Irrigation Scheduling in Blackberries

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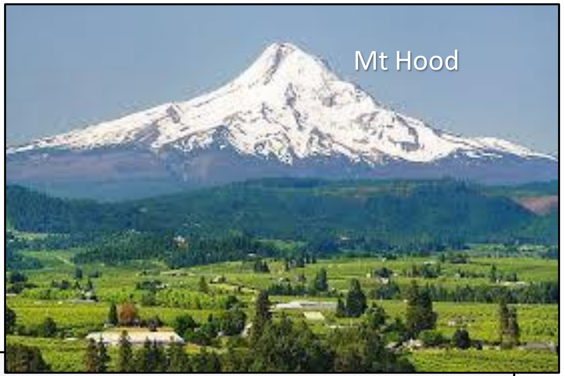
Horticultural Crops Production and Genetic Improvement Research Unit

Oregon Blackberries

- Largest producer of processed blackberries in USA
  24,900 tons from 6200 acres in 2022
- Concentrated in the Willamette Valley
- Machine harvested and processed into IQF, purees, and juice



Florida Blackberries

- In Florida, blackberries are considered an emerging crop, with **only around 150 acres being commercially grown throughout the state**
- The fruit typically ripen during May and June
- The harvest season of most cultivars lasts about 3 to 4 weeks
- The plants are usually harvested by hand once or twice a week during the harvest period
- Plantings usually remain productive for 4 to 7 years
- **Irrigation is required for consistent blackberry production in Florida**

Reasons to Irrigate Blackberries

Water is essential for minimizing plant loss and establishing healthy roots and shoots

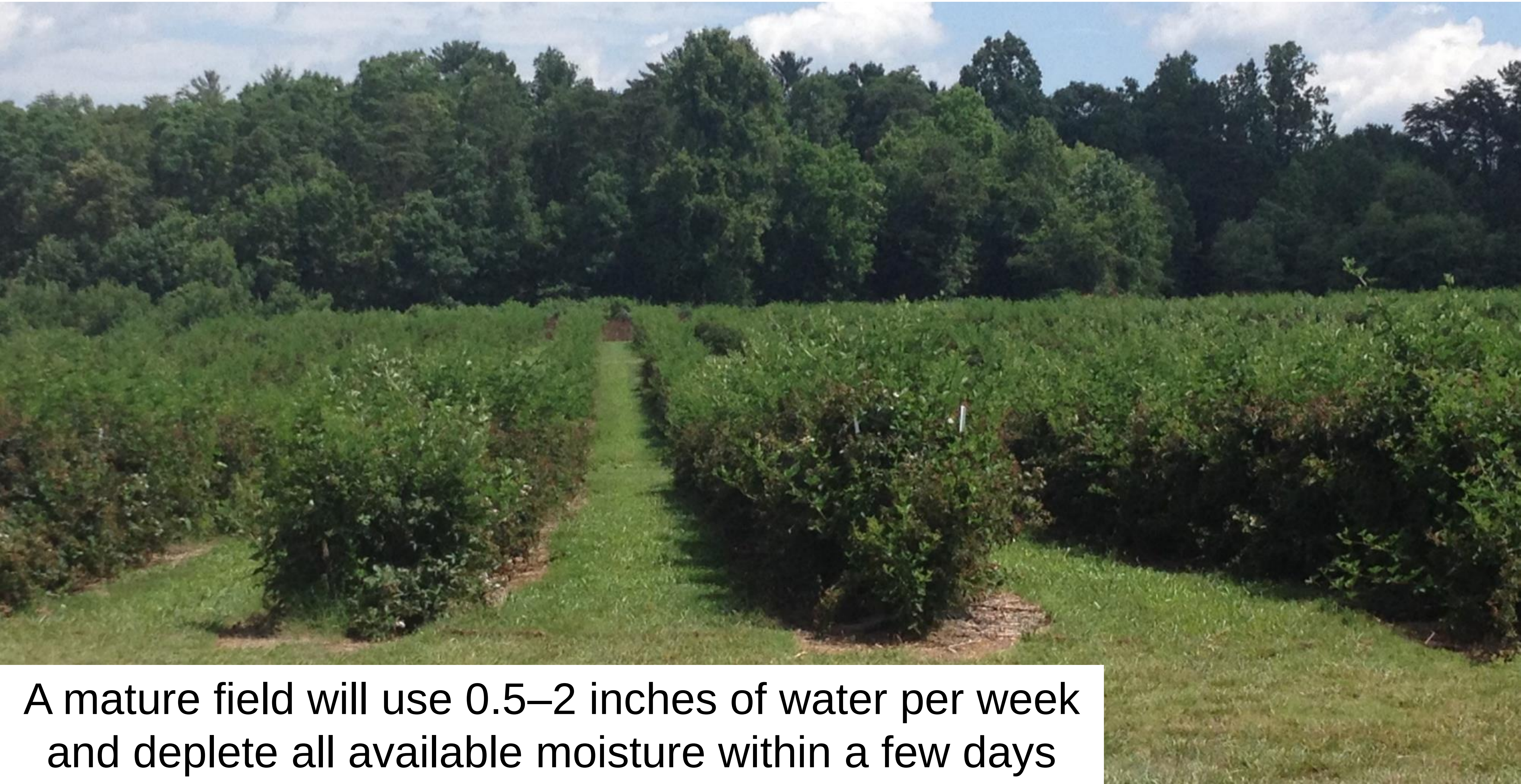
Reasons to Irrigate Blackberries

Water limitations during fruit development reduce fruit size, yield, and fruit quality

Reasons to Irrigate Blackberries

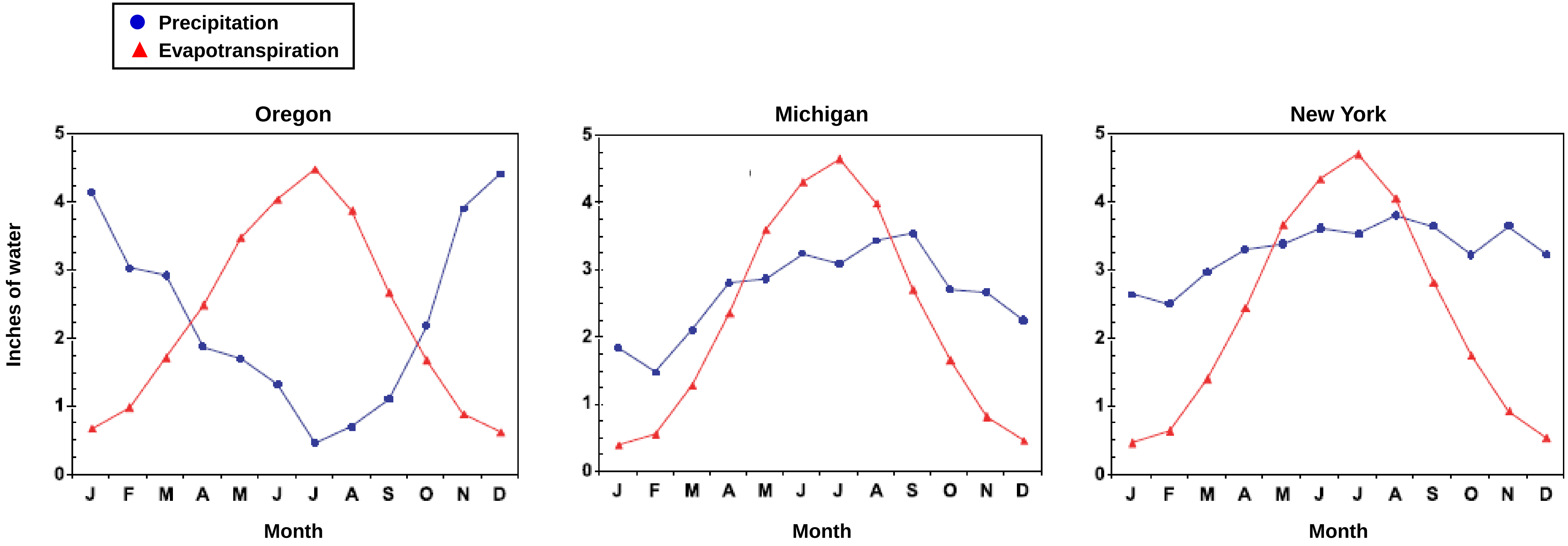
Water limitations reduce primocane vigor and flower bud development

Reasons to Irrigate Blackberries



A mature field will use 0.5–2 inches of water per week and deplete all available moisture within a few days

Do Not Plant Without an Irrigation System



From *Raspberry and Blackberry Production Guide: For the Northeast, Midwest, and Eastern Canada, NRAES-35.*

Irrigation is beneficial even in humid climates and is cheap insurance against catastrophic loss

Most Growers Use Drip Irrigation

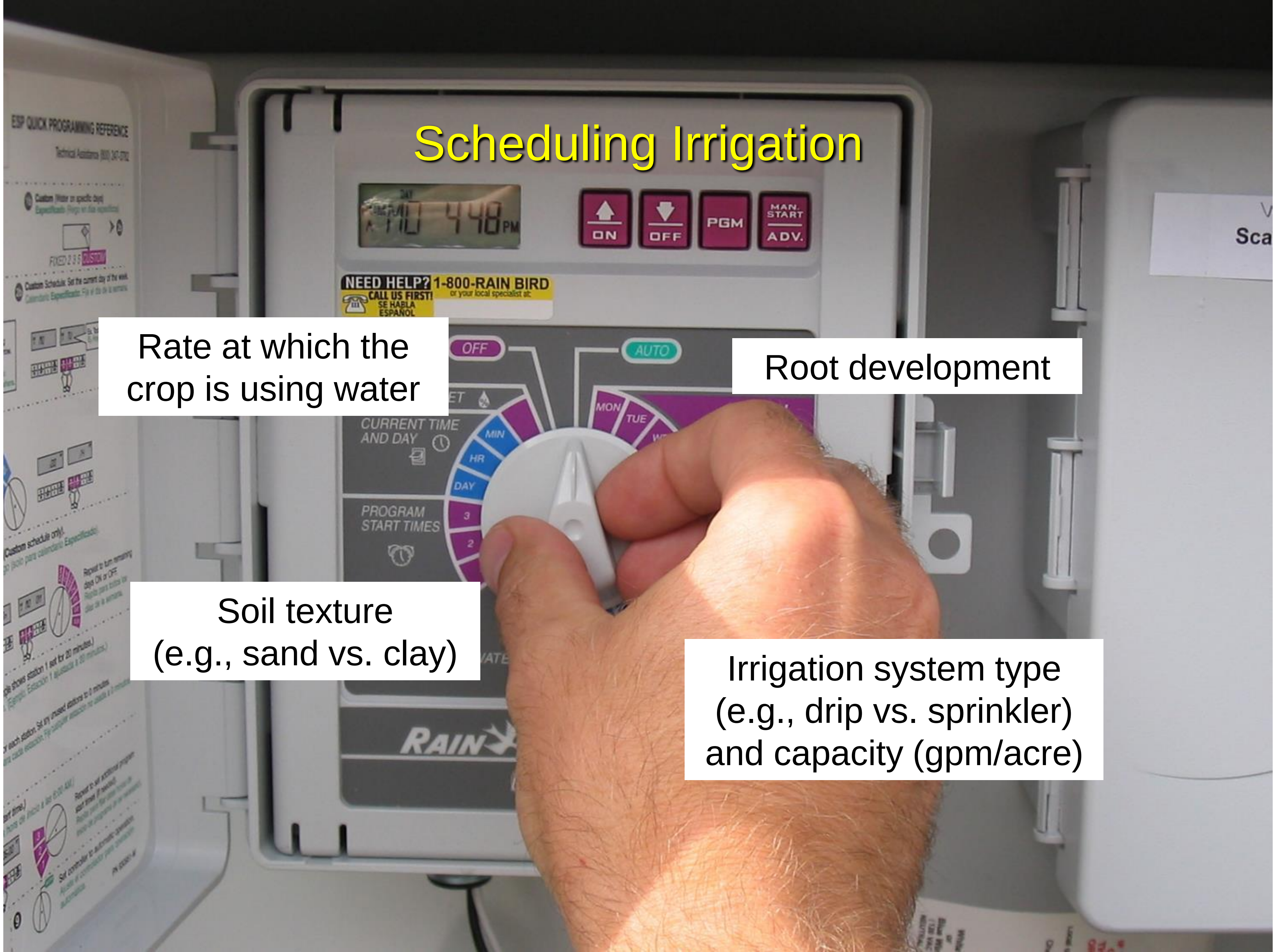
- **Potential benefits**
  - Lower energy costs
  - Higher water use efficiency
  - Fewer weeds
  - Discourages fungal and bacterial diseases
  - Less fertilizer
  - Easily automated

Oregon

- One line/row (surface or subsurface)
- 1-2.5 ft. emitter spacing *(adjust for soil type)*
- 0.25-1.0 gph emitters *(self-cleaning, pressure-compensating)*

When plastic mulch is used during establishment, it is common to place two lines of drip tape on either side of the row. Drip tape is replaced with tubing after 1 or 2 years and attached to wires at 12-18 inches above the soil surface.

Scheduling Irrigation



Rate at which the crop is using water

Root development

Soil texture (e.g., sand vs. clay)

Irrigation system type (e.g., drip vs. sprinkler) and capacity (gpm/acre)

"Rule-of-Thumb" Method

1. Assume 1-1.5 inches of water is required weekly (2 inches/week during fruiting)
2. Account for average weekly rainfall and apply the difference
3. Monitor soil conditions and avoid under- and over-irrigation

“Look-and-Feel” Method

How it works

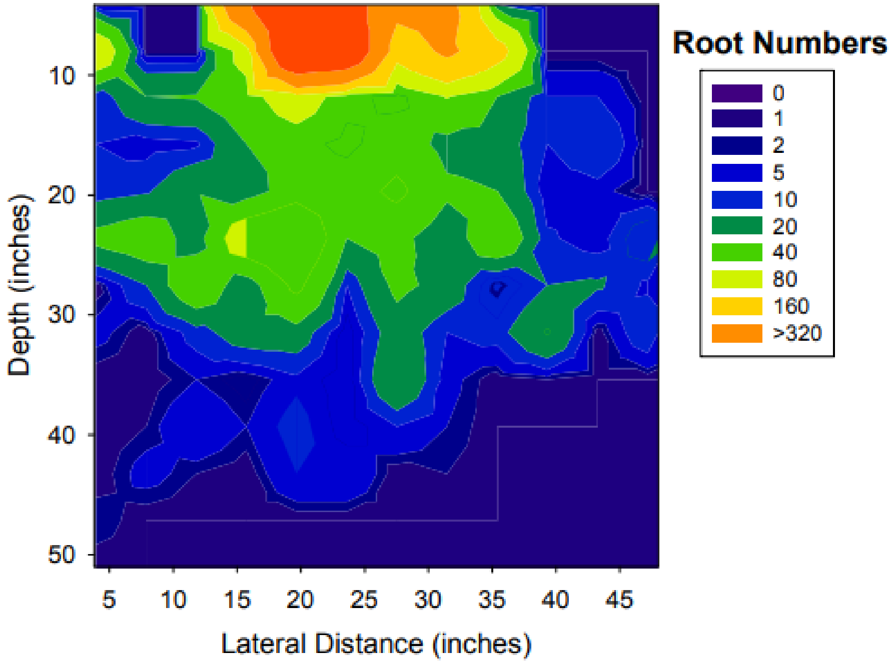
1. Soil is at “field capacity” when it is holding as much water as possible
2. It is best to irrigate when 25-50% of the available water is depleted
3. The goal when irrigating is to return the water in the soil to field capacity.

"Look-and-Feel" Method

What you need to know

- What is the effective root zone of your crop?
- What does the soil look like when half of that water is gone?
- How much water should be applied to return to field capacity?

