

Irrigation Management Technology and Soil Moisture Sensors

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Irrigation Management
Efficiency and Water
Conservation in Nurseries

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Modesto, CA



Topics

- Soil moisture measurement
 - Volumetric water content
 - Matric potential
- Sensors
- Using soil moisture measurement to control irrigation

Soil moisture measurement

- Volumetric water content
 - How much water is in the soil
 - Proportion of the soil volume that is water
- Expressed as %

Soil moisture measurement

- Matric potential
 - aka “tension”
 - How tightly water is held by soil
- Expressed as
kPa (kilopascal), MPa
(megapascals), or cbar (centibar)

Water potential

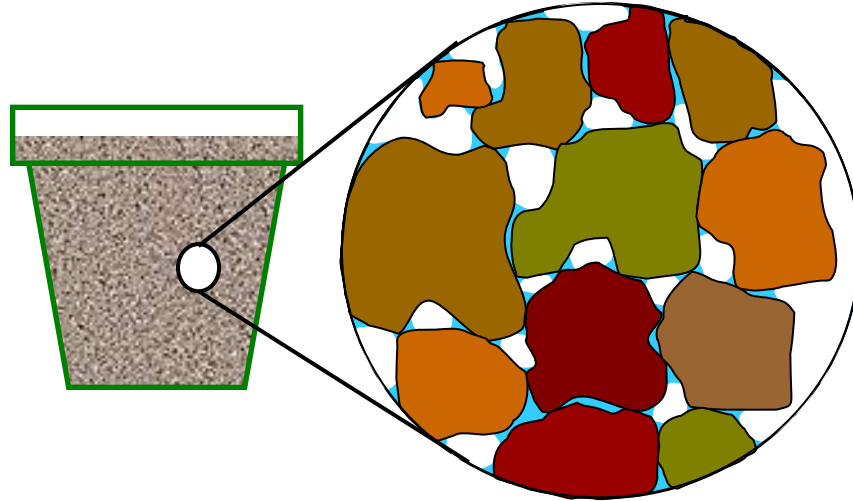
Potential energy components of water in substrates

- **Matric potential** - the energy required to remove water from the substrate
- **Gravimetric potential** - the energy required to “lift” water
- **Solute potential** - The energy required to dissolve things in it (salts, for example)

