

TAWC Field Site Data: What We Learned from the 2023 Growing Season

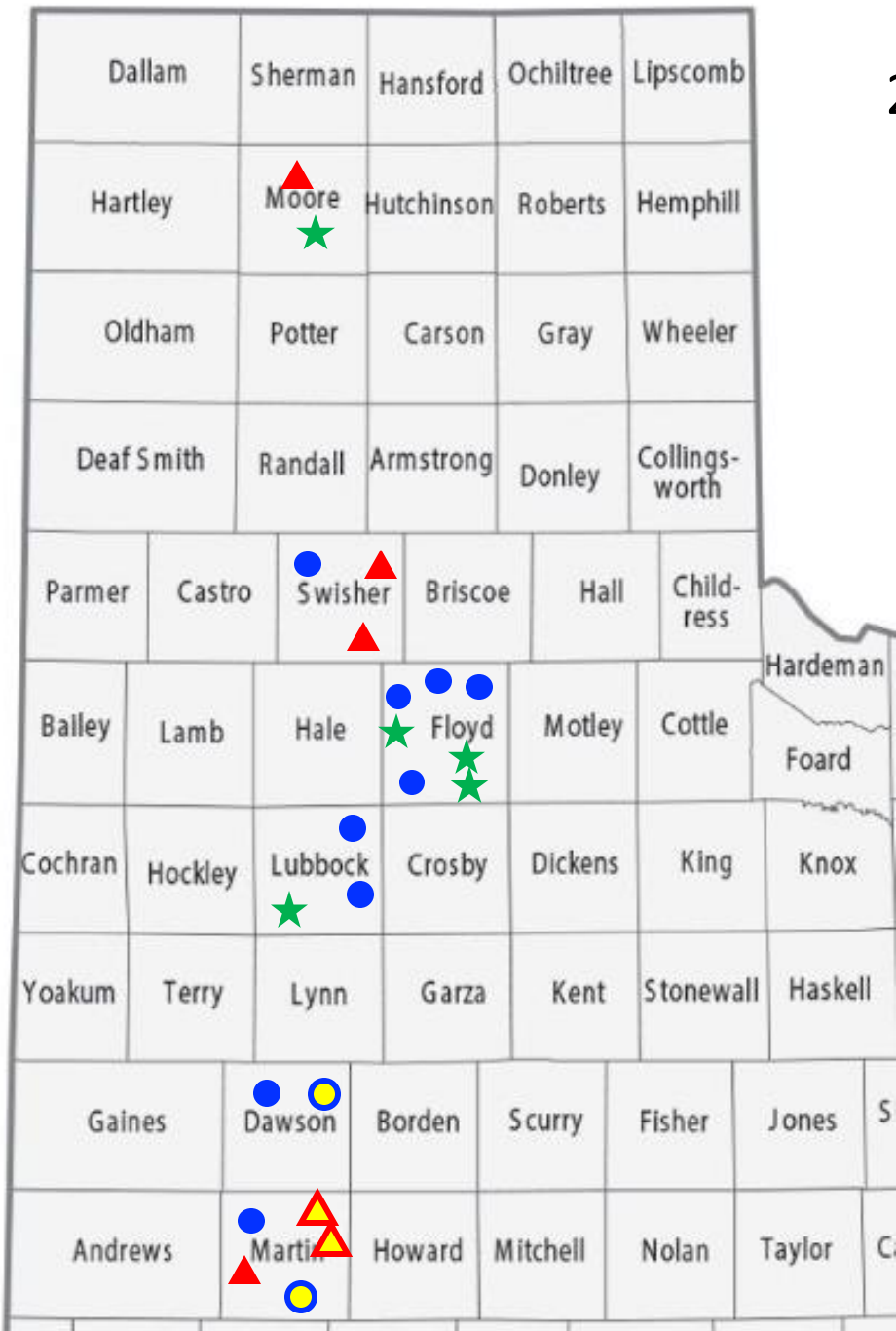
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22 Fields

- 11 cotton
- 6 sorghum
- 5 corn

- cotton
- ▲ sorghum
- ★ corn
- not harvested

Moore County

- pivot

Swisher

- pivot (rainfed +)

Floyd

- pivot
- drip

Lubbock

- pivot
- drip (40" and 50-30" spacing)

Dawson

- pivot (80")
- drip (40")

Martin

- pivot
- rainfed

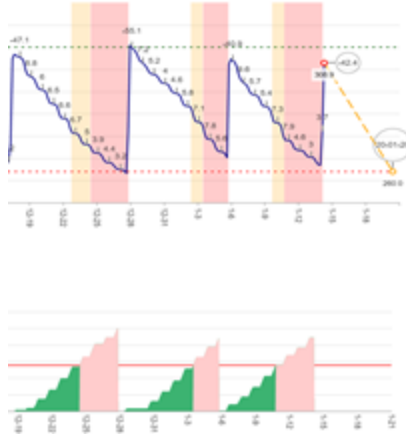
Crop	Yield (lbs per acre)	Irrigation	Irrigation (inches)	County
cotton	548	pivot	1.5	Swisher
seed sorghum	3800	pivot	10.5	Floyd
seed sorghum	1212	pivot	6	Floyd
cotton	1148	drip	14	Lubbock
cotton	not harvested	pivot	x	Dawson
cotton	1595	pivot	13	Martin
cotton	649	pivot	16	Martin
cotton	113	pivot	8	Martin
sorghum	2150	pivot	11.9	Martin
sorghum	not harvested	pivot	x	Martin
sorghum	not harvested	rainfed	x	Martin
sorghum	not harvested	rainfed	x	Martin
cotton	647	pivot	8	Floyd
corn	11820	pivot	21.6	Moore
seed sorghum	4620	pivot	8.9	Moore

Data Collection and Irrigation

- Fields and regions were selected by TAWC and KJ consultation with the grower
- Irrigation controlled by the grower using either Goanna GoField irrigation scheduling data or by the grower's method
- Data collected:
 - ❖ seasonal weather – temperature, rainfall, radiation, growing degree days, ETC
 - ❖ hourly soil moisture (capacitance probe) and soil temperature to 3' (reported in 4" increments)
 - ❖ continuous (15-minute) crop canopy temperature (CT)
 - ❖ weekly satellite imagery (NDVI) for crop growth
 - ❖ yield



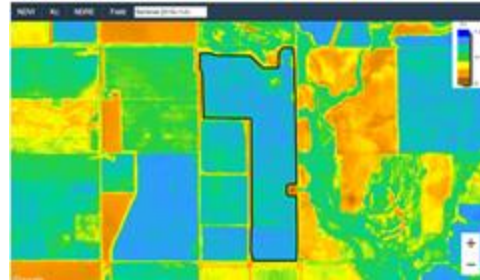
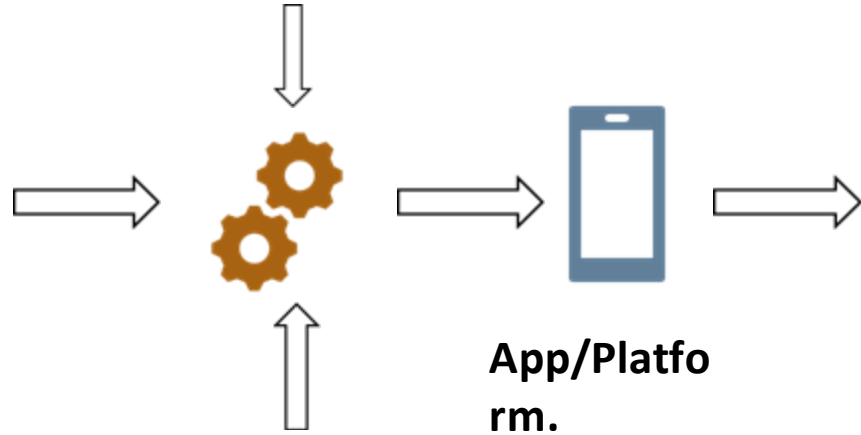
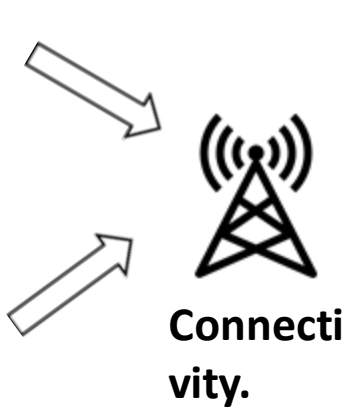
Sensors.



Algorithms

GoField uses crop water status (CT), available soil moisture, weather, and forecast data to optimize irrigation scheduling

Weather



Satellite Imagery

Deficit Irrigation and Crop Growth

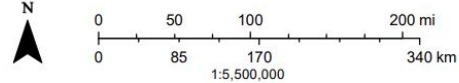
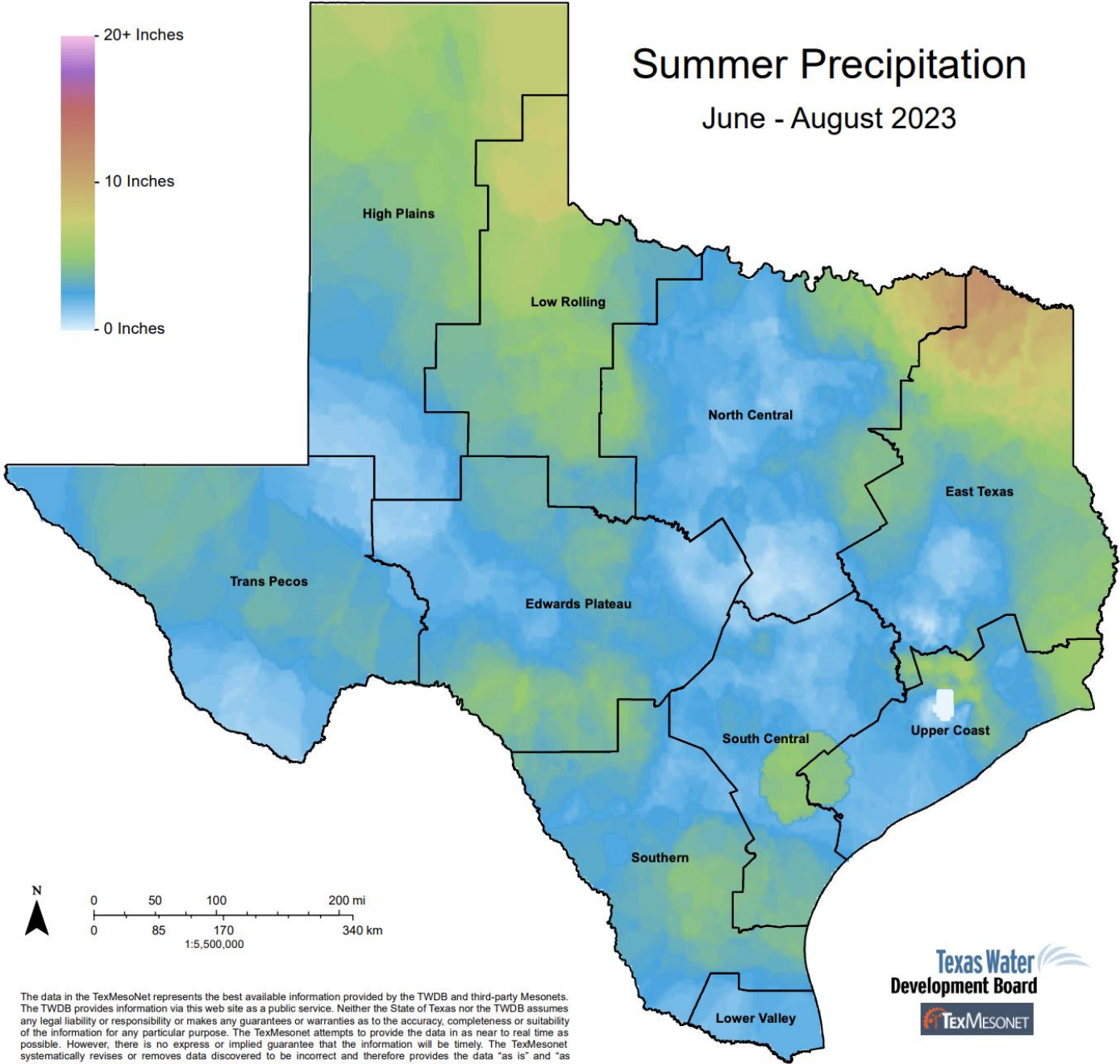
Great, so GoField can tell me when to irrigate and prevent me from over-irrigating. I don't have enough water to over-irrigate. I don't even have enough to fully irrigate?