Effective Rooting Depth



California

First year – 24” deep, 40” wide (33% of a 10-ft wide row)

Second year – 30” deep, 50” wide (42% of the row)

Cahn et al. (2008)

Evaluate Soil Moisture

Available water remaining in the soil	Sand, loamy sand	Sandy loam	Clay, clay loam, sandy clay loam
100%	When ball is squeezed, no free water appears on soil, but wet outline is left on hand		
Irrigation amount	None	None	None
75% to 100%	Sticks together only slightly	Forms a ball that breaks easily	Forms a ball; very pliable
Irrigation amount	0.1-0.2 inches/ft	0.2-0.3 inches/ft	0.2-0.4 inches/ft
50% to 75%	Appears dry, will not form a ball	Forms weak ball that falls apart	Forms ball; slightly plastic; slightly slick
Irrigation amount	0.2-0.3 inches/ft	0.3-0.4 inches/ft	0.3-0.5 inches/ft
25% to 50%	Appears dry, will not form a ball	Appears dry, will not form a ball	Somewhat crumbly, but holds under pressure
Irrigation amount	0.3-0.5 inches/ft	0.3-0.6 inches/ft	0.3-0.6 inches/ft
0% to 25%	Dry, loose, single grained, flows through fingers	Dry, loose, flows through fingers	Powdery, dry; easily breaks into powdery condition
Irrigation amount	0.3-0.5 inches/ft	0.3-0.6 inches/ft	0.3-0.7 inches/ft

Applying the Correct Amount of Irrigation Water

Recommended irrigation depth (previous step) x effective rooting depth = **amount of irrigation water needed**

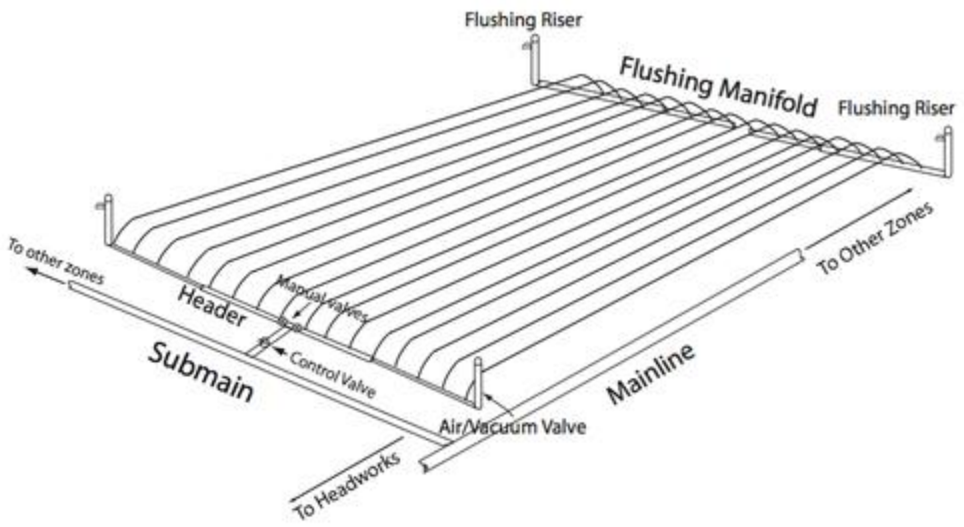
Example: *The soil is a sandy loam, and rooting depth is 18 inches. You feel the soil and observe that it forms a weak ball, which falls apart. Based on the guidelines in the previous table, you should apply 0.3 to 0.4 inch of water per foot of root zone depth.*

For an 18-inch (1.5-feet) root zone depth, the permissible irrigation amount is:

0.3 inches/foot of root zone x 1.5 feet = 0.45 inches
0.4 inches/foot of root zone x 1.5 feet = 0.60 inches

The recommended irrigation amount is between 0.45 and 0.60 inches

Hours of Irrigation

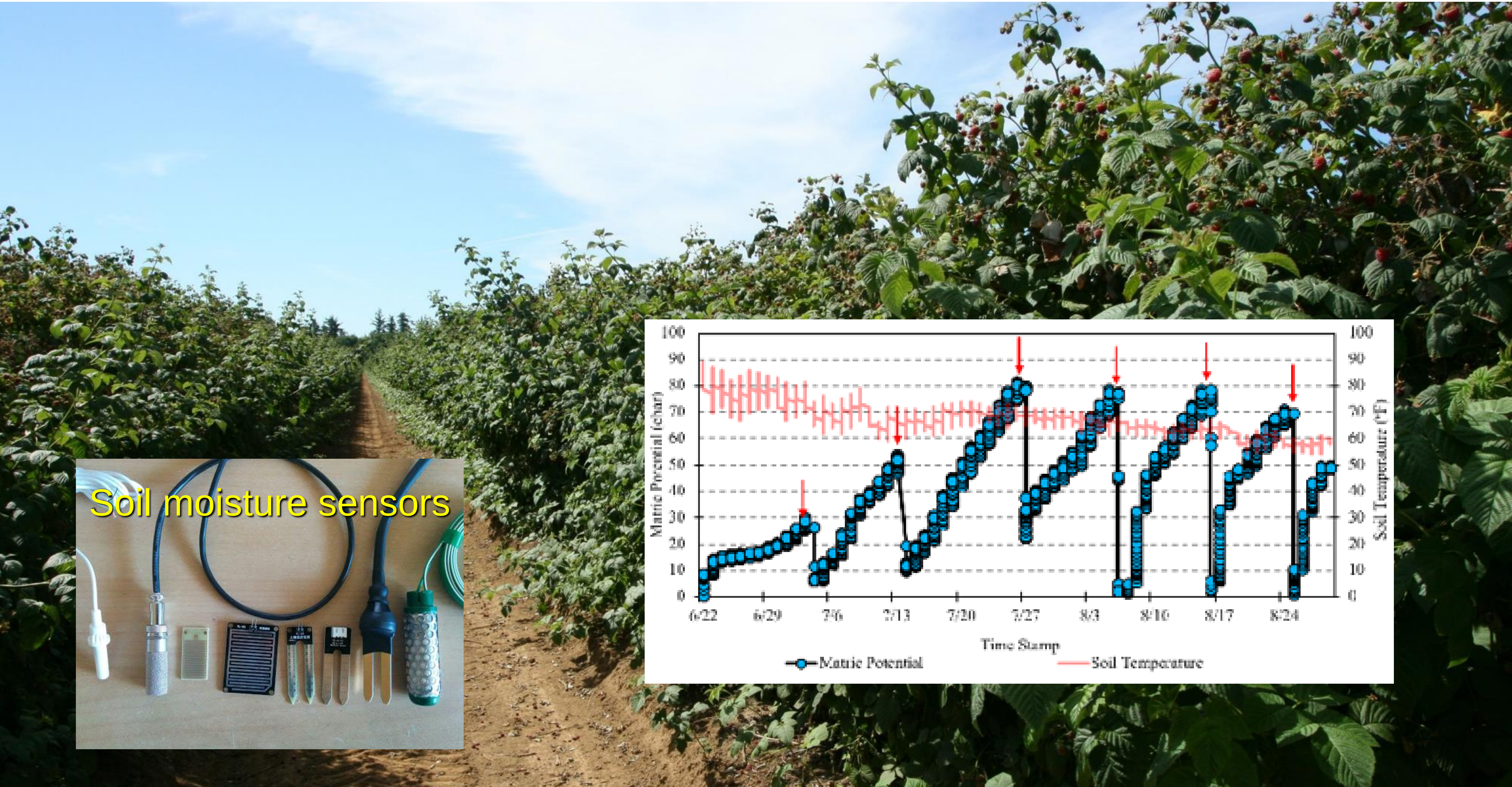


Rate of application depends on:

- emitter flow rate
- distance between emitters
- row spacing
- laterals per row
- operating pressure

Volume applied should be confirmed with a water meter

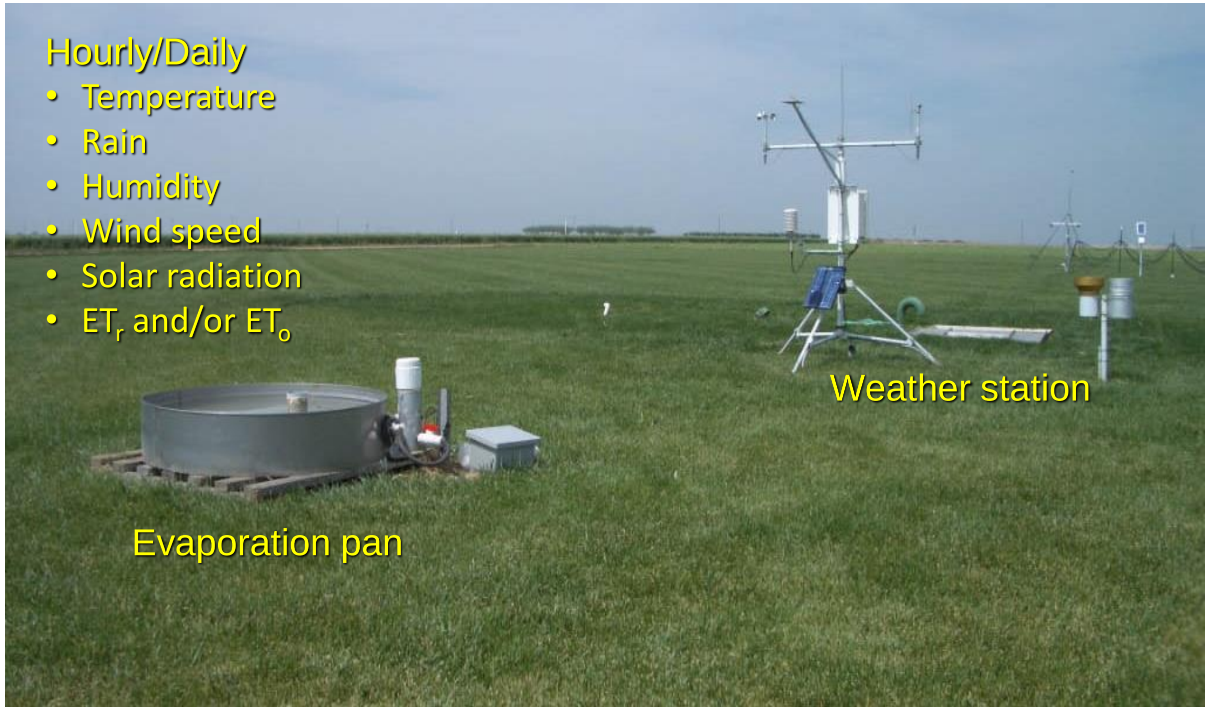
Soil-Based Irrigation Scheduling



Weather-Based Irrigation Scheduling

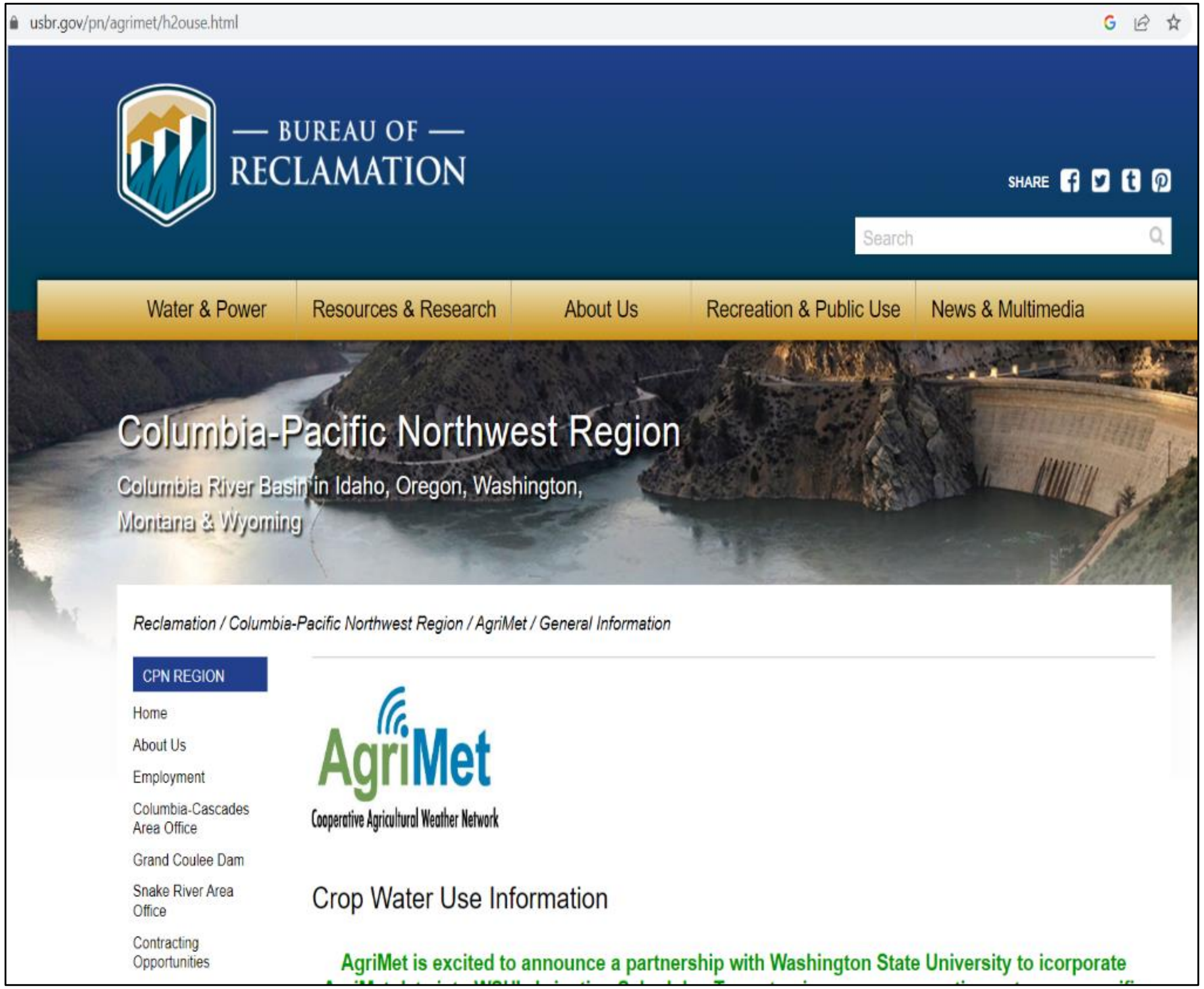
$$ET_c = ET_o \times K_c$$

- ET_c = crop evapotranspiration
  (crop water use estimate)
- ET_o = potential evapotranspiration
  (Available from automated weather networks)
- K_c = crop coefficient
  (differs for every crop)