Water potential

Potential energy components of water in substrates

- **Matric potential** - the energy required to remove water from the substrate

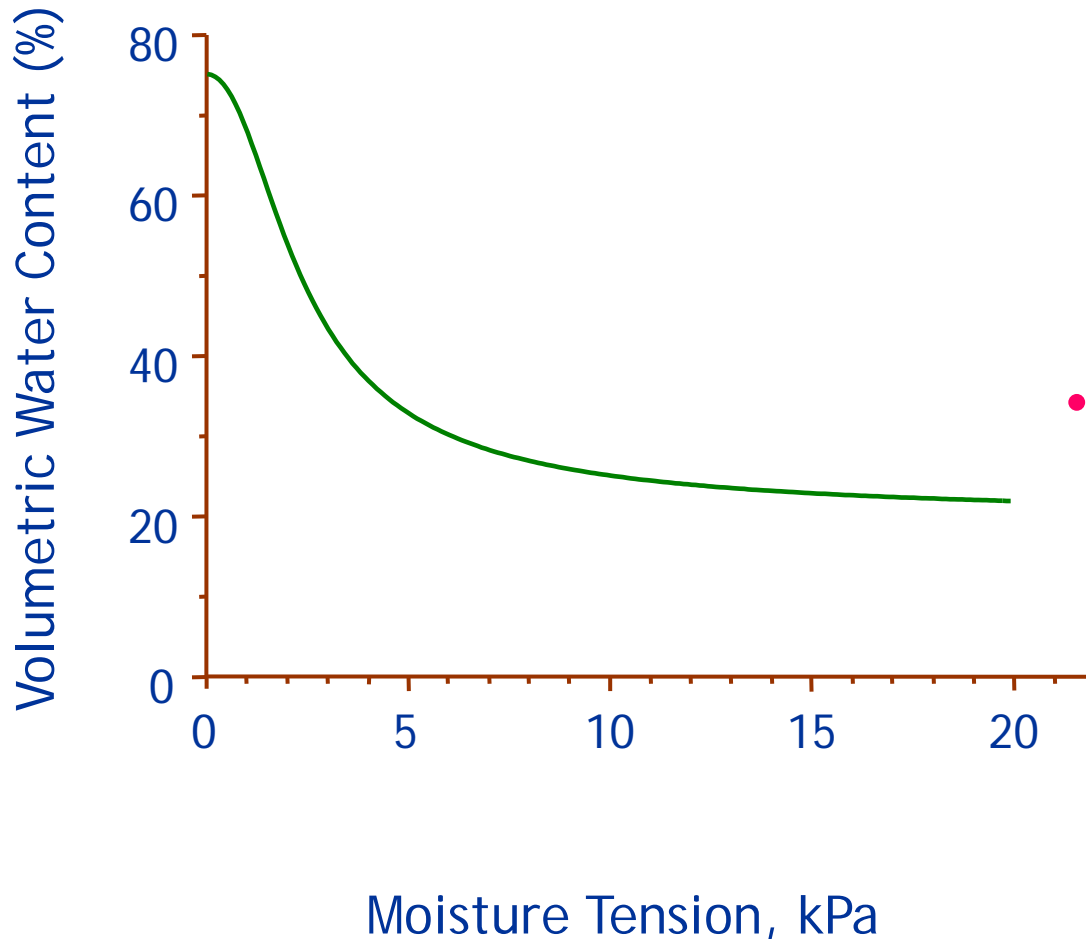


Units of
Measure:

Kilopascals
(kPa)

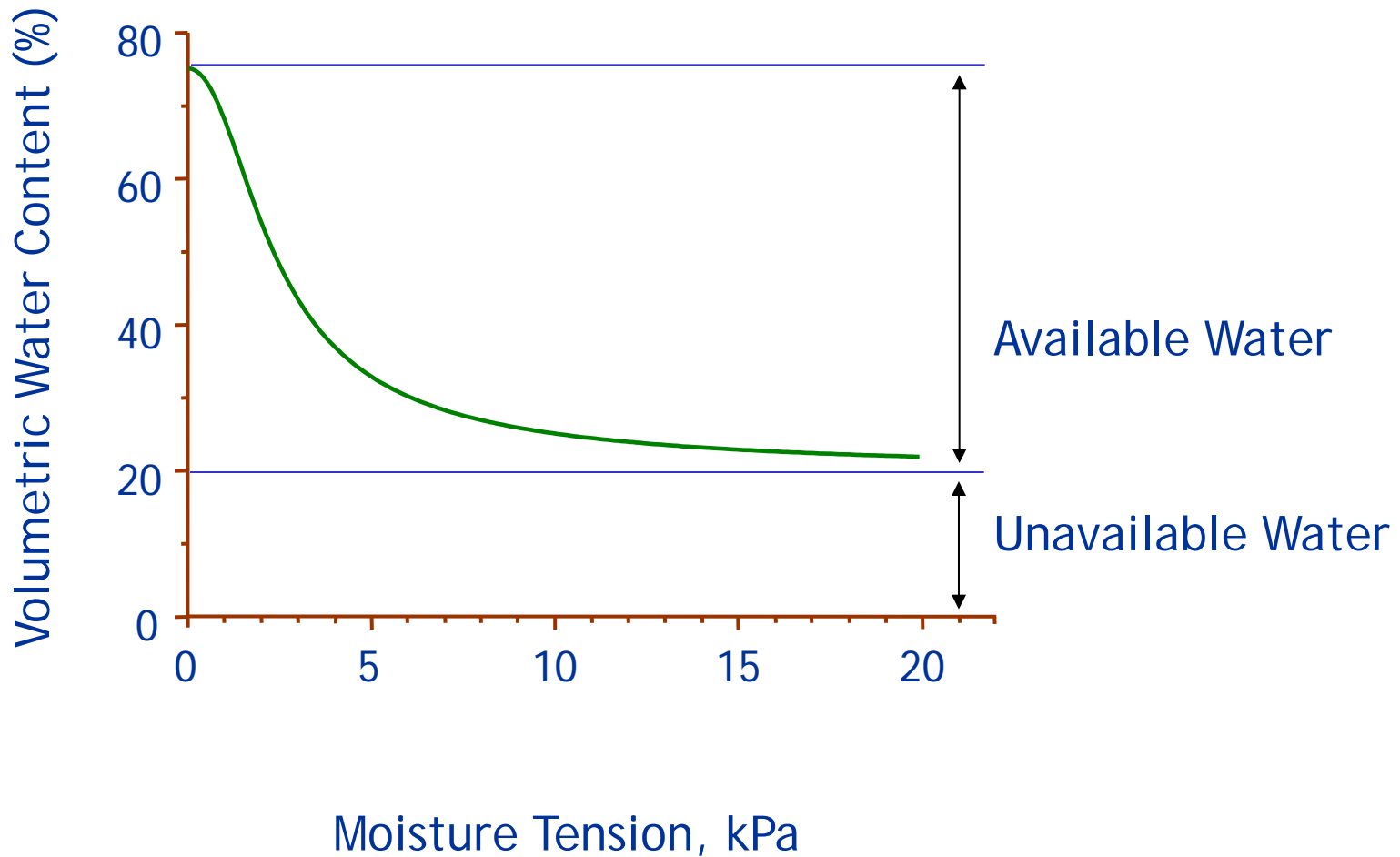
Also:
pounds per square
inch (psi), bars or
centibars (cbar)

