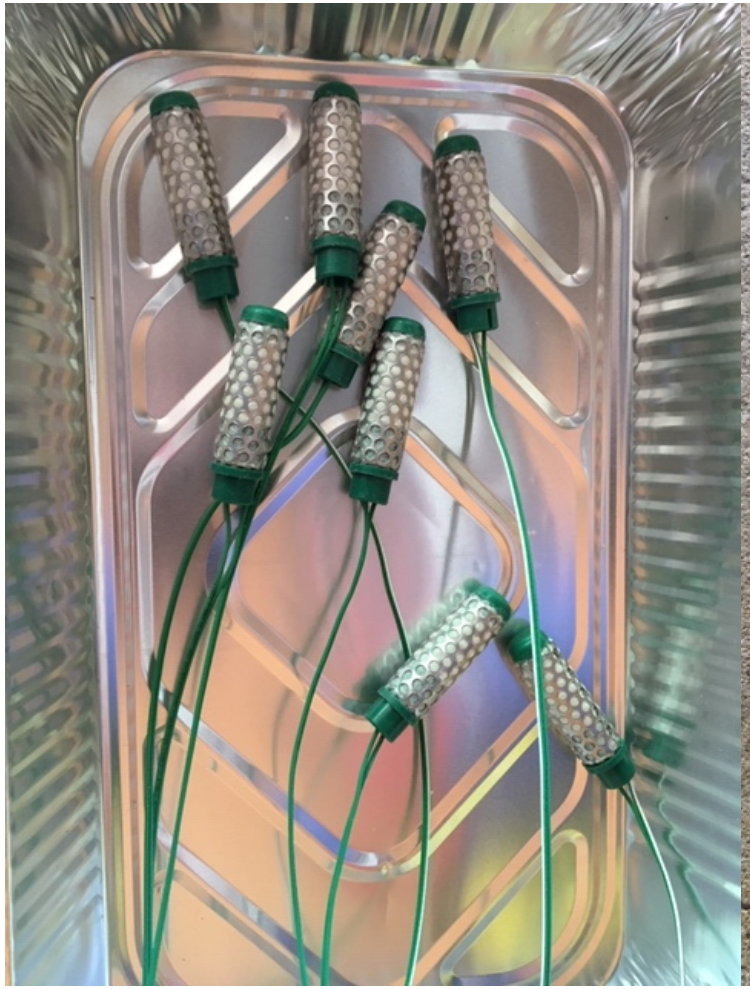
Soil Moisture Sensor Inquiry, 2018 - 2019



Jeremy DeLisle, Field Specialist, UNH Cooperative Extension, jeremy.delisle@unh.edu

Soil Moisture Sensor Inquiry – 2018 - 2019

- Started using in various cropping systems in 2018, including high tunnel tomatoes, field-grown peppers, greens, blueberries, tree fruit, and nursery seedlings.
- 8 farms participated in 2018, 10 in 2019.
- Readings resulted in significant reductions in frequency and duration of irrigation in some locations.
- Tool to better manage water resources on the farm.
- Easily relocated to new areas as needed.
- WaterMark Sensor with 5 ft. cable - $36 each
- WaterMark Reader - $210

Understanding water in the soil…

Soil moisture content indicates the amount of water present in the soil.

Soil water holding capacity is the amount of water that a given soil can hold for crop use.

Field capacity is the point where the soil water holding capacity has reached its maximum for a given field.

Measuring soil moisture content

- **Volumetric measurement-** measuring the percentage of water by volume in a given amount of soil

- **Tensiometric measurement-** measuring the physical force actually holding water in the soil, measured in Centibars (or kPa) of soil water tension

Soil water tension (or matric potential) has to be overcome for the plant to move water in to its root system. Different soil types will have different tensions even at the same volumetric measurement.

Understanding water in the soil…

Permanent Wilting Point: The minimal amount of water in the soil that the plant requires not to wilt.

Available Water: The amount of water that can be stored in a soil profile and be available for growing crops, typically defined as the range between field capacity and the wilting point.