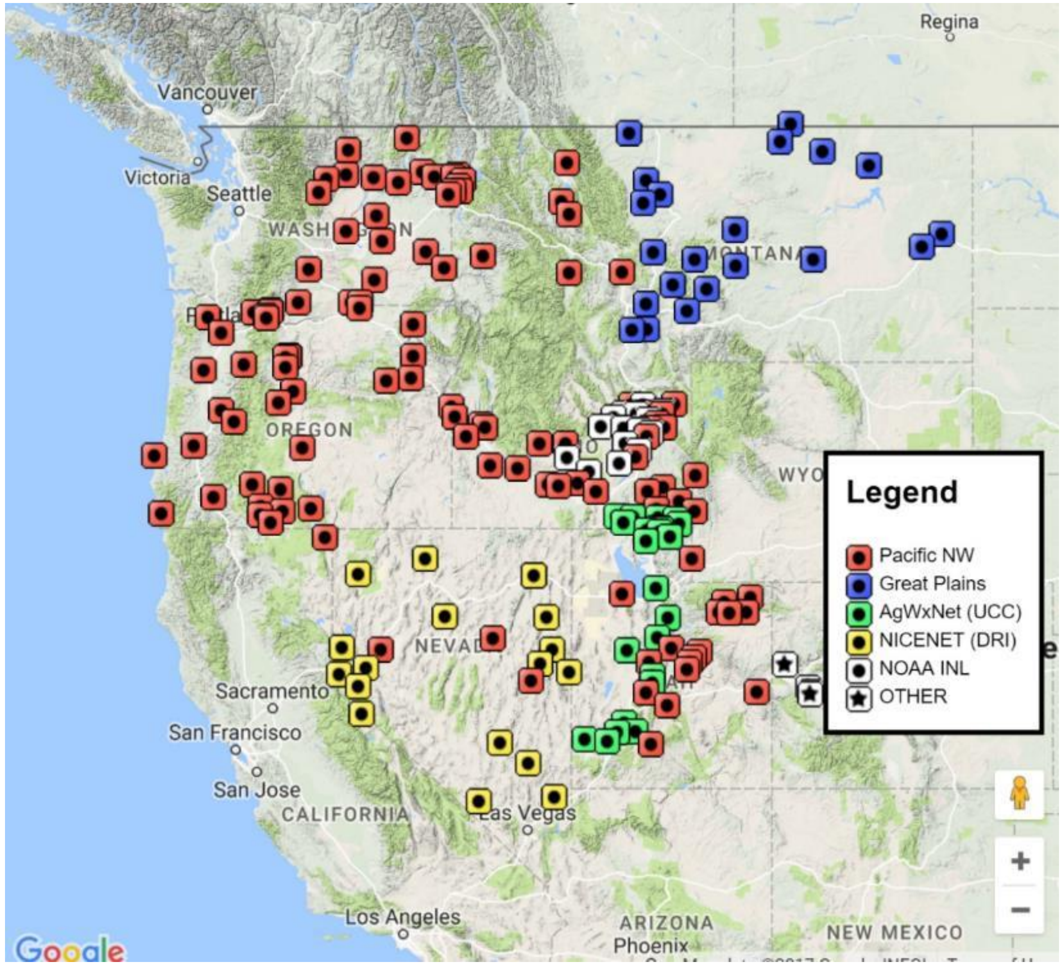


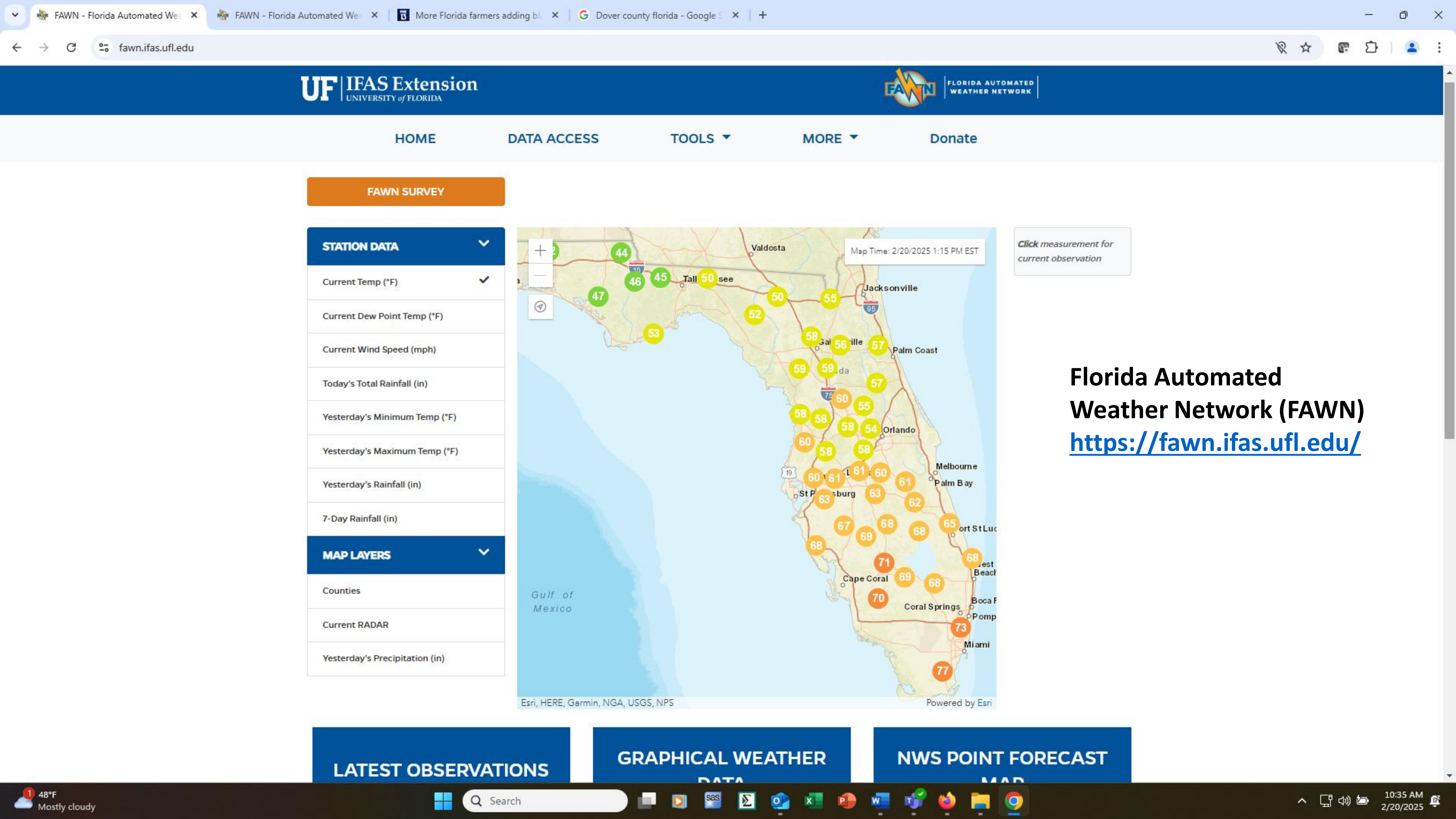
AgriMet

https://www.usbr.gov/pn/agrimet/



AgriMet Weather Stations





Florida Automated Weather Network (FAWN)

https://fawn.ifas.ufl.edu/

FAWN - Florida Automated We | FAWN - Florida Automated We | More Florida farmers adding bl | Dover county florida - Google S

fawn.ifas.ufl.edu

UF | IFAS Extension
UNIVERSITY of FLORIDA

FAWN | FLORIDA AUTOMATED WEATHER NETWORK

HOME | DATA ACCESS | TOOLS | MORE | Donate

- COLD PROTECTION
- IRRIGATION
  - Evapotranspiration (ET)
  - Citrus Irrigation
  - Strawberry Irrigation
  - Vegetable Irrigation
  - Row Crop Irrigation
  - Urban Irrigation
  - Your Virtual Lawn
  - Home Irrigation Presentation
  - Fact Sheets
  - Application Rate Worksheet
- CLIMATE
- Citrus Pesticide Tool

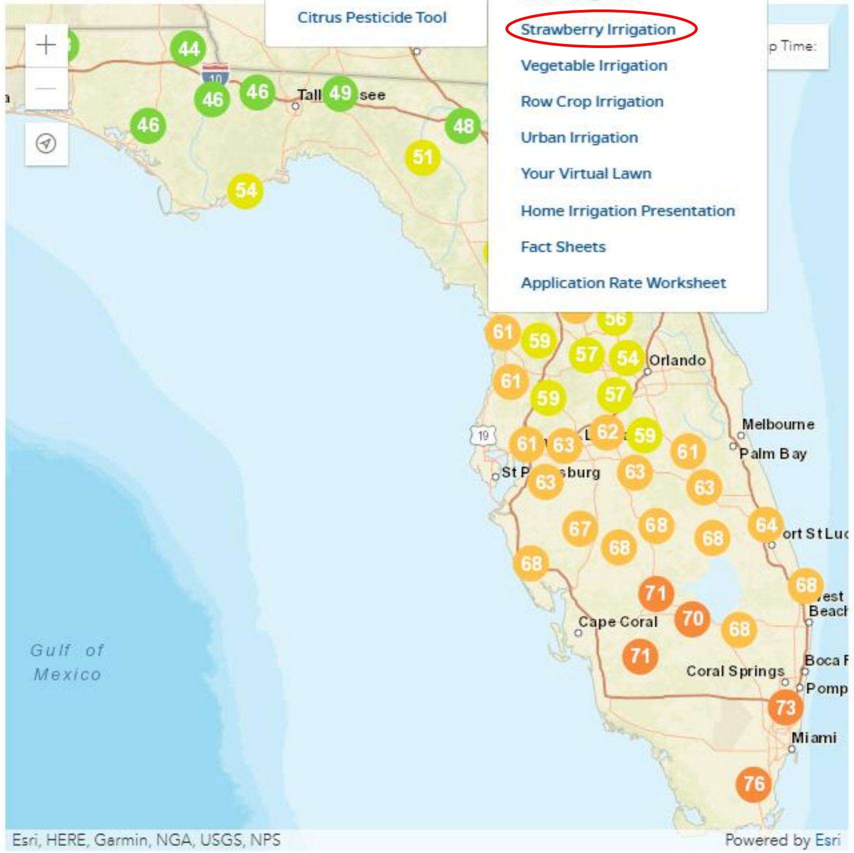
FAWN SURVEY

STATION DATA

- Current Temp (°F) ✔
- Current Dew Point Temp (°F)
- Current Wind Speed (mph)
- Today's Total Rainfall (in)
- Yesterday's Minimum Temp (°F)
- Yesterday's Maximum Temp (°F)
- Yesterday's Rainfall (in)
- 7-Day Rainfall (in)

MAP LAYERS

- Counties
- Current RADAR
- Yesterday's Precipitation (in)



Click measurement for current observation

LATEST OBSERVATIONS

GRAPHICAL WEATHER

NWS POINT FORECAST

https://fawn.ifas.ufl.edu/#

48°F Mostly cloudy

Search

10:40 AM
2/20/2025

STRAWBERRY IRRIGATION SCHEDULER

Please enter the specifications of your irrigation system and click [Create Schedule] to create a 2-week irrigation schedule.

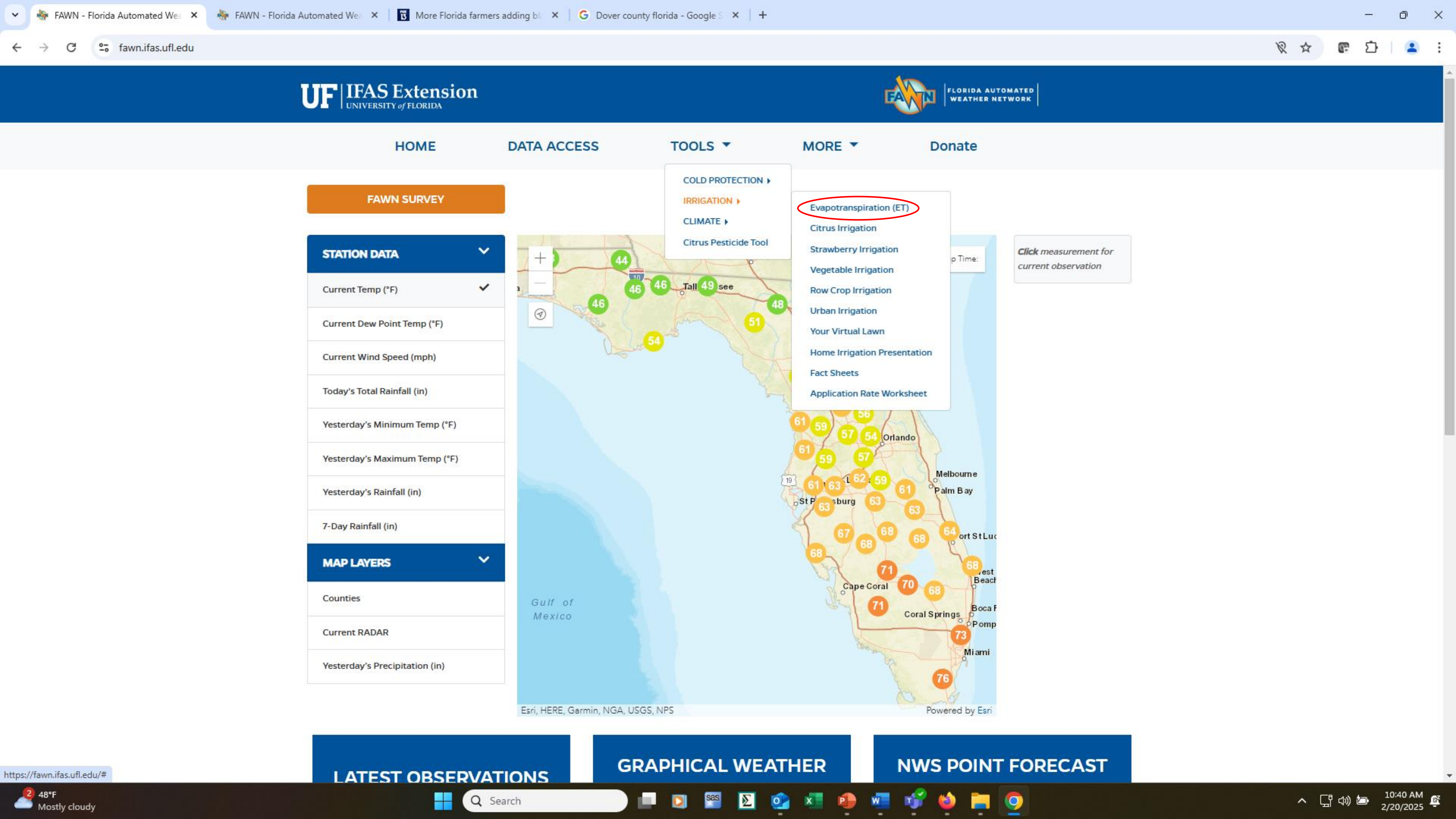
Planting	**Between-Row:** [ ] ft (1 - 10)
	Planting Date: [ ] mm/dd
	Harvest Date: [ ] mm/dd
Irrigation System	**Rate:** [ ] gals/100ft Row/hr (1 - 45)
	System Efficiency: 95 % (50 - 100)
Scheduling	**FAWN Station:** --choose--

Create Schedule

ABOUT / HELP

For help or more information about the scheduler, contact:

K.T. Morgan, Ph.D. <ktm@ifas.ufl.edu>
Assistant Professor, Soil and Water Science
University of Florida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STATION DATA
Current Temp (°F)
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Today's Total Rainfall (in)
Yesterday's Minimum Temp (°F)
Yesterday's Maximum Temp (°F)
Yesterday's Rainfall (in)
7-Day Rainfall (in)
MAP LAYERS
Counties
Current RADAR
Yesterday's Precipitation (in)
Click measurement for current observation
Orlando
Melbourne
Palm Bay
Cape Coral
Coral Springs
Miami
Gulf of Mexico
Esri, HERE, Garmin, NGA, USGS, NPS
Powered by Esri
LATEST OBSERVATIONS
GRAPHICAL WEATHER
NWS POINT FORECAST
https://fawn.ifas.ufl.edu/#
48°F
Mostly cloudy
Search
10:40 AM
2/20/2025

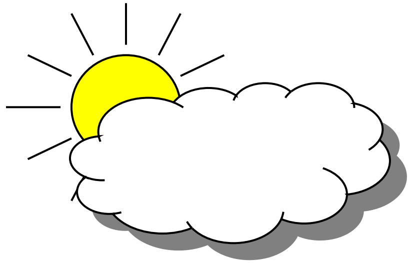
ET (EVAPOTRANSPIRATION) FOR PREVIOUS 7 DAYS IN INCHES

New! See 14-day graph: Dover Go

Station	2/13	2/14	2/15	2/16	2/17	2/18	2/19	7 Day Total	Daily Avg (gals/acre/day)
Alachua	0.10	0.09	0.10	0.07	0.08	0.09	0.05	0.57	0.08 (2225)
Apopka	0.11	0.08	0.12	0.09	0.09	0.09	0.08	0.67	0.10 (2593)
Arcadia	0.11	0.10	0.12	0.10	0.10	0.10	0.10	0.75	0.11 (2908)
Avalon	0.11	0.09	0.12	0.10	0.10	0.10	0.09	0.70	0.10 (2699)
Babson Park	0.11	0.10	0.13	0.11	0.10	0.11	0.10	0.76	0.11 (2956)
Balm	0.11	0.11	0.12	0.09	0.10	0.10	0.09	0.73	0.10 (2849)
Belle Glade	0.12	0.09	0.12	0.11	0.10	0.11	0.12	0.75	0.11 (2927)
Bristol	0.06	0.09	0.08	0.09	0.07	0.08	0.04	0.51	0.07 (1997)
Bronson	0.10	0.09	0.11	0.08	0.08	0.09	0.05	0.60	0.09 (2343)
Brooksville South	0.10	0.09	0.11	0.08	0.09	0.09	0.07	0.63	0.09 (2427)
Carrabelle	0.05	0.07	0.06	0.08	0.08	0.08	0.05	0.46	0.07 (1791)
Citra	0.11	0.08	0.10	0.08	0.08	0.09	0.05	0.60	0.09 (2315)
Clewiston	0.11	0.10	0.12	0.12	0.12	0.11	0.13	0.80	0.11 (3112)
Dade City	0.11	0.10	0.12	0.09	0.10	0.09	0.08	0.69	0.10 (2690)
DeFuniak Springs	0.08	0.09	0.07	0.09	0.07	0.07	0.05	0.53	0.08 (2069)
Dover	0.11	0.09	0.11	0.08	0.09	0.09	0.08	0.66	0.09 (2560)

Estimating crop evapotranspiration (ET_c)

Climate



Net radiation (R_n)
Soil heat flux (G)
Air temperature (T)
Wind speed (u_2)
Saturated VPD (e_s-e_a)
Slope vapor pressure curve (Δ)
Psychrometer constant ($\surd$)

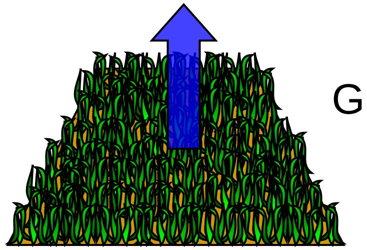
+

Penman-Monteith equation

$$\frac{0.408\Delta(R_n - G) + \surd \frac{900}{T + 273} u_2 (e_s - e_a)}{\Delta + \surd (1 + 0.34u_2)}$$

=

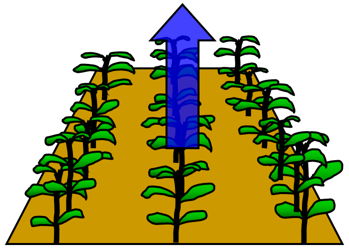
Potential evapotranspiration (ET_o)



