


Soil Moisture Sensors

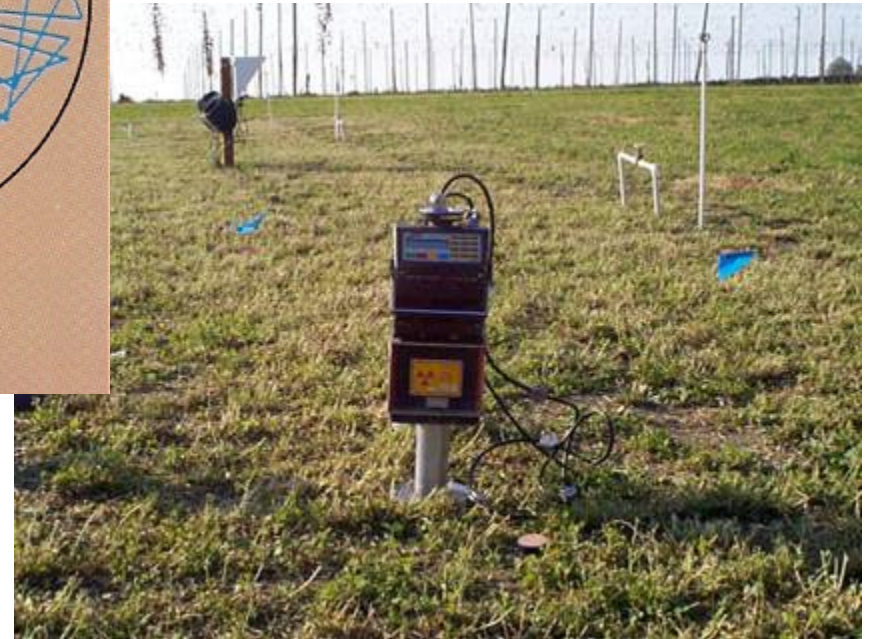
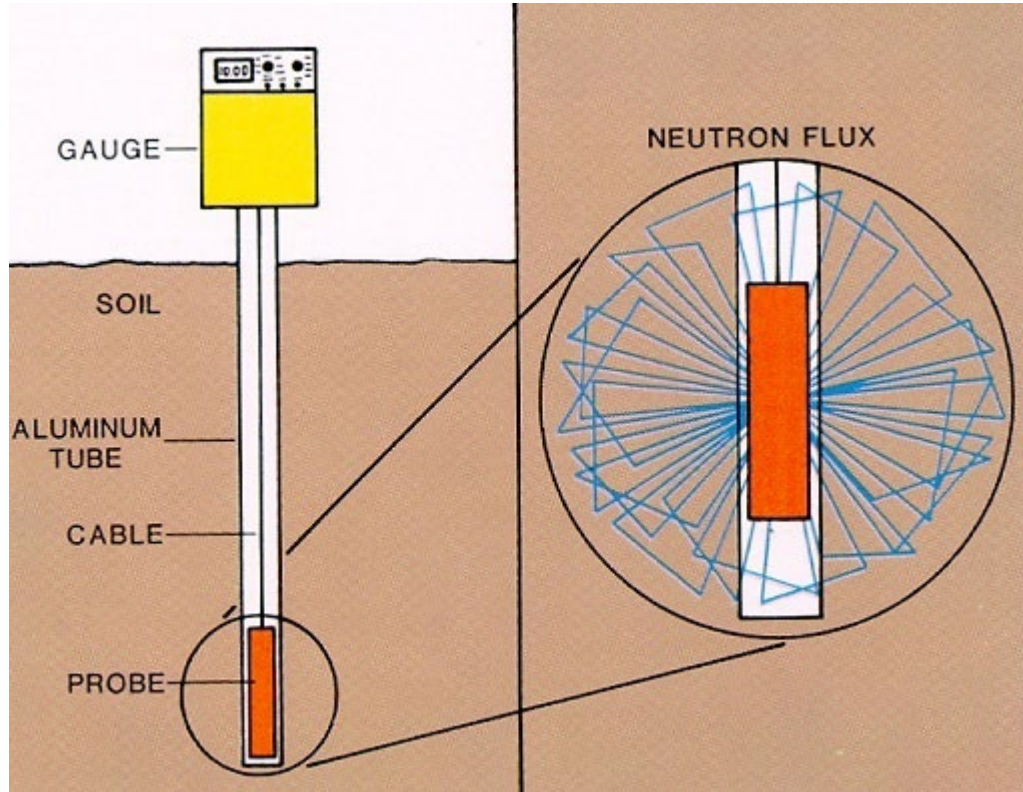
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Types of Soil Moisture Sensors

