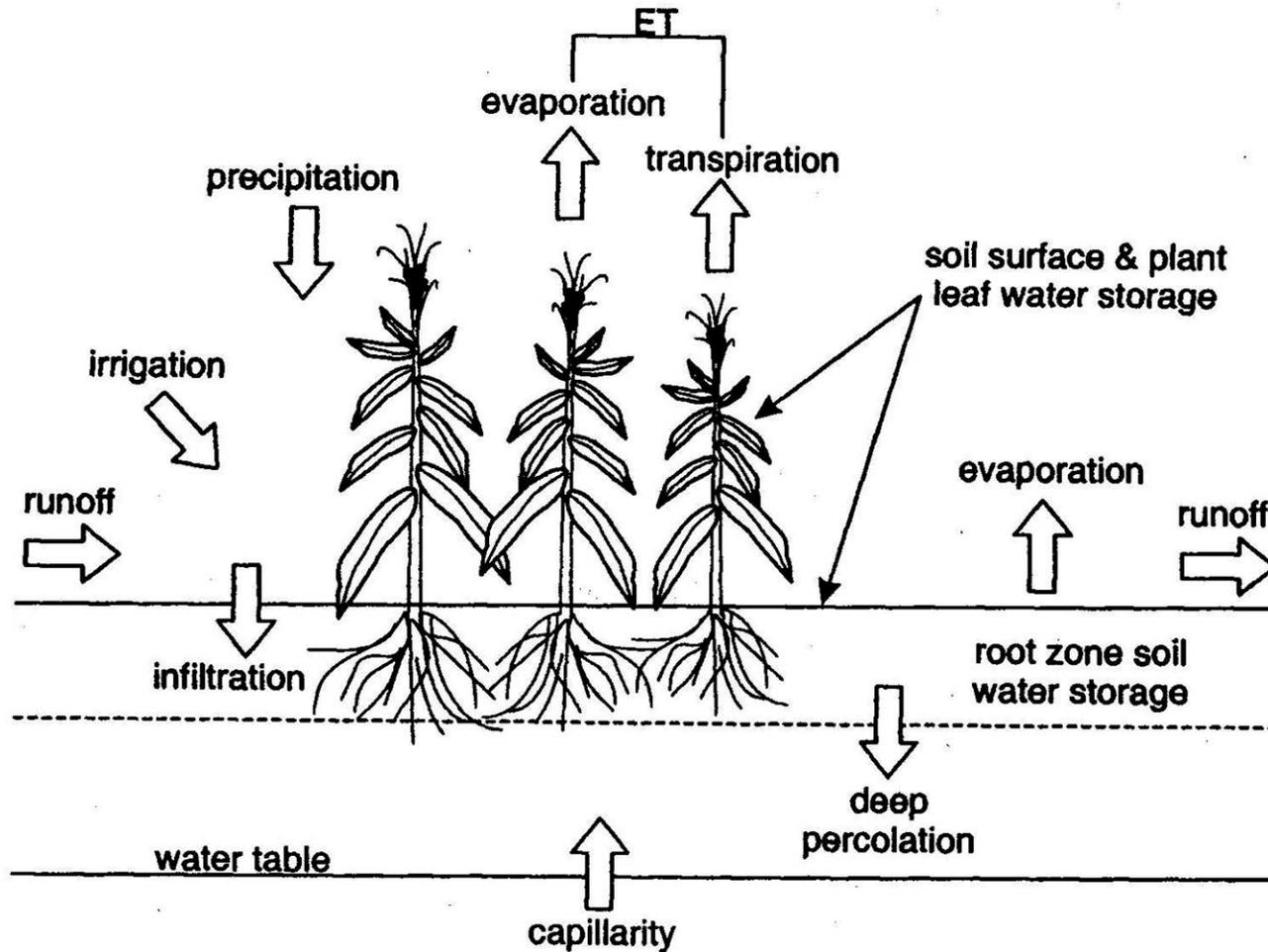


Irrigation Scheduling Options

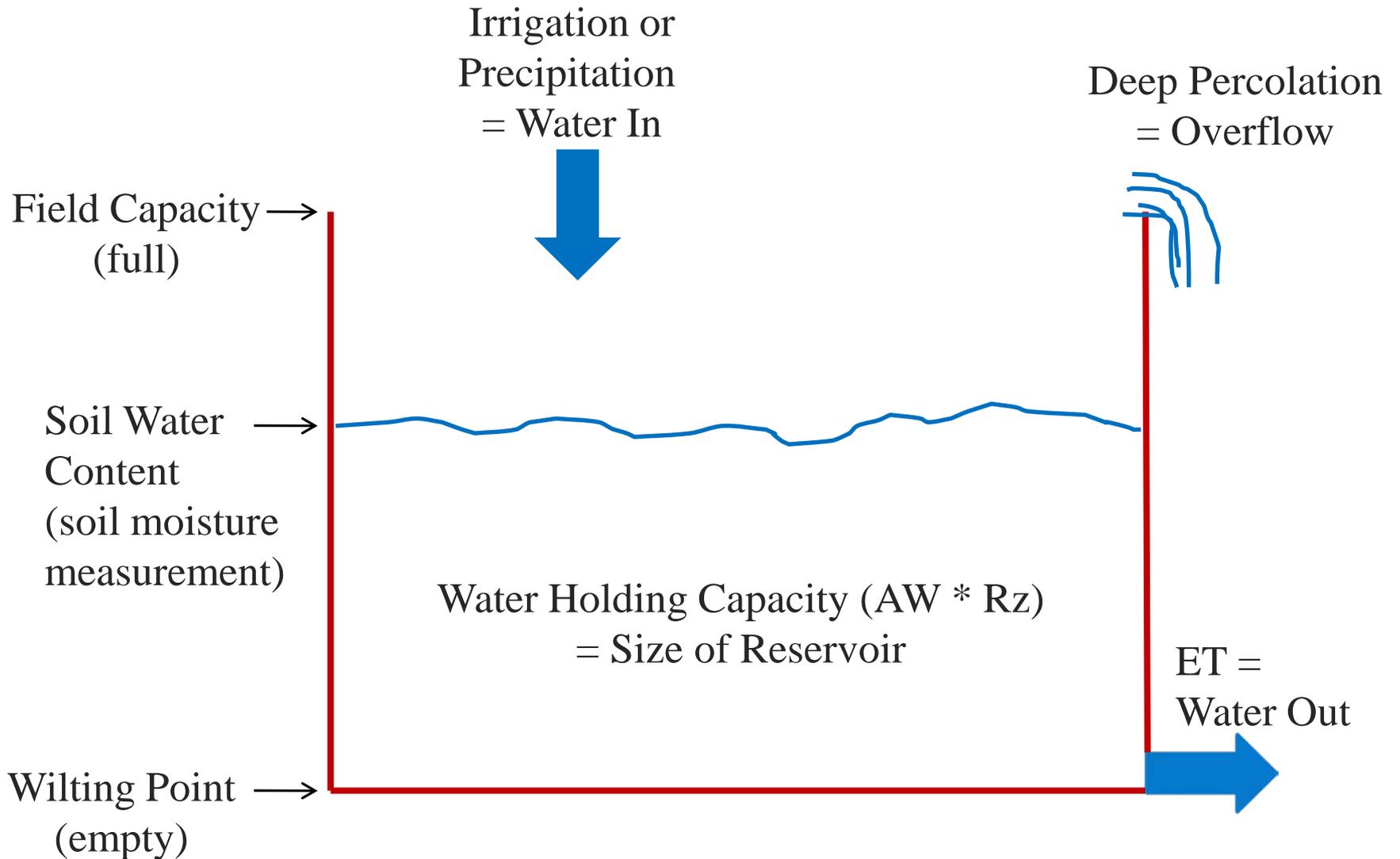
R. Troy Peters, Ph.D., P.E.

Water Balance



$$SW_2 = SW_1 + Rain + Irrig. + Capillary - ET - DeepPerc - Runoff$$

Soil is a Water & Nutrient Reservoir



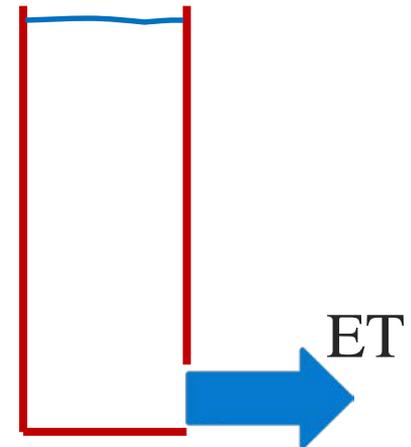
How Big is Your Reservoir?