Allowable Depletion: The percentage of available water that can be depleted before irrigation is required to prevent crop stress.

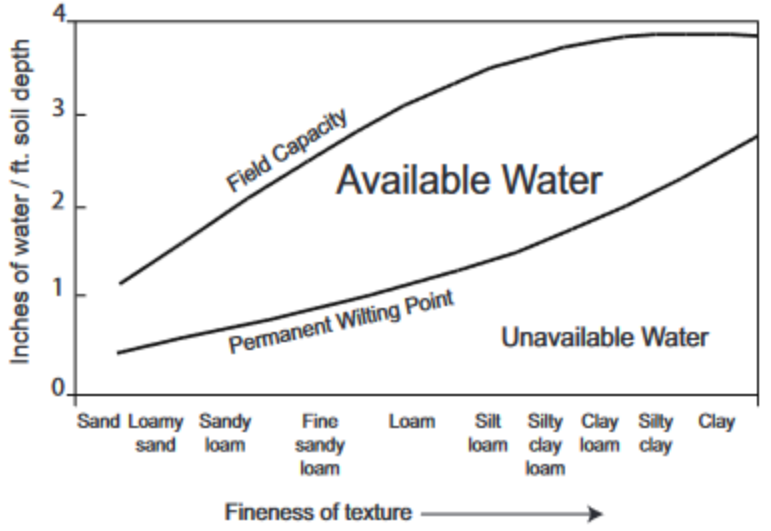
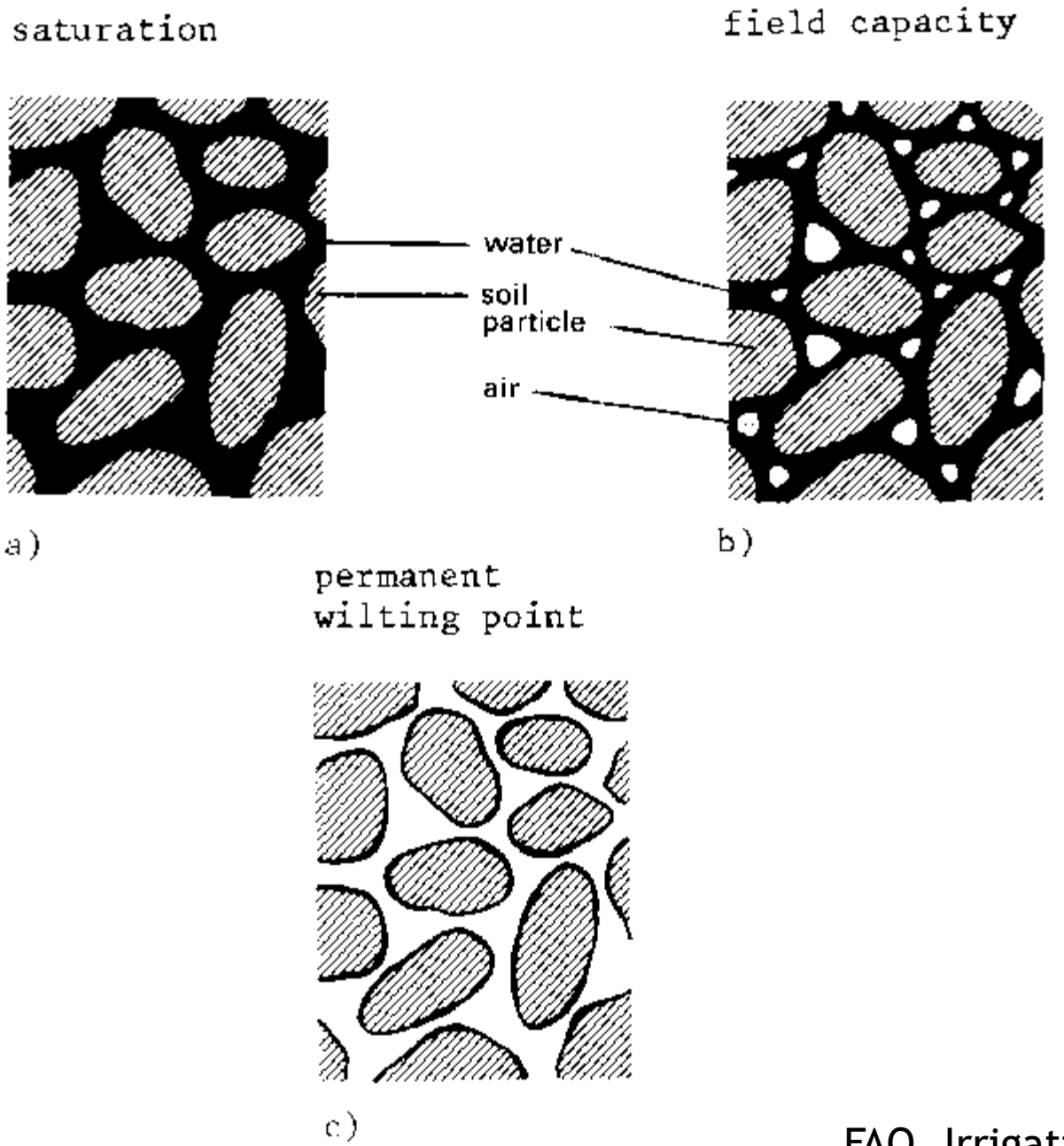