- Neutron Probe
- Tensiometers
- Resistance
- Capacitance
- Time Domain Reflectometry (TDR)
- Look and Feel

Neutron Probe



Buy one, use it everywhere. Ours are 20-30 years old and still going strong.

Neutron Probe

(soil water content/*volume*)

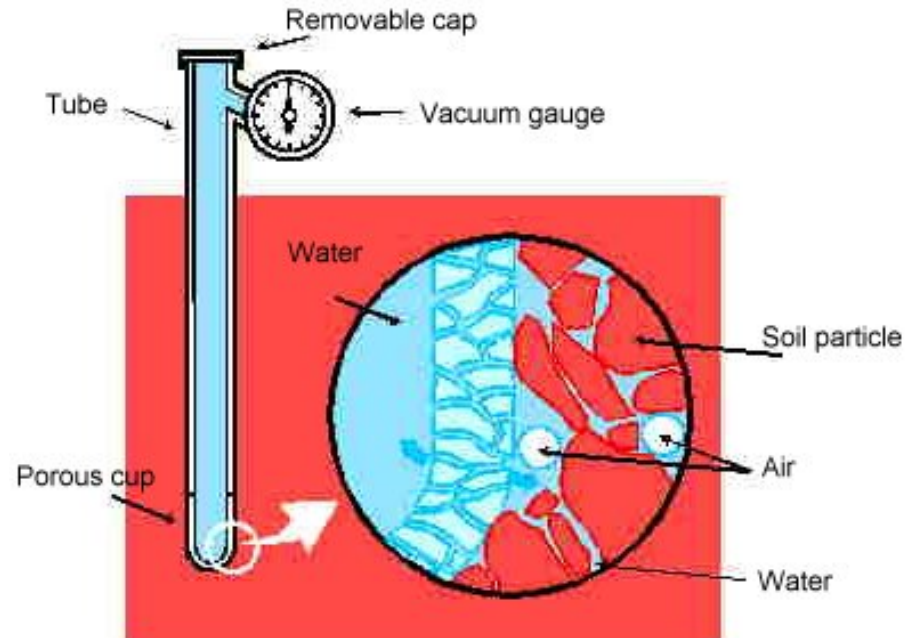
- **Strengths**

- 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=paperwork)
- Can't leave in the field (discontinuous data)
- Expensive to operate (labor)

Tensiometers (soil water *tension*)



Tensiometers (soil water *tension*)



Tensiometers

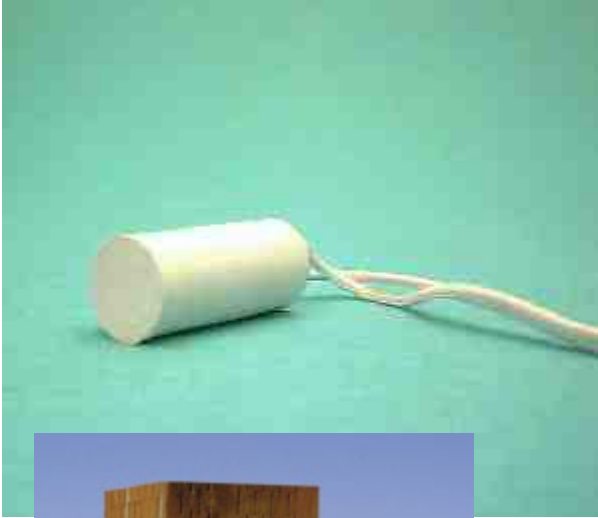
- **Strengths**

- 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 (soil water *tension*)



Resistance type

- **Strengths**

- Inexpensive
- Low power use (AA batteries, vs. solar panels)
- Usable trends
- Give soil water potential (same as roots fight)
- Easy to log data