Grass reference surface

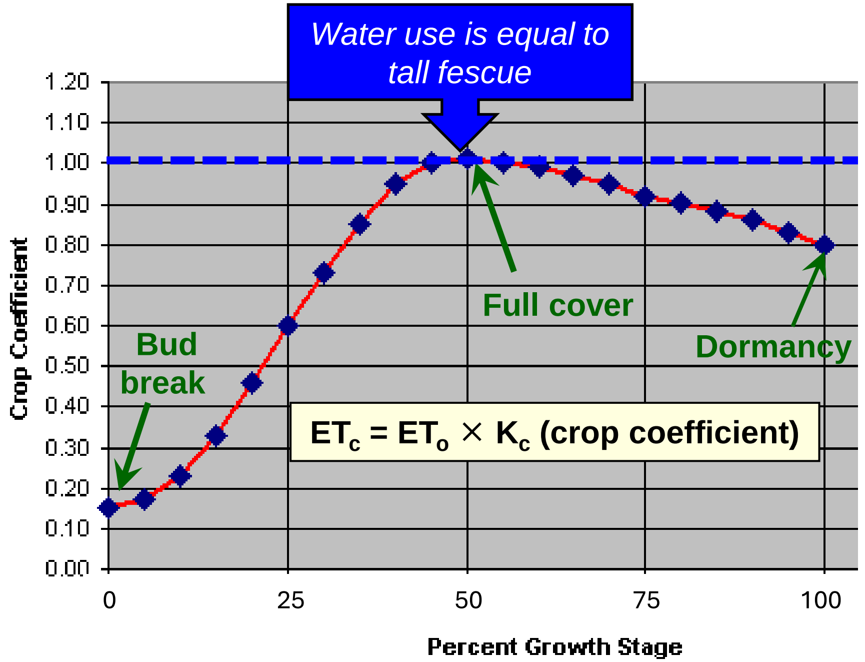
ET_o X **Crop coefficient (K_c)** =

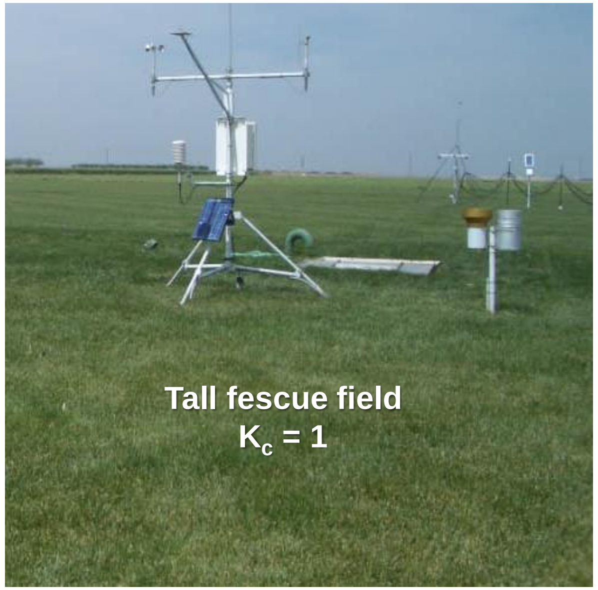
Crop evapotranspiration (ET_c)



Irrigation scheduling

Crop Coefficients for Blackberries





A survey in CA showed that growers using the K_c approach increased yield by 8% and reduced water use by 13%

Problem
No curve for blackberry

Mar. 23

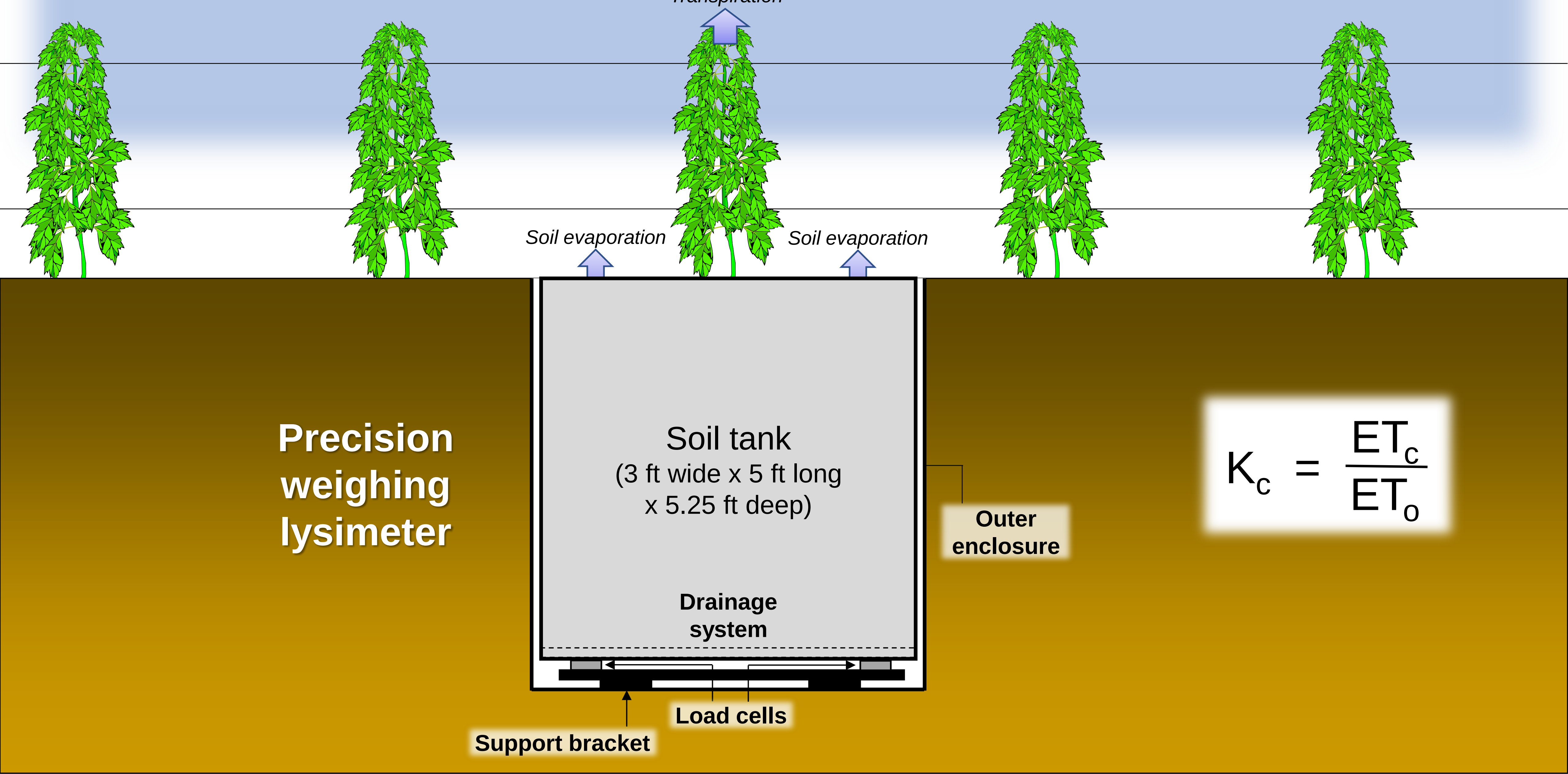
Apr. 21

May 18

June 15

Oct. 10

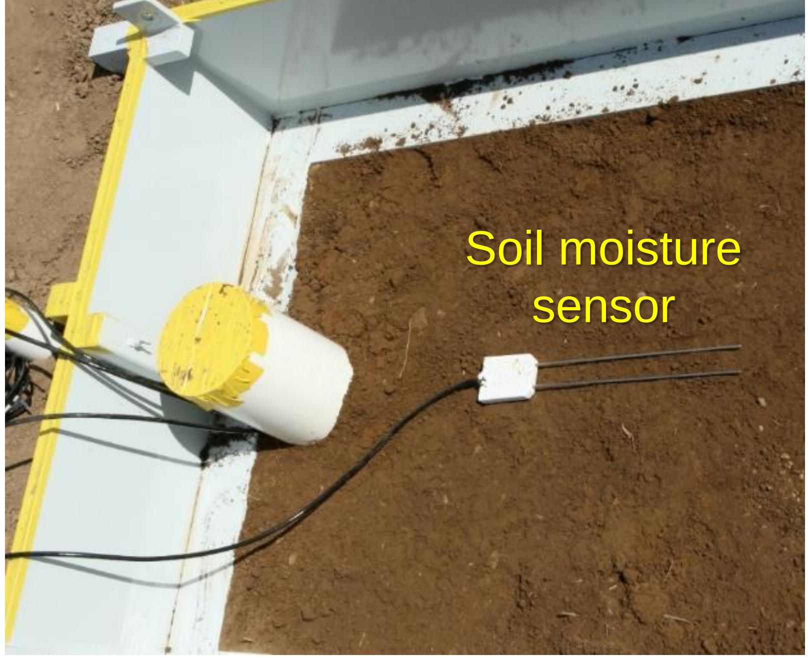
How Do We Develop Crop Coefficients?



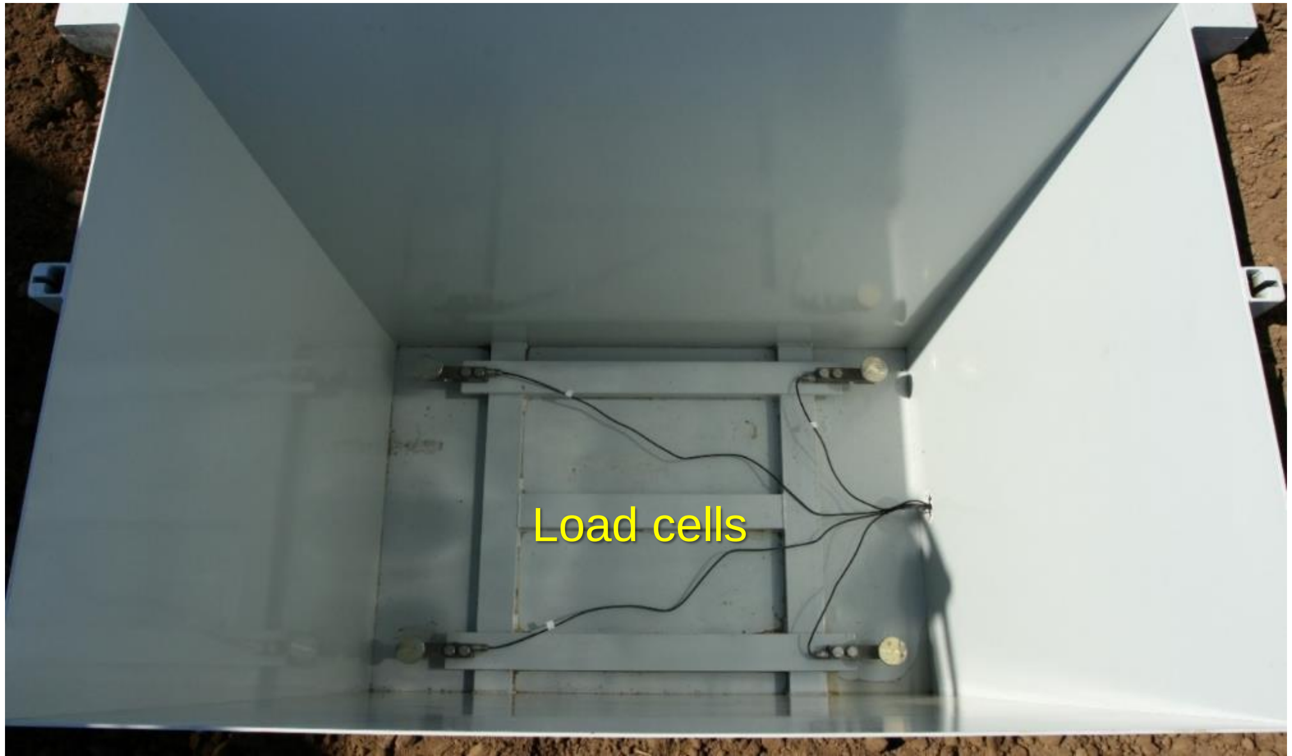
$$K_c = \frac{ET_c}{ET_o}$$

2019


2019
Wilco


Soil moisture
sensor

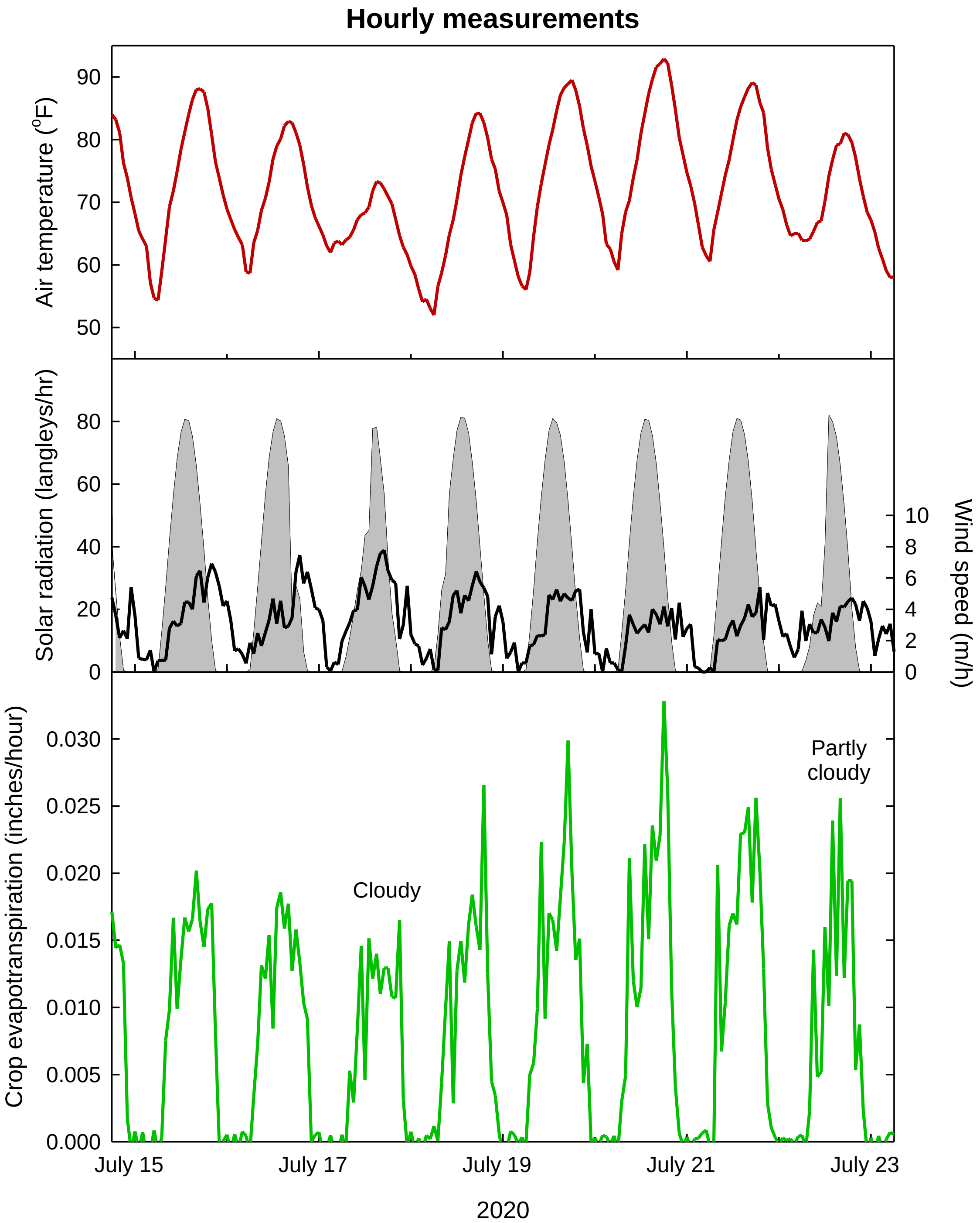

Installing
drainage
system

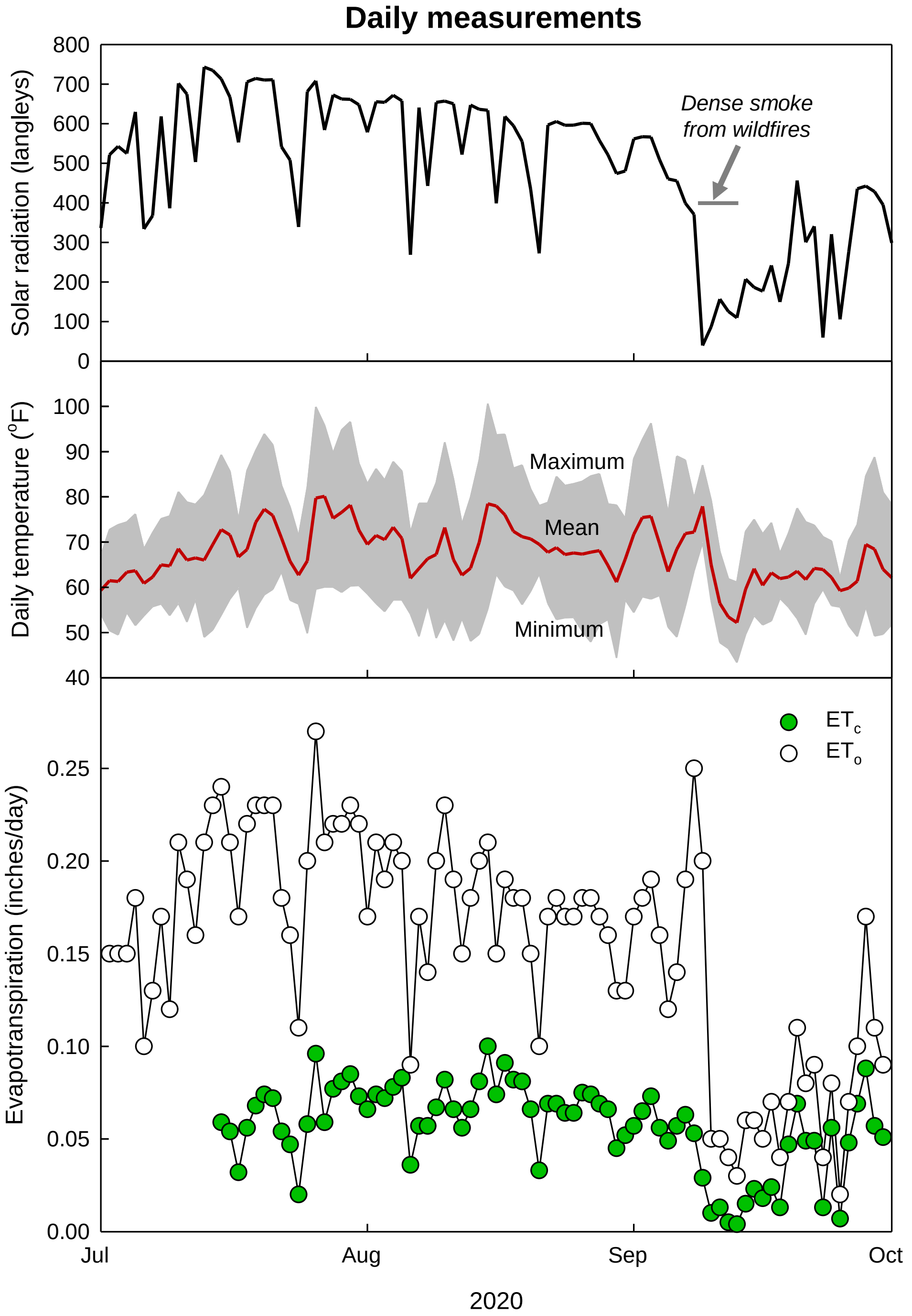

Load cells


2020
'Columbia Star'
Downloading data
from the lysimeter
$25K each

Crop Evapotranspiration (ET_c)