Figure 1. General relationship between soil moisture and texture. Ohio Agronomy Guide, 14th edition, Bulletin 472-05



FAO, Irrigation Water Management Training Manual

WaterMark Reader

Simply attach the alligator clips to each of the two lead wires, press read twice, and your soil moisture reading is instantly displayed.

Grounding Stone Organic Blueberry Farm

4 sensors placed at 12” depth

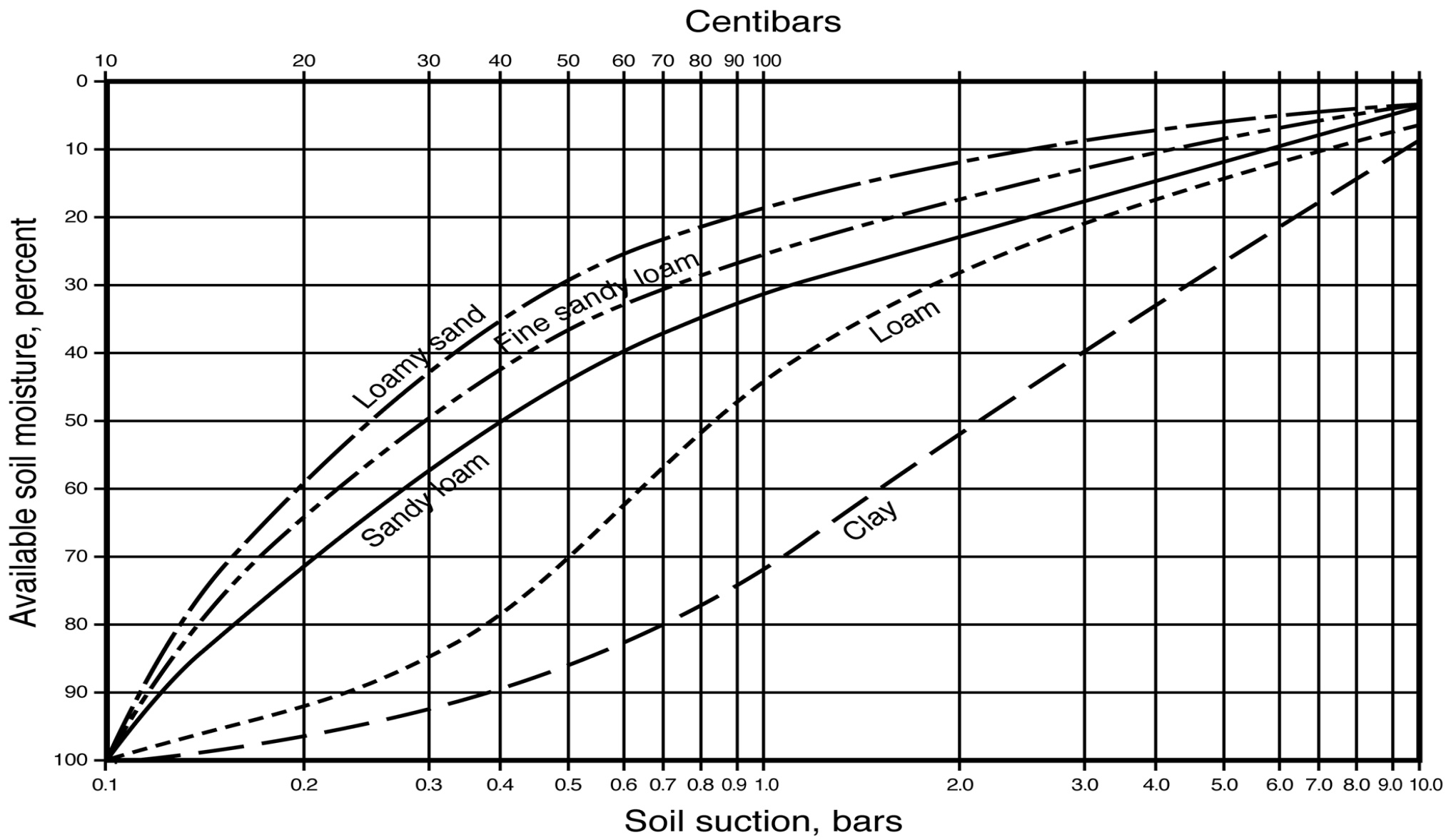
Municipal water source

Map Unit Legend