How can it help me?

- Soil and rooting information – maximize water capture and set the crop up for time when demand is highest
- Spot paddock or pivot applications – optimally irrigate a sub-set of acres and take advantage of opportunities to supplement low irrigation or rainfed-plus acres
- Quantify application efficiencies, rainfall capture (cover crop or tillage effects), soil anomalies
- Quantify water productivity – Cotton Trust, BCI, et al.

Summer Precipitation

June - August 2023



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Canopy Temperature

Pros

- Easy to use
- Cheap
- Provides information on physiological status of the crop
- Available from several commercial vendors
- Wireless data connection can provide real-time data

Cons

- Not as familiar to growers
- Point measurement
 - Only measuring a small point in the field
- **Do not provide information about soil water deficit**
 - How much water do I need to apply?

Soil Moisture Probes

Pros

- Easy to use
- Cheap
- Provide basic information about soil profile and plant water use
- Available from several commercial vendors
- Wireless data connection can provide real-time data

Cons

- Point measurement
 - Only measuring a small point in the field
- Often not accurate in exact amount of plant available water
 - May require calibration
- Subject to variability in different soils
- **Do not provide information about crop water status**
 - Is the crop under stress?
 - How effective was my irrigation rainfall on alleviating stress?

How it works

- Capacitance soil moisture probe measures soil moisture to a depth of 3 feet.
 - Soil moisture profile is reported in 4" increments
 - Provides information on root depth and soil capacity
- Canopy temperature sensor measures the temperature of the crop canopy via an infrared thermometer
 - Provides information on crop water status

How deep are my roots?
How much water should I apply?
How much water was absorbed?

Does the crop need water today?
How effective was the irrigation or rainfall event?

Combining CT and soil moisture data provides data on soil capacity, rooting depth, and plant stress

Field ↑	Today	Forecast	Irrigation Forecast	Active	Last Update	Time Zone	Full Point	Refill Point	Current	Current Us...	ETc	Cumulative
AFF Cobran Field 04	● OK	●●●●●●●●●●	01/24/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	12.0472	10.4724	10.7874	0.3071	0.2795	8
AFF Cobran Field 23	● OK	●●●●●●●●●●	01/22/2024 04:09 PM	✓	01/23/2024 08:00 AM	AEDT	12.2047	10.6299	10.315	0.1024	0.189	5.4
AFF Cobran Field 43a	● OK	●●●●●●●●●●	01/22/2024 04:11 PM	✓	01/23/2024 08:00 AM	AEDT	12.3622	11.0236	11.0236	0.0984	0.2205	7.2
AFF Cobran Field 48	● OK	●●●●●●●●●●	01/22/2024 04:09 PM	✓	01/23/2024 08:00 AM	AEDT	12.5984	11.0236	10.8661	0.1693	0.2244	5.9
AFF Cobran Field 68	● OK	●●●●●●●●●●	01/23/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	12.9921	11.0236	11.1417	0.2126	0.2165	6
AFF Cobran Field 76	● OK	●●●●●●●●●●	01/29/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	12.5984	10.6299	12.2441	0.3189	0.2205	6
AFF Cobran Field 97	● OK	●●●●●●●●●●	01/22/2024 04:10 PM	✓	01/23/2024 08:00 AM	AEDT	12.0866	10.6299	10.3937	0.0748	0.2638	7
AFF Cobran Field R11	● OK	●●●●●●●●●●	01/25/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	11.5748	10.4331	11.2205	0.1417	0.2441	7.2
Agricom Field AB2	● OK	●●●●●●●●●●	01/27/2024 06:00 AM	✓	01/23/2024 07:00 AM	AEST	12.9528	10.315	11.7323	0.2717	0.315	14.2
Agricom Field KL4	● OK	●●●●●●●●●●	01/27/2024 06:00 AM	✓	01/23/2024 07:00 AM	AEST	12.7165	10.4331	11.9685	0.2795	0.3268	15.9
Alcheringa Field B02 Sam Coulton	● OK	●●●●●●●●●●	01/26/2024 06:00 AM	✓	01/23/2024 07:00 AM	AEST	12.2047	10.6299	12.1654	-1.7756	0.5197	8.9
Alcheringa Field B2	● OK	●●●●●●●●●●	01/27/2024 06:00 AM	✓	01/23/2024 07:00 AM	AEST	13.2283	10.6299	12.874	-1.8504	0.5197	8.9
Alcheringa Field C1	● OK	●●●●●●●●●●	01/27/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	12.5197	9.6063	11.7717	-0.3386	0.4685	9.2
Alderton Field 02	● OK	●●●●●●●●●●	01/25/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	12.0866	10.5118	11.5748	0.185	0.378	14.3
Alderton Field 03	● OK	●●●●●●●●●●	01/25/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	12.2835	10.4331	11.3386	0.3465	0.374	10.4
Aldinga - Field Riley C01	● OK	●●●●●●●●●●	01/22/2024 04:12 PM	✓	01/23/2024 08:00 AM	AEDT	12.0866	10.5118	10.1575	0.1614	0.378	12.6
Alloria Field 06	● OK	●●●●●●●●●●	01/23/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	11.811	10.2362	10.3937	0.0787	0.3031	10.5
Alloria Field 08	● OK	●●●●●●●●●●	01/26/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	12.5984	10.2362	11.378	0.1969	0.3071	11.3
Alma Field 1 & 2	● OK	●●●●●●●●●●	01/25/2024 06:00 AM	✓	01/23/2024 08:00 AM	AEDT	12.7953	10.6299	11.811	0.3346	0.4173	16.3



Soil Probe Report

Location Details

Name : Eveler Farm 14 acre
 Owner : Eveler Farm
 Start Date : 06-05-22
 Start Date Canopy : 20-06-22
 End Date Canopy : 16-09-22
 Last Reading : 04-10-22 20:00
 Current Crop : Cotton
 Active : true

Rainfall

0 mm Last Hour
 0 mm 6 Hours
 0 mm 24 Hours
 0 mm 48 Hours
 0 mm 7 Days
 15.40 mm 30 Days
 49.80 mm 365 Days

Irrigation Details

Default Usage(mm/day) : 5.00
 Current Usage(mm/day) : 0.3
 Irrigation Date (default): 21-09-22 06:00
 Irrigation Date (etc): 05-10-22 23:00

Save

Irrigation Limits

Full Point : 272.03

Refill Point : 236.03

Current (mm) : 227 (mm)

(mm) **Set to 227**

(mm) **Set to 227**



Save

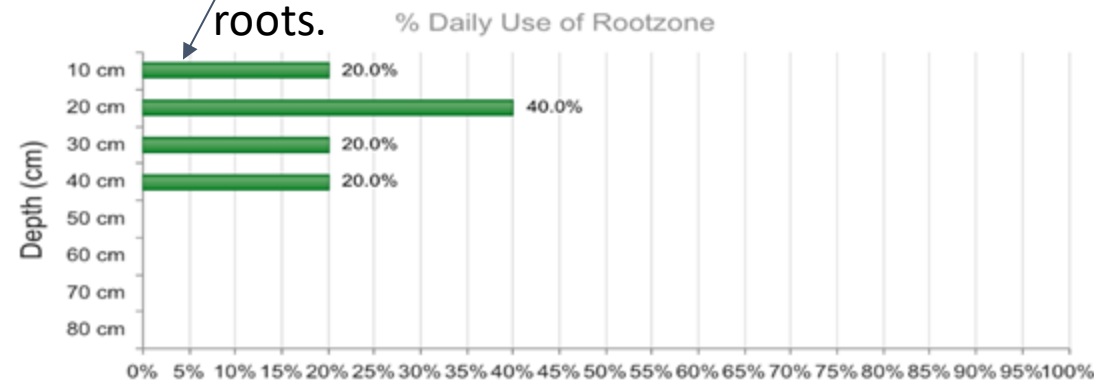
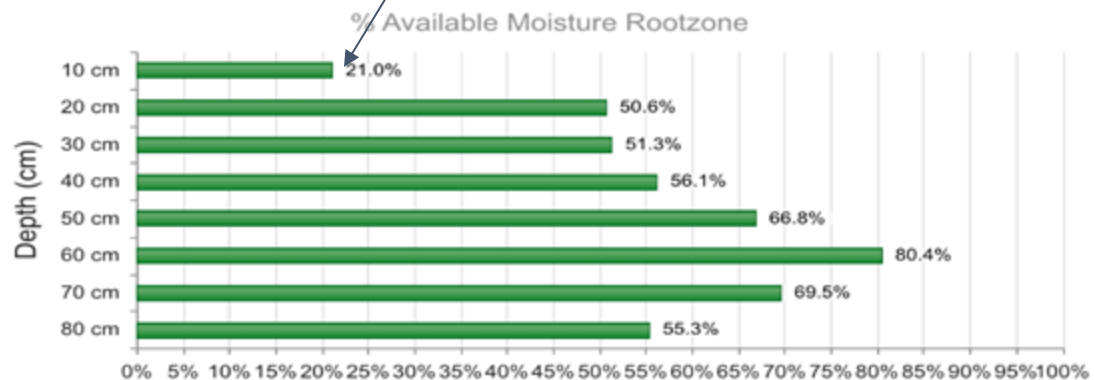
Current Crop Details

Crop Summary

Planting Date : 17-04-2022
 End Date :
 Refill Point : 236.03 mm
 Full Point : 272.03 mm

Percentage of soil moisture available from each sensor level.

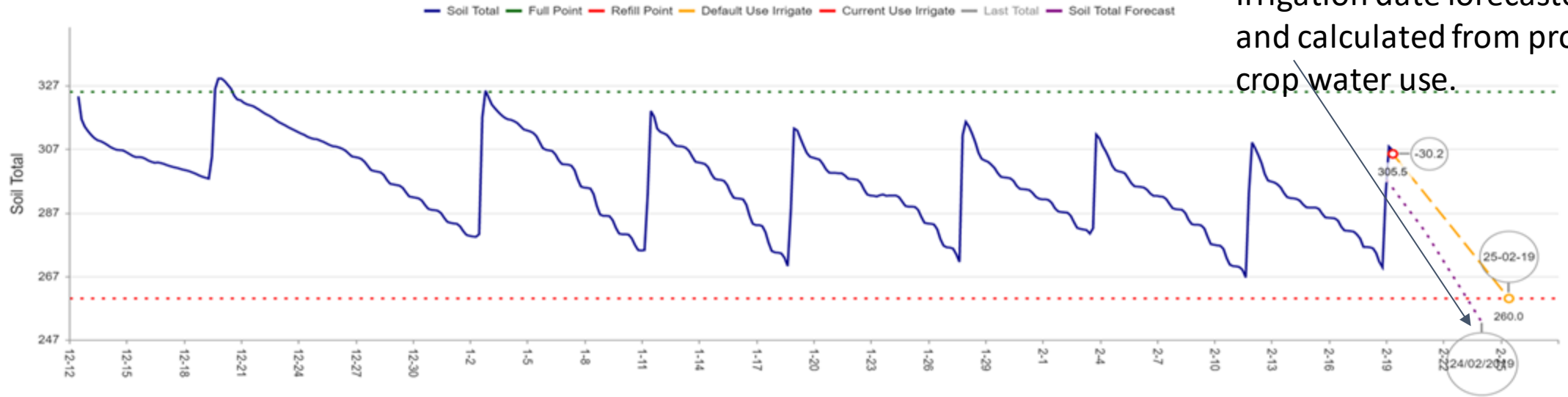
Percentage of daily crop water use from each sensor level extracted by the roots.



Soil Probe Report

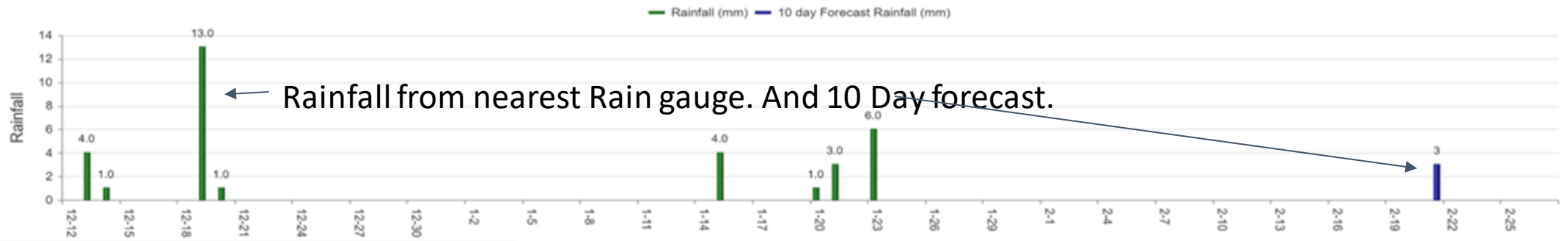
- Hide Daily Usage
- Show Notes
- Hide Etc Forecast Irrigate
- Hide Default Usage Irrigate
- Hide Current Usage Irrigate
- Print Summary Report

Soil Total



Irrigation date forecasted and calculated from probe crop water use.