- **Weaknesses**

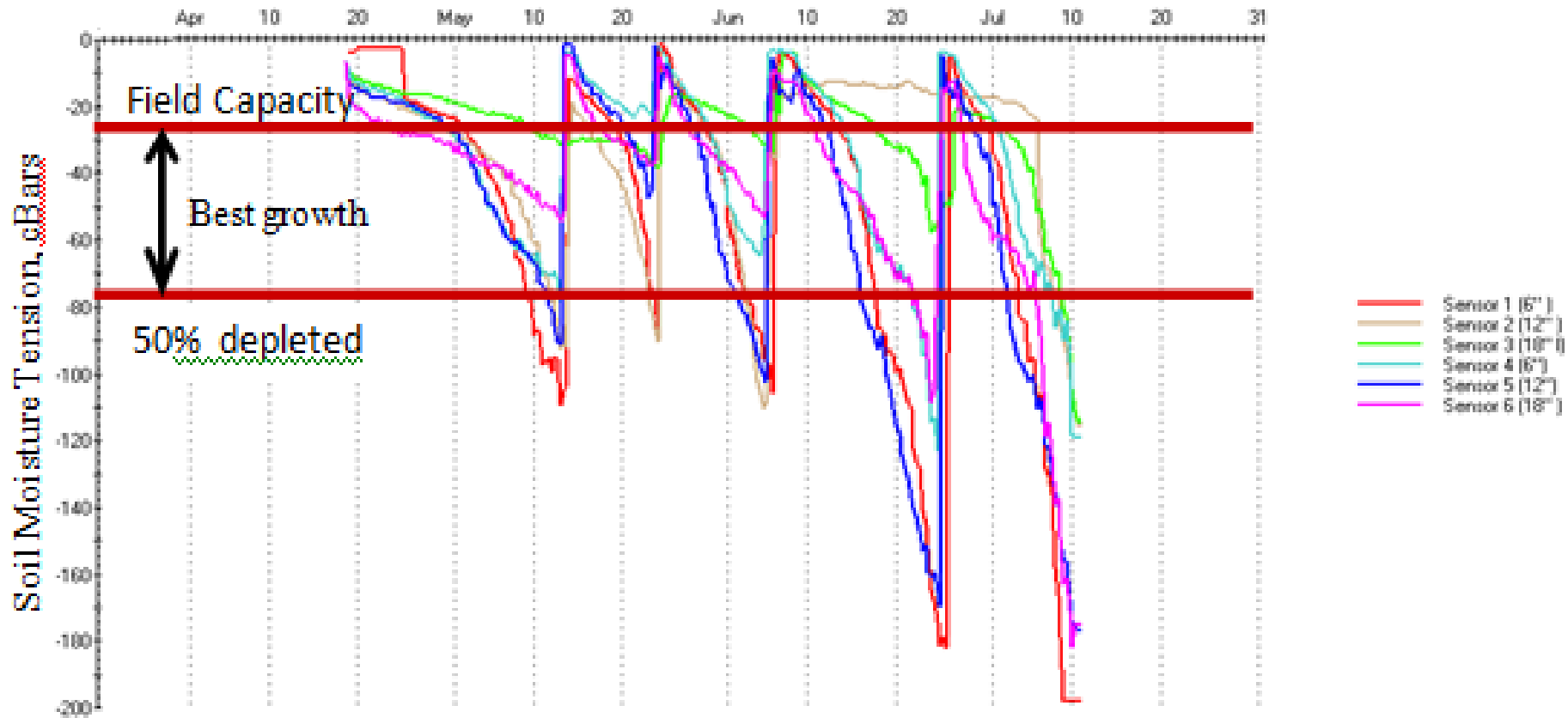
- Imperfect accuracy
- Affected by salinity (ions -> electrical conductivity)
- Samples small area
- Sensors degrade over time



Practical use of Soil Water *Tension* Soil Moisture Sensors (tensiometers, resistance)

- Start with 30-50 centibars as irrigation point for no stress.
- Increase to 80-100 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.