Moisture Retention Curve

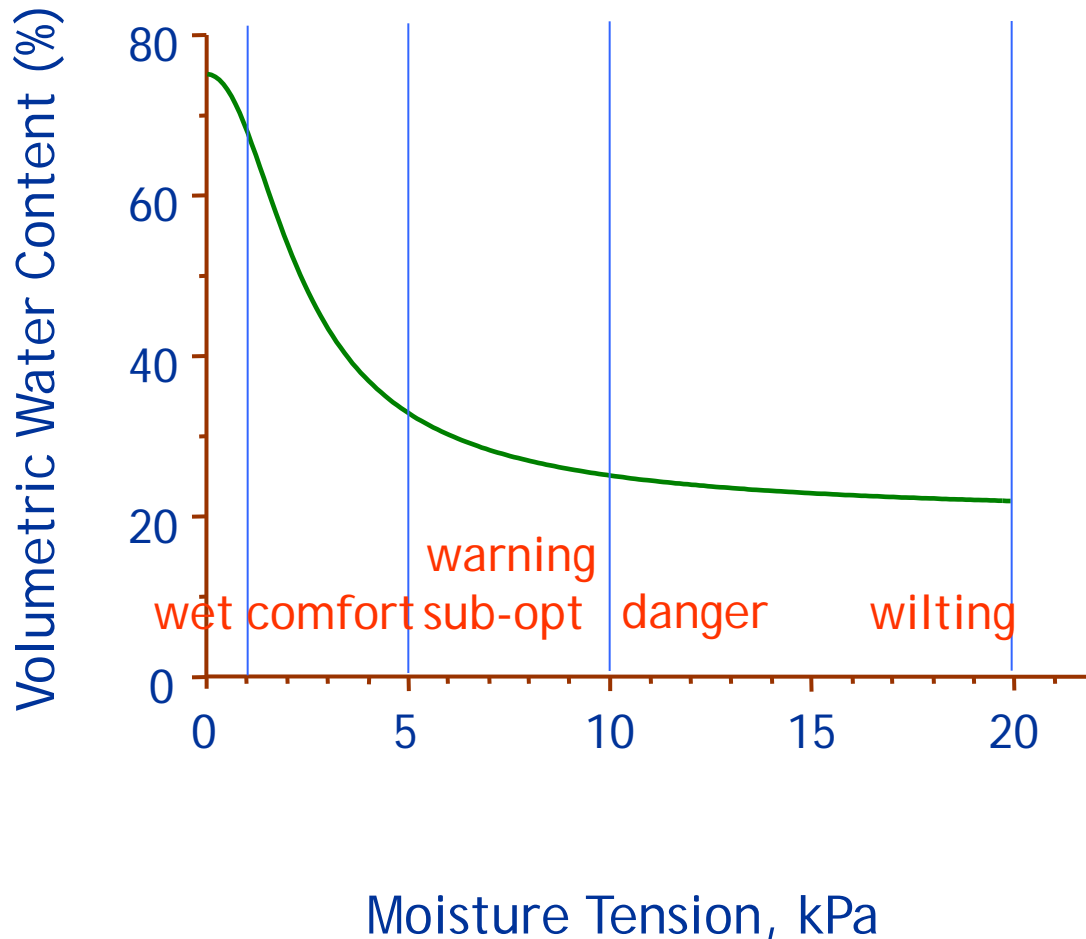


- describes the relationship between moisture content and moisture tension
- is different for every soil, but shape is similar for all potting soils