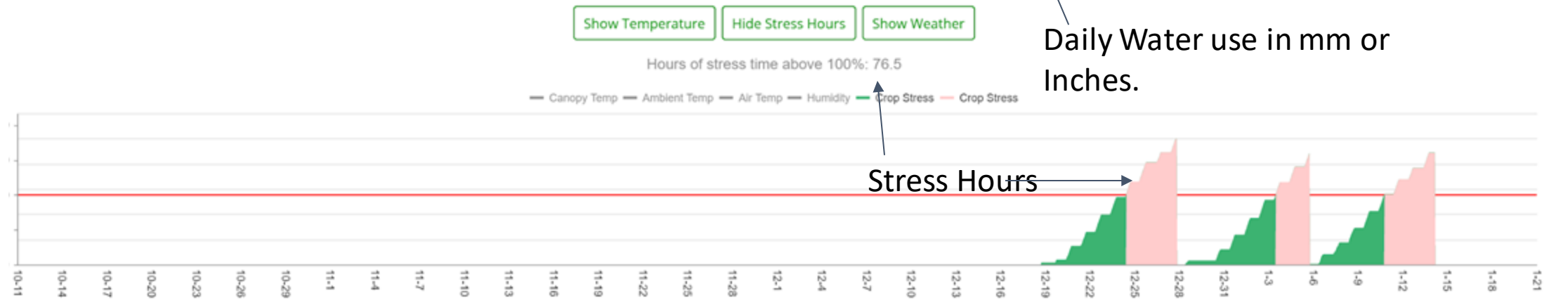
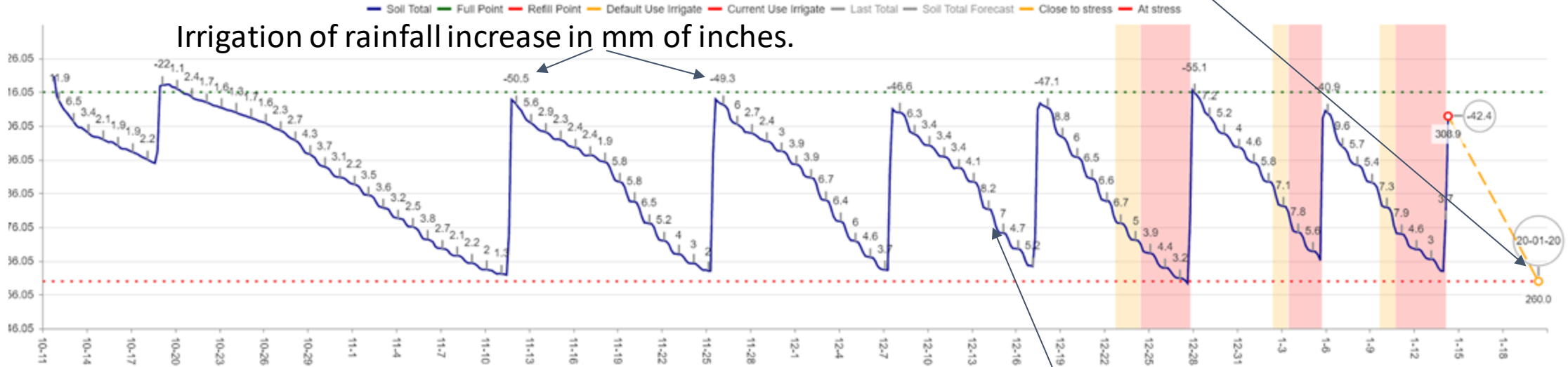
Rainfall



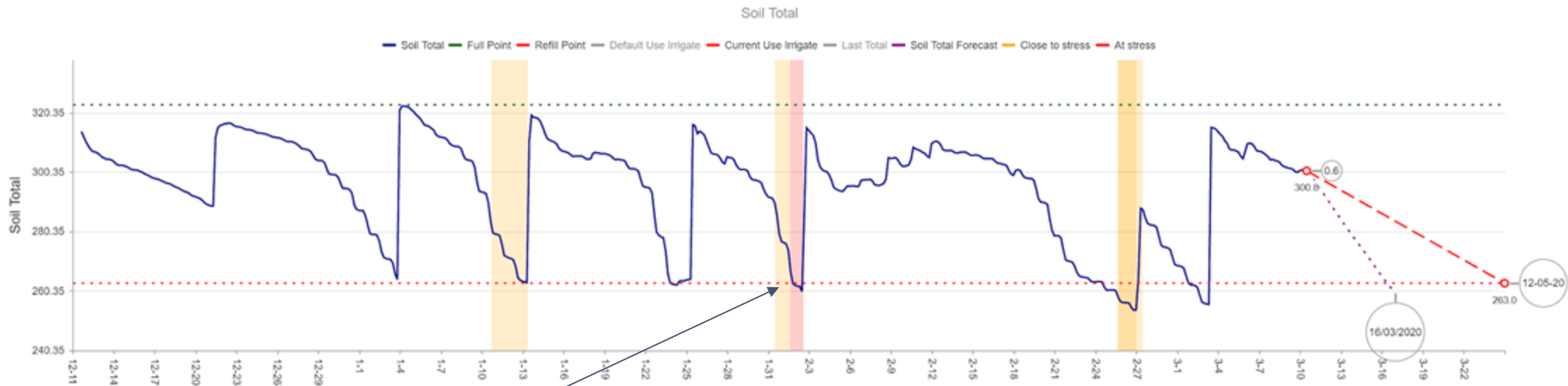
Rainfall from nearest Rain gauge. And 10 Day forecast.

Soil Probe Report

Soil Total

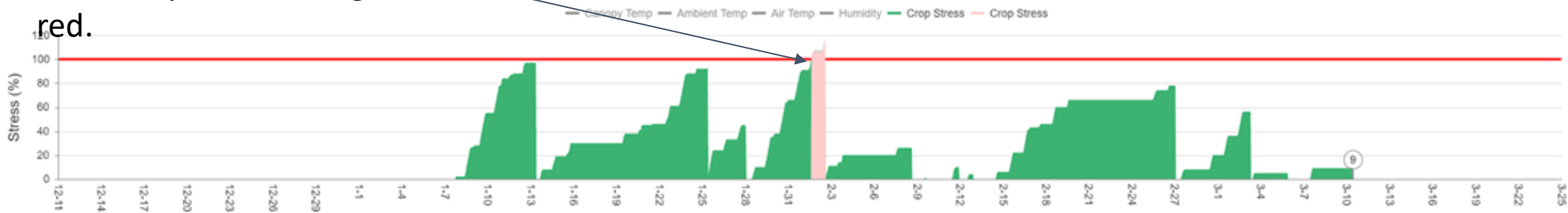


Show Daily Usage Show Notes Hide Etc Forecast Irrigate Show Default Usage Irrigate Hide Current Usage Irrigate Print Summary Report



Show Temperature Hide Stress Hours Show Weather

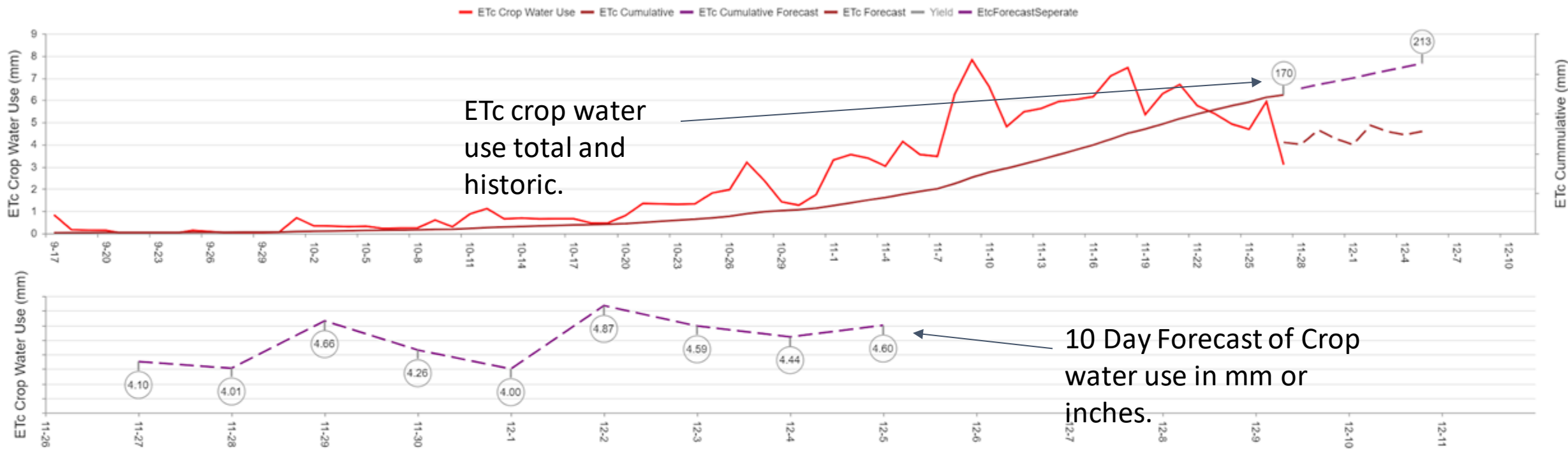
Hours of stress time above 100%: 6.0



Onset of yield affecting stress in red.

Show Images

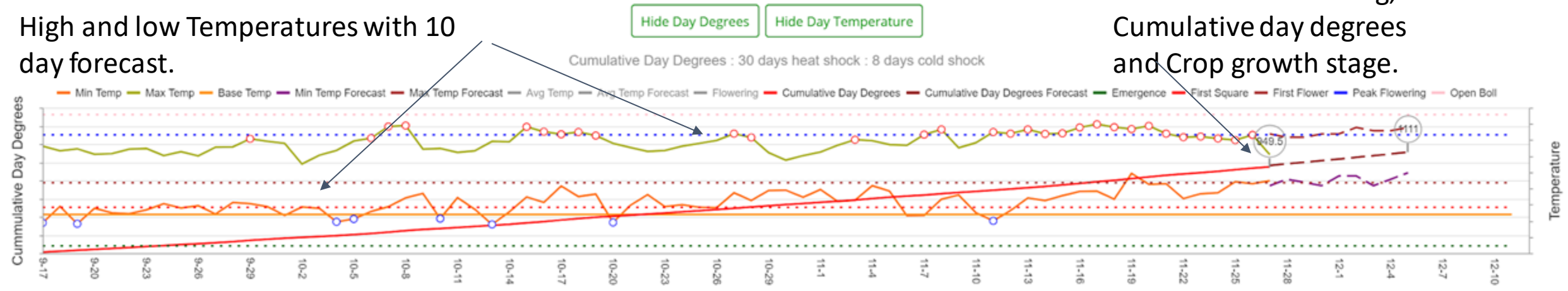
ETc Crop Water Use



High and low Temperatures with 10 day forecast.

10 Day Forecast of Crop water use in mm or inches.

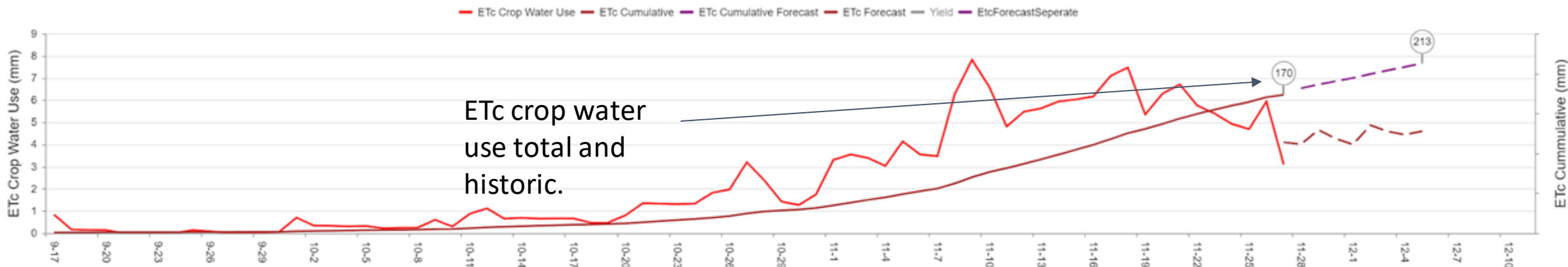
Growth Parameters.eg, Cumulative day degrees and Crop growth stage.