How much water can it hold? When will it be empty?

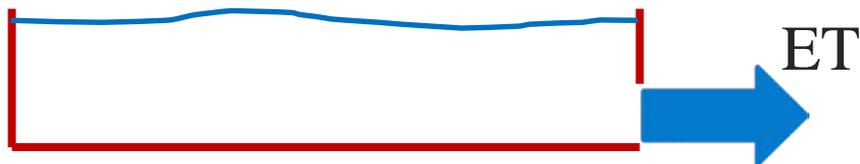
Deep Silt



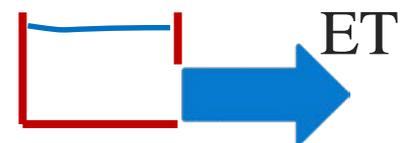
Deep Sand



Shallow Silt



Shallow Sand



Estimate ET

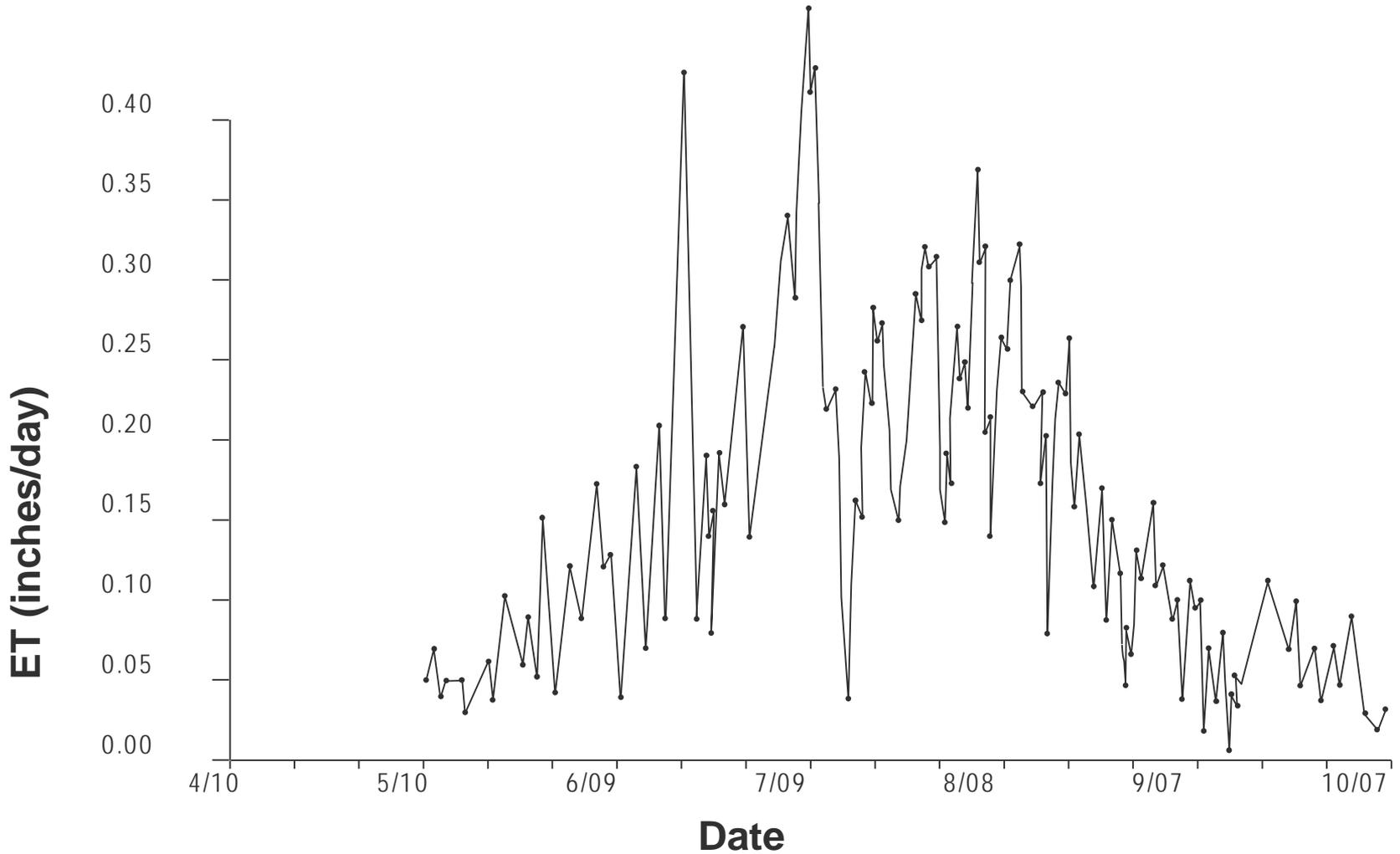
$$ET_c = ET_r \times K_c$$

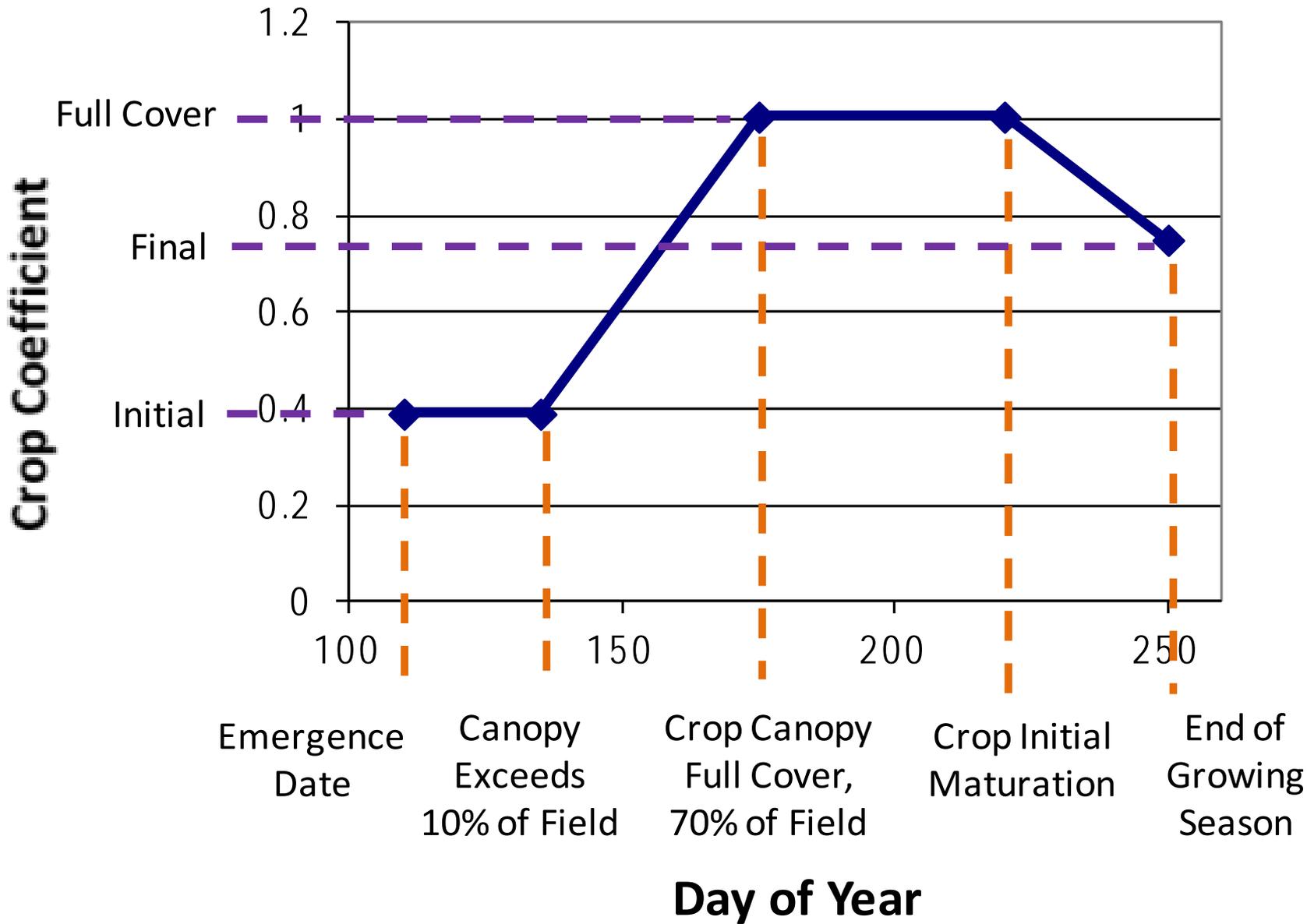
ET_c = crop evapotranspiration

ET_r = evapotranspiration rate of a reference crop (alfalfa). *Function of the weather.*