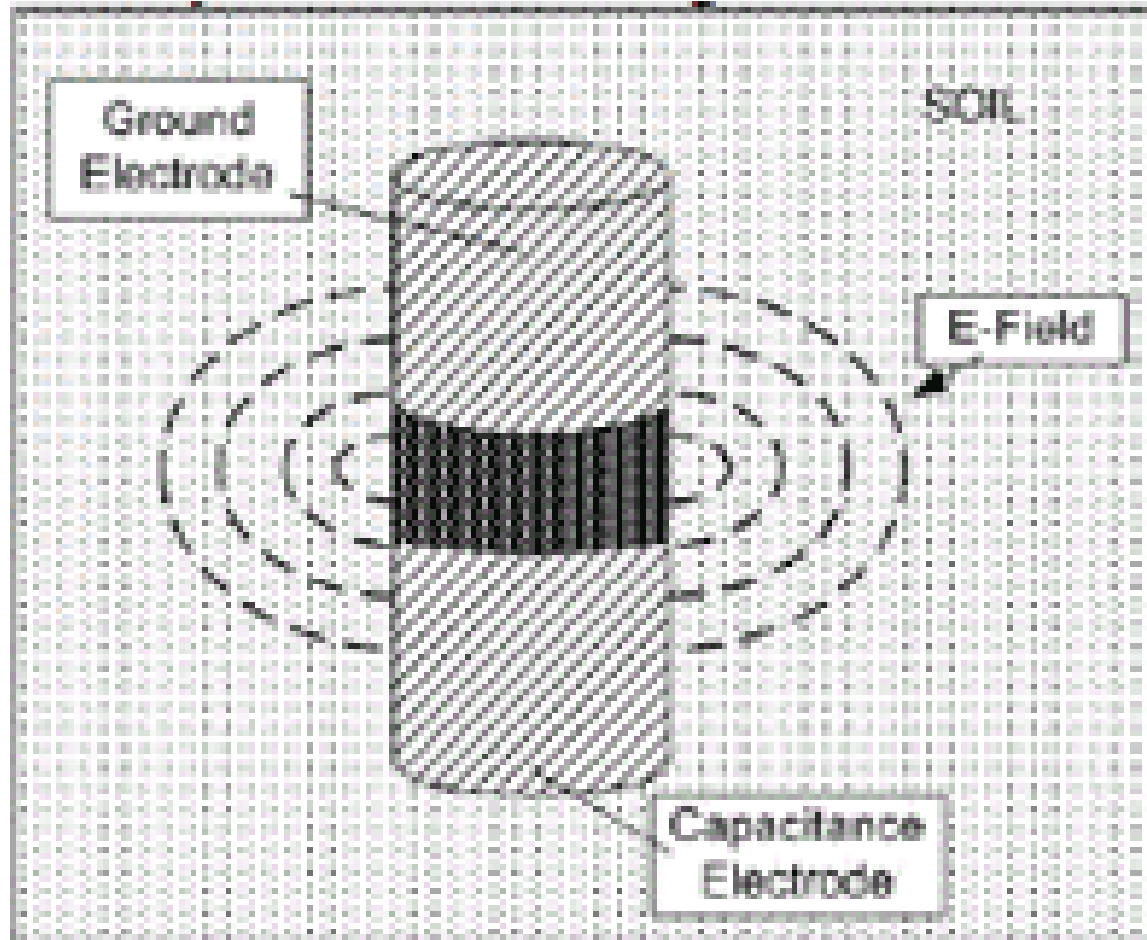
Soil Water Tension



Capacitance Probes *(soil water content/Volume)*



Capacitance Sensors



Measures dielectric permittivity (ability to store an electrical charge)