Merrimack and Belknap Counties, New Hampshire (NH609)

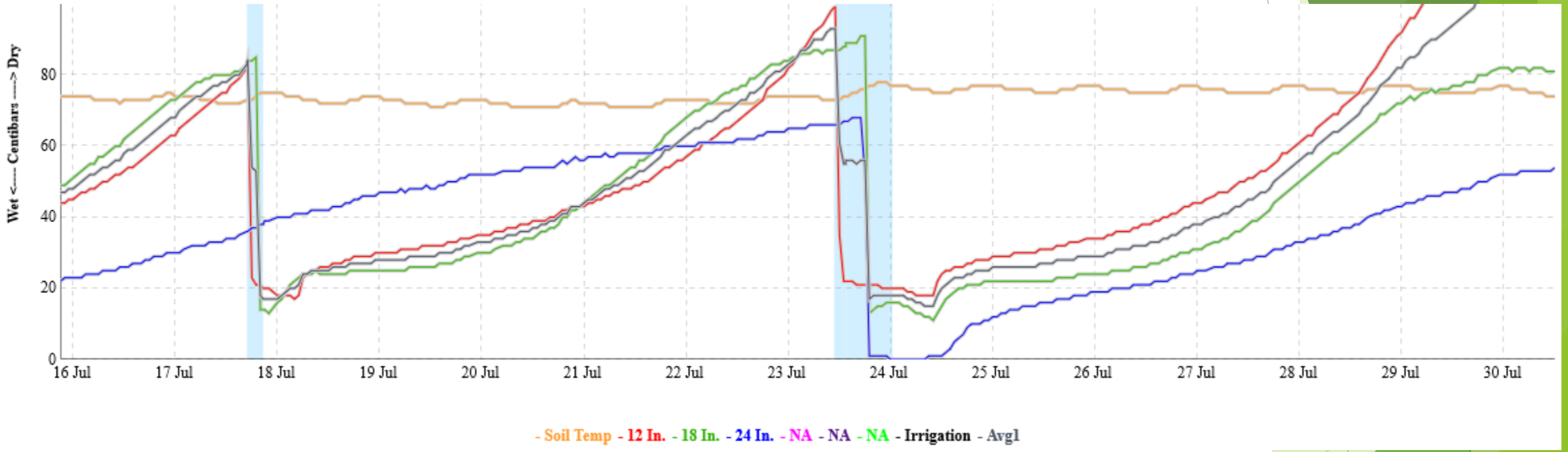
Merrimack and Belknap Counties, New Hampshire (NH609)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
35E	Champlain loamy fine sand, 15 to 60 percent slopes	0.2	0.2%
94A	Agawam-Ninigret fine sandy loams, 0 to 3 percent slopes	14.2	20.4%
214A	Naumburg loamy sand, 0 to 5 percent slopes	0.8	1.2%
220A	Boscawen fine sandy loam, 0 to 3 percent slopes	21.0	30.3%
220B	Boscawen fine sandy loam, 3 to 8 percent	11.0	15.8%