Moisture Retention Curve

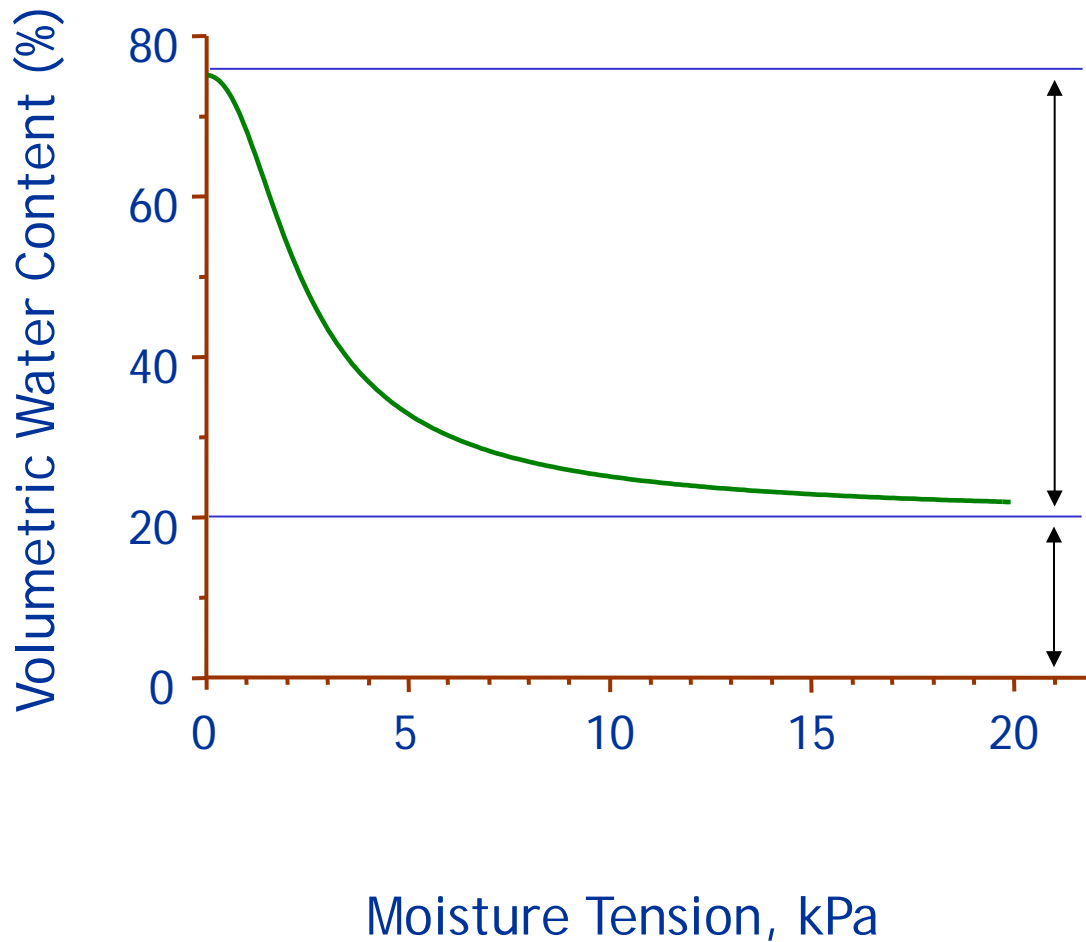


Moisture Retention Curve



- Note how plants “feel” about different levels of moisture

Moisture Retention Curve



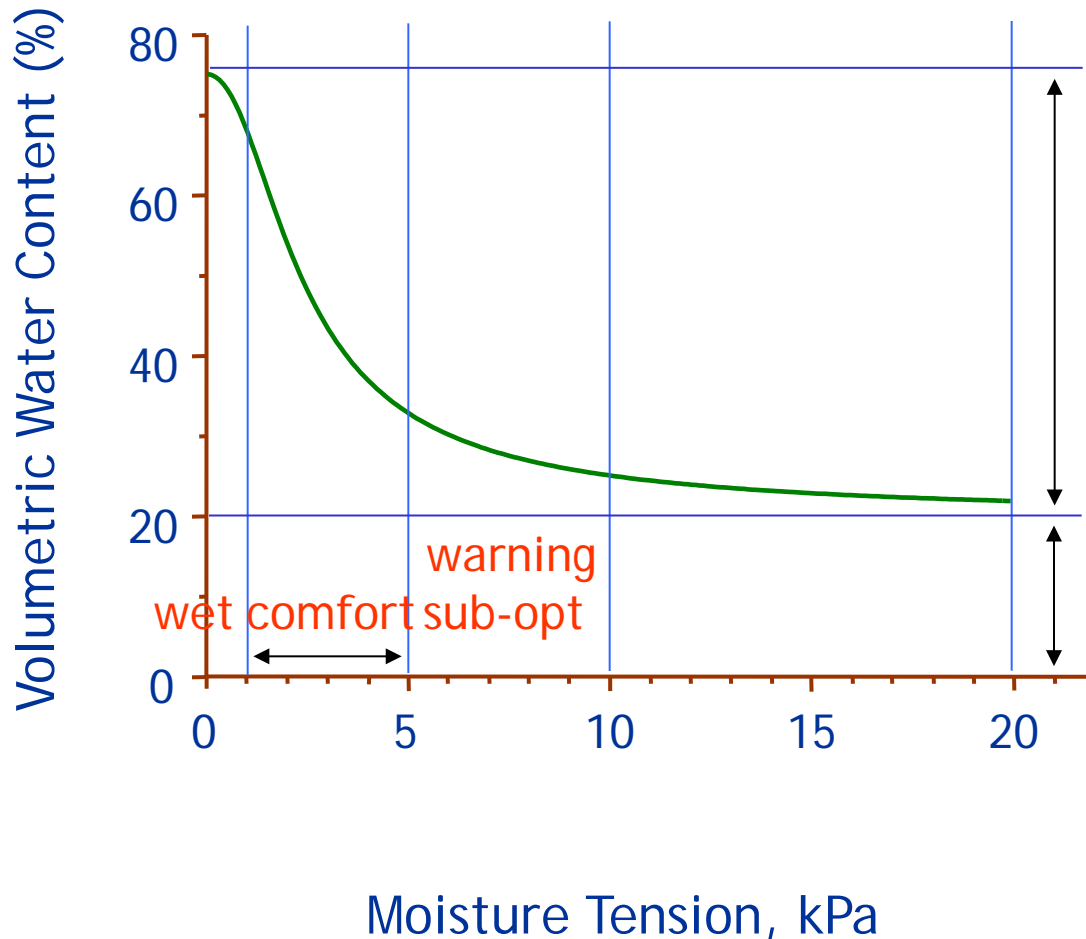