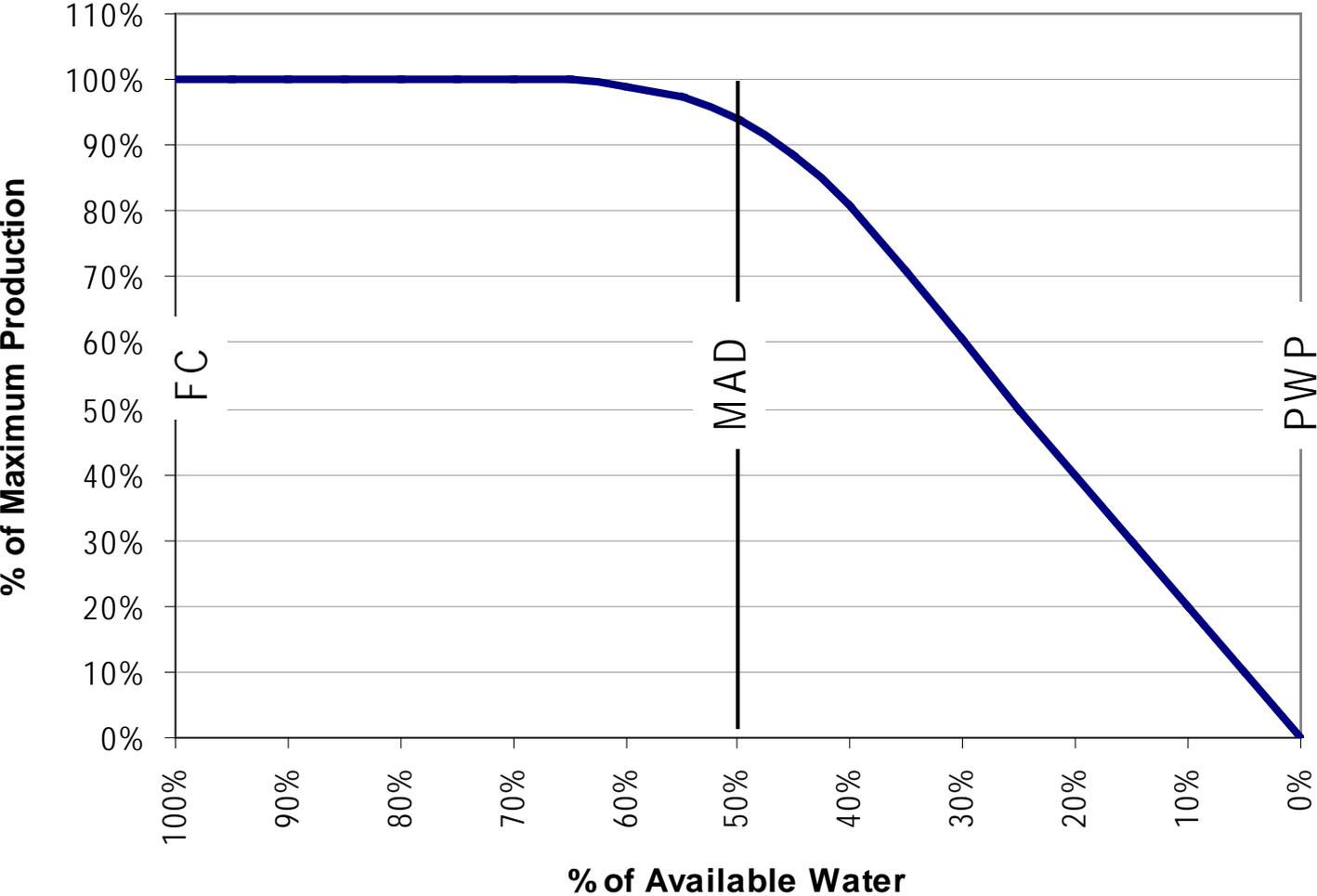
K_c = crop coefficient. *Function of the plants.*