Adapted (with permission) from the *BC Trickle Irrigation Manual,* BC Ministry of Agriculture and Food, Irrigation Industry Association of British Columbia (T.W. Van der Gulik)
Note: 1 kpa = 1 centibar; 100 centibars = 1 bar

Track the trends to fine tune your irrigation schedule



Wetting pattern

4 hour irrigation cycle

Wet areas starting to merge together

Soil moisture readings were:

13 kPa at 12 inch depth

17 kPa and 18” depth

What does this tell us about the effectiveness of the irrigation cycle?

How could we improve our process based on data collected?

Small farm – mixed vegetables w/ high tunnels

2018 – Began tracking soil moisture in high tunnel tomatoes

Found that tomatoes were being overwatered, resulting in significant fruit cracking.

By tracking irrigation events and resulting soil moisture levels, farmer was able to reduce irrigation frequency and correct cracking issue.

High Tunnel Tomatoes

Farm broken into several irrigation zones

Watering schedule automated using timer

Both drip and overhead irrigation used

Marginal well capacity, so understanding soil moisture management is even more important here.

Lots of factors at play

Different crops have different rooting depths.

Soil type and structure make a major difference.

Cultural practices like mulching can either help to conserve water or prevent it from reaching rooting zones.

Sensors on this farm get moved around as crops change as part of the rotational plan.

Small farm specializing in mixed greens

Both field and high tunnel production

No rain in high tunnels, so it’s all up to you!

Many successional plantings

Crops direct-seeded and short lived

Overhead irrigation primary means

Growers decided a shallow depth of 3” was most useful.

Fine sandy loam to a depth of 24”.

Soil building practices on this farm may aid in water holding capacity going forward.

Minimal tillage approach using power harrow, broad fork, compost and tarping/landscape fabric.

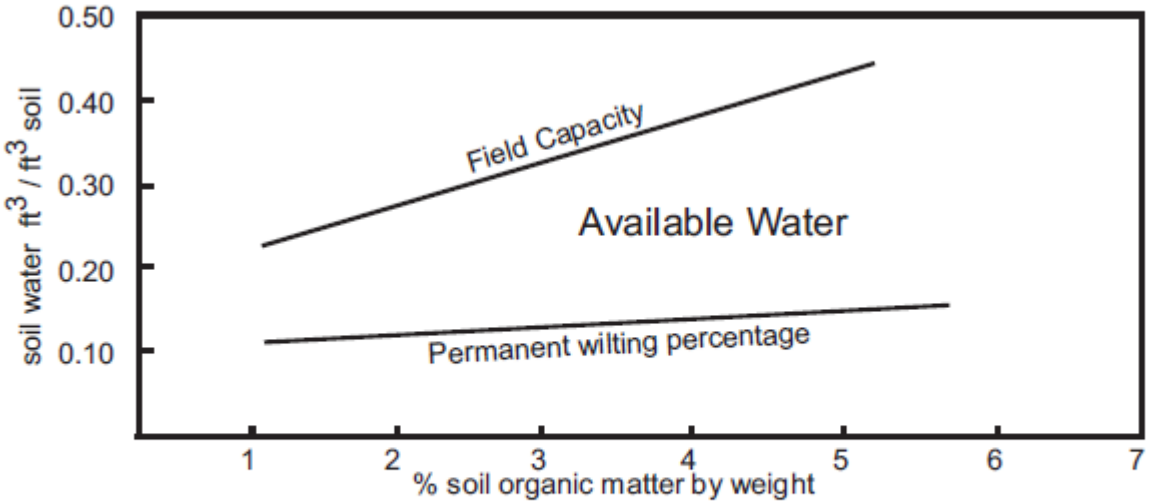


Figure 2. Effect of increasing organic matter on available water capacity of silt loam soils. Adapted from Hudson, SWCS, 1994.