Increasing the Measured Volume by Increasing the Length



Capacitance Sensors

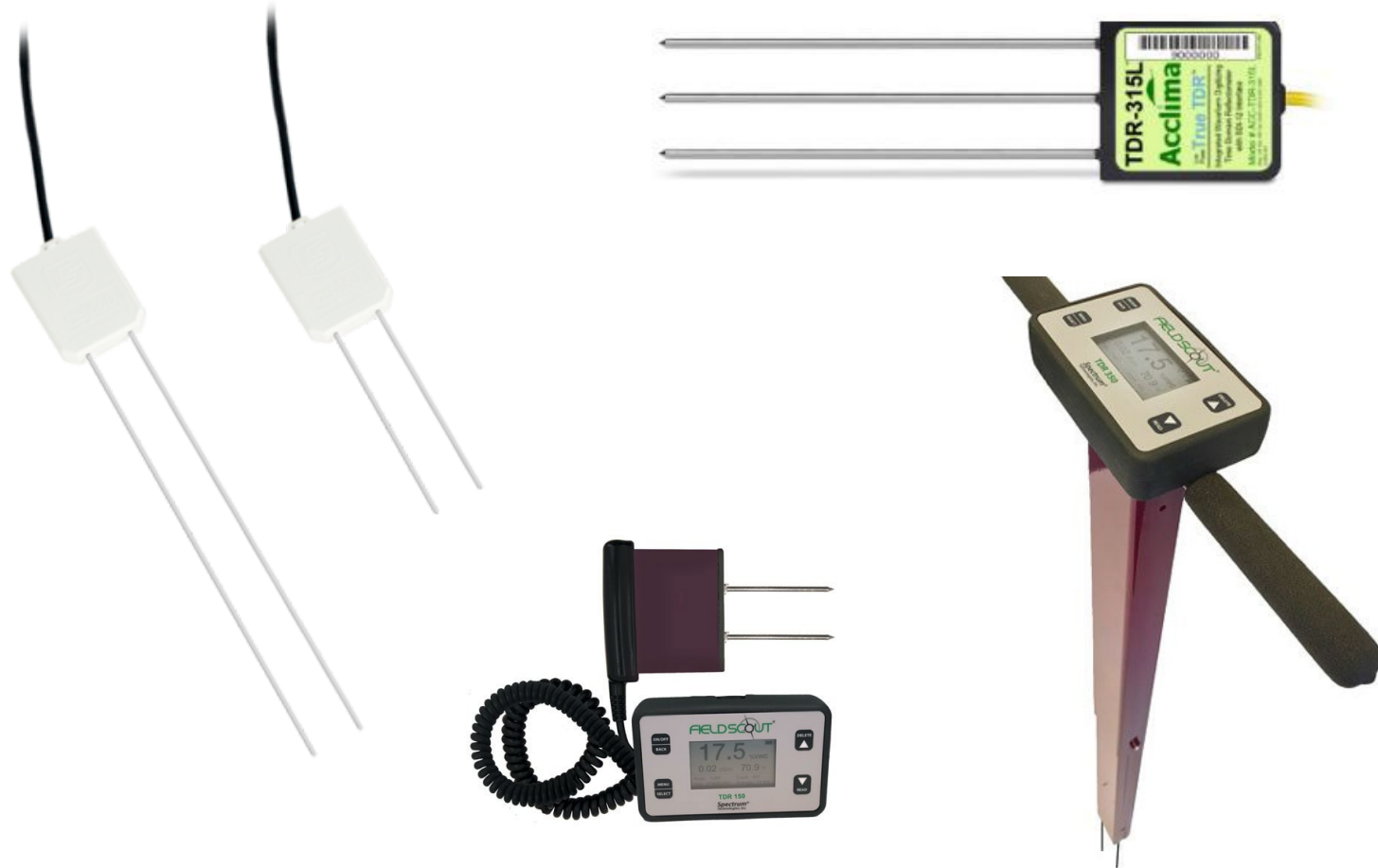
- **Strengths**

- Gives soil water content
- Easy to log data (real-time and continuous data)
- Low power use (AA batteries)