ET and Weather

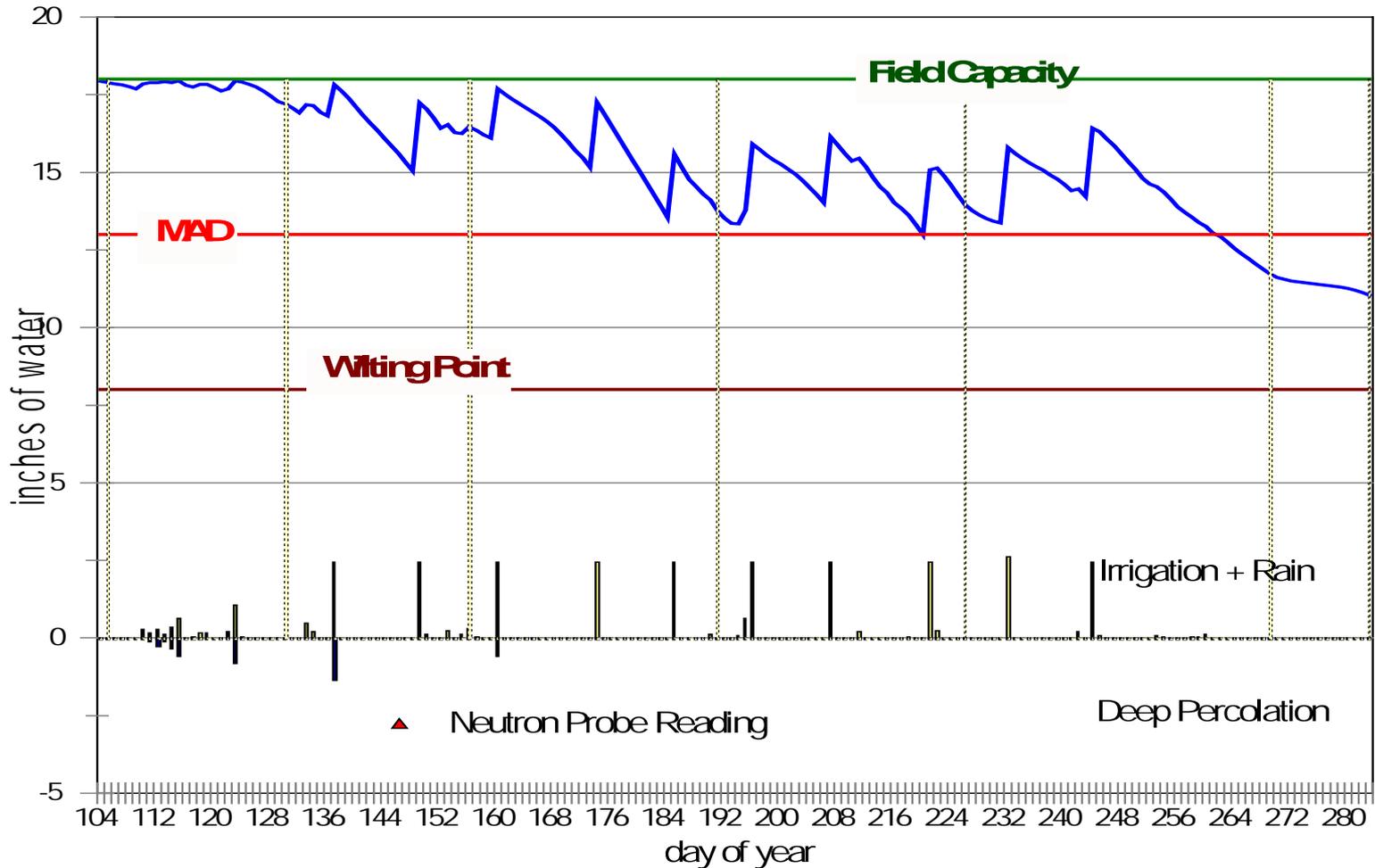




Production Reduction Function



Good Irrigation Management



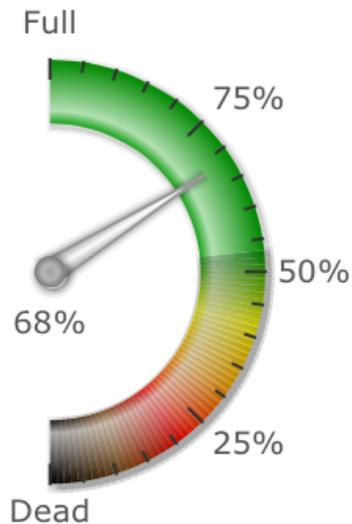
irrigation scheduler **mobile**

- *Simple soil water balance based on ET.*
- *Designed for use on a smart phone, but usable on any desktop web browser.*
- *Designed for usability #1.*
- *Quick & easy to set up.*
- *Automatically pulls ET data from selected weather stations.*
- *Can run on any weather network who's data can be automatically accessed.*

Soil Water Dashboard

Field:

N Pod Pasture, 2014; Grass (Pasture)



This Morning's Soil Water Deficit: 0.9 in. or 5.4 hrs

Today's Irrigation: 0.00 hrs

I Irrigated Today: hrs

[Save](#)

Green is good. Crops increasingly stressed below green.



Dashboard



Daily Budget Table



Soil Water Chart



More Charts



Field Settings

irrigation scheduler mobile

Login

Username:

Password:

Remember me

[Forgot Username?](#)

[Forgot Password?](#)

Register

In order to use the irrigation scheduler, please [register](#) for an AgWeatherNet

irrigation scheduler mobile

Add New Field

[Help](#)

Check box to start with existing field:

Field Name:

Field Year:

Network:

Station:

Field Crop:

Field Soil:

Daily Budget Table

Soil Water Chart

More Charts

Field Settings

Add/Delete Fields

irrigation scheduler mobile

7-Day Daily Budget Table

Field: Potatoes, 2011; Potatoes

[Help](#)

Date	Water Use (in)	Rain & Irrig. (in)	Available Water (%)	Water Deficit (in)	Edit Data
07/12	0.22	0	80.9	0.88	Edit
07/13	0.25	0	75.5	1.13	Edit
07/14	0.22	0	70.7	1.35	Edit
07/15	0.24	0	65.4	1.59	Edit
07/16	0.23	0	60.4	1.82	Edit
07/17	0.22	1	77.5	1.04	Edit
07/18	0.2	0	73.1	1.24	Edit

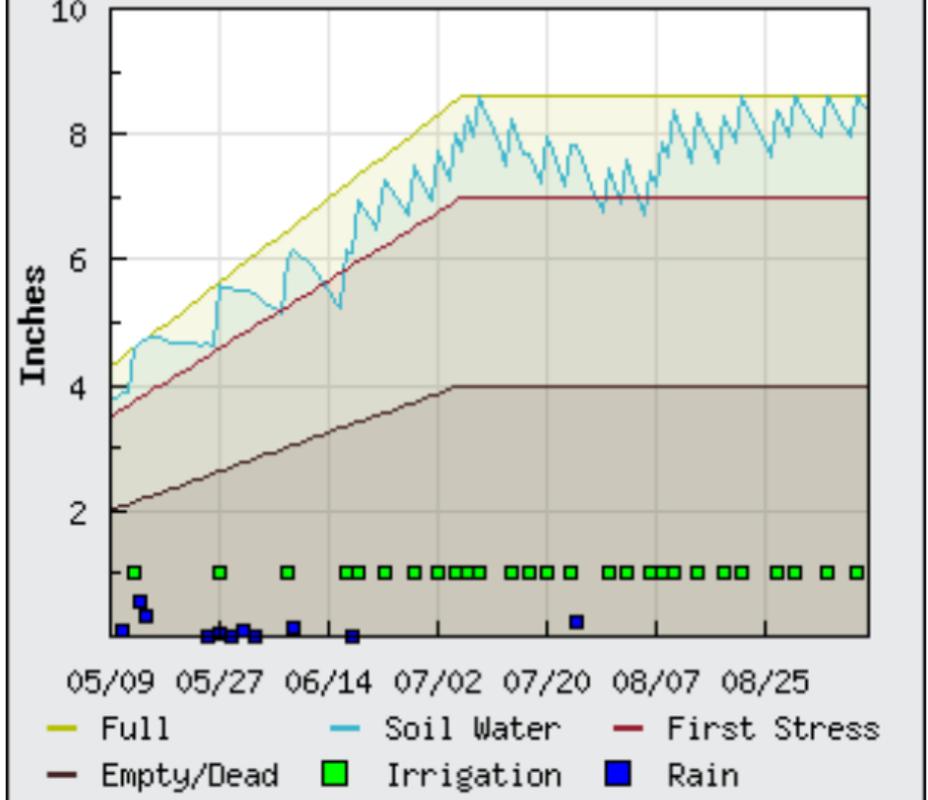
<<< <<< Jul 12, 2011 >>> >>>

irrigation scheduler mobile

Field: Potatoes, 2011; Potatoes

[Help](#)

Field Soil Water Content, Rain & Irrigation



Dotted lines indicate forecast values.

7-Day Daily Budget Table

Field: Creek Pasture, 2013; Grass (Pasture)

[Help](#)

Date	Water Use (in)	Rain& Irrig. (in)	Avail. Water (%)	Water Deficit (hrs)	Edit Data
07/26	0.24	0	61.2	19	Edit
07/27	0.24	0	57.7	20.7	Edit
07/28	0.21	0	54.7	22.2	Edit
07/29	0.18	0	52.1	23.5	Edit
07/30	0.19	0	49.3	24.8	Cancel

Irrigation: hours

Reset/Correct Soil Water Availability

Set To: %

[Save](#)

07/31	0.17	0	46.8	26	Edit
-----------------------	------	---	------	----	----------------------

[Help](#)

Date	Water Use (in)	Rain& Irrig. (in)	Avail. Water (%)	Water Deficit (in)	Edit Data																																
08/14	0.12	0	97.8	0.1	Edit																																
08/15	0.13	0	95.4	0.3	Edit																																
08/16	0.13	0	93	0.4	Edit																																
<table border="0"> <tr> <td>Day of Year:</td> <td>227</td> <td>Measured Available Water:</td> <td>0%</td> </tr> <tr> <td>Irrigation:</td> <td>0 in.</td> <td>Modeled Available Water:</td> <td>93%</td> </tr> <tr> <td>Precipitation:</td> <td>0 in.</td> <td>Field Capacity:</td> <td>10 in.</td> </tr> <tr> <td>Reference ET:</td> <td>0.15 in.</td> <td>Wilting Point:</td> <td>4.5 in.</td> </tr> <tr> <td>Crop Coefficient:</td> <td>0.88</td> <td>Avail. Water Capacity:</td> <td>5.5 in.</td> </tr> <tr> <td>Crop ET:</td> <td>0.13 in.</td> <td>Water Storage At MAD:</td> <td>8.08 in.</td> </tr> <tr> <td>Root Depth:</td> <td>30 in.</td> <td>Current Water Storage:</td> <td>9.61 in.</td> </tr> <tr> <td>Root Zone Water Deficit:</td> <td>0.39 in.</td> <td>Volumetric Water Content:</td> <td>32 %.</td> </tr> </table>						Day of Year:	227	Measured Available Water:	0%	Irrigation:	0 in.	Modeled Available Water:	93%	Precipitation:	0 in.	Field Capacity:	10 in.	Reference ET:	0.15 in.	Wilting Point:	4.5 in.	Crop Coefficient:	0.88	Avail. Water Capacity:	5.5 in.	Crop ET:	0.13 in.	Water Storage At MAD:	8.08 in.	Root Depth:	30 in.	Current Water Storage:	9.61 in.	Root Zone Water Deficit:	0.39 in.	Volumetric Water Content:	32 %.
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Root Zone Water Deficit:	0.39 in.	Volumetric Water Content:	32 %.																																		
08/17	0.12	0	90.7	0.5	Edit																																
08/18	0.12	0	88.5	0.6	Edit																																
08/19	0.12	0	86.2	0.8	Edit																																
08/20	0.11	0.22	88.2	0.7	Edit																																