Tree fruit, small fruit and mixed vegetables

Merrimack and Belknap Counties, New Hampshire (NH609)

Merrimack and Belknap Counties, New Hampshire (NH609)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
35B	Champlain loamy fine sand, 3 to 8 percent slopes	0.1	0.1%
167C	Canterbury fine sandy loam, 8 to 15 percent slopes, very stony	42.4	44.4%
167D	Canterbury fine sandy loam, 15 to 25 percent slopes, very stony	18.2	19.1%
167E	Canterbury fine sandy loam, 25 to 35 percent slopes, very stony	3.4	3.6%

Findings

Taking more water to sufficiently wet soil that initially thought.

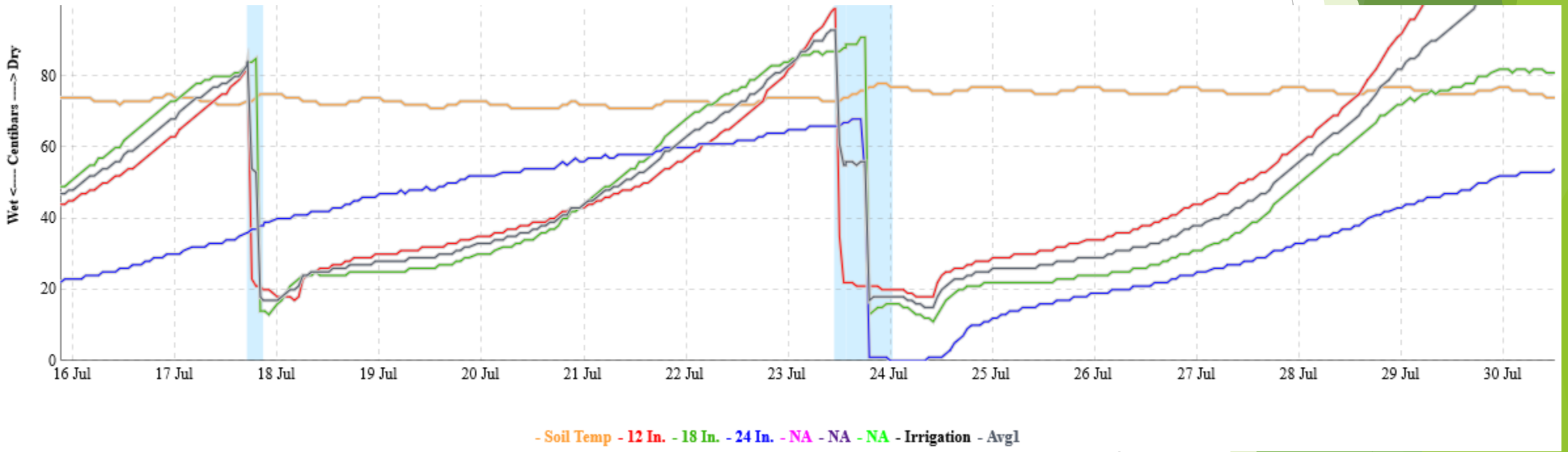
While plastic mulch can hold soil moisture if laid while soils is moist, it can also prevent rainfall from reaching the root zone at times.

Crop diversity along with diversity of cropping systems (plastic, bare ground, annuals, perennials) requires more data to maximize irrigation efficiency.

Lessons learned over the past two seasons

- Having a number to base irrigation decisions on provides peace of mind for growers, especially during periods of hot dry weather.
- Pair numbers collected with visual observations of plant status.
- Frequency of data collection is critical…More really is better in this case.
- Additional sensors at varying depth can provide a clearer picture of soil moisture status, aiding in irrigation management decisions.