Soil Probe Report

Show Images

ETc Crop Water Use



ETc crop water use total and historic.

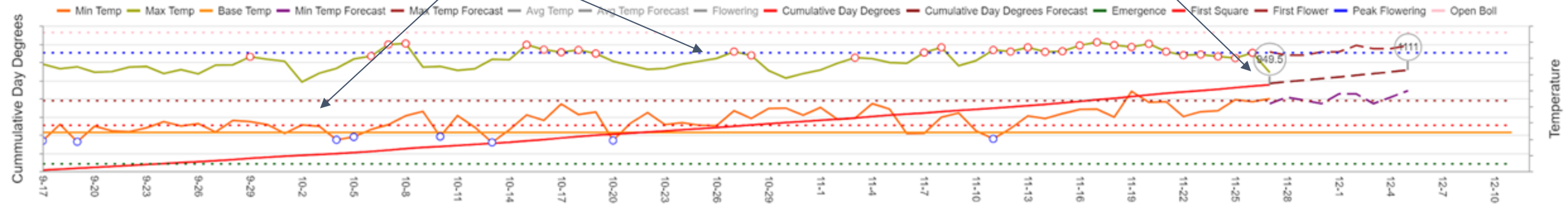
10 Day Forecast of Crop water use in mm or inches.

High and low Temperatures with 10 day forecast.

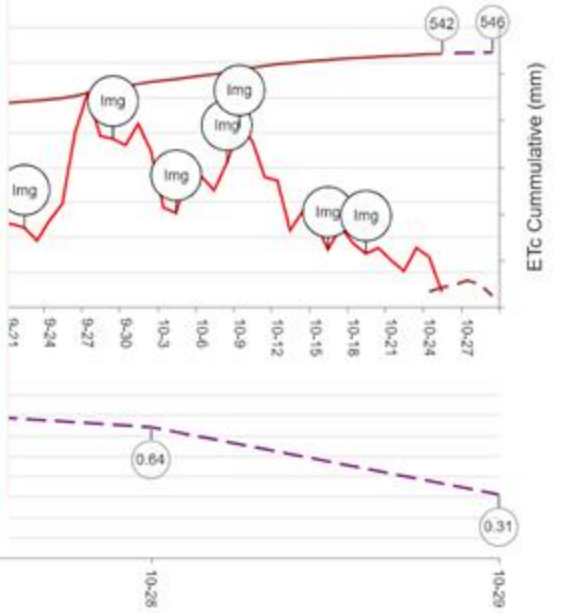
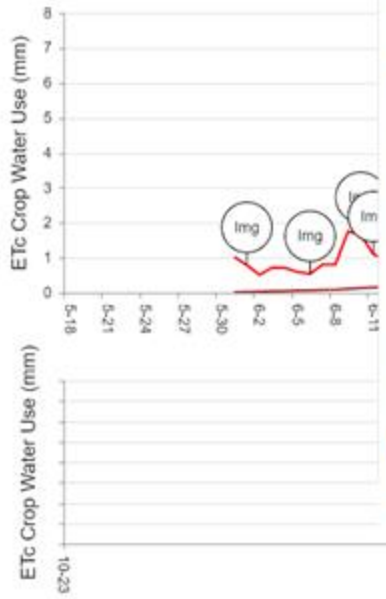
Growth Parameters.eg, Cumulative day degrees and Crop growth stage.

Hide Day Degrees Hide Day Temperature

Cumulative Day Degrees : 30 days heat shock : 8 days cold shock



Soil Probe Report



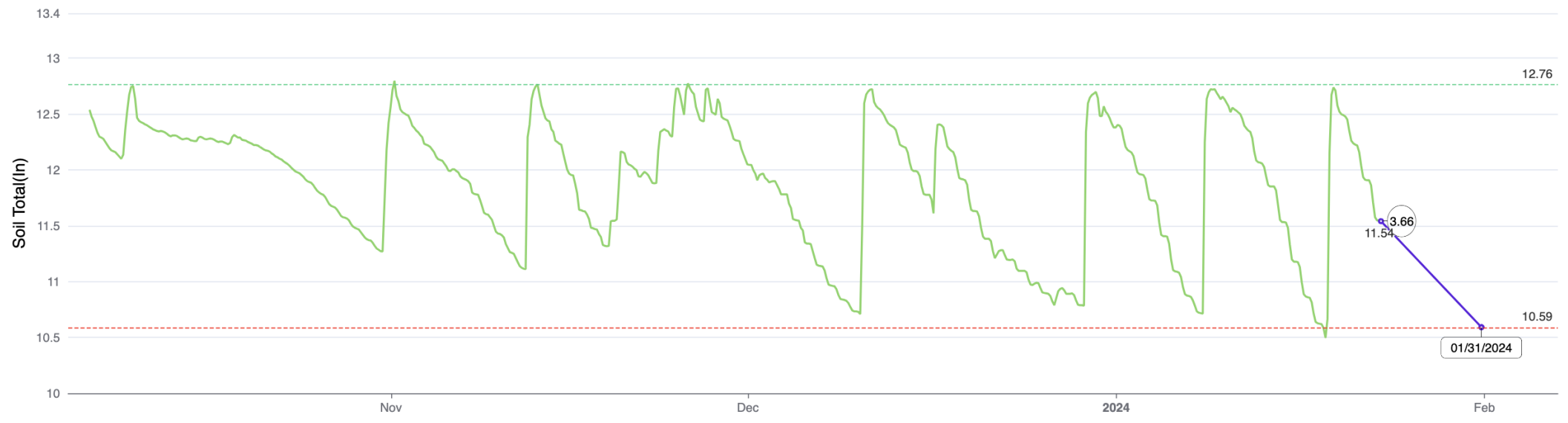
NDVI, Kc & NDRE
Satellite imagery.

Hide Day Degrees Hide Day Temperature

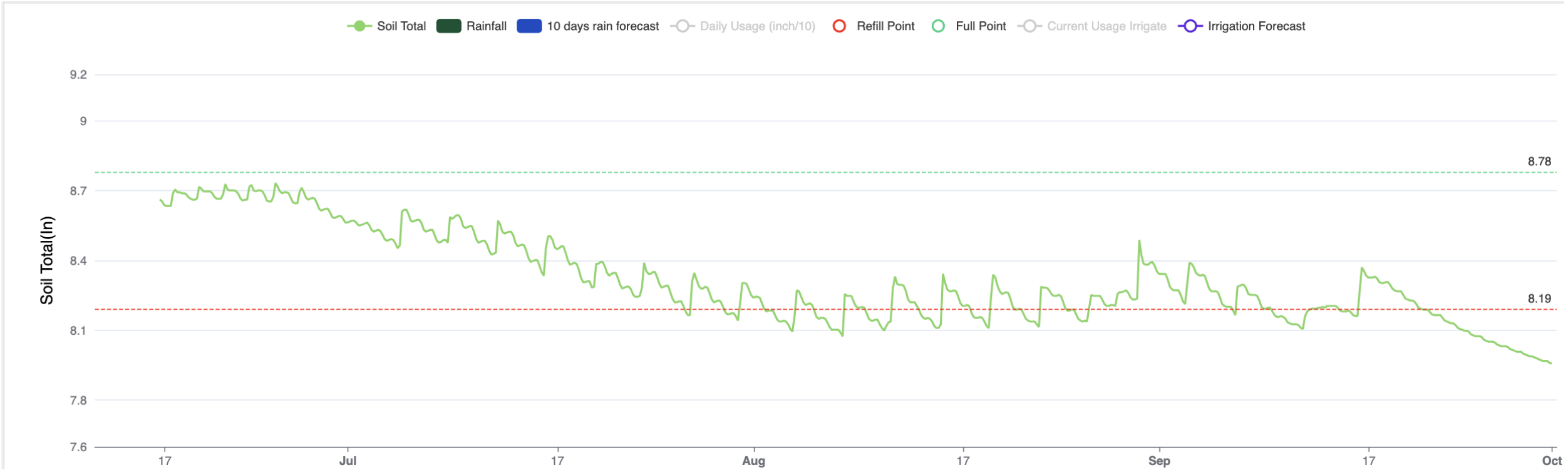
Cumulative Day Degrees : 52 days heat shock : 14 days cold shock

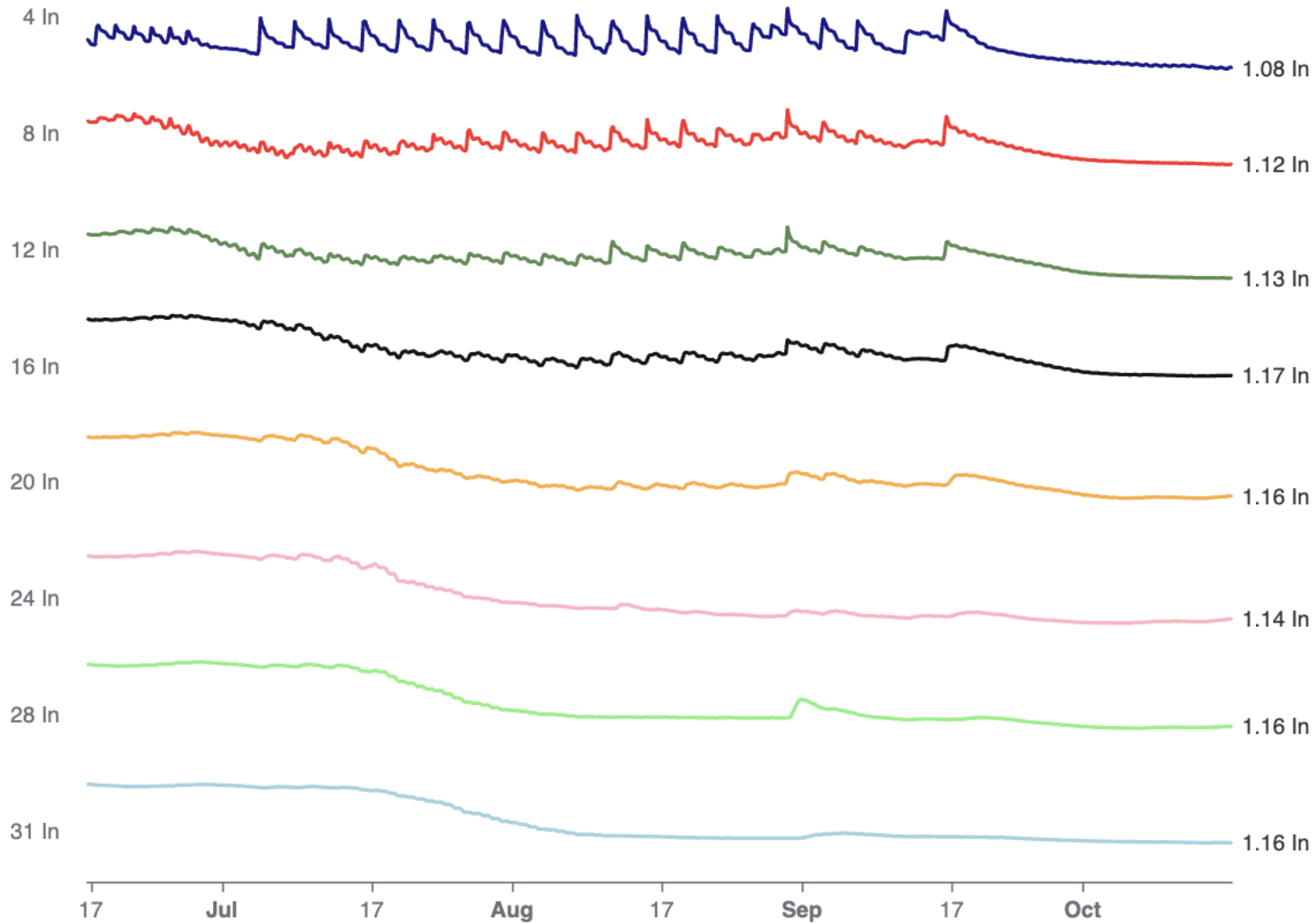
ETc Kc coefficient
calculated from an
algorithm using NDVI
imagery.