[|<<](#) [<<<](#)

[Forecast](#)

08/08	0.3	0	91.4	0.5	Edit
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[|<<](#)
[<<<](#)
Aug 02, 2013
[Forecast](#)

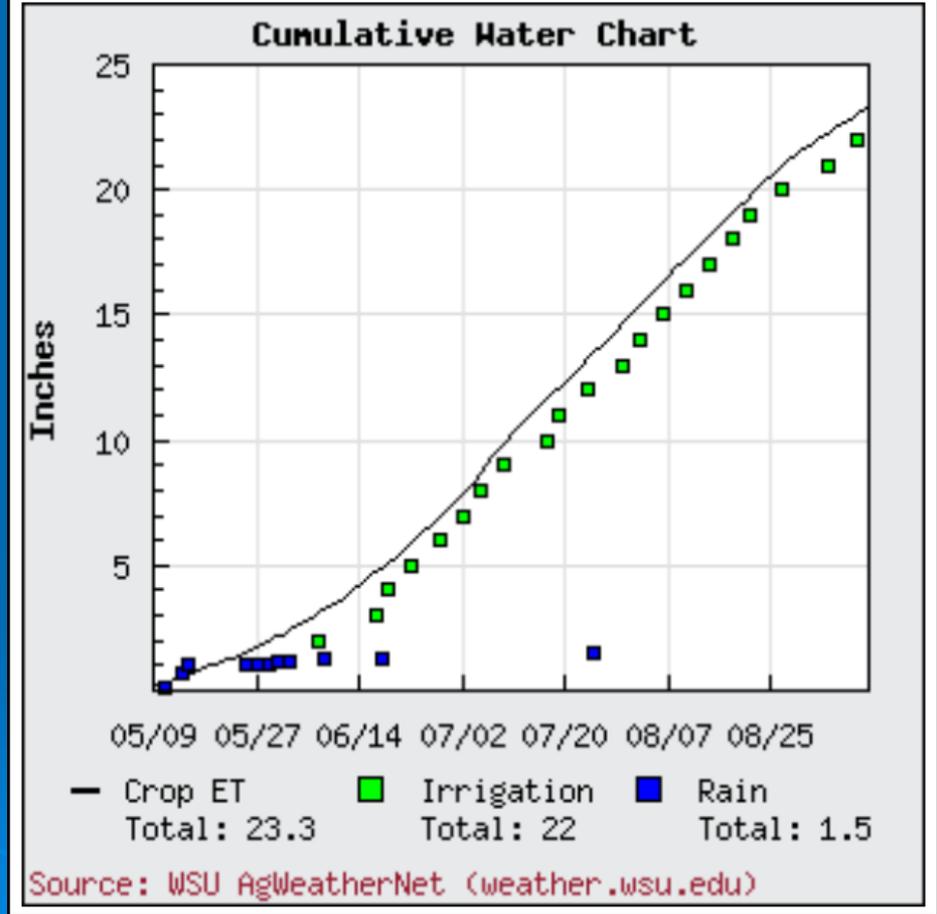
-  [Daily Budget Table](#)
-  [Soil Water Chart](#)
-  [Less Charts](#)
-  [Daily Water Use Chart](#)
-  [Cumulative Water Chart](#)
-  [Crop Coefficient Chart](#)
-  [Deep Water Loss Chart](#)
-  [Water Stress Chart](#)
-  [Field Settings](#)
-  [Add/Delete Fields](#)

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irrigation scheduler mobile

Field: 

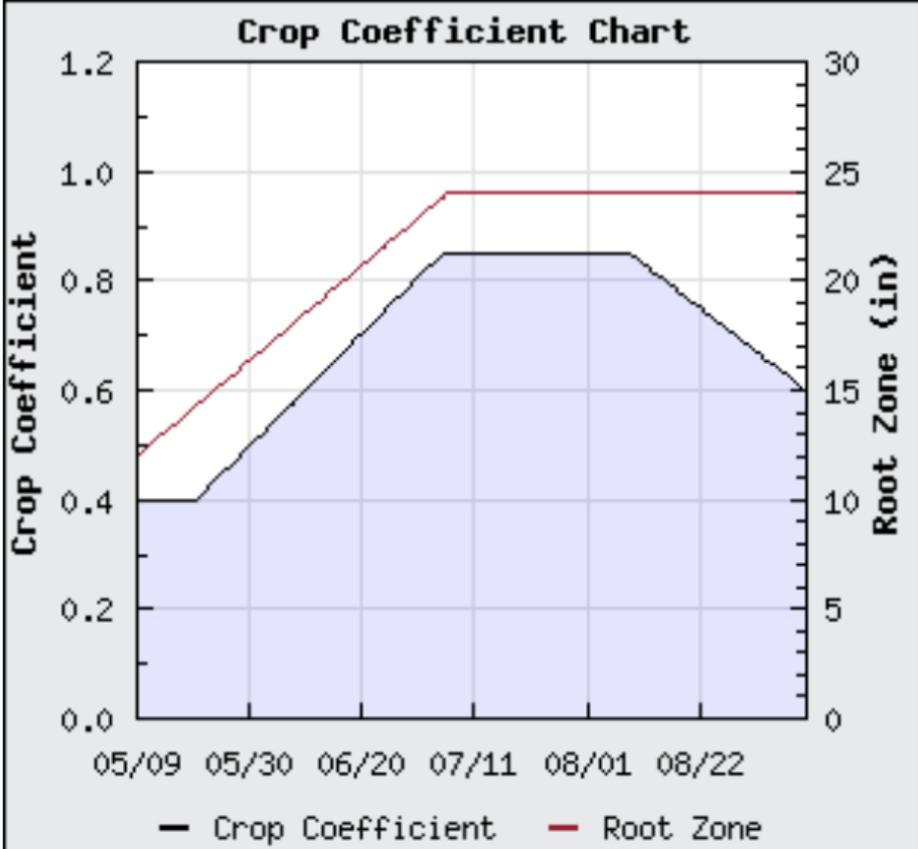
[Help](#)



irrigation scheduler mobile

Field: Potatoes, 2011; Potatoes

[Help](#)

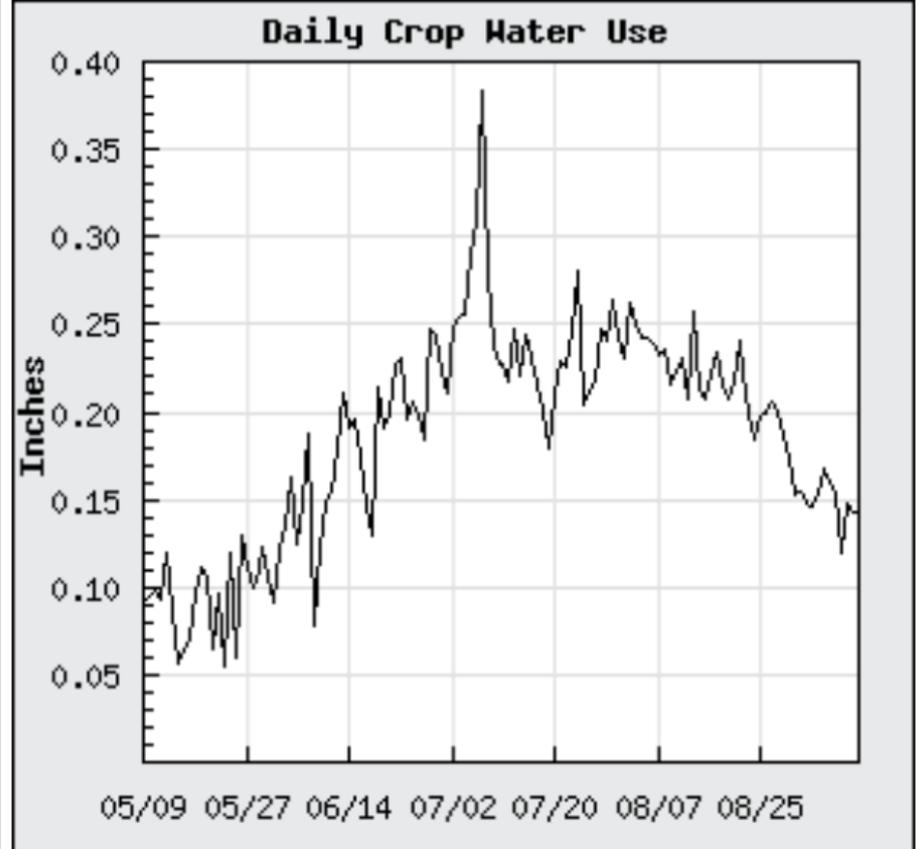


Source: WSU AgWeatherNet (weather.wsu.edu)

irrigation scheduler mobile

Field: Potatoes, 2011; Potatoes

[Help](#)