- **Weaknesses**

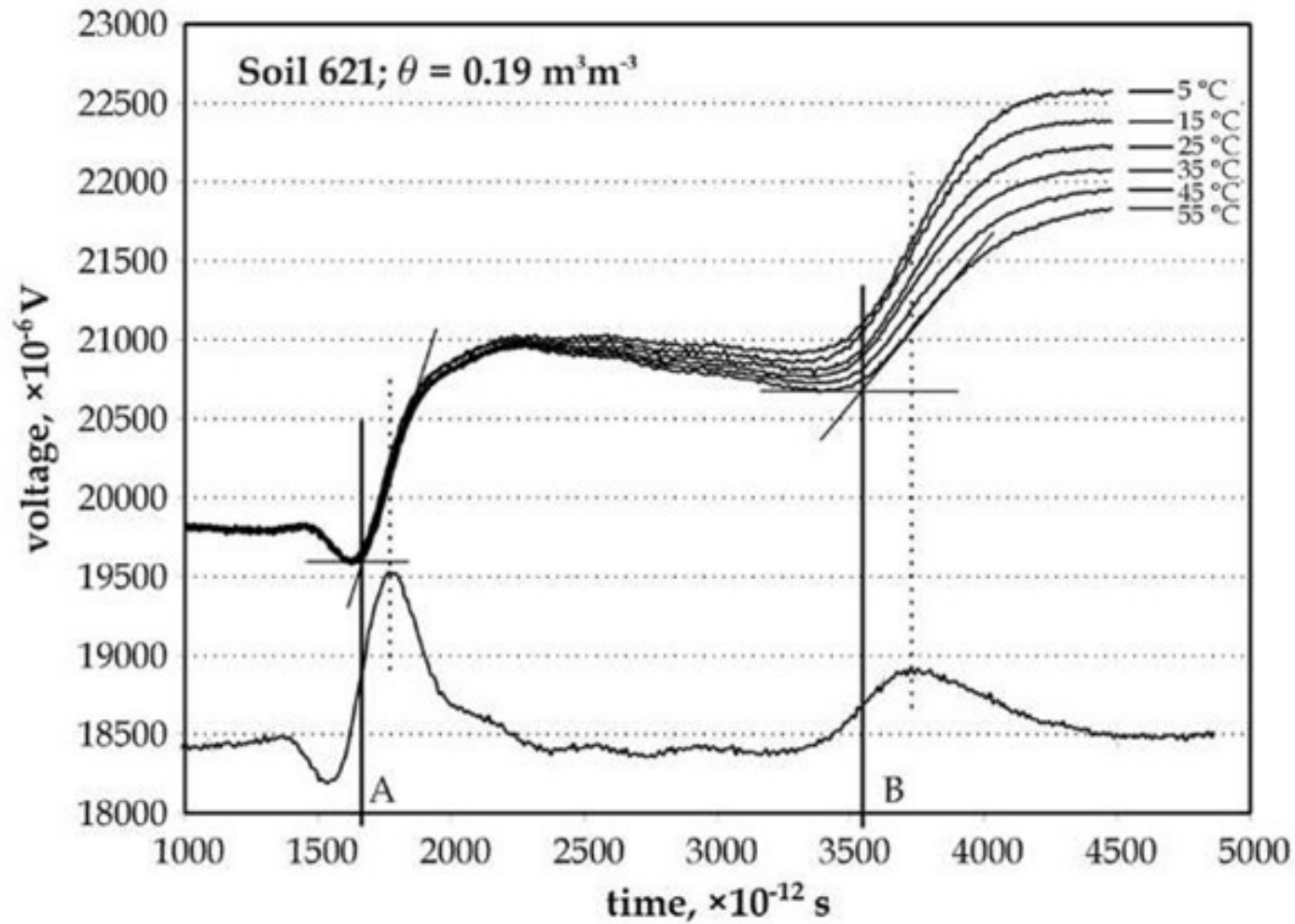
- Small sample area
- Highly dependant on very local soil structure
- Inconsistent (high variability)
- Can be expensive
- Proper installation is critical, and not always easy
- Can be affected by salinity and temperature
- Can be affected by the soil bulk density
- Most need to be calibrated

Time Domain Reflectometry (TDR) And Frequency Domain Reflectometry (FDR) *(Soil Water Content/Volume)*



Measures dielectric permittivity (ability to store an electrical charge)

Time Domain Reflectometry (TDR)



Measures bulk dielectric permittivity which is a function of soil moisture.