Field ▼	Today	Forecast ↑	Irrigation Forecast	Full Point	Refill Point	Current	Current Usage	ETc	Cumulative ETc	Total Day Degrees
CSD Trial - Avondale	● OK	●●●●●●●●	01/22/2024 03:07 PM	13.189	11.0236	10.1575	0.3819	0.2008	22.5	2696
Argoon Field 01 CSD CQ	● OK	●●●●●●●●	01/22/2024 03:07 PM	13.5433	10.8661	10.3543	0.2598	0.3189	29.7	2712
CSD Single Pixel Trial - Bundanoor	● OK	●●●●●●●●	01/26/2024 06:00 AM	12.2047	10.315	11.2598	0.1457	0.3031	19.9	2602
CSD Multipixel Trial - Bundanoon	● OK	●●●●●●●●	01/27/2024 06:00 AM	11.9685	10.2362	11.3386	0.1969	0.3031	20	2602
CSD Trial - Retreat	● OK	●●●●●●●●	01/31/2024 06:00 PM	12.7559	10.5906	11.5354	0.3661	0.126	20.7	2643



Martin County Pivot
High frequency (2-3 day interval)
Low volume (0.25-0.5")
sandy soil
cotton 1595 lbs/ac on 16.5" applied





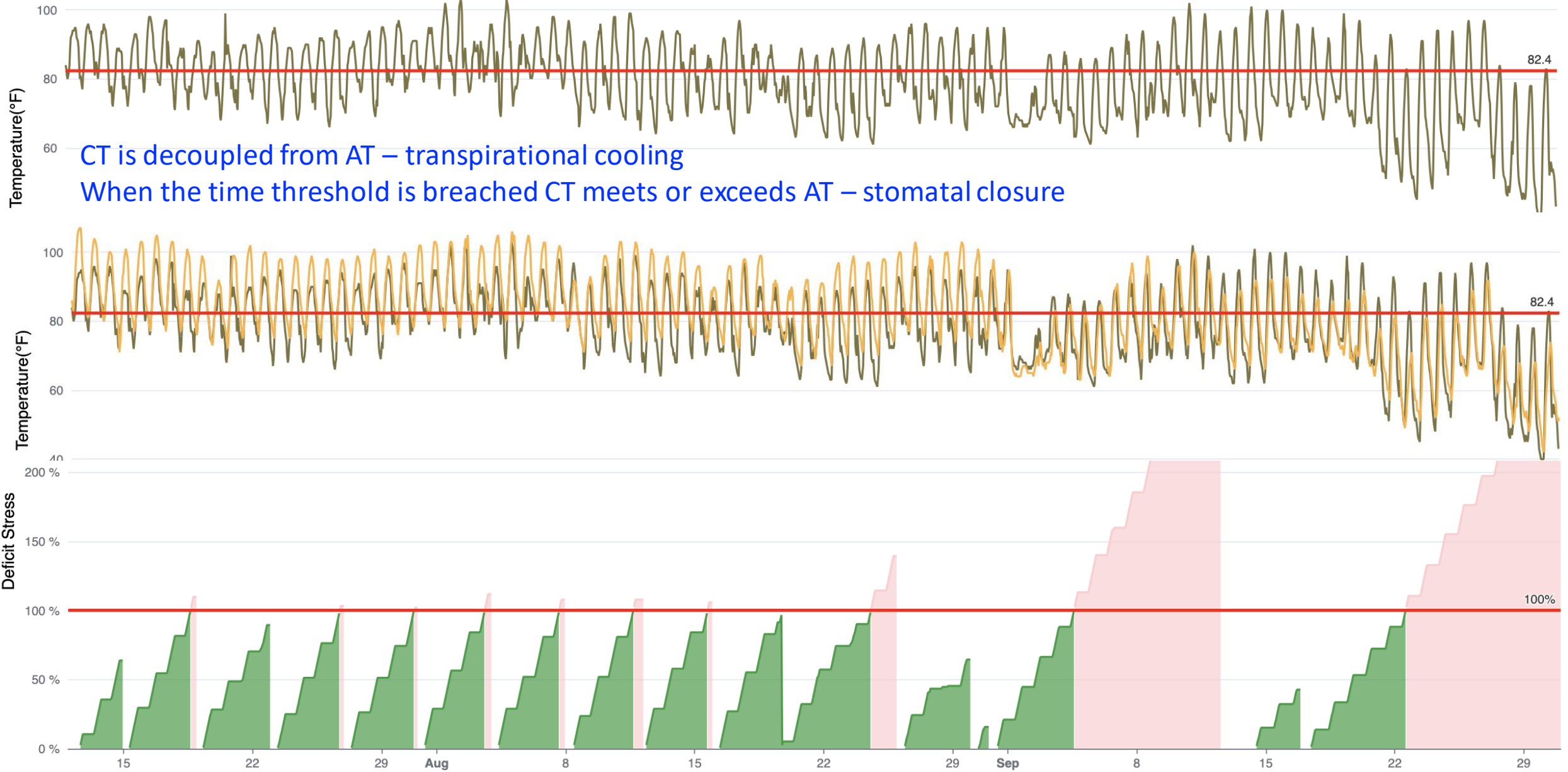
Sandy Soil

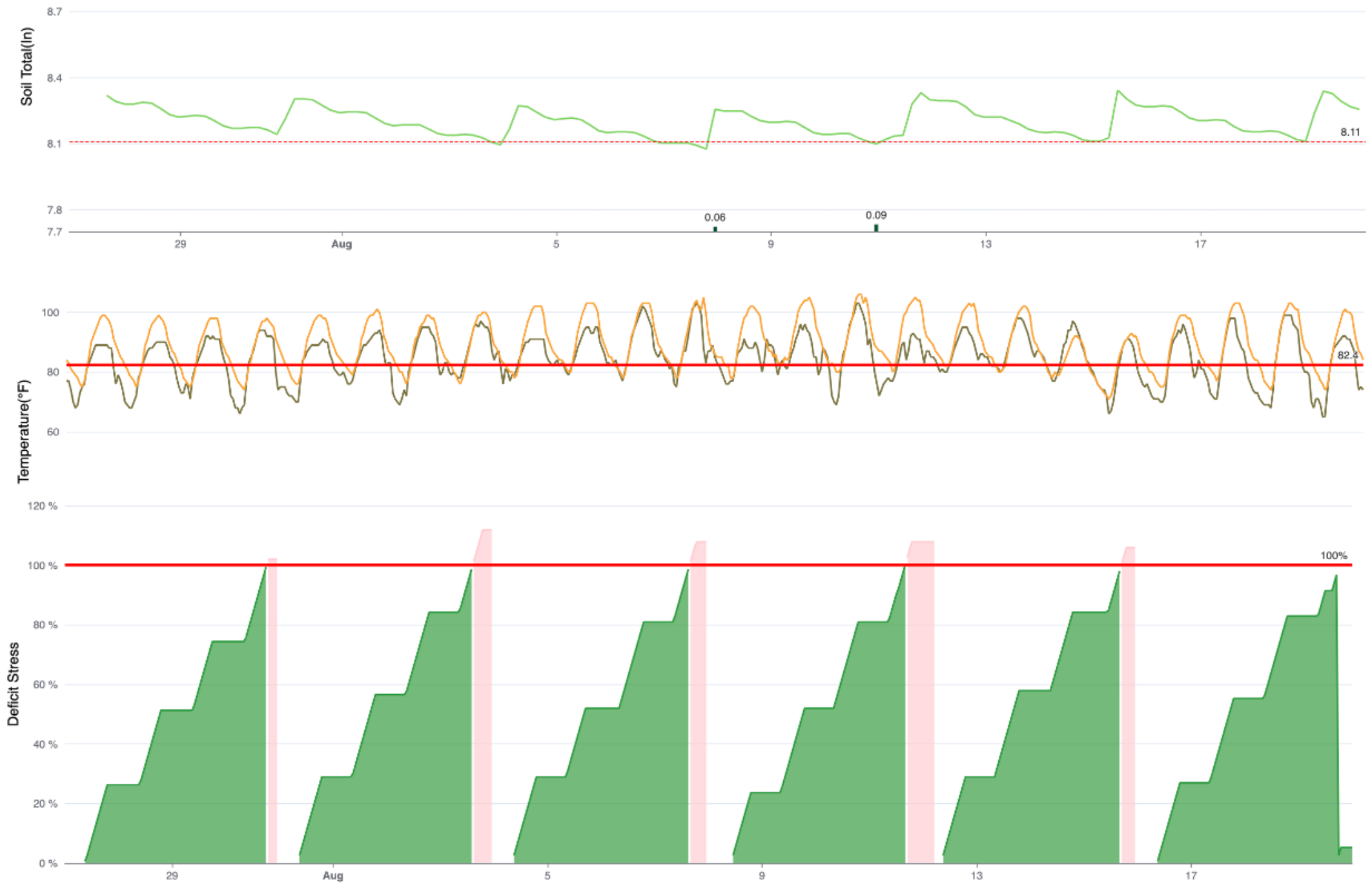
deep rooted with high irrigation efficiency

infiltration down 16" and rainfall event Sept 1 infiltration to 28"

crop was extracting water below 32" by August

Canopy Temperature





Swisher County Pivot

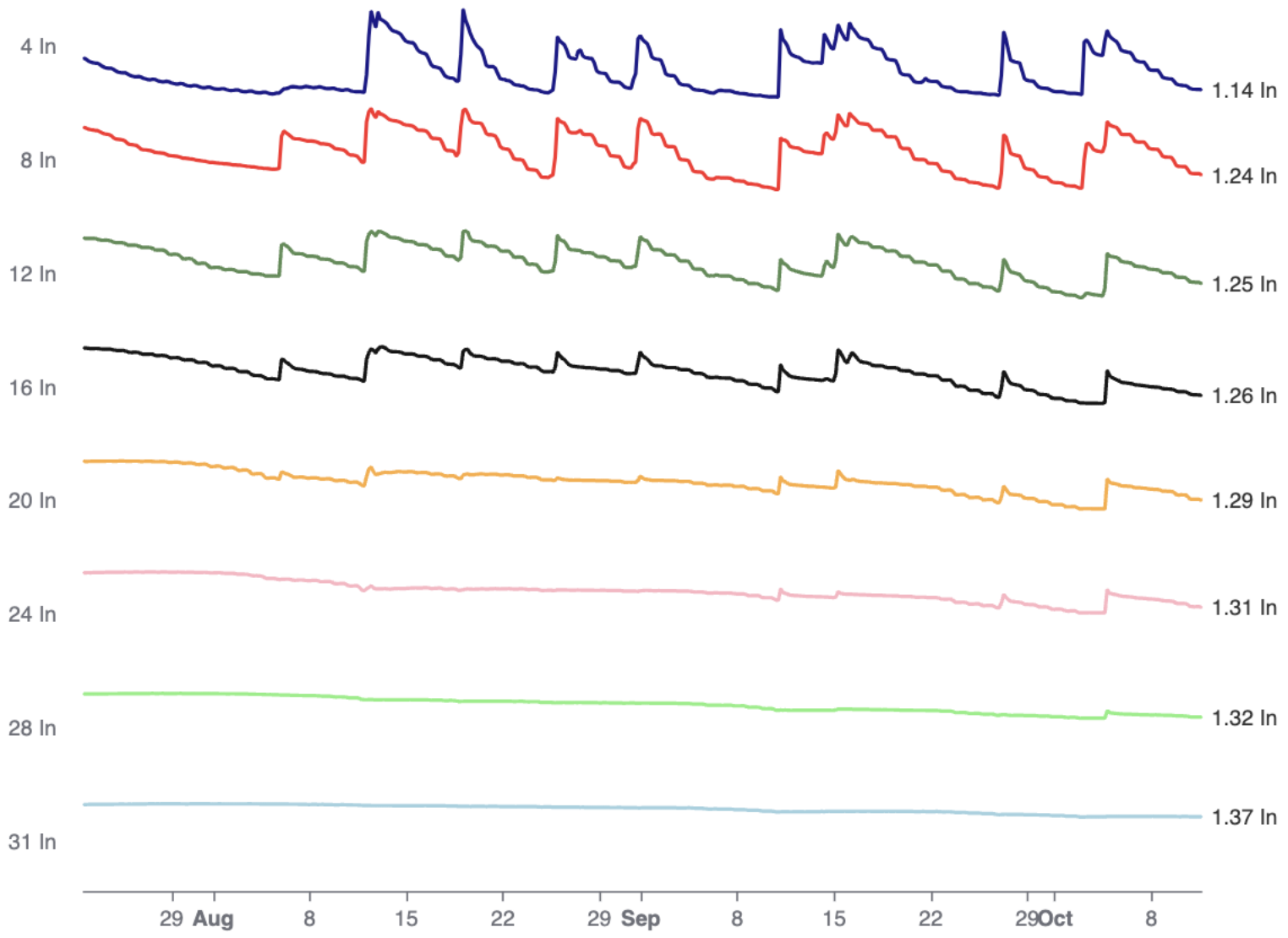
Low frequency (7-day interval)