It’s really about the trends. Understanding your soil’s water holding capacity and how quickly it dries down will allow you to make good irrigation decisions.

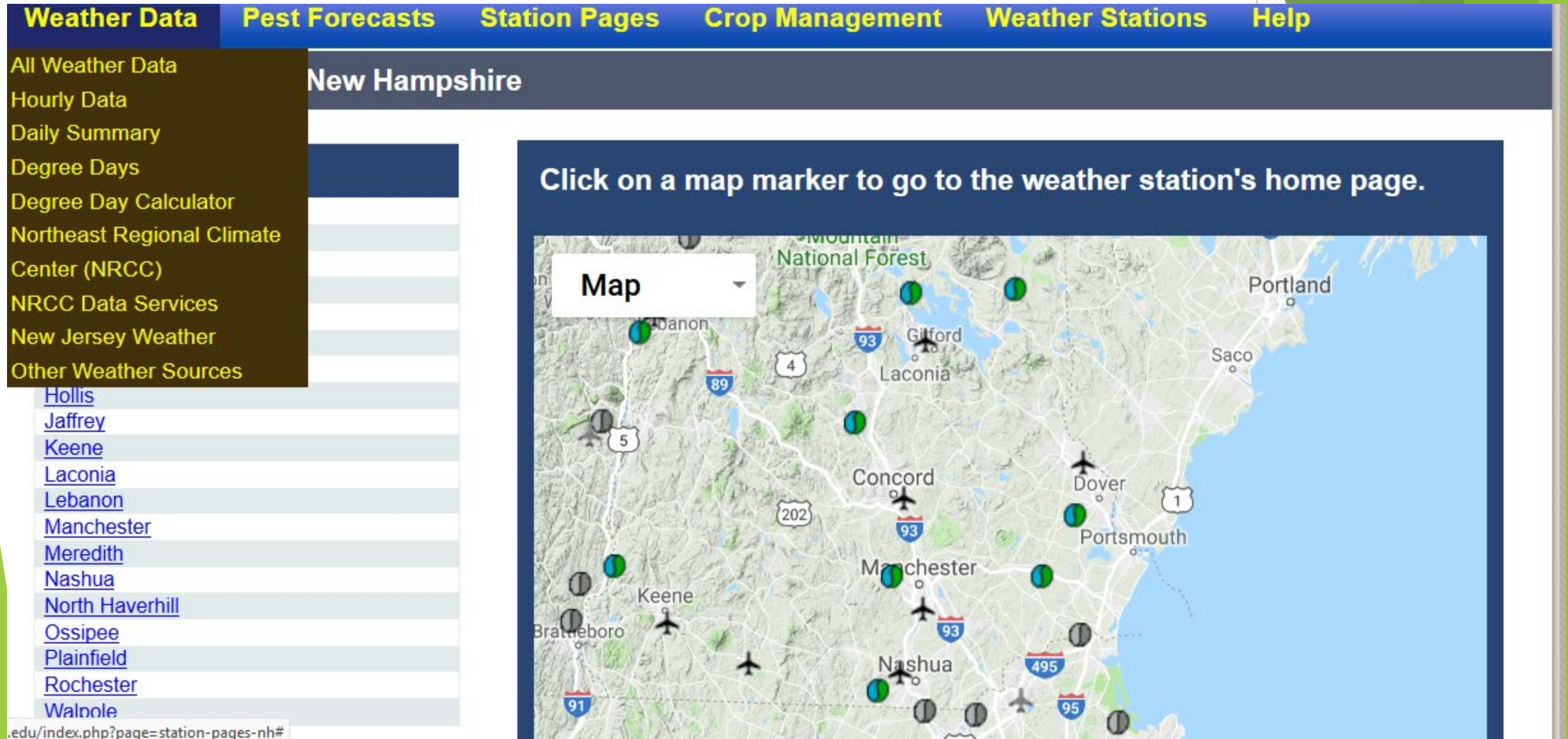


RainWise Weather Stations and NEWA

Collecting weather data from 10 farm locations across the state.