Irrigate based on

- Water content

Available Water

Unavailable Water

Moisture Retention Curve



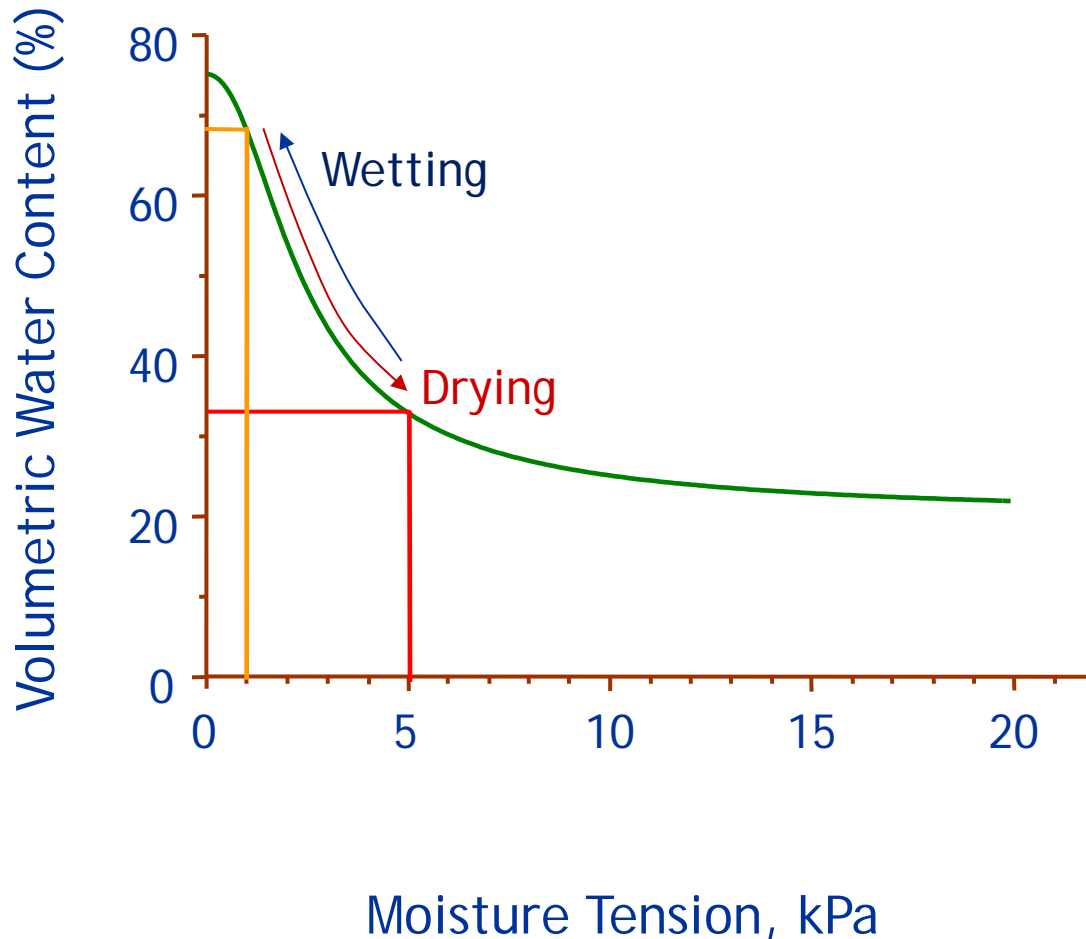
Irrigate based on

- Water content
- Water potential