High Volume (1.5" per pass)

sandy loam

sorghum 3800 lbs/ac on 10.5" applied





Sandy Loam
 deep rooted with high irrigation
 efficiency

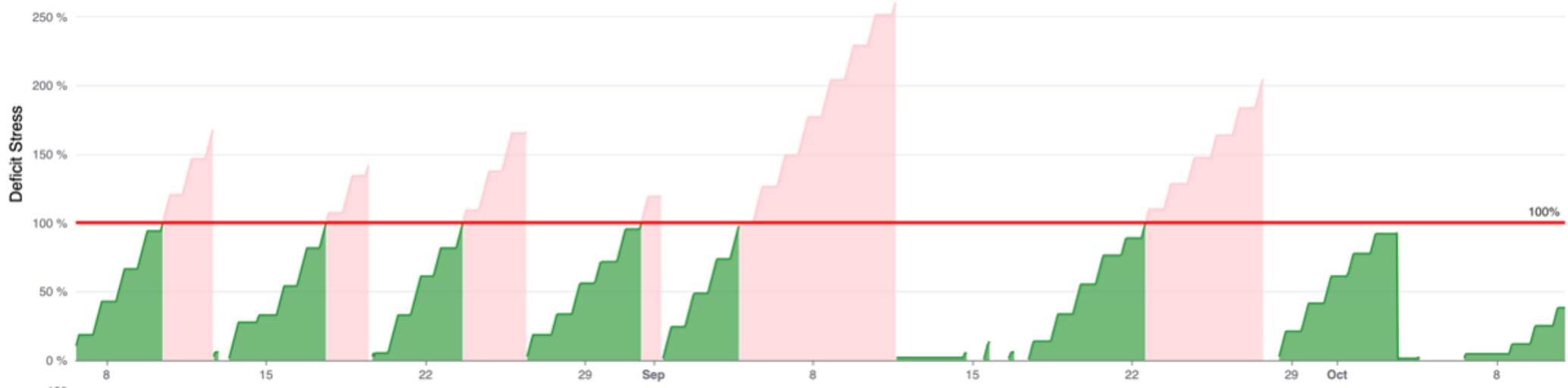
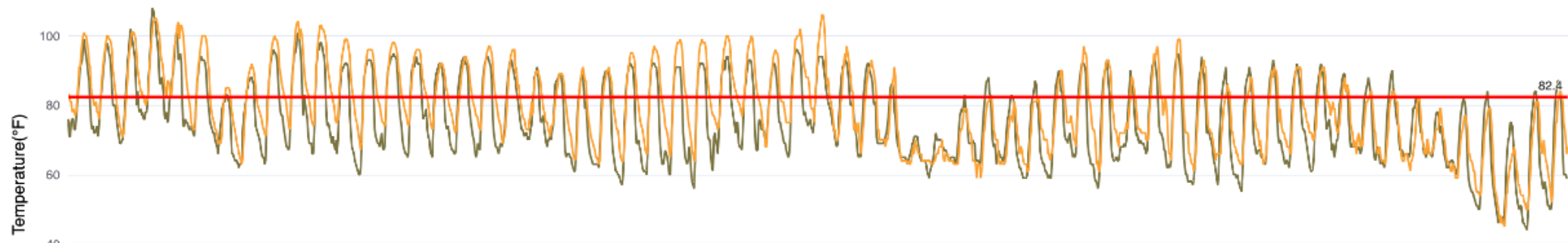
infiltration > 20" and rainfall event
 Sept 15 infiltration to 24"

crop was extracting water below 24"
 by August and 38" by mid-Sept.

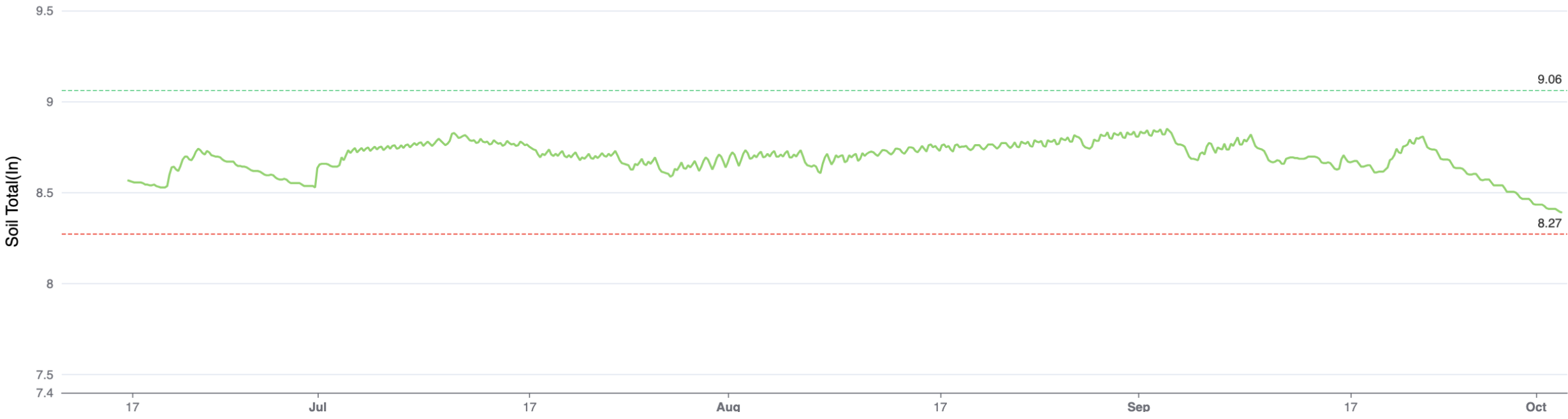


CT is decoupled from AT but only slightly

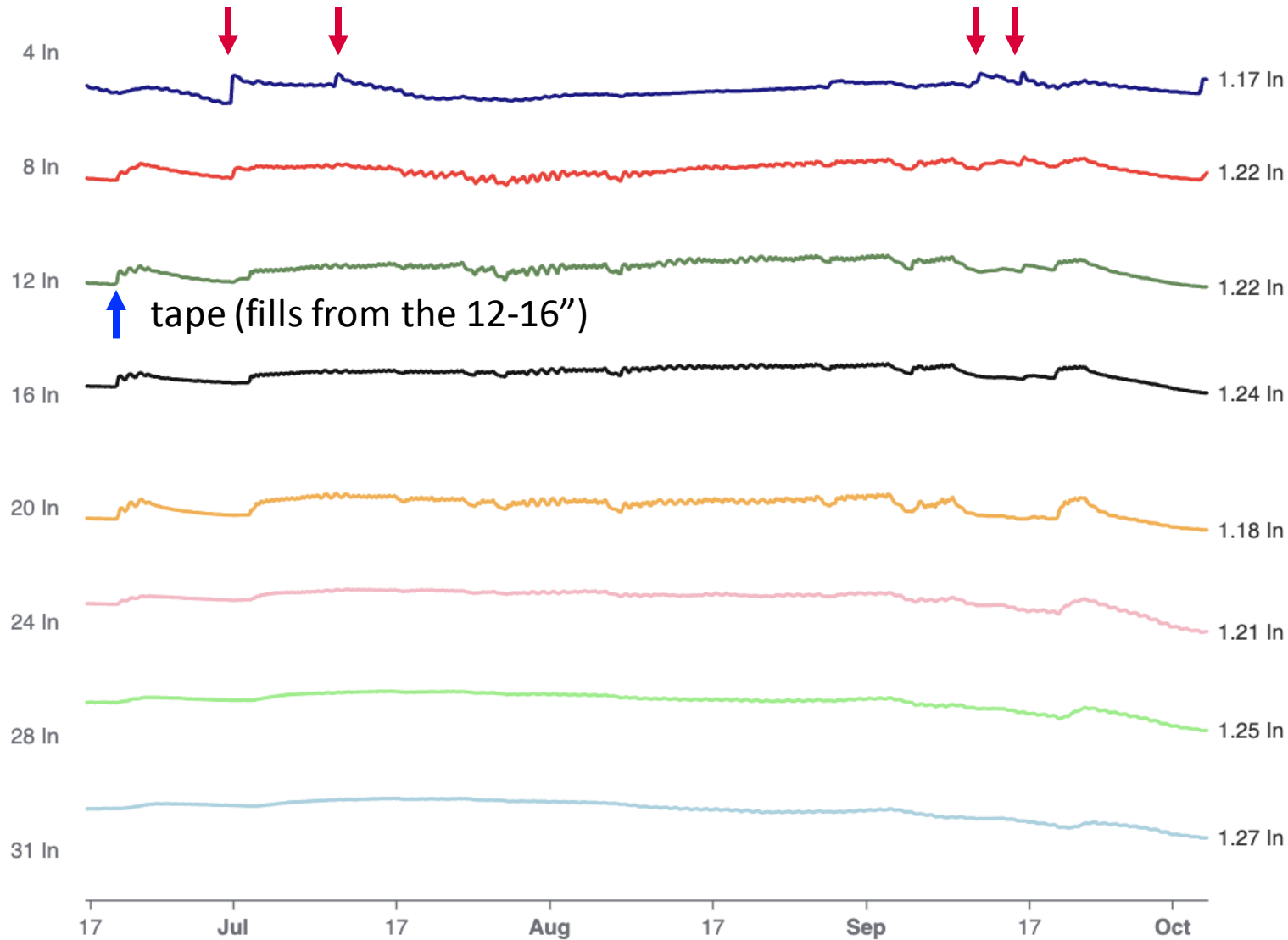
Crop is experiencing water deficit stress at the end of each interval (day 5 or 6)



Dawson County Drip
0.25" per day
High Volume (1.5" per pass)
sandy loam
cotton 1623 lbs/ac on 21" applied



rain (fills from the surface)

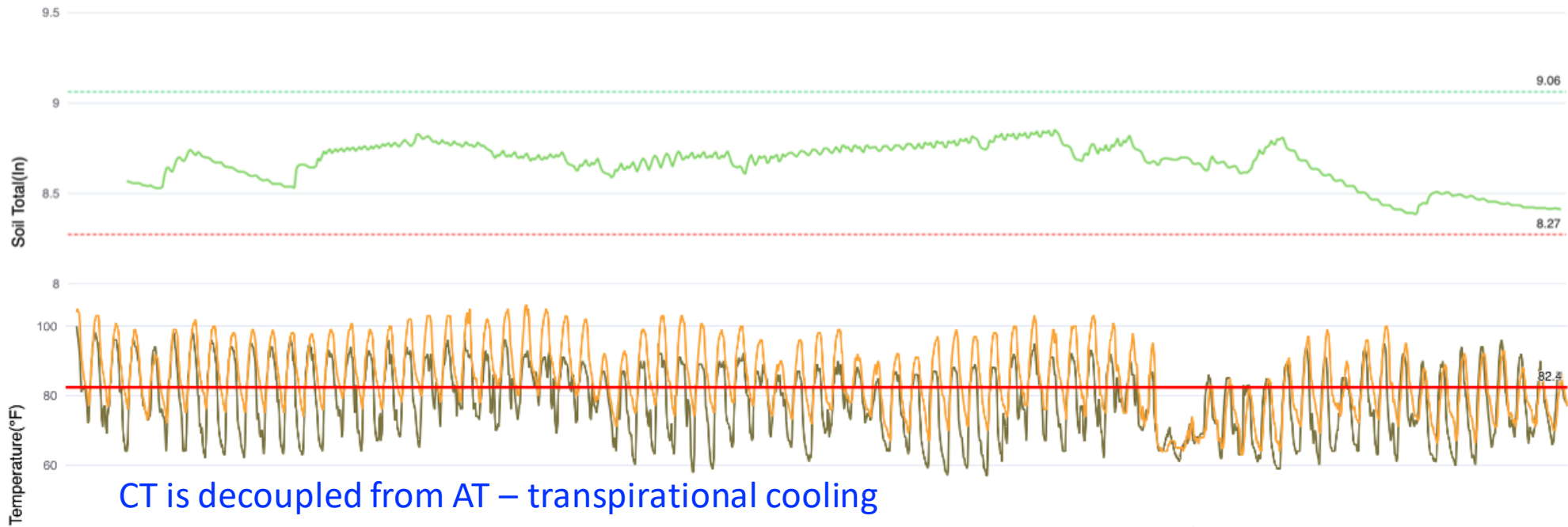


Sandy Loam

deep rooted with high irrigation efficiency (drip = no evap)