Time Domain Reflectometry (TDR)



TDR Sensors

- **Strengths**

- Gives soil water content
- Can also give electrical conductivity (EC), bulk density, and temperature
- Easy to log data. (real time and continuous data)
- Sample volume depends on the length

- **Weaknesses**

- Often more expensive than capacitance (sophisticated electronics)
- Highly sensitive to soil immediately next to the tines
- Proper installation is critical, and not always easy
 - Need to dig a trench, or large hole
- Uses a lot of power (big batteries + solar panels)

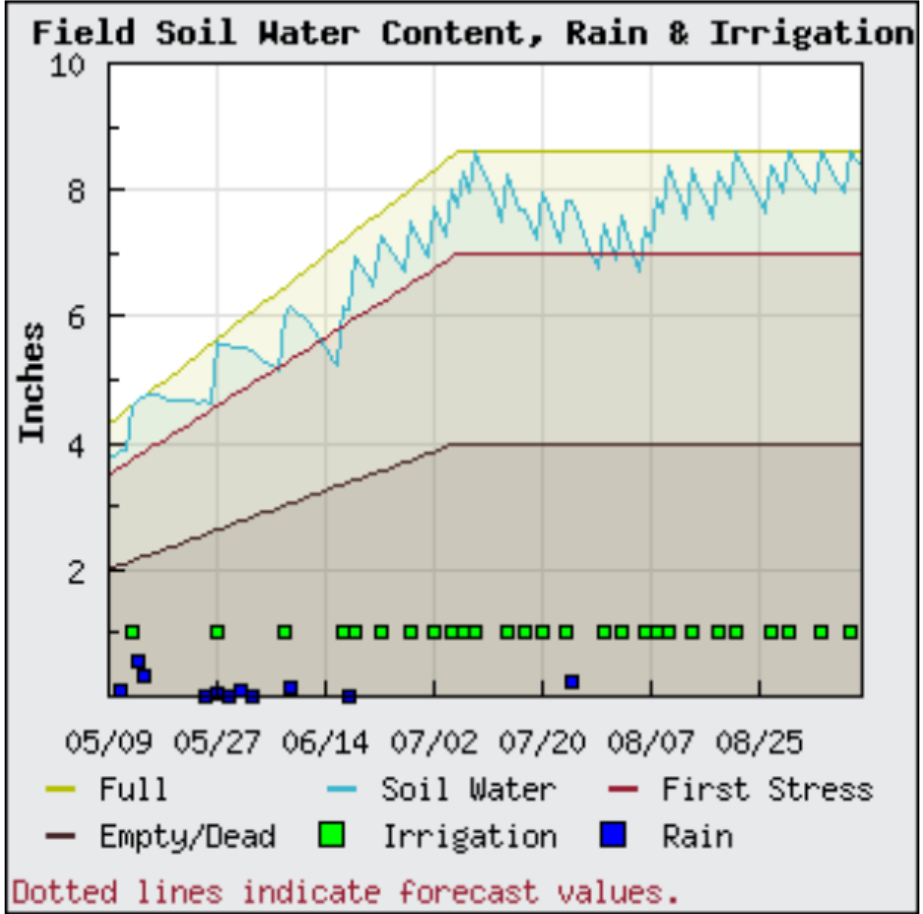
Practical use of Soil Water *Content/Volume* Sensors (capacitance, TDR, neutron probe)

- Find field capacity (full) point:
 - Measure as soon as soil thaws, or 24 hrs after heavy irrigation.
 - Less important whether it is "right".
 - Or estimate from soil water dynamics curve
- Then use 75% of FC for first estimate of "first water stress" point (MAD). Refine this using feedback from plants and experience.
 - Assumes $WP=50\%$ of FC, and $MAD = 50\%$ of (FC-WP)

irrigation scheduler mobile

Field: Potatoes, 2011; Potatoes

[Help](#)



