[30-Day Outlook](#)

[Climate Change](#)

[Info](#)

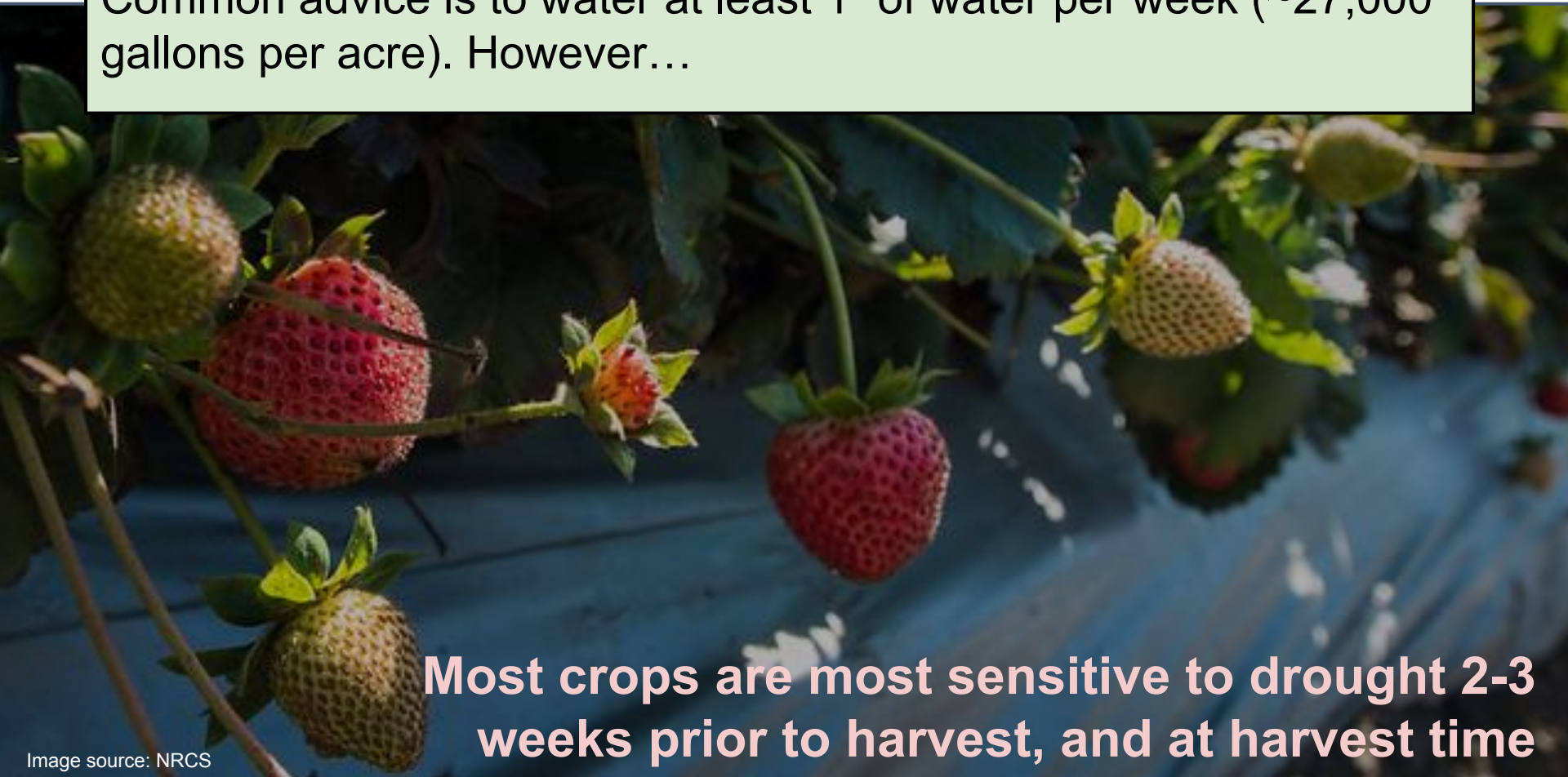
Water deficit for 2024

@ Cornell University, Ithaca, NY



Calculating needs across a season

Common advice is to water at least 1" of water per week (~27,000 gallons per acre). However...

A close-up photograph of several strawberries growing on a plant. The strawberries are in various stages of ripeness, with some showing bright red color and others being more greenish-yellow. The background is a blurred blue sky.

Most crops are most sensitive to drought 2-3 weeks prior to harvest, and at harvest time

Leafy vegetables

These crops are shallow rooted. Keep soil near or at field capacity from leaf expansion → harvest. Too much water can = split heads in cabbage.

Broccoli & cauliflower

These crops are sensitive to drought at all stages of development. Shallow rooting. To develop heads w/good flavor, keep well watered.

Roots, tubers, bulbs

Most sensitive to drought during below-ground bulking. Inconsistent water conditions can lead to poor formation.

Fruiting vegetables

Flowering, fruiting, and seeding periods are critical. Inconsistent application can lead to cracking, blossom end rot. REDUCE water as fruit and seed crops mature, in some crops.