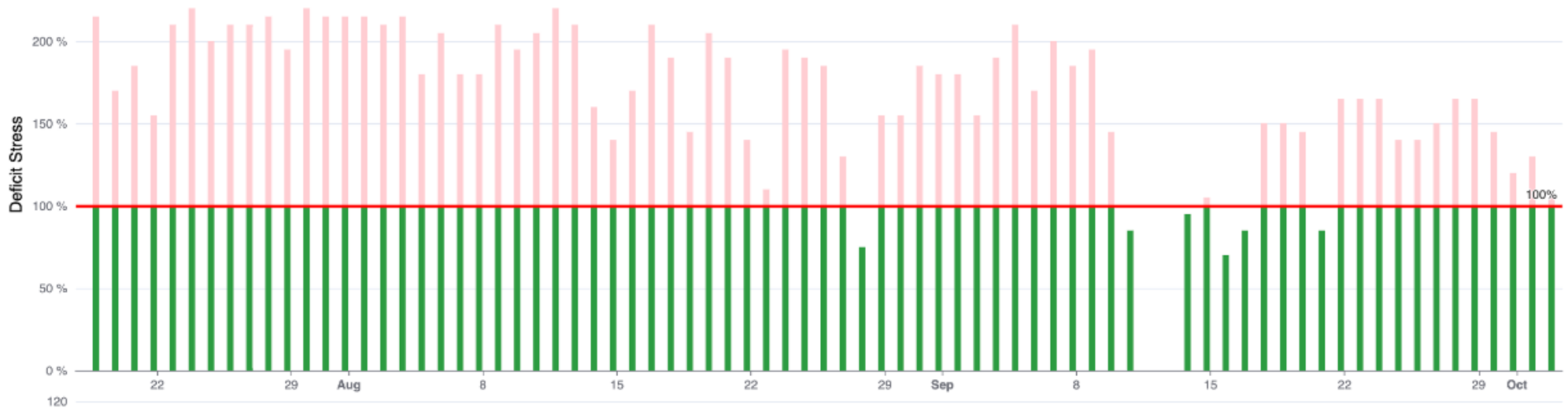
infiltration > 20" and rainfall event July 1 infiltration to 24"

crop was extracting water below 24" by July 1 and 38" by Aug 1.



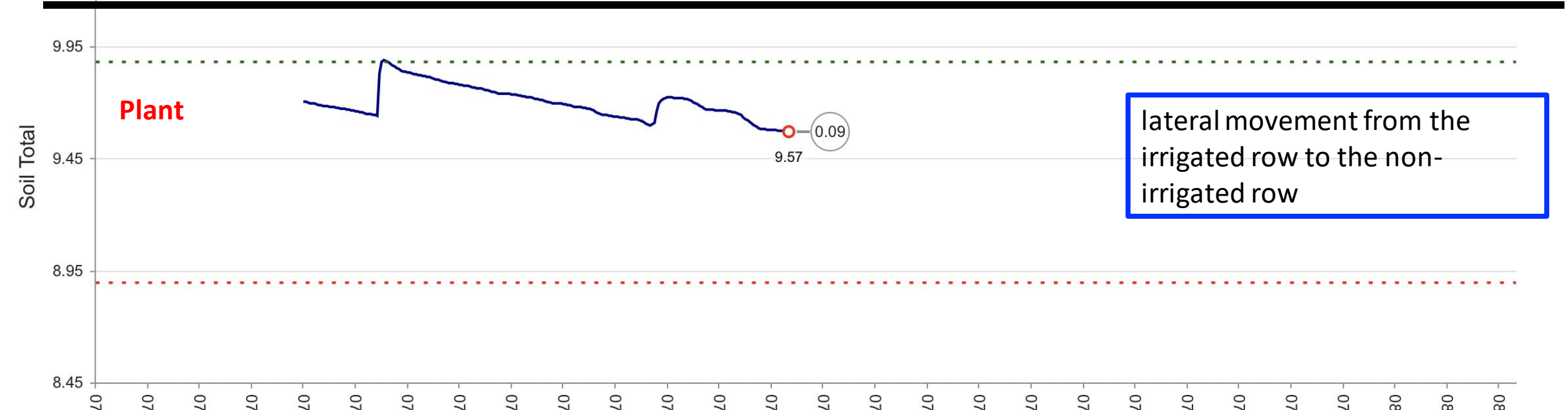
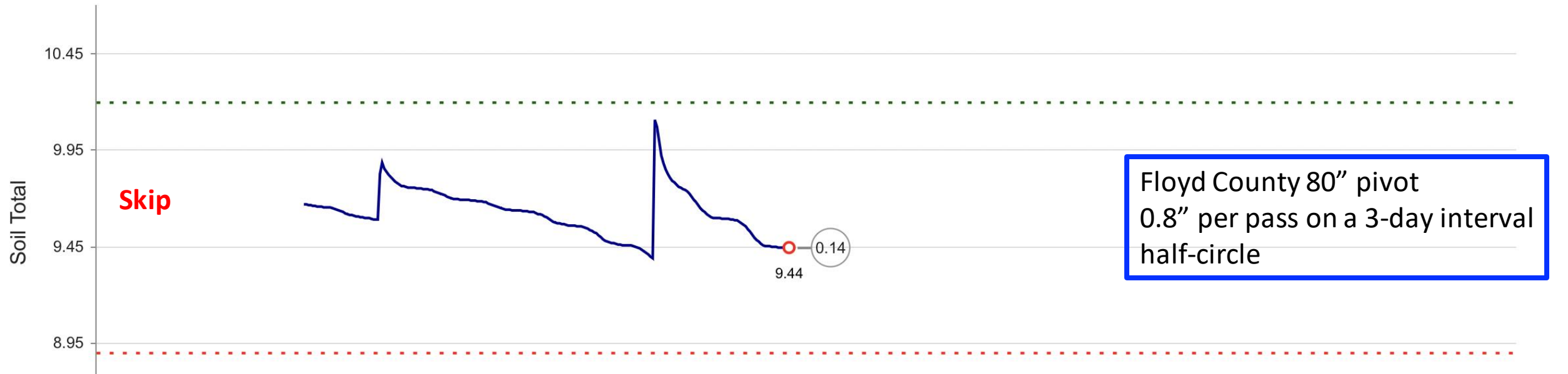
CT is decoupled from AT – transpirational cooling

CT stress is calculated on a daily basis – crop is experiencing water deficit stress daily but temperatures are controlled



Soil Total with Etc Forecast

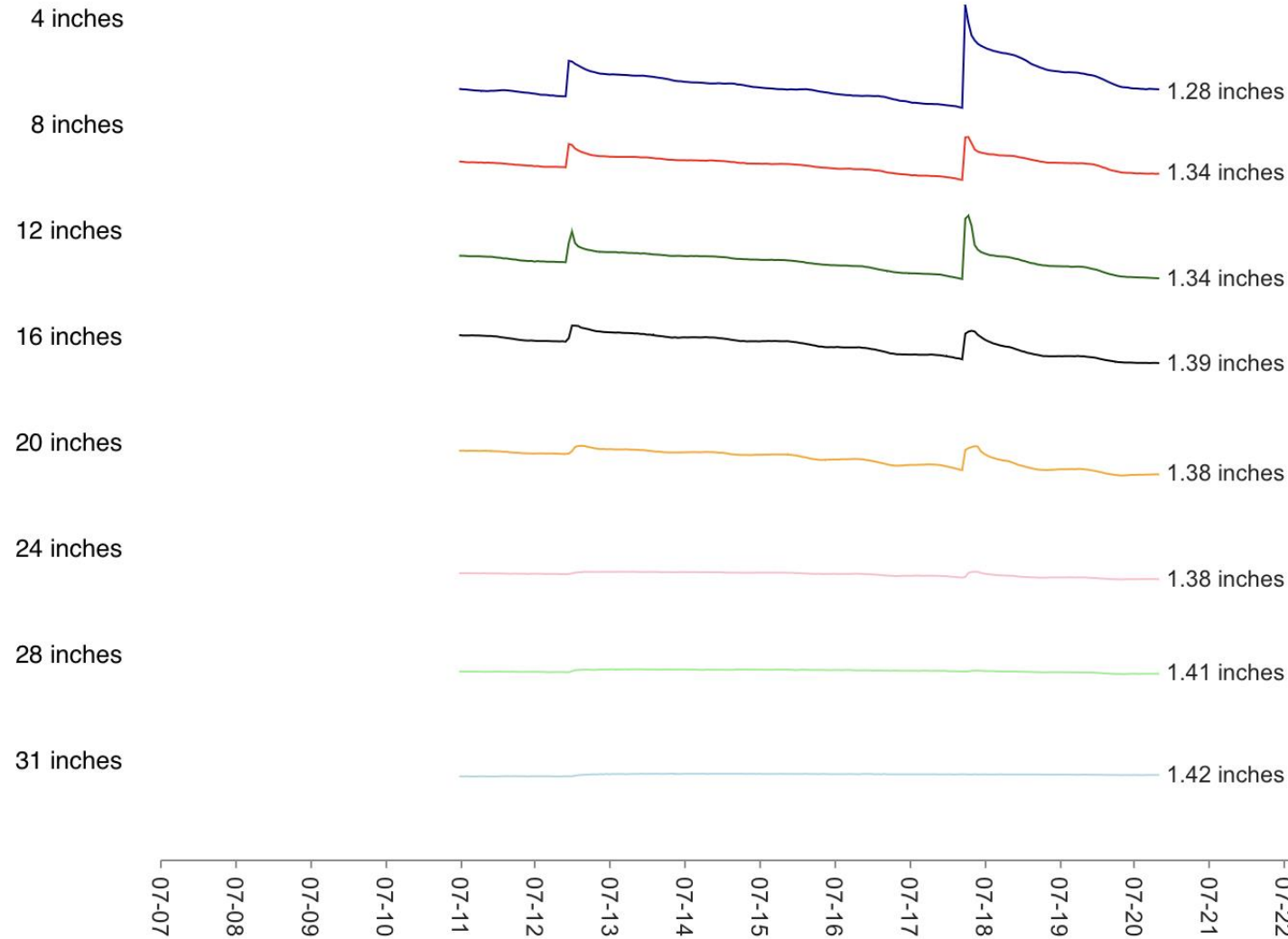
Soil Total Full Point Refill Point Default Use Irrigate Current Use Irrigate Last Total Soil Total Forecast Current Use Irrigate default



Skip

Soil Moisture Profile

Depth1 (4 inches) Depth2 (8 inches) Depth3 (12 inches) Depth4 (16 inches) Depth5 (20 inches) Depth6 (24 inches) Depth7 (28 inches) Depth8 (31 inches)