Year 1



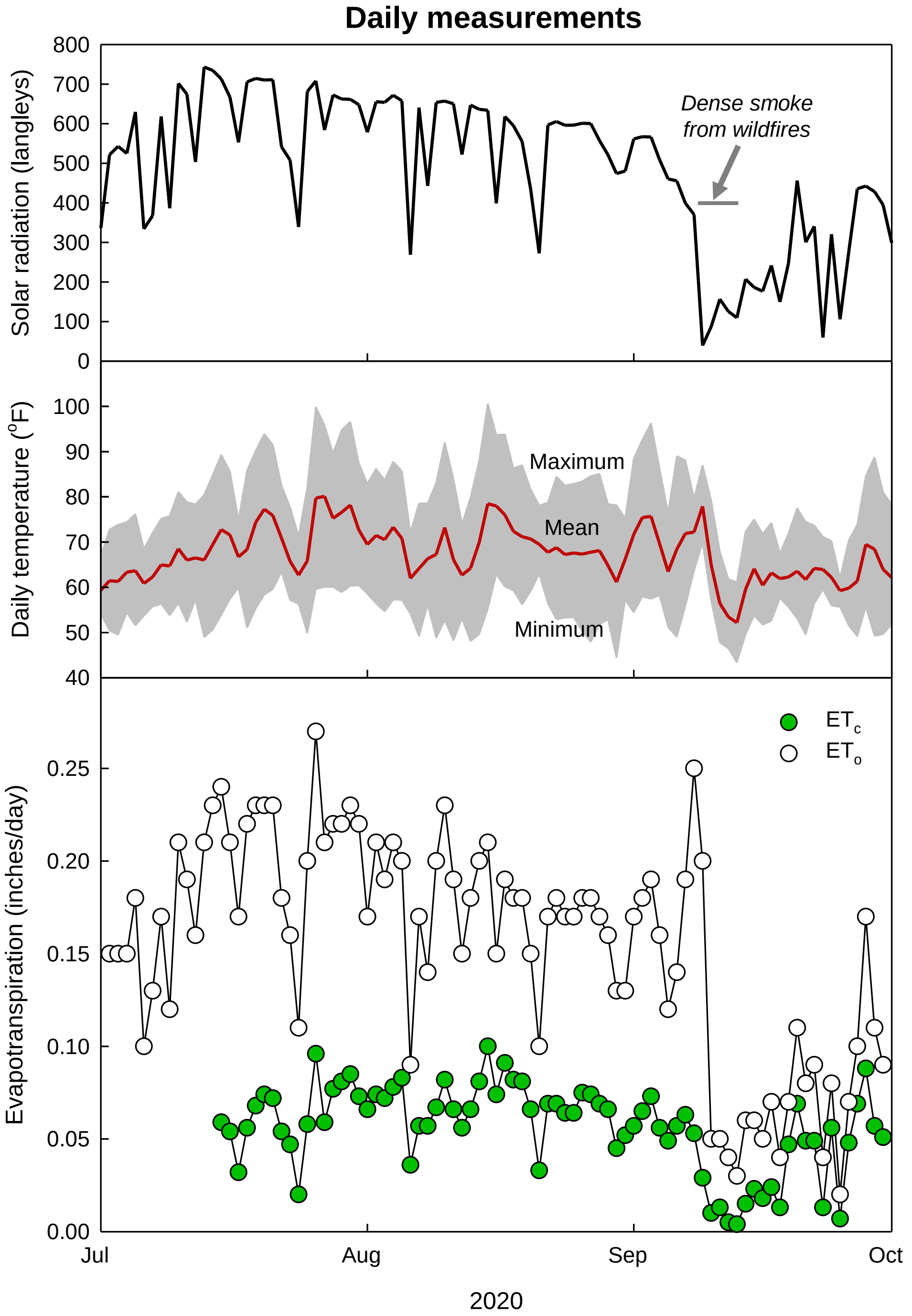


Crop Evapotranspiration (ET_c)

Year 1

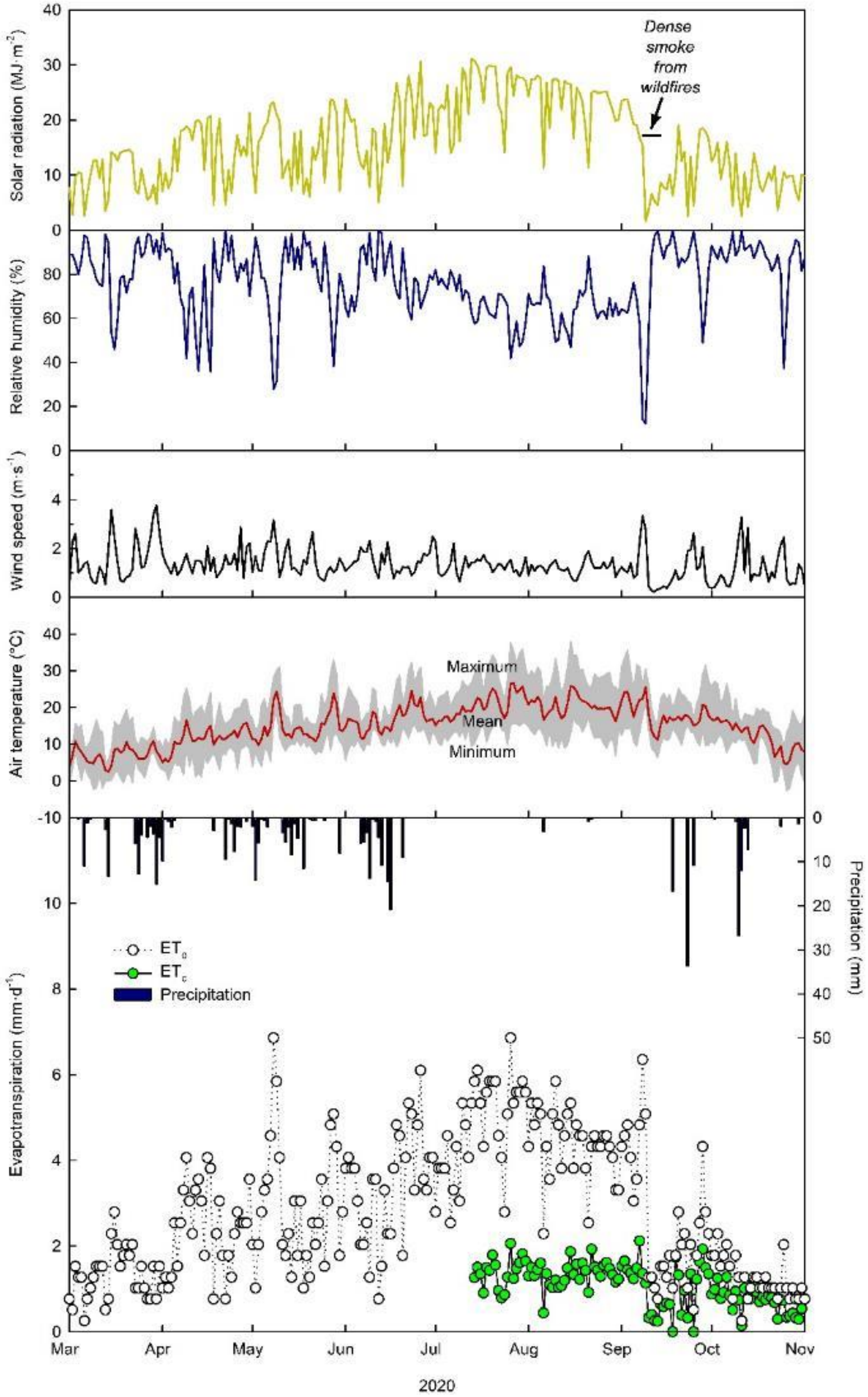
Crop Evapotranspiration (ET_c)

Year 1



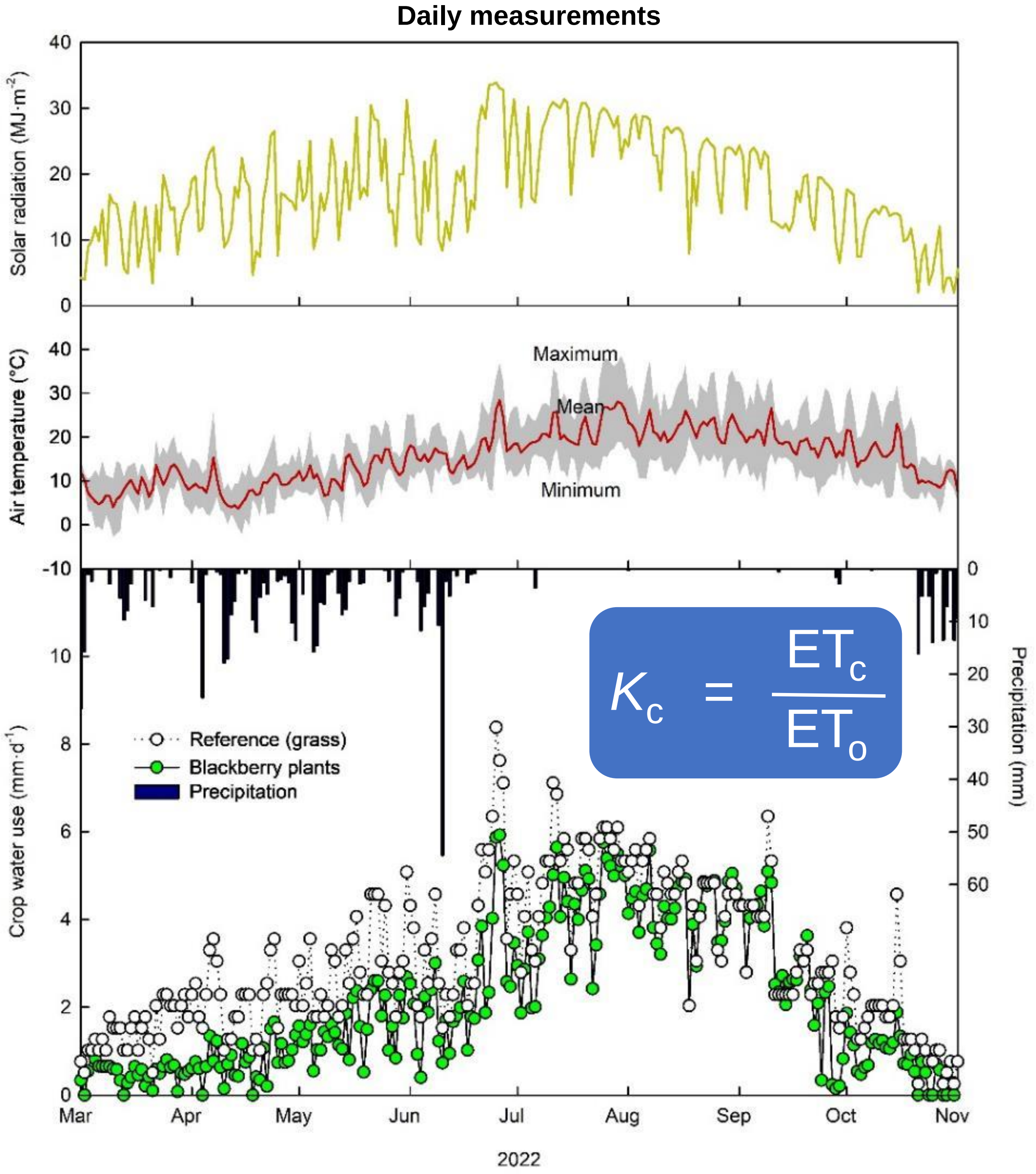
Crop Evapotranspiration (ET_c)

Year 1



Crop Evapotranspiration (ET_c)