Analyze your data through graphical display

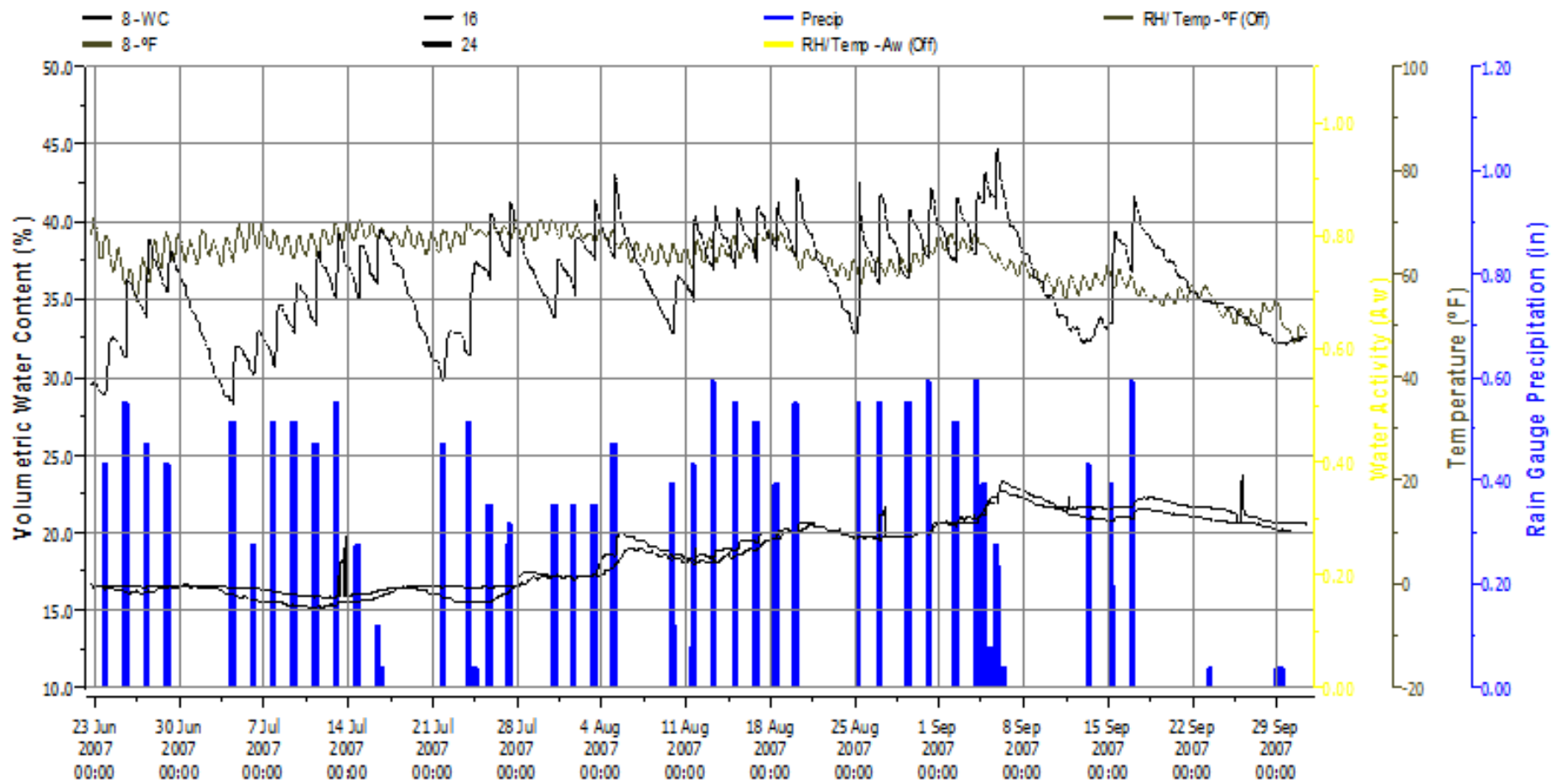
08-10-2012 (1:15 PM) to 09-10-2012 (1:15 PM) - America/Los_Angeles

Sensors: All, Use Interpolation: Yes, Show Zeros: No



Graphical display

The John Deere Field Connect solution provides a robust graphing capability to allow producers to view and analyze soil moisture information. Graphs are available showing total moisture as well as individual moisture readings by sensor. Producers can choose different time ranges, filters, and viewing options to customize the graph for their needs.



Summary

- Neutron Probe will give the “most correct” answer.
- Most sensors will give a trend that is usable for irrigation scheduling.
- Proper installation of sensors is critical and must be done right for good data!
- Actually using the sensor is most important!
- Keep records... calibrate yourself using numbers, crop response and experience.
- Hire a consultant, watch them and ask lots of questions.