Accessible to everyone by visiting NEWA website.

http://newa.cornell.edu/



Date	Avg Air Temp (°F)	Max Air Temp (°F)	Min Air Temp (°F)	Avg Soil Temp (°F)	Total Precip (inches)	Leaf Wetness Hours	RH Hrs ≥ 90%	Avg Wind Spd (mph)	Solar Rad (langleys)	Avg Soil Tension (kPa)
07/01/2019	72.2	84.0	59.0	66.0i	0.00i	5	5	7.0	680	35.2i
07/02/2019	74.1	84.5	63.5	77.5i	0.00i	0	0	2.3	582	36.9i
07/03/2019	78.1	92.5	60.8	81.0i	0.00i	0	0	1.3	685	57.8i
07/04/2019	77.5	92.7	64.1	79.3	0.00i	0	0	0.6	614	83.1
07/05/2019	77.5	89.1	62.9	80.1	0.00i	0	0	1.5	648	105.7
07/06/2019	76.8	90.2	70.8	78.9	0.40i	9	0	2.7	478	114.5
07/07/2019	72.6	83.9	60.5	76.5	0.00	1	0	1.7	683	98.0
07/08/2019	69.9	84.9	52.5	75.2i	0.00i	0	2	1.0	667	100.2i
07/09/2019	72.9	87.0	55.0	-	-	4i	6	5.3	661	-
07/10/2019	75.5	88.0	61.0	-	0.01i	5i	6	3.2	625	-
07/11/2019	71.3	86.0	63.0	-	2.37i	9i	19	4.4	358	-
07/12/2019	74.4	83.2	68.8	82.3i	0.43i	4i	9	2.5	381	7.8i
07/13/2019	75.5	86.0	64.0	68.8i	0.00i	0i	6	4.9	620	7.8i
07/14/2019	77.8	88.0	66.0	-	-	0	7	5.8	589	-
07/15/2019	72.3	82.0	63.0	-	-	0	2	6.1	633	-
07/16/2019	73.2	84.0	57.0	-	-	0	7	1.5	485	-

07/17/2019	76.3	88.0	73.0	-	0.28i	9	10	1.2	191	-
07/18/2019	71.4	75.0	66.0	-	0.00i	9	7	5.0	486	-
07/19/2019	77.4	89.1	65.0	87.8i	0.00i	3	2	2.1	563	21.7i
07/20/2019	84.7	93.7	73.2	87.5	0.00i	0	0	1.9	546	27.0
07/21/2019	82.6	91.0	74.2	85.8	0.00i	0	0	3.3	526	36.5
07/22/2019	69.2	78.3	63.0	72.3	1.31	12	0	1.2	186	29.4
07/23/2019	64.3	72.8	60.2	68.2	1.36i	12	0	1.5	267	9.3
07/24/2019	70.0	82.4	58.6	74.9	0.00i	0	0	1.2	590	8.6
07/25/2019	69.5	84.4	57.0	82.2i	0.00i	0i	6	1.2	607	10.6i
07/26/2019	72.5	86.4	56.7	79.0	0.00i	0	0	0.7	624	12.9
07/27/2019	73.4	85.7	63.0	83.3i	0.00i	1i	7	1.2	603	15.9i
07/28/2019	76.0	89.0	60.9	82.6	0.00	0	0	1.9	613	19.1
07/29/2019	77.6	89.3	65.3	84.6	0.01i	0	0	1.7	632	23.0
07/30/2019	79.0	92.6	65.9	84.8	0.00	0	0	1.3	580	28.1
07/31/2019	73.6i	82.3i	70.0i	86.1i	0.00i	0i	7i	0.5i	124i	30.3i
Monthly summary	74.5	93.7	52.5	79.3	6.17	83	108	2.5	16527	40.0

Thank you
Questions?

Jeremy DeLisle
UNH Cooperative Extension
Fruit and Vegetable Team
Jeremy.Delisle@unh.edu
603-796-2151