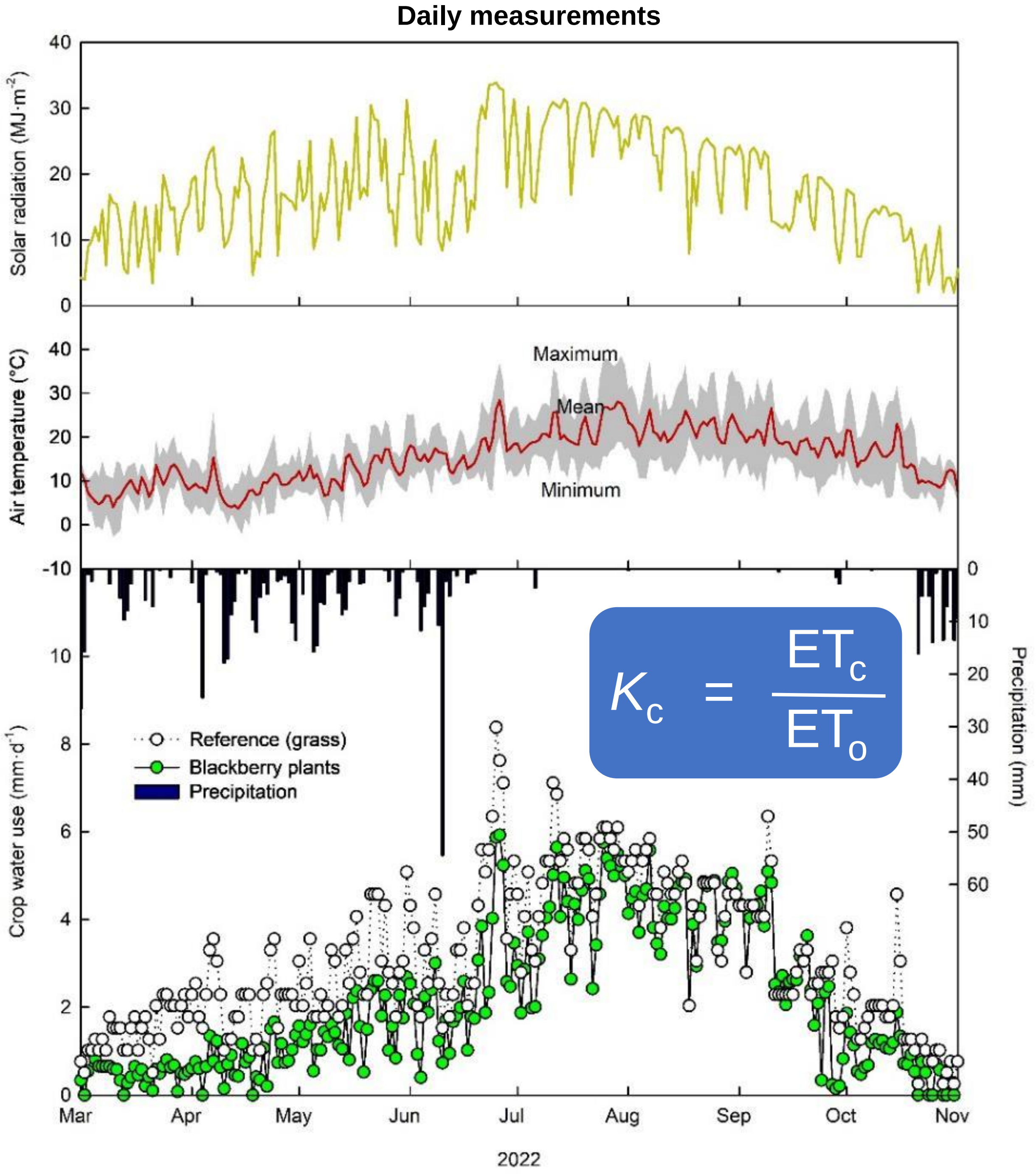
Year 3



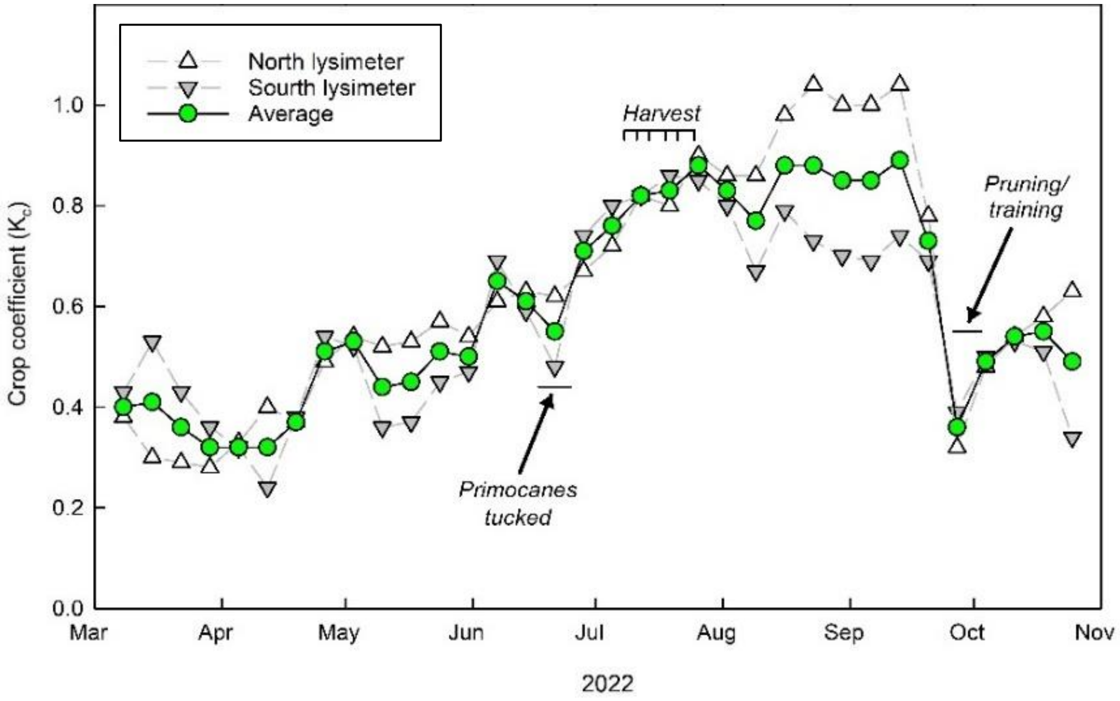
$$K_c = \frac{ET_c}{ET_o}$$

Crop Evapotranspiration (ET_c)

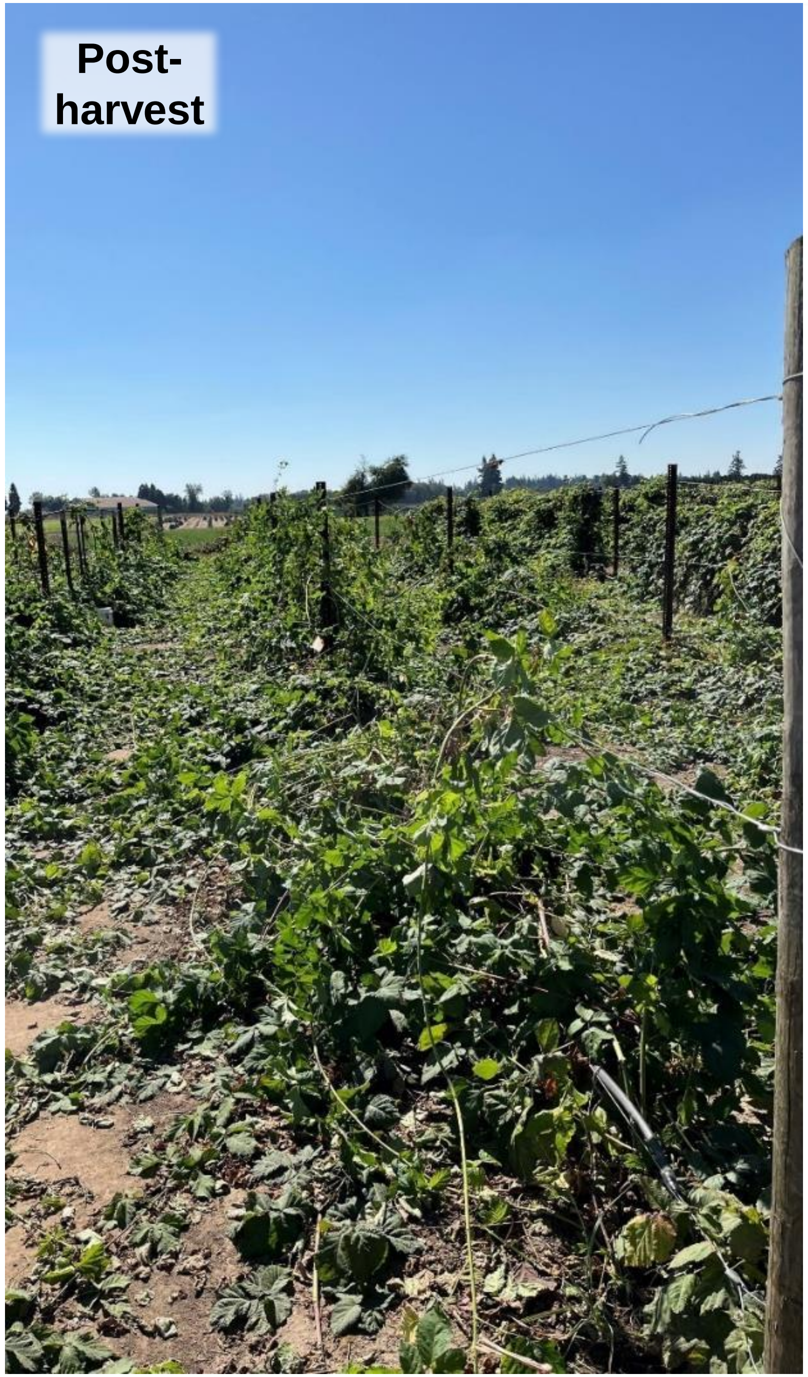
Year 3



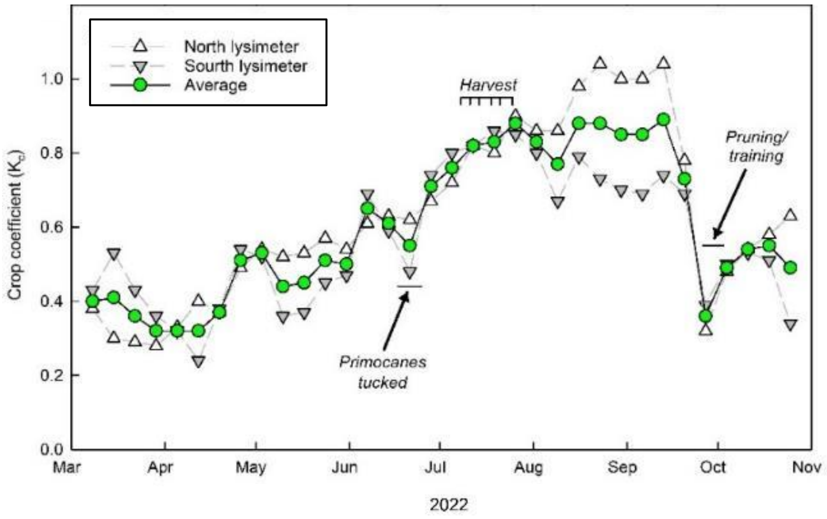
$$K_c = \frac{ET_c}{ET_o}$$



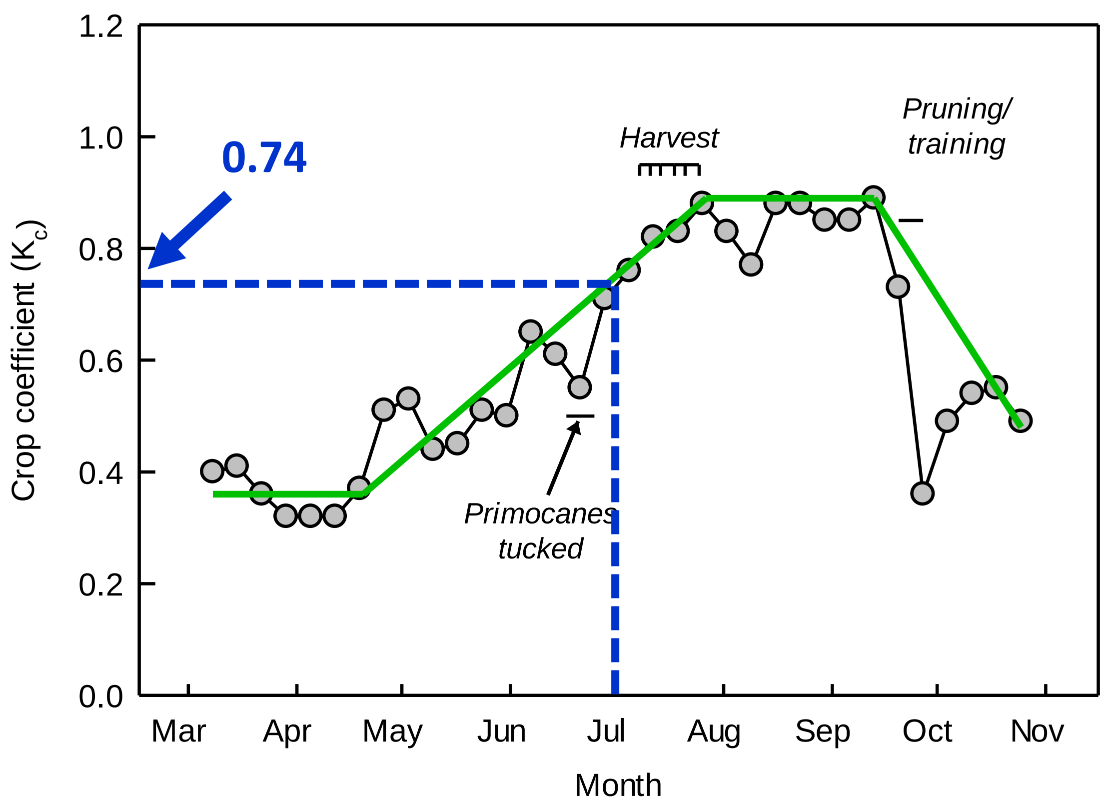

Harvest


Post-
harvest


After pruning
& training


North lysimeter
Sourth lysimeter
Average
Harvest
Primocanes
tucked
Pruning/
training
Crop coefficient (Kc)
0.0
0.2
0.4
0.6
0.8
1.0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
2022

How does it work?



Example: Irrigation requirements during week of July 1

Step 1. Obtain ET_o and rainfall from AgWeatherNet (use nearest weather station)

ET_o = 2.0 inches **Precip. = 0.3 inches**

Step 2. Find K_c for July 1

K_c = 0.74

Step 3. Calculate ET_c

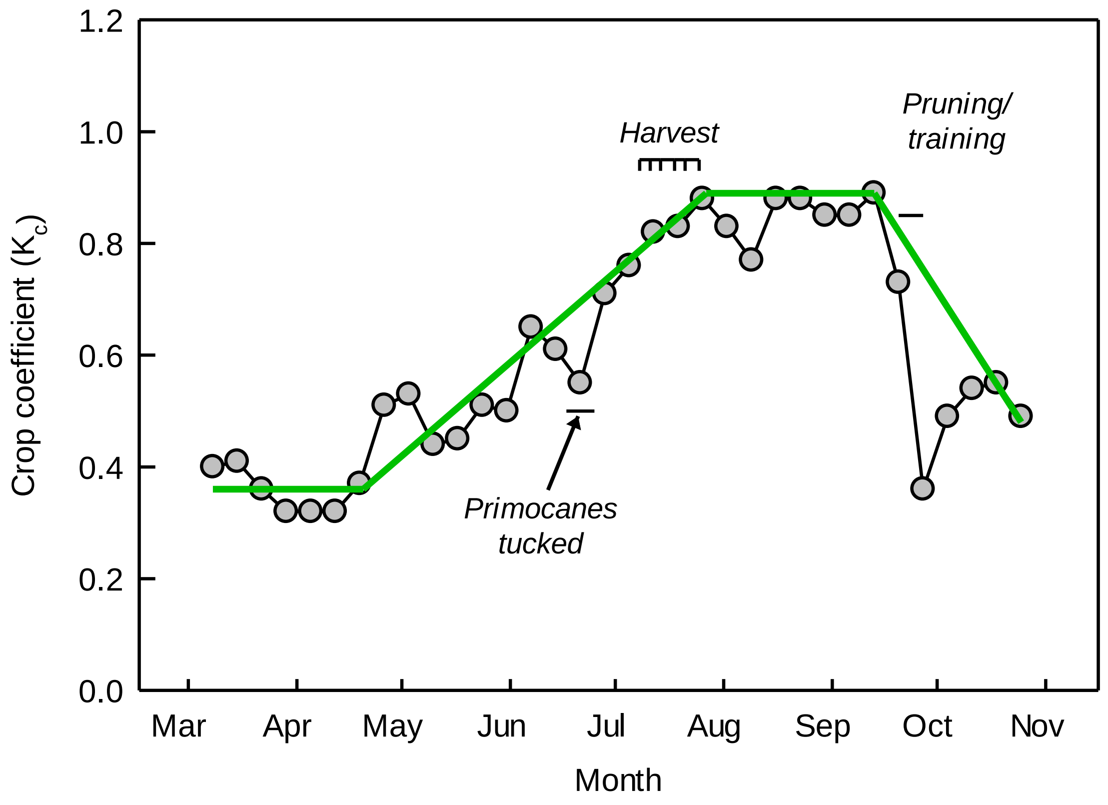
$ET_c = ET_o \times K_c$ = 2.0 inches × 0.74 ≈ <u>1.5 inches</u>

Step 4. Determine irrigation requirements

Irrigation requirements = ET_c – Precipitation

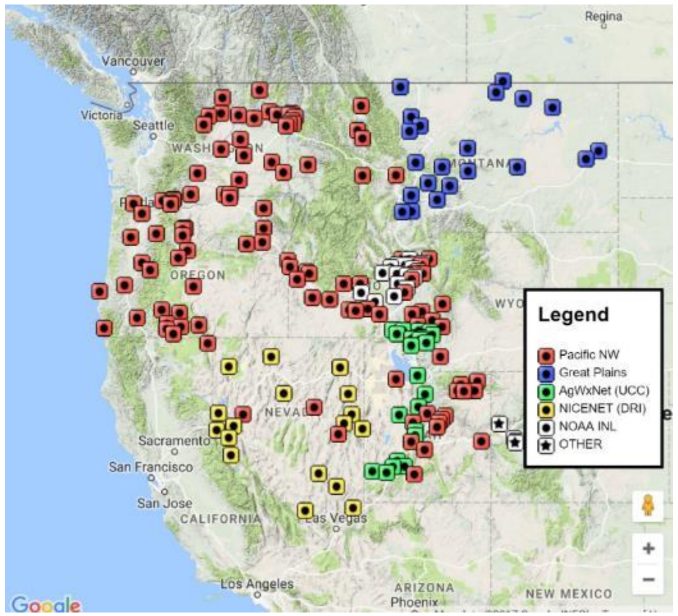
= 1.5 – 0.3 = <u>1.2 inches/week</u>

How does it work?



Example: Irrigation requirements during week of July 1

Done automatically by AgriMet



https://www.usbr.gov/pn/agrimet/

Seasonal water use (April through October)

Year	Rain (inches)	ET_o (inches)	ET_c (inches)	Irrigation (inches)[1]	Deep percolation (inches)[2]
2020	12.4	26.1	4.7	5.6	4.6
2021	14.0	31.6	10.8	12.6	12.5
2022	17.2	28.1	20.1	15.5	12.1
2023	18.5	31.8	23.2	16.6	14.1

[1] Total applied to the lysimeters (by irrigation).

[2] Total lost from the lysimeters (by deep percolation).

