

## Monitoring and Controlling Substrate Water Content in Controlled Environments

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### Why bother?

- Not part of minimum guidelines
  - Watering: frequency, amount, and type of water
- Plants do not respond to amount of water supplied
- Plants respond to water availability

Vinca grown at different substrate water contents



### Capacitance sensors

- Based on same principle as TDR
- Measurements are simplified
- No expensive electronics needed

### Soil Moisture Probes (Decagon)



### Soil Moisture Probes (Delta T)



### Soil moisture probes (Campbell Sci.)

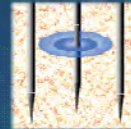


CS616/CS625

### General principle



Install or insert probe in soil or substrate



Sensor generates electromagnetic field

### General principle



Water, soil particles, and EC affect electromagnetic field

Dielectric permittivity:

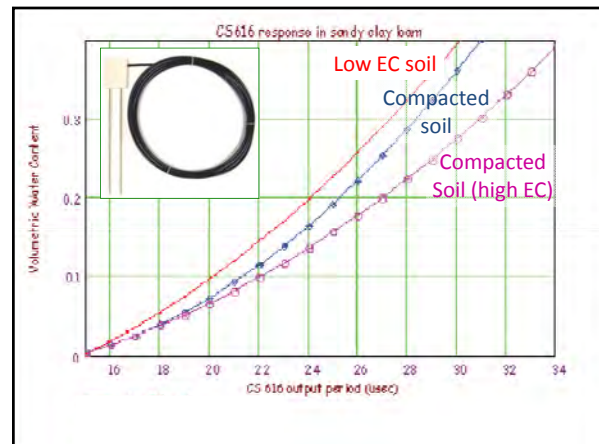
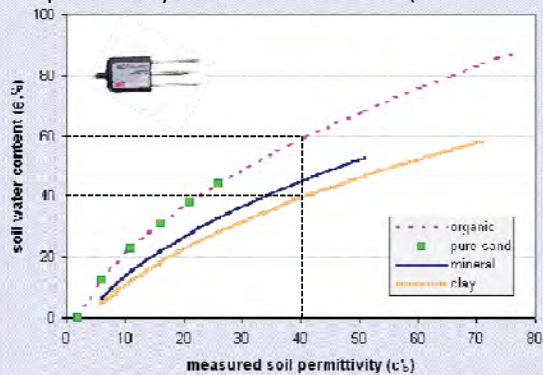
- Soil : 2-8
- Air: 1
- Water: 80.4
- Also affected by EC

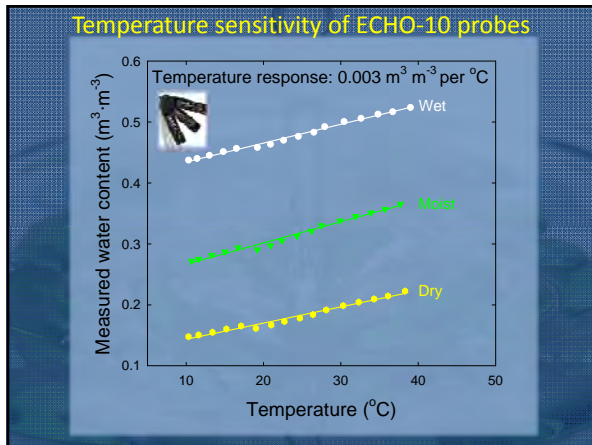
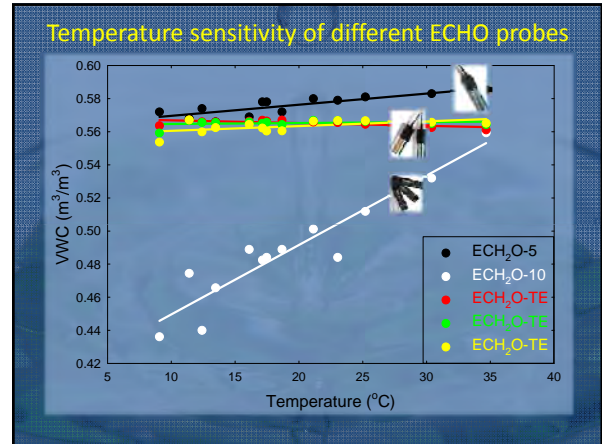
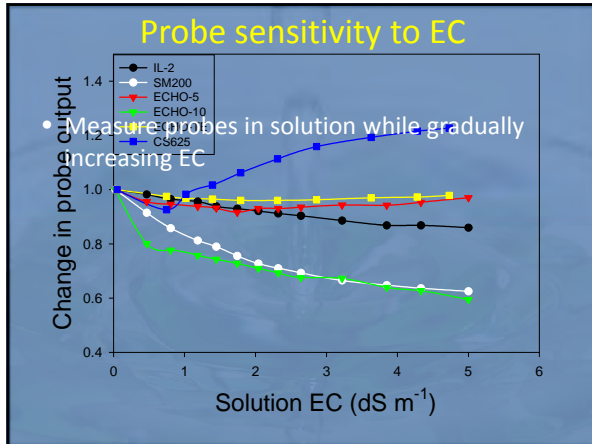
### Probe frequencies

ECHO-5	70 MHz
ECHO-10	20 MHz
ECHO-20	20 MHz
ECHO-TE	70 MHz
ThetaProbe	100 MHz
SM200	100 MHz
W.E.T sensor	20 MHz
CS616/625	70 MHz

Higher frequencies minimize the effect of soil texture and salinity

### Soil permittivity versus water content (W.E.T sensor)





### Soil moisture probes (summary)

- Great advances during the last few years
- Decide between:
  - handheld, insertable probes
  - *in situ* probes
- Substrate specific calibrations needed

### Soil moisture probes (summary)

- How important is:
  - Temperature sensitivity
  - EC sensitivity
  - Sampling volume (W.E.T sensor  $\approx$  ECHO-5  $\approx$  ECHO-TE  $\approx$  SM200 < ThetaProbe  $\approx$  ECHO-10 < ECHO-20 < CS625)
  - Price
- Interfacing sensors:
  - Handheld meter/logger: Delta T and Decagon sensors
  - Datalogger: all sensors
  - Greenhouse control systems: depends on system