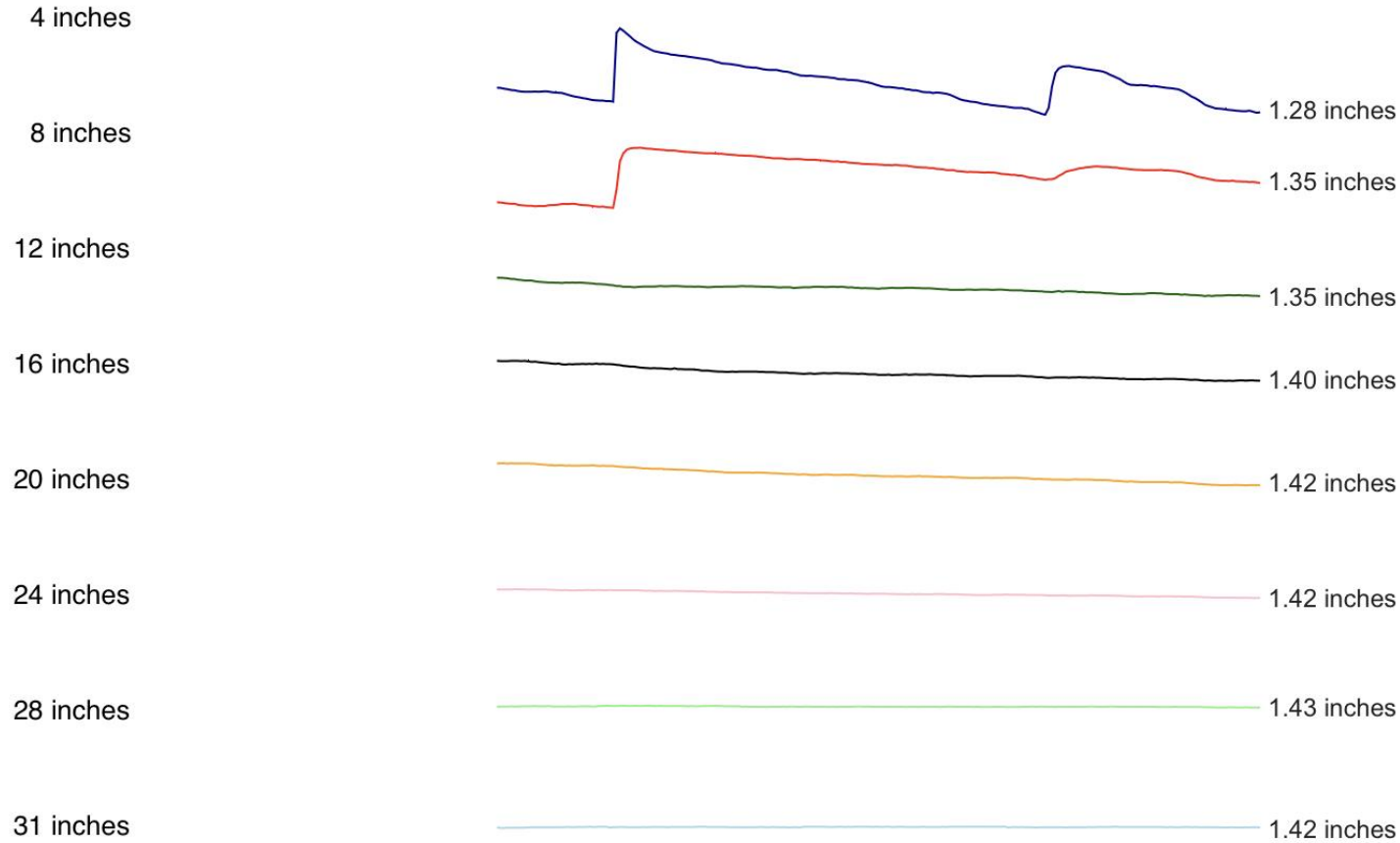


deep infiltration > 20"
root extraction > 24"

Plant

Soil Moisture Profile

Depth1 (4 inches) Depth2 (8 inches) Depth3 (12 inches) Depth4 (16 inches) Depth5 (20 inches) Depth6 (24 inches) Depth7 (28 inches) Depth8 (31 inches)



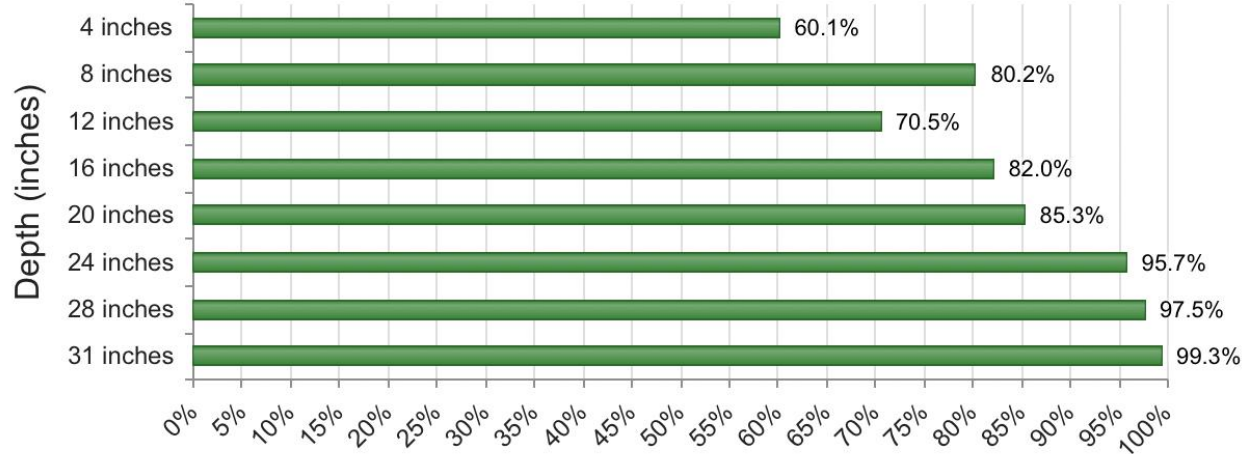
non-irrigated row
deep infiltration > 12"
root extraction > 20"

07-07 07-08 07-09 07-10 07-11 07-12 07-13 07-14 07-15 07-16 07-17 07-18 07-19 07-20 07-21 07-22 07-23 07-24 07-25 07-26 07-27 07-28 07-29 07-30 07-31 08-01 08-02 08-03

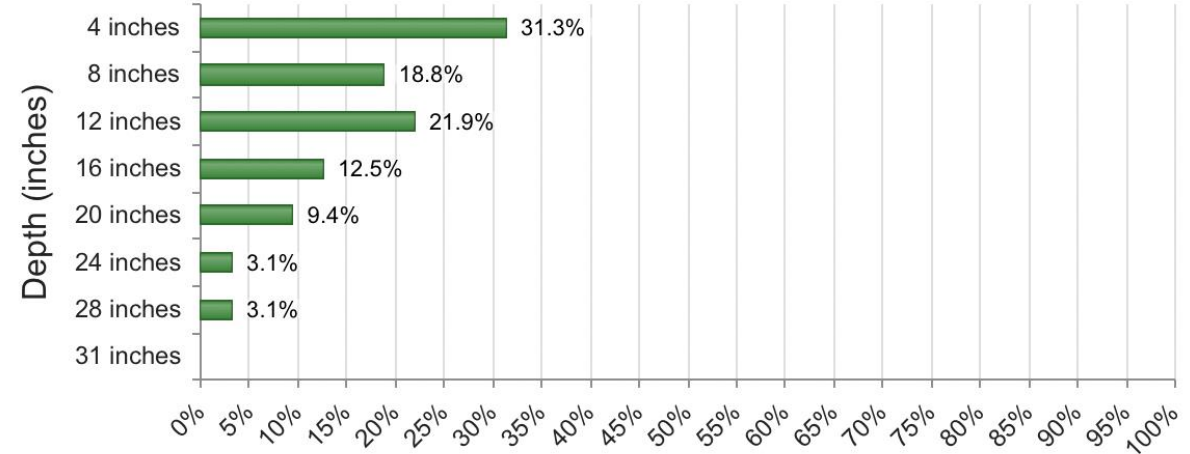
Skip

Water use at depth 1 day after irrigation

% Available Moisture Rootzone

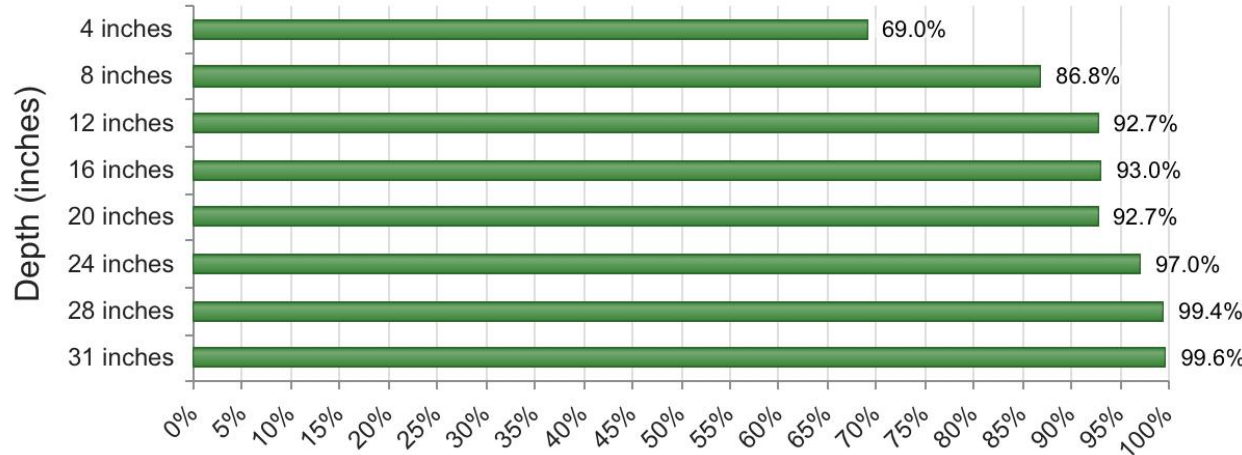


% Daily Use of Rootzone

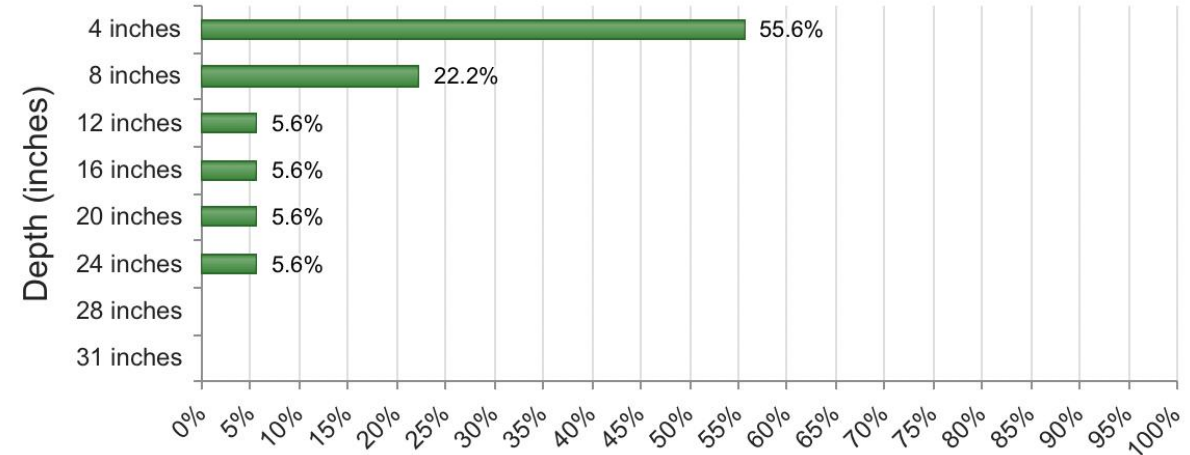


Plant

% Available Moisture Rootzone



% Daily Use of Rootzone



Simple Rules

1. Deep roots are important

- Do not start irrigation until roots are extracting water at 20" or deeper
 - there are some exceptions, e.g. sandy soils or extreme early season water deficits
- If the first irrigation of the season is too early, you may short root the crop

2. Only apply enough water to refill the profile.

- If there is room for 1" in the profile, don't add 2"
- Depends on your efficiency (you may have to apply 1.5" to get 0.75" in the profile)
- Efficiency may be improved by management
 - cover crops, optimal timing, pulsed irrigation – all specific to region, infrastructure, and system

3. Irrigate as few times as possible

- maximizing efficiency and timing will minimize the number of irrigation events
 - minimizes lift costs, equipment usage, and in some cases total water applied
 - potential for split paddocks or pivots with cash crops and opportunity crops (rainfed +)

Conclusion

- Most irrigators have figured this out over time
 - Sensors help when conditions deviate from average
 - Quantitative measurement of soil water infiltration from irrigation and rainfall (moisture probe) and how that water is being used by the plant (canopy temperature)
- The combination of soil-moisture sensor and canopy temperature measurement tell you how and when to irrigate and the information is provided in a straight-forward way
 - Soil moisture content alone is limited in terms of quantifying crop water stress
 - Coupled with an actual plant measurement results in an improved irrigation control system
- Increased application efficiencies
- Reduced crop water deficit stress
- Increased water productivity (lbs of yield per inch of irrigation)
 - Not necessarily increased yields but maximized profit

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