Information on this slide has been adapted from the UMass Center for Agriculture, Food, and the Environment

UMass Extension Vegetable Program,
[Irrigating Vegetable Crops fact sheet \(2013\)](#)



Table 1. Critical Periods of Water Need (by crop)

CROP	CRITICAL PERIOD
Asparagus	Brush
Beans, lima	Pollination and pod development
Beans, snap	Flowering and pod enlargement
Broccoli	Head development
Cabbage	Head development
Carrots	Root enlargement
Cauliflower	Head development
Corn	Silking and tasseling, ear development
Cucumbers	Flowering and fruit development
Eggplants	Flowering and fruit development
Greens Continuous	Lettuce Head development
Melons (musk melons & watermelons)	Flowering and fruit development
	Bulb enlargement

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Planning ahead if you don't
know your ET_c



Image source: NRCS

CROP:		Fresh market or storage Onion			
				Amount of water needed	
Week	Days		Growth stage	Inches	Gallons
1	7	Pre-bulb	Seeding	1	27,000
2	14			1	27,000
3	21			1	27,000
4	28		Radical and flag leaf emergence	1	27,000
5	35			1	27,000
6	42			1	27,000
7	49		1-2 true leaves	1	27,000
8	56			1	27,000
9	63			1	27,000
10	70		3 - 4 true leaves	1	27,000
11	77			1	27,000
12	84			1	27,000
13	91		5-7 true leaves	1	27,000
14	98			1	27,000
15	105			1	27,000
16	112		8- 12 true leaves	1	27,000
17	119	Post-bulb		1.5	40,500
18	126		Bulb diameter 2.5 - 4.0 cm	1.5	40,500
19	133			1.5	40,500
20	140			1.5	40,500
21	147			1.5	40,500
22	154		Bulb diameter 4.0 - 7.5 cm	1.5	40,500
23	161			1.5	40,500
24	168		Bulb diameter 7.5 cm +	0	0
25	175		Blub enlargement complete. Wait until 50% crop drops to dry down	0	0
			Total needed	27	715,500
Sources:					
			Onion IPM. Washington State University		
			Successful onion irrigation scheduling. Oregon State University		

Putting it all together in a water management plan



**IRRIGATION
WATER
MANAGEMENT
PLAN
CENTER PIVOT SYSTEM**



Owner/Operator

As the owner/operator of this Irrigation Water Management Plan, I certify that I, as the decision maker, have been involved in the planning process and agree to the items/practices listed in this document. I understand that I am responsible for the implementation of this IWM Plan and for keeping all the required records.

Signature: _____ Date: _____

Name: _____

Farm Number/s: _____

Tract Number/s: _____

Consultant: _____

Do you have access to all the information you need?

- How and when should water be applied? (Crop needs, soil water conditions)
- Do you recognize runoff and erosion?
- Do you know where the water goes once you apply it (soil and subsoil conditions, soil intake characteristics, crop root zones, available water holding capacity)
- Can you assess uniformity in water application, and troubleshoot nonuniform application?
- Can you assess weather conditions to make real-time irrigation decisions?
- Are you keeping the relevant records? (rainfall, daily ET, soil water content, plant available water, amount of irrigation water applied)?

Question	Crop Field 1
Please answer one of the two following questions, <u>set the other as N/A</u> .	
- What is the predominate Maine soil (its name) in your area?	Atherton
- <u>OR</u> , if unlisted or unknown, what is the predominate general soil type?	N/A
What crop is to be irrigated?	Horseradish
What irrigation scheduling method do you use?	Soil Moisture Monitoring
In what month do you begin irrigation?	August
In what month do you end irrigation?	September
What irrigation system do you use?	Overhead/Sprinkler - Stationary Big Gun
**If you use a trickle/drip irrigation system:	
What is the seed/plant spacing (ft) between crop rows?	2 feet
What is the irrigated /wetted width (ft) within the crop rows?	1 feet
What is the amount of water (in) to be applied per irrigation?	1 inches
What is the total area (in acres) used by the crop?	20 acres
How many irrigation events per season?	1 events
Answer #10a if you want a proposed pumping rate, or Answer #10b if you want a proposed length of time to irrigate (set answers to the other question to zero).	
How long (in hours) is each irrigation event?	0.25 hours
Please answer one of the two following sets of questions, <u>set the other as 0</u> .	
- What is your planned pumping rate (gpm)?	40 gallons per minute
<u>OR</u> , **If you prefer, and use a trickle/drip irrigation system,	
- What is your emitter flow rate (gph)?	40 gallons per hour
- What is your emitter spacing (inches)?	8 inches
How long do you irrigate a day (hours/day)?	1 hours per day

Irrigation calculator

developed by
Maine DACF is
available online

*** Download before
using (it will only work in
Excel)

While this tool is specifically
designed for Maine soils, you can
estimate similar soil types and
approximate with fairly good
outcomes!

Summary

- ❖ Diversified farms use water for many different purposes;
- ❖ Knowing how much water you need (and matching that with water availability) is important.
- ❖ There are tools available!

Thank you!

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