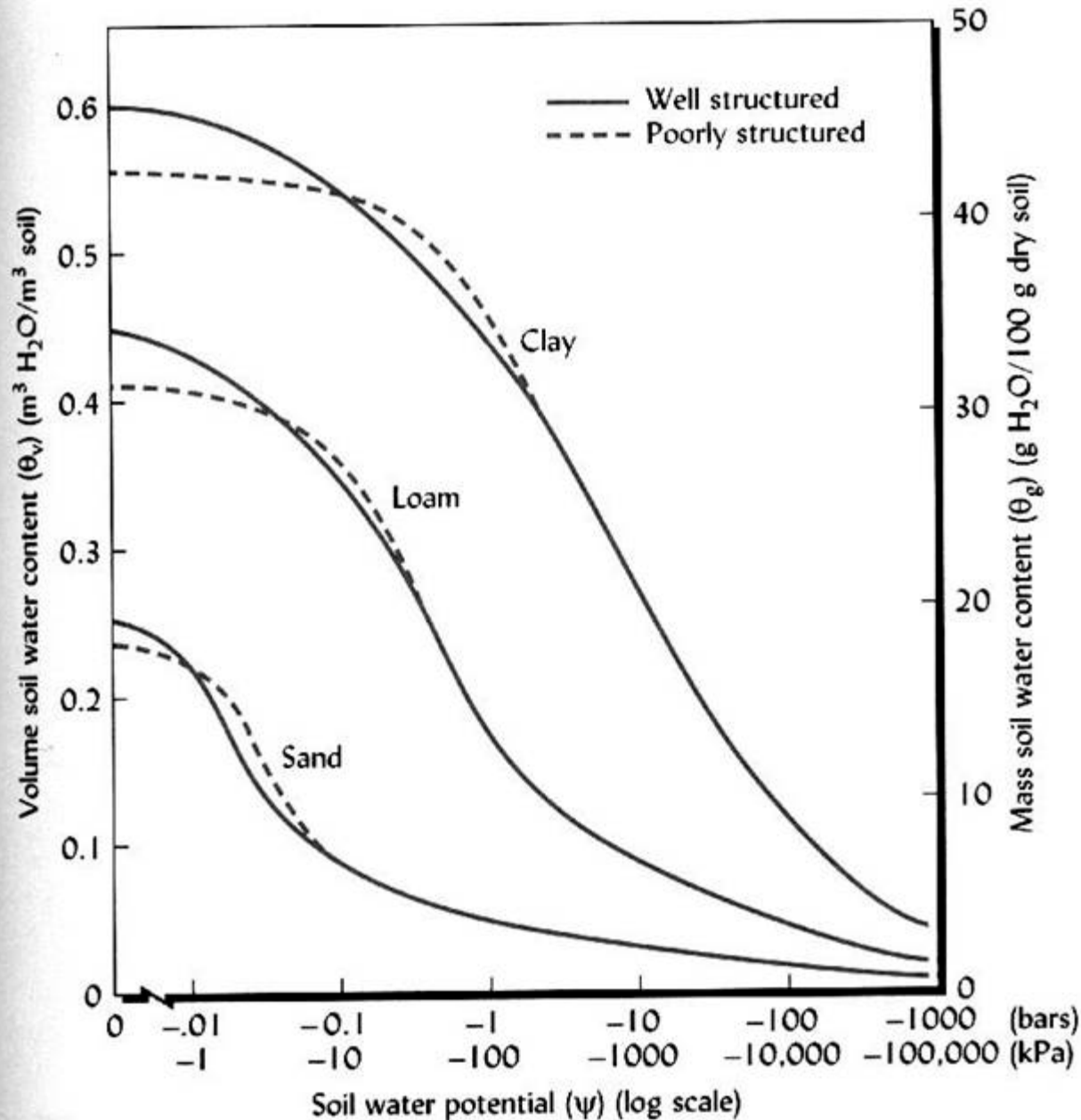
Available Water

Unavailable Water

Moisture Retention Curve



- Let tensions rise to 5 kPa
- Begin irrigating
- Stop irrigating when tensions fall to 1 kPa