Seasonal water use (April through October)

Year	Rain (inches)	ET_o (inches)		ET_c (inches)	Irrigation (inches)[1]	Deep percolation (inches)[2]
2020	12.4	26.1	**26%**	4.7	5.6	4.6
2021	14.0	31.6	**34%**	10.8	12.6	12.5
2022	17.2	28.1	**72%**	20.1	15.5	12.1
2023	18.5	31.8	**73%**	23.2	16.6	14.1

[1] Total applied to the lysimeters (by irrigation).

[2] Total lost from the lysimeters (by deep percolation).

How much H_2O does it take to produce blackberries?

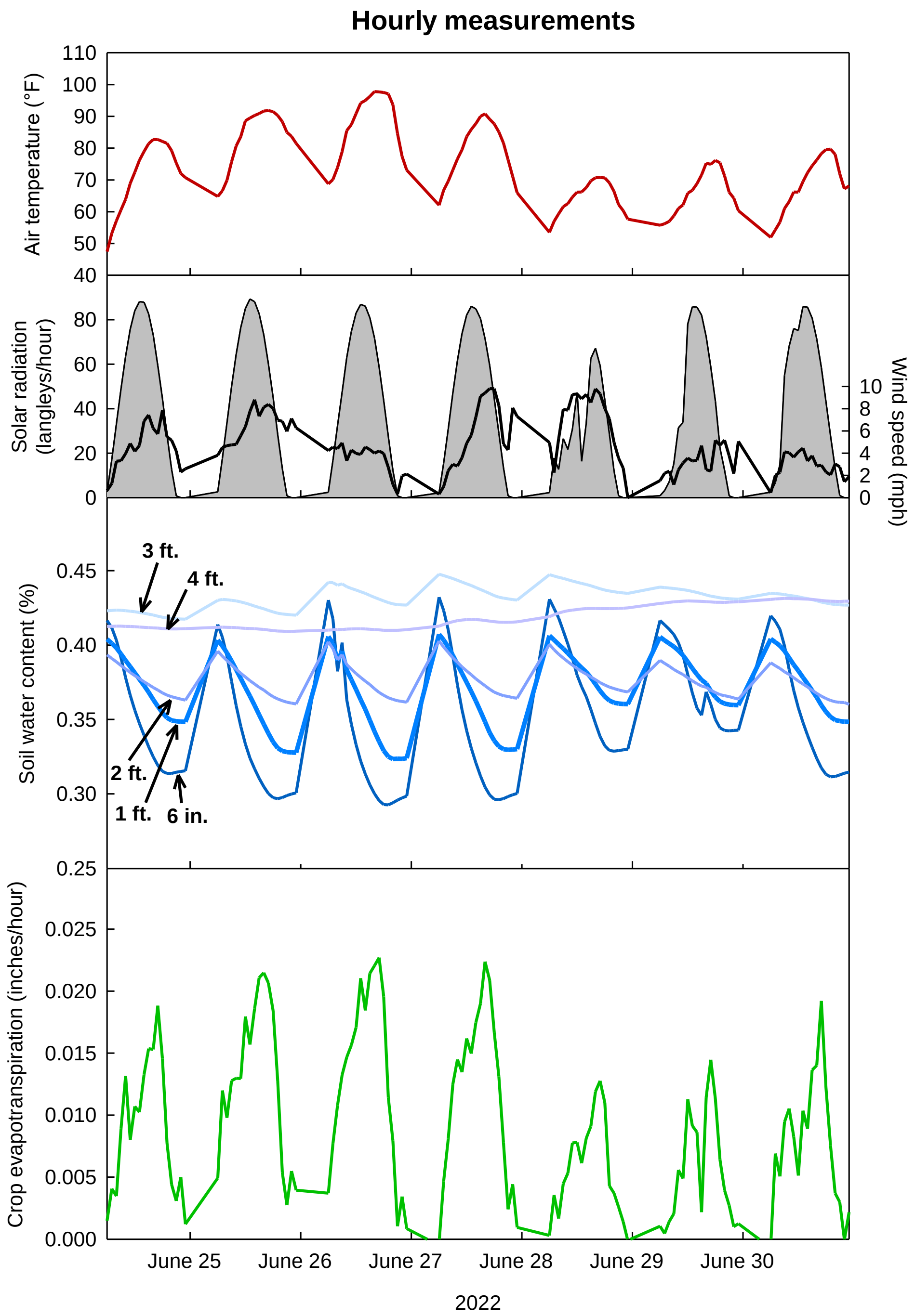
How much H_2O does it take to produce blackberries?

It takes 2 L or ½ gallon of H_2O to produce just one blackberry…

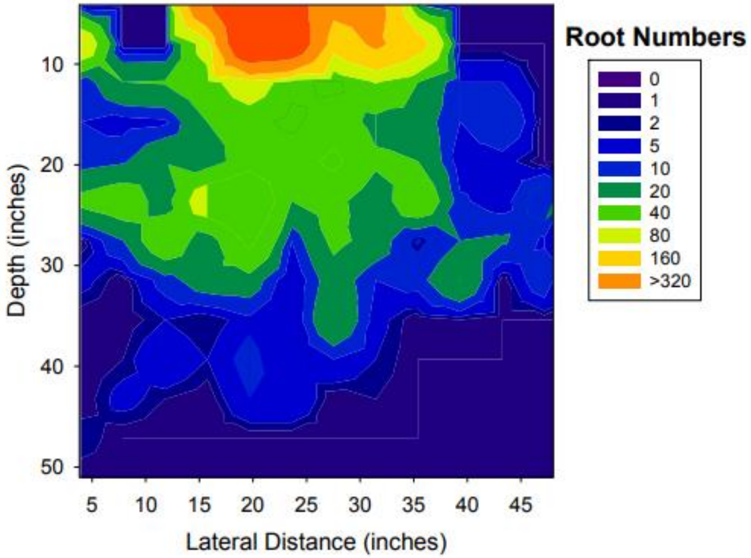
How much H_2O does it take to produce blackberries?

=

…and over 48 L or 12.5 gallons to produce enough berries to fill a 6 oz. clamshell



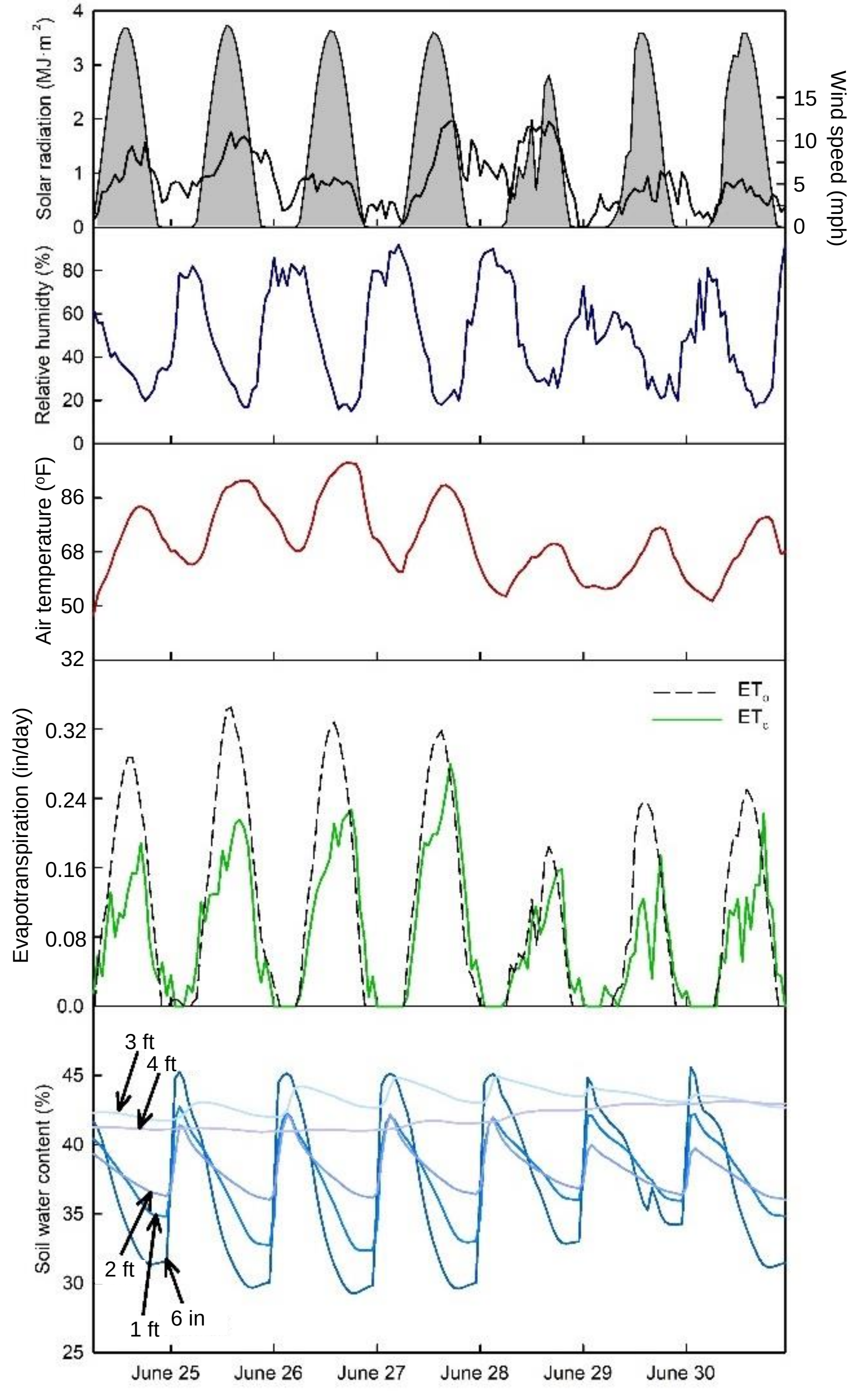
Distribution of Blackberry Roots



Cahn et al. (2008)

First year: 2-ft deep, 3-ft wide (33% of a 10-ft-wide row)

Second year: 2.5-ft deep, 4-ft wide (42% of the row)



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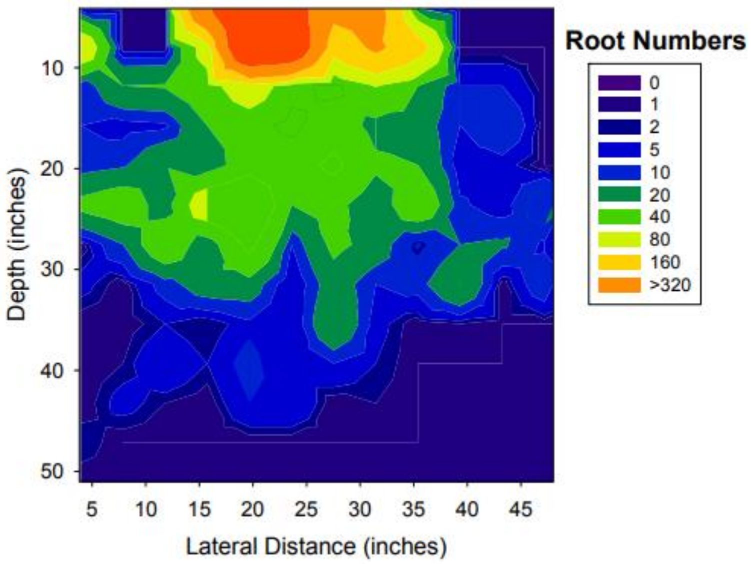

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Determining irrigation frequency

Effective rooting depth (m)

X *soil water holding capacity (available inches per foot of soil)*

X *fraction of soil volume wetted (proportion of soil in the field)*

X *management allowable depletion (proportion of soil water)*

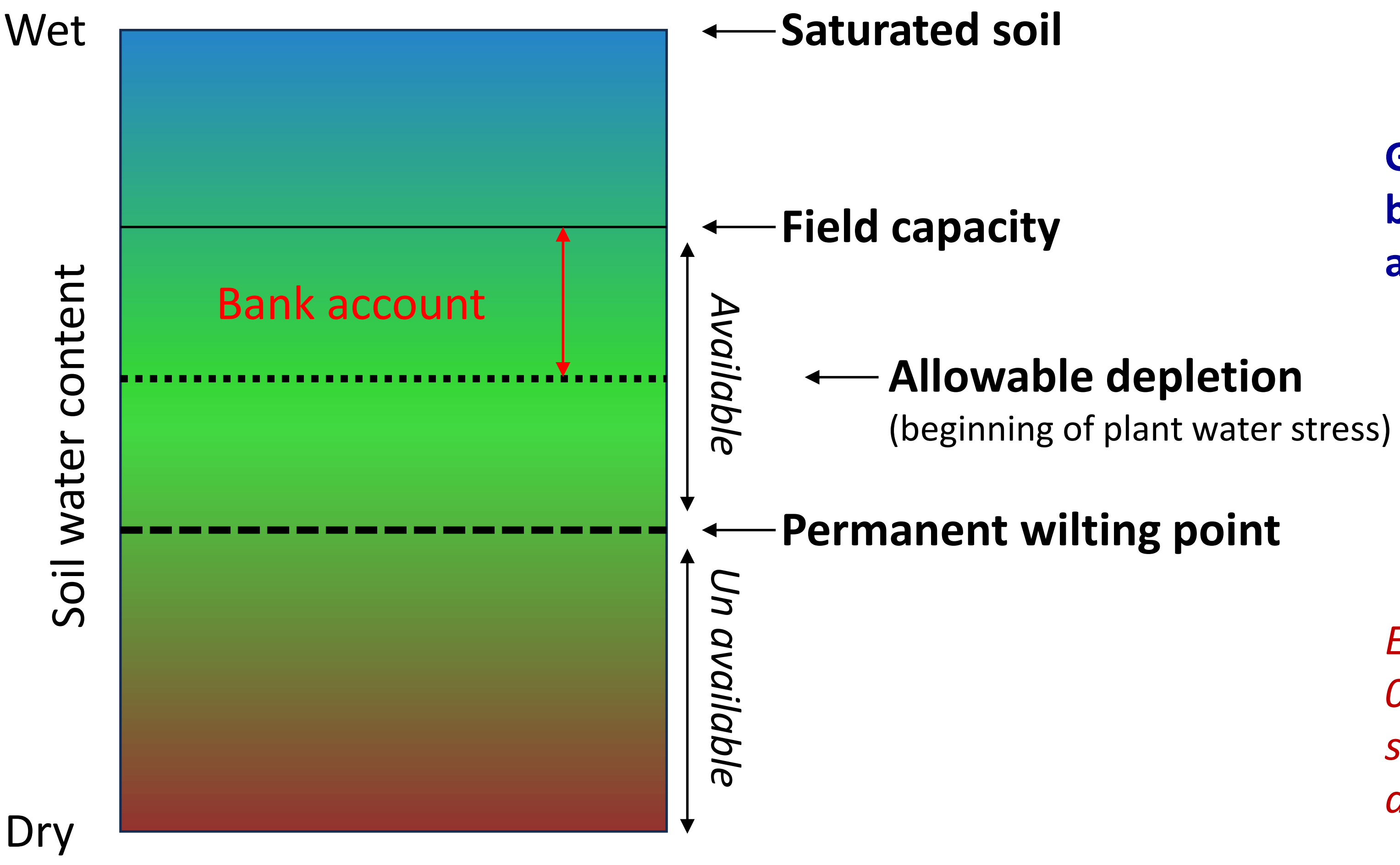
= maximum ET_c between irrigations

Soil Water Holding Capacity

Soil		Available moisture per foot soil (inches)
General description	**Texture class**	
Light, sandy	Coarse sand	0.7
	Fine sand	0.9
	Sandy loam	1.2
Medium, loamy	Fine sandy loam	1.5
	Loam	1.8
	Silt loam	2.0
Heavy clay	Clay loam	2.2
	Clays; peats/mucks	2.4

*Values are for deep, uniform soil profiles. Layering or changes in soil texture within the profile may increase or decrease effective available water.