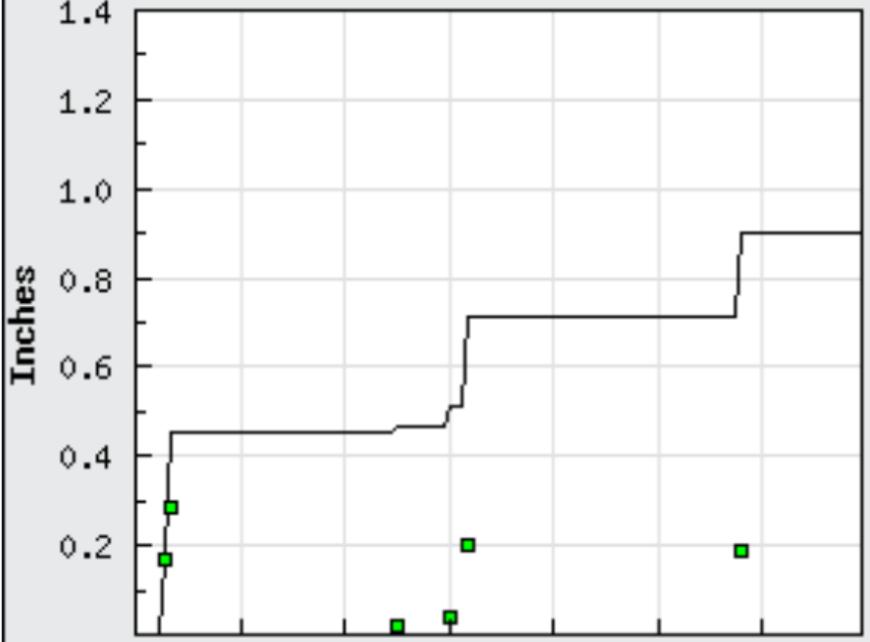
Source: WSU AgWeatherNet (weather.wsu.edu)

irrigation scheduler mobile

Field: Potatoes, 2011; Potatoes

[Help](#)

Deep Water Loss Chart



05/09 05/27 06/14 07/02 07/20 08/07 08/25

— Cumulative Deep Water Loss 0.9 in
 ■ Daily Deep Water Loss

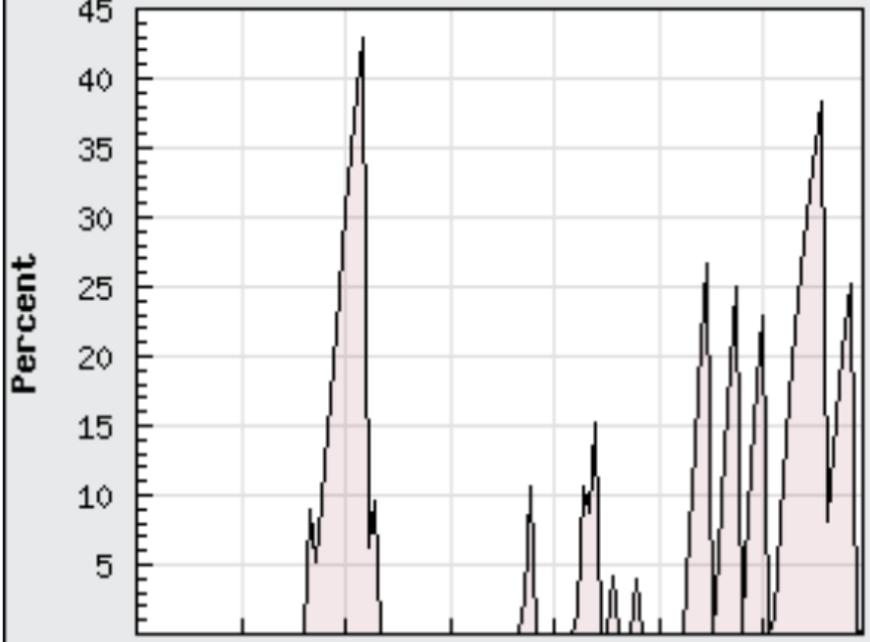
Source: WSU AgWeatherNet (weather.wsu.edu)

irrigation scheduler mobile

Field: Potatoes, 2011; Potatoes

[Help](#)

Yield Reduction Due to Water Stress



05/09 05/27 06/14 07/02 07/20 08/07 08/25

— Total estimate yield loss to water stress: 6%

Source: WSU AgWeatherNet (weather.wsu.edu)

irrigation scheduler mobile

irrigation scheduler mobile

Field:

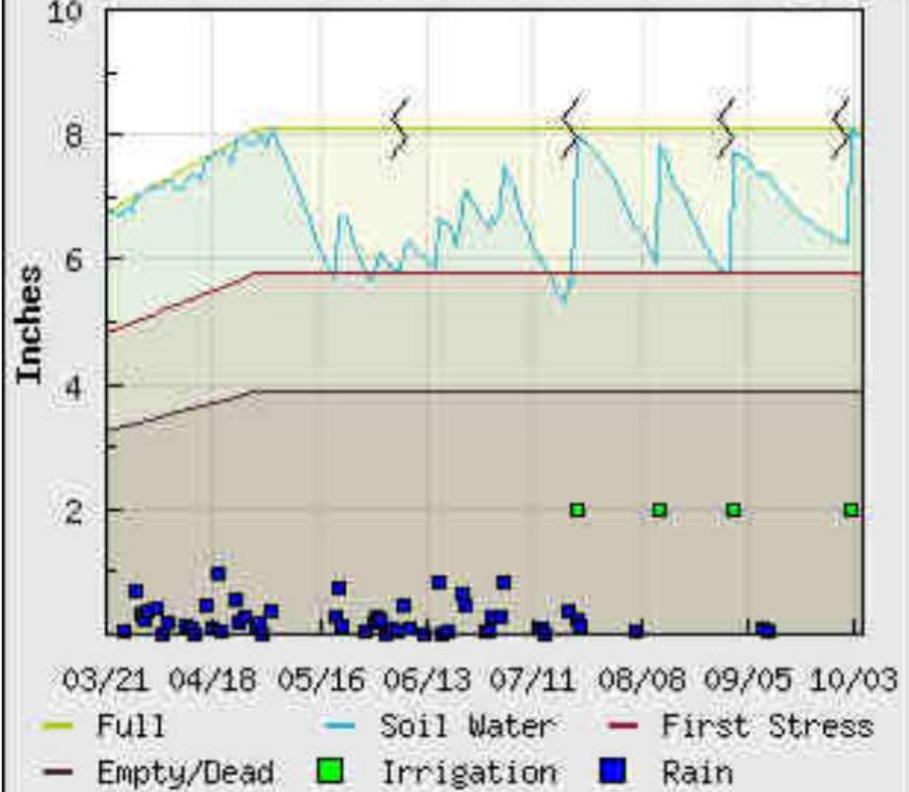
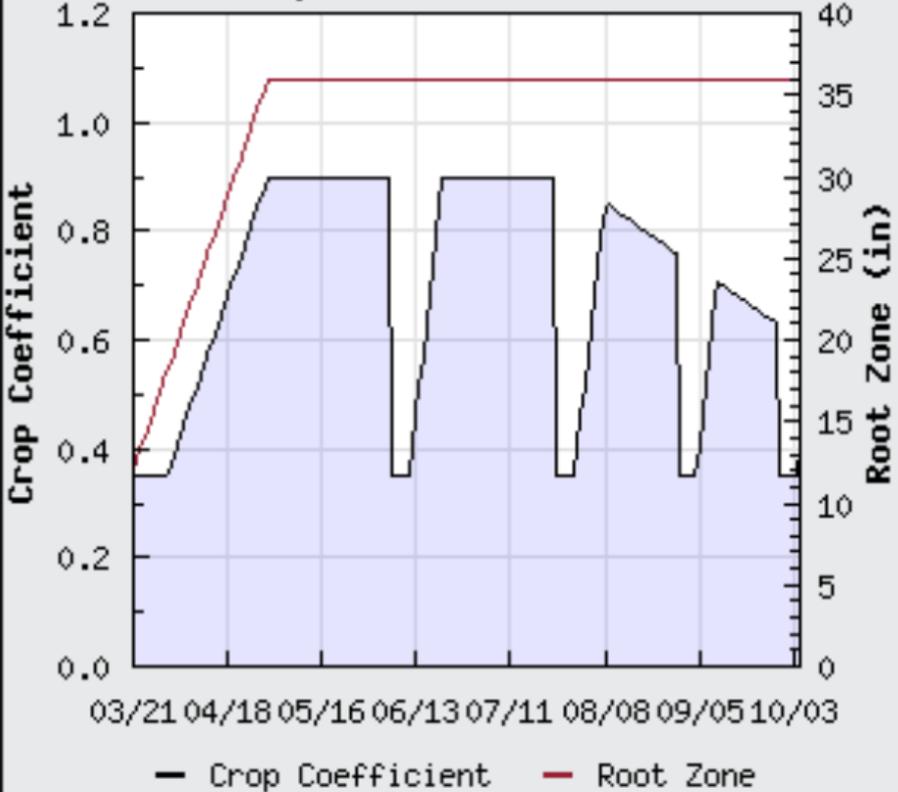
Field:

[Help](#)

[Help](#)

Crop Coefficient Chart

Field Soil Water Content, Rain & Irrigation



Source: WSU AgWeatherNet (weather.wsu.edu)

Dotted lines indicate forecast values.

Advanced Field Information

Field: Creek Pasture, 2013; Grass (Pasture)

[Help](#)

- Show Forecast Values
- Send Me Notifications By Text (SMS)

Phone Number: 5097781748

Service Provider: Verizon

Each day at: 08:10

Only If % Avail. Water Is < 60 %

Use Volumetric Soil Water Content

Use Hours Irrigation Instead of Inches

Irrigation Application

Rate: 0.141 in/hr

[Help Calculate My Application Rate](#)

For Drip/Micro

% of Soil Wetted: 100 %

Soil Water Content at

Field Capacity: 4.5 in/ft

Send Me Notifications By Text (SMS)

Phone Number: 5097781748

Service Provider: Verizon

Each day at: 08:10

Only If % Avail. Water Is < 60 %

Use Volumetric Soil Water Content

Use Hours Irrigation Instead of Inches

Irrigation Application

Rate: 0.140 in/hr

[I know my Application Rate](#)

Irrigation Type: Sprinkler Irrigation

Nozzle Diameter: 5 32nds in

Pressure: 50 psi

Head Spacing: 40 ft

Line Spacing: 60 ft

Sprinkler Efficiency: 70

Calculate Rate

For Drip/Micro

% of Soil Wetted: 100 %

Specific help
link on every
screen

Verizon 3G 11:19 AM 89%
irrigation scheduler mobile

7-Day Daily Budget Table Help

Use this table to view the calculated daily crop water use, percent available soil water, and soil water deficit. From this table you can enter irrigation events and/or soil moisture measurements using the "Edit" link. If the percent available water is within the range for maximum production the line will be green. As it gets close to the First Water Stress line (Management Allowable Deficit; MAD) it turns yellow. If the soil water content is depleted below the MAD or First Water Stress point it will turn red.

Water Use (in/day) - This is the daily



Additional Features

- Copy settings from an existing field for quick setup/reset for new year.
- One-week ETc forecast
 - NWS max & min forecast & Hargreaves eqtn.
- Can use hrs of irrigation run time instead of inches of applied water.
 - Integrated calculators to help calc app. rate.
- Option for notifications via email or text.
- Download all data to a .csv from full-page.

irrigation scheduler mobile

<http://weather.wsu.edu/ism>

Google it!

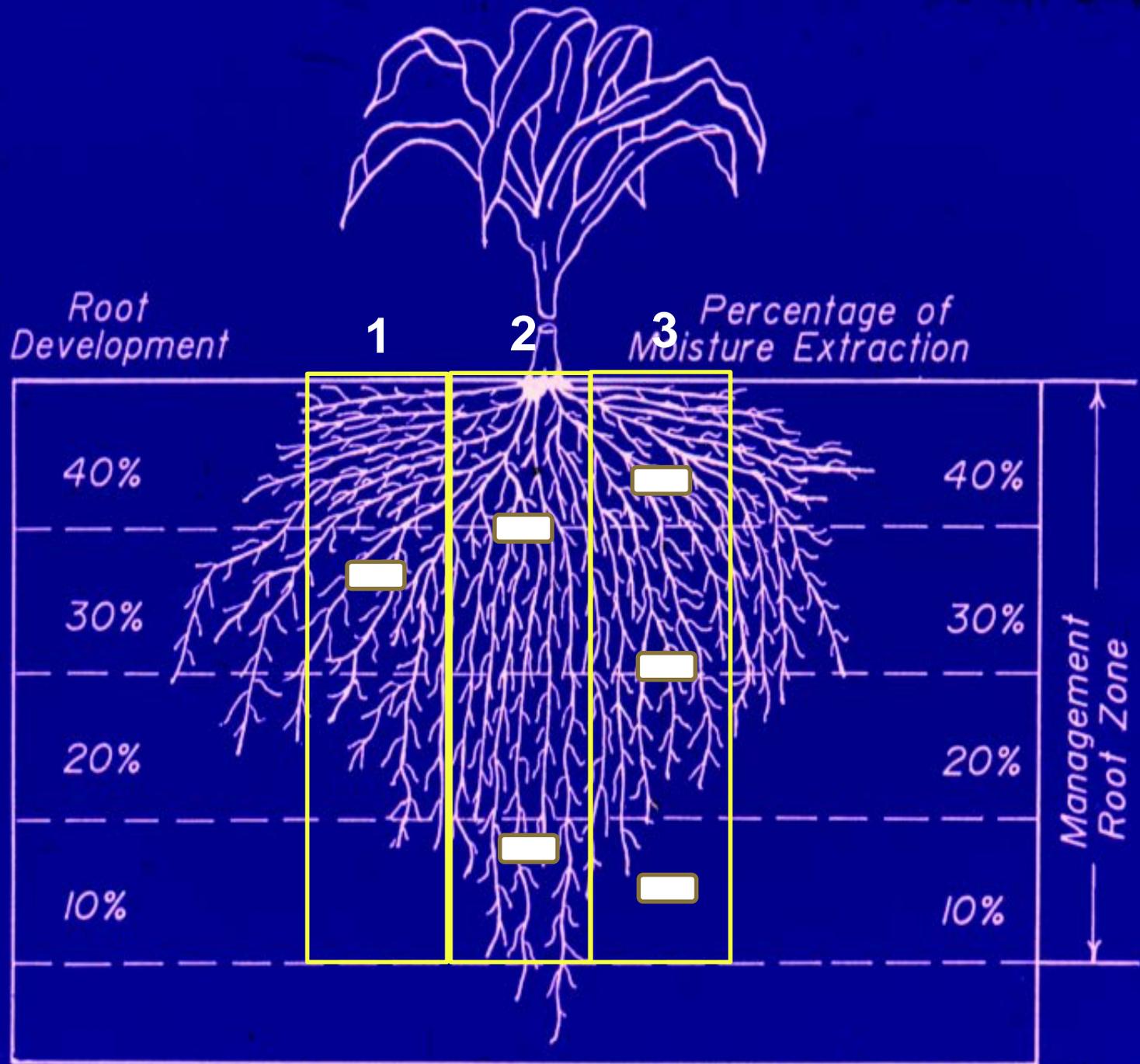
**Or search wherever you find
your mobile phone apps.**