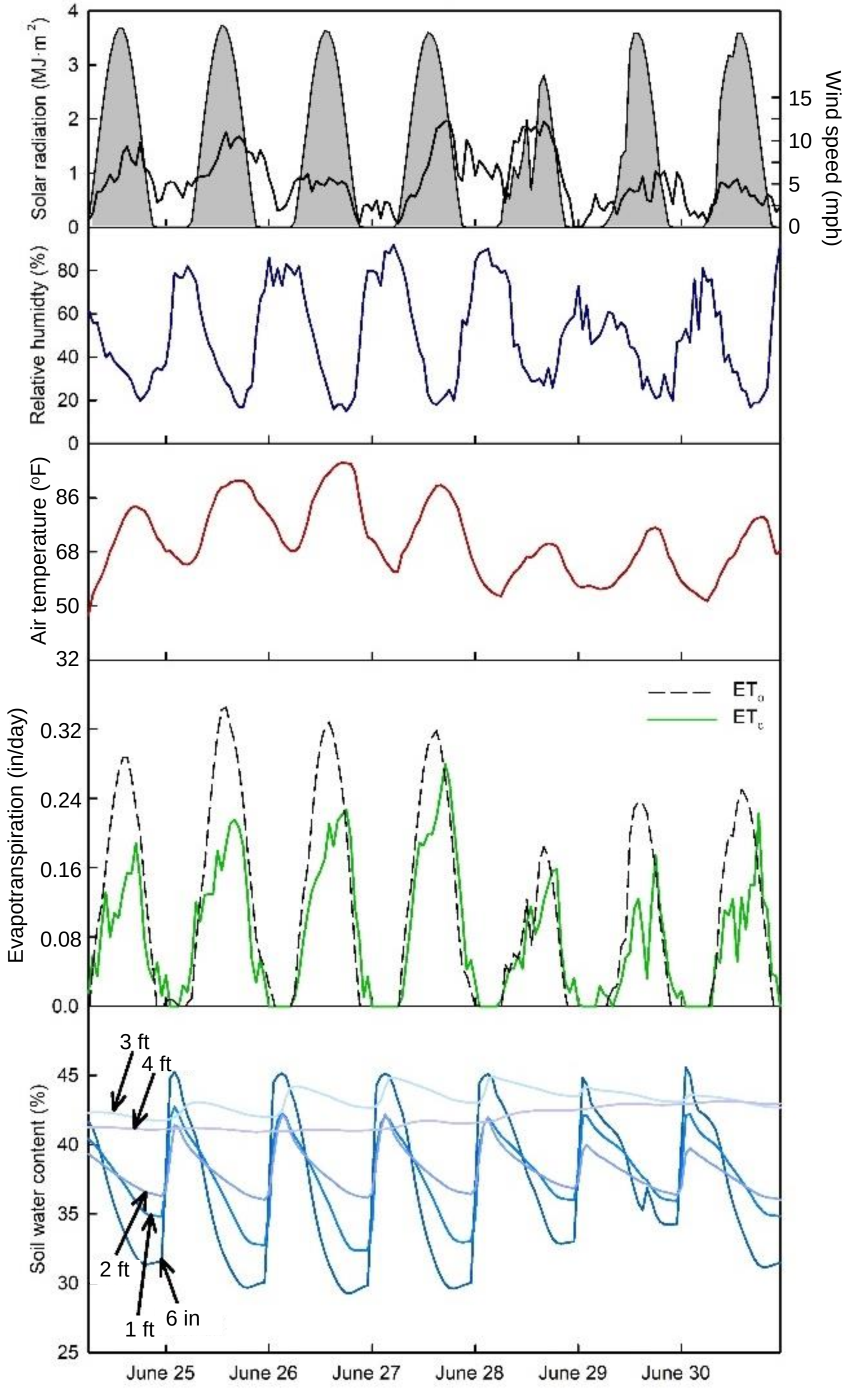
Management Allowable Depletion (MAD)



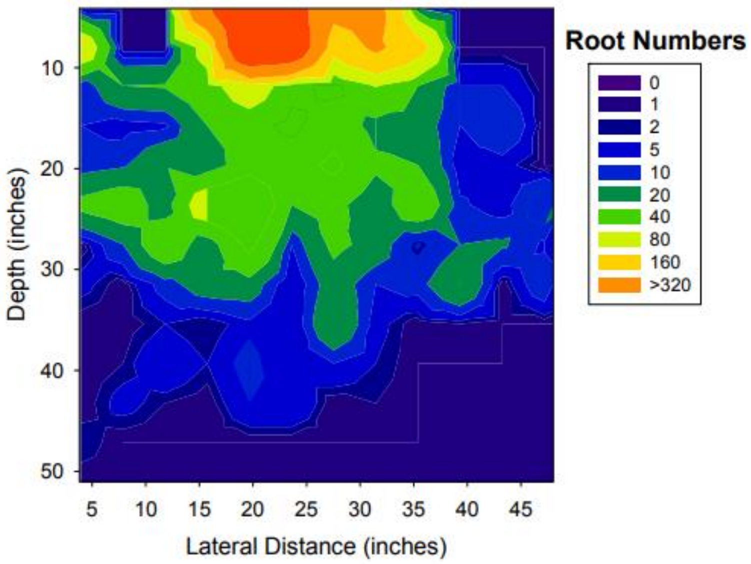
Goal: Maintain soil moisture between field capacity and allowable depletion

For blackberries, allowable depletion is about 30% of the total available water prior to harvest & 50% after harvest

E.g., Silt loam (2.0 inches/ft) = 0.6 inches of water per foot of soil prior to harvest & 1.0 inch after harvest



Distribution of Blackberry Roots



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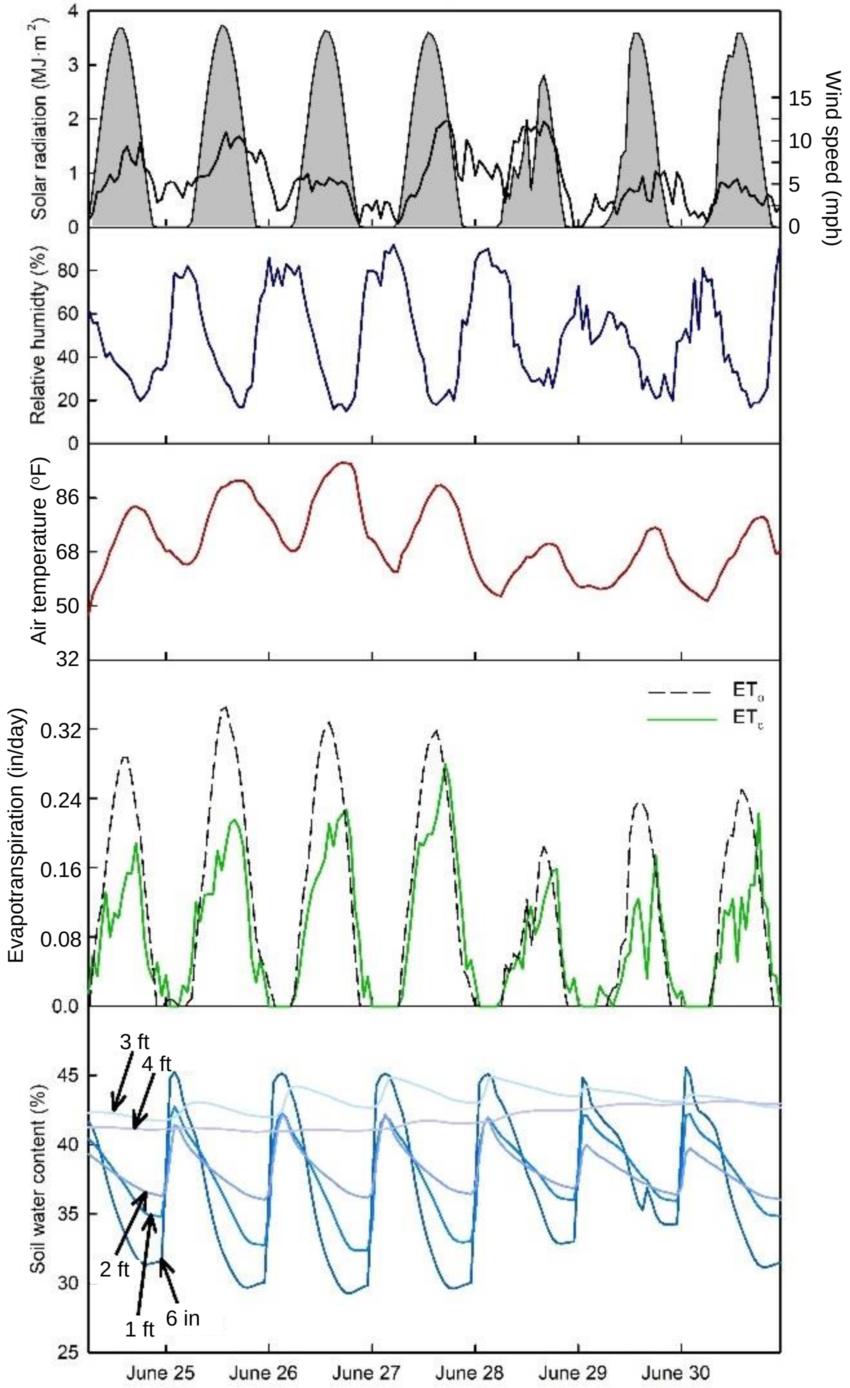

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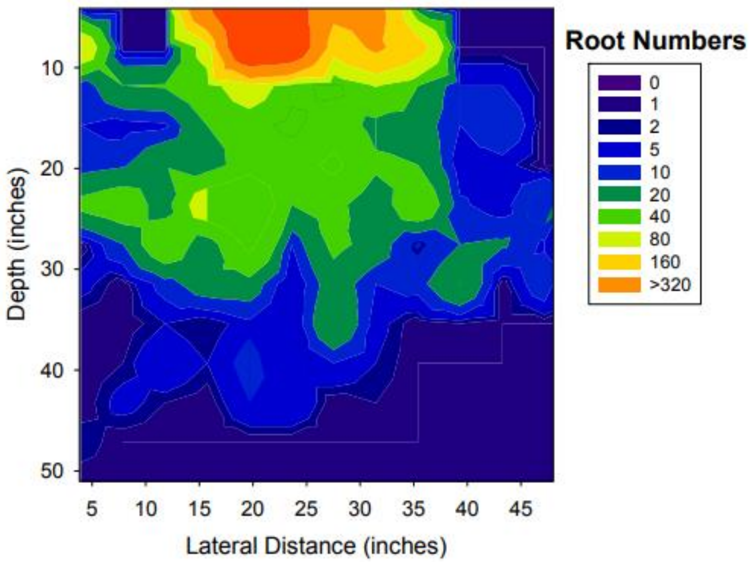

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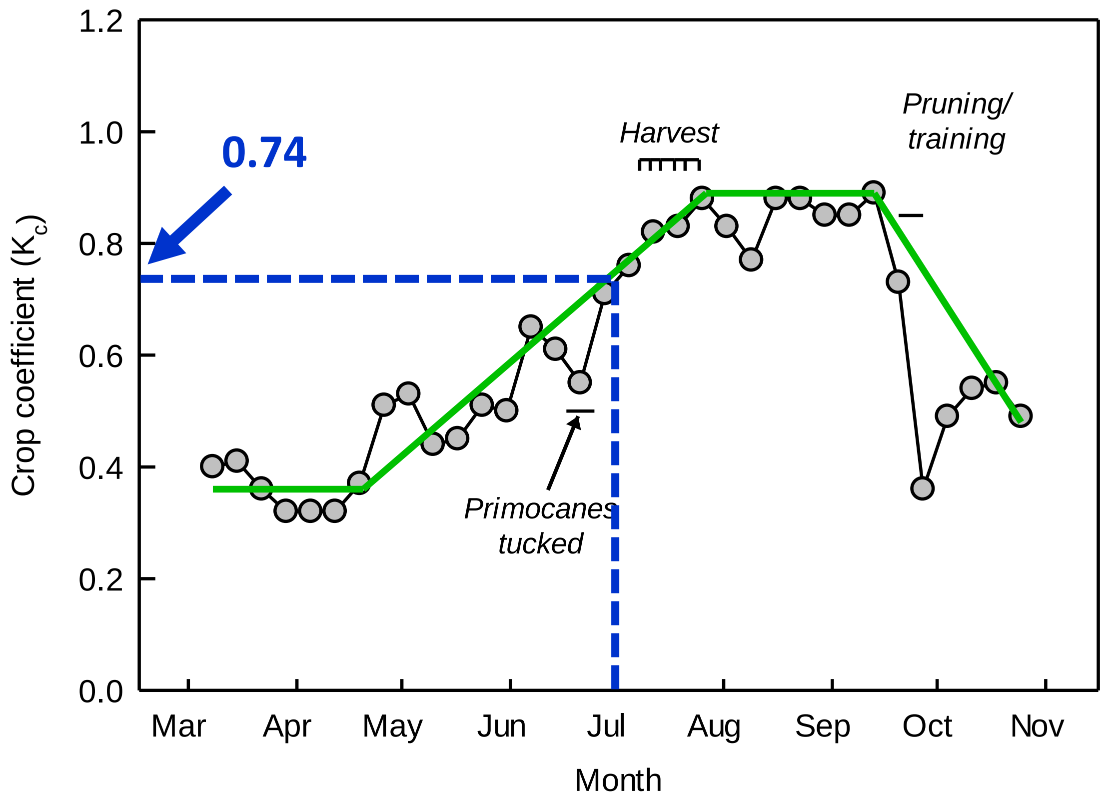
Determining irrigation frequency

Example: Silt loam soil with mature blackberry plants

2.5 ft. rooting depth **X** *2.0 in. of H_2O per ft.* **X** *0.4 (10 ft. row spacing)* **X** *0.30 (i.e., 30% MAD)*

≈ 0.6 inches per irrigation

Irrigation Frequency



Example: Irrigation requirements during week of July 1

Step 4. Determine irrigation requirements

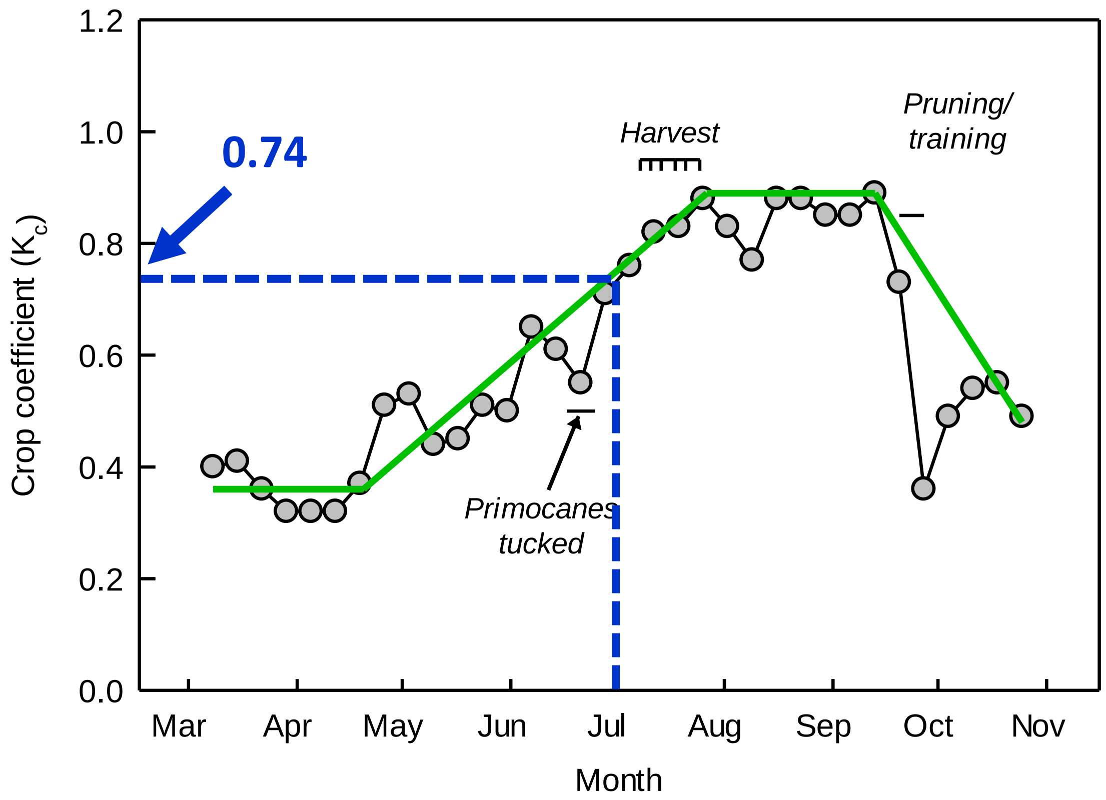
Irrigation requirements = ET_c – Precipitation

= 1.5 – 0.3 = <u>1.2 inches/week</u>

Step 5. Determine irrigation frequency

<u>≈ 0.6 inches per irrigation</u> ➡ **<u>Irrigate twice per week</u>**

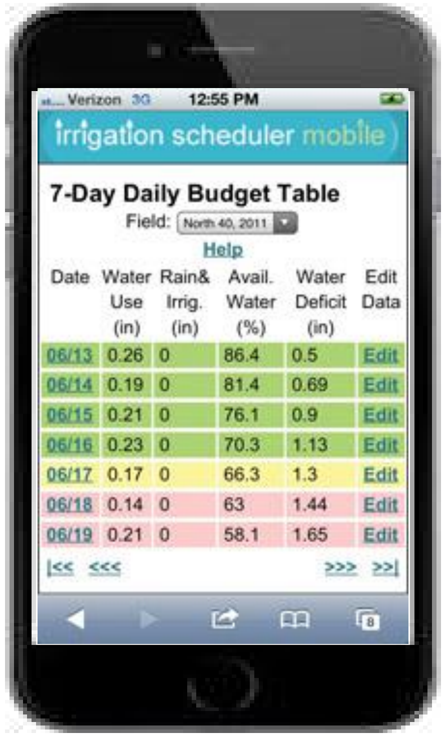
Irrigation Frequency



Example: Irrigation requirements during week of July 1

Mobile App

Irrigation Scheduler



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http://weather.wsu.edi/is/

Developed by Troy Peters and Sean Hill (WSU)

Questions?

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