SOIL MOISTURE SENSORS

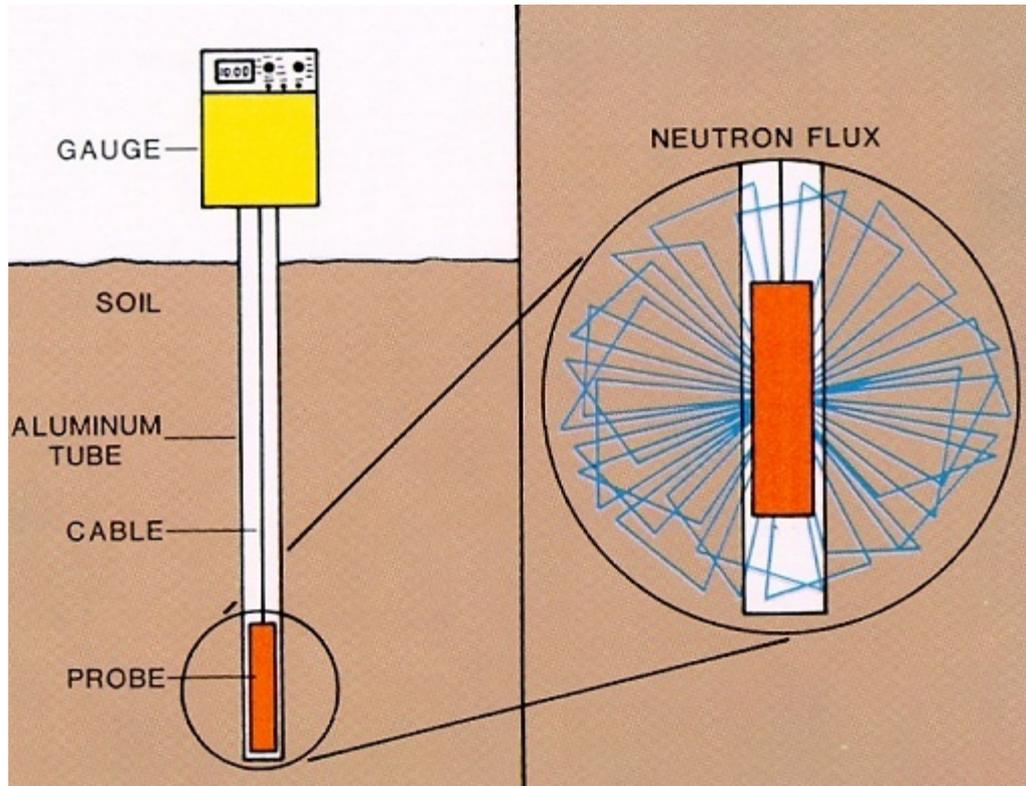


Where to put them?

- Field location
 - *Not* right on the edge of the field.
 - Average soil condition?
 - Lowest water holding capacity (sandy).
- Depths
 - (1) Middle of root zone.
 - (2) 1/3 – middle, and bottom of root zone.
 - (3) Top, middle, and bottom of root zone.
 - Top sensors tell you *when* to water, bottom shows more severe stress, and shows water holding capacity of soil... *how much*.



Neutron Probe



Neutron Probe

- Strengths
 - Accurate
 - Gives soil water content
 - Large soil sample area
 - Unaffected by salinity or temperature
 - Repeatable
 - Easy to sample at different depths
- Weaknesses
 - Highly regulated (nuclear device)
 - Can't leave in the field
 - Expensive

Capacitance Probes





Courtesy Rick Hamman, Mercer Estate Winery

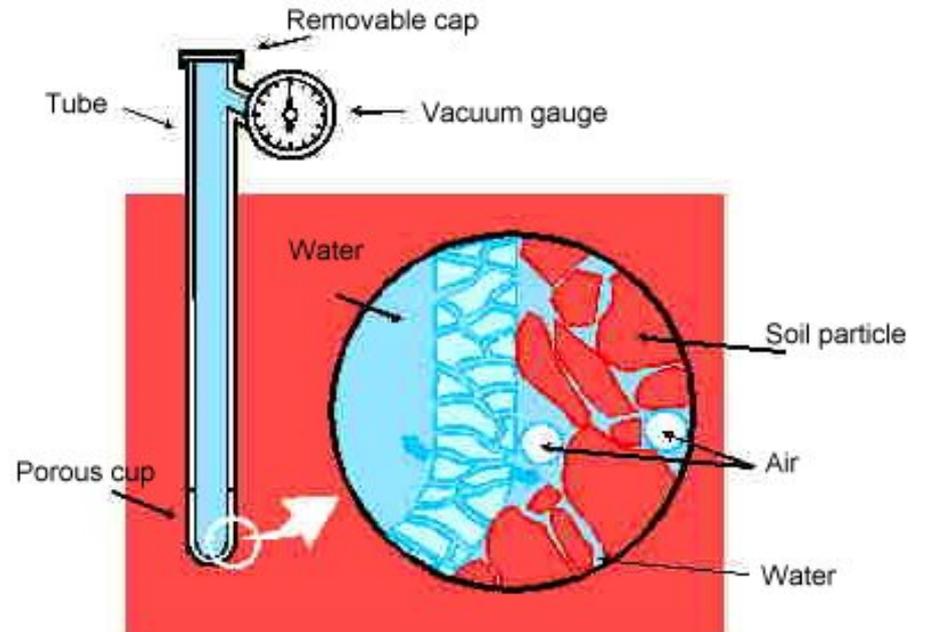
Capacitance Sensors

- Strengths
 - Gives soil water content
 - Easy to log data (real-time)
- Weaknesses
 - Small sample area
 - Highly dependant on very local soil structure
 - Inconsistent (high variability)
 - Can be expensive
 - Proper installation is critical, and not always easy
 - Affected by salinity and temperature

Practical use of soil content sensors (capacitance, neutron probe)

- Measure as soon as soil thaws = field capacity, or 24 hrs after heavy irrigation
- Then use AWC by soil texture and start with 50% MAD for grapes. Refine this using feedback from plants and experience.

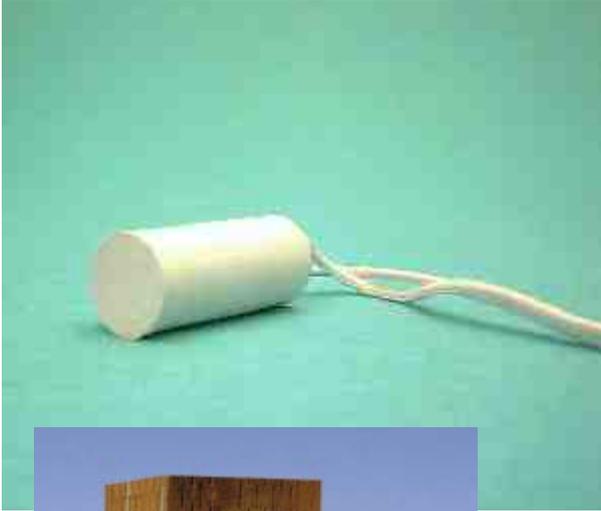
Tensiometers



Tensiometers

- Strengths
 - Soil water tension (same as plant sees)
 - Less expensive
 - Widely used, studied and accepted
 - Not affected by salinity
- Weaknesses
 - Small sample area
 - Indicates “when” to irrigate, not “how much”

Resistance



Resistance type

- Strengths
 - Inexpensive
 - Usable trends
 - Give soil water potential (same as plant sees)
 - Easy to log data
- Weaknesses
 - Affected by salinity
 - Imperfect accuracy
 - Samples small area

Practical use of Tension-Based Soil Moisture Sensors

- Start with 30-50 centibars as irrigation point for no stress.
- Increase to 80 centibars or higher for imposed stress.
- Correlate numbers to crop condition, then use numbers in future to indicate degree of soil dryness.
- Watch deep sensor after an irrigation to indicate depth of penetration.

Soil Moisture Sensors

The “Look and Feel Method”



- Advantages
 - Cheap
 - Easy
- Weaknesses
 - Subjective - especially w/ dry soil.

Look and Feel

- May take time and experience to train yourself to do this correctly.
- Start with the NRCS pamphlet recommendations
- Refine your techniques for your particular soil by condition of soil at particular crop stress points, or correlated with a soil sensor.
- Go deep!



\$4,500

\$50

Most important thing is:

- Do Something!
- Stop Guessing.
You can't manage what you don't measure.