Moisture Retention Curve

All soils have a characteristic curve

Soil moisture measurement

Dielectric
permittivity

Time domain
reflectometry
TDR

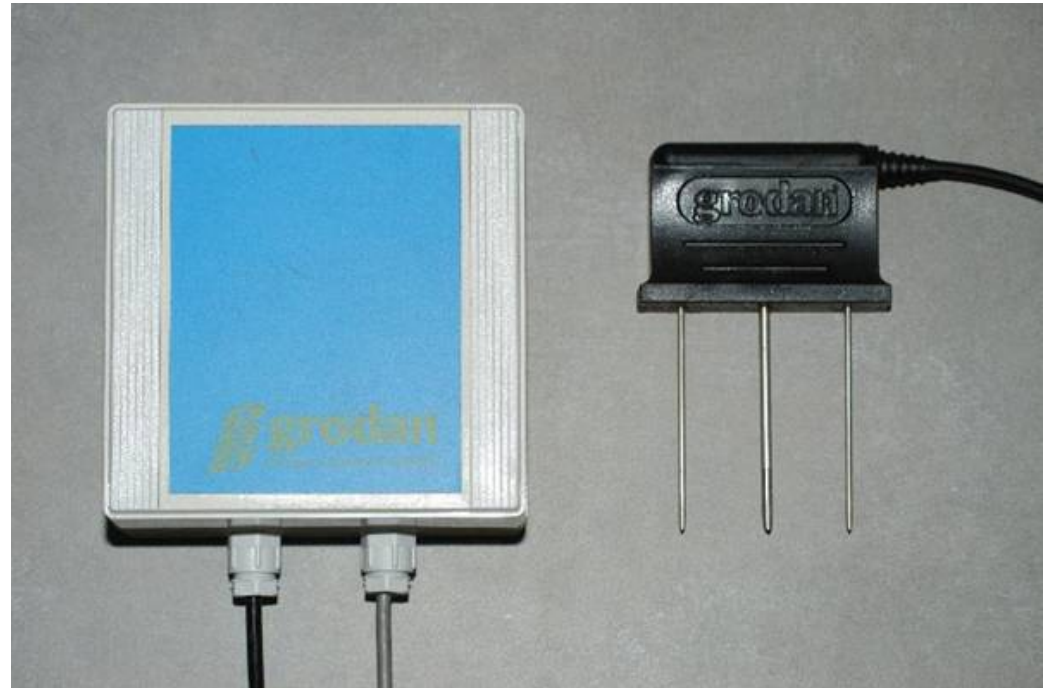


Photo: L. Oki

Soil moisture measurement

Dielectric permittivity



Decagon EC-5



Decagon 5TE

Capacitance

Decagon ECH₂O-10, -20

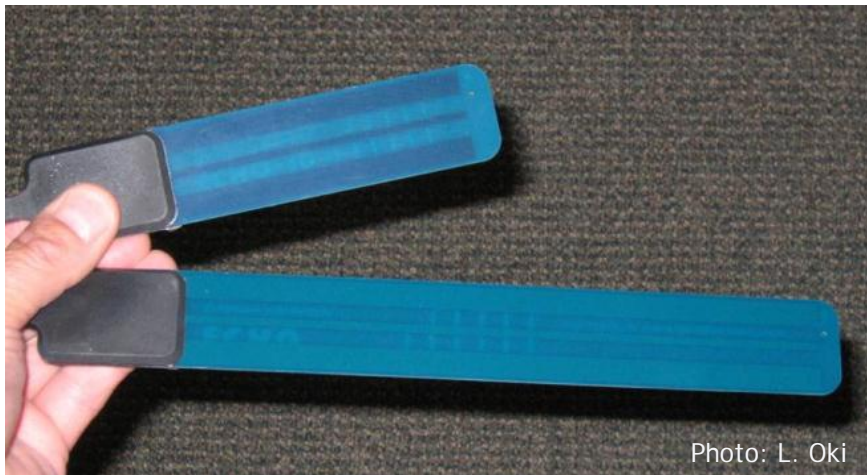


Photo: L. Oki



Decagon GS3

Soil moisture measurement

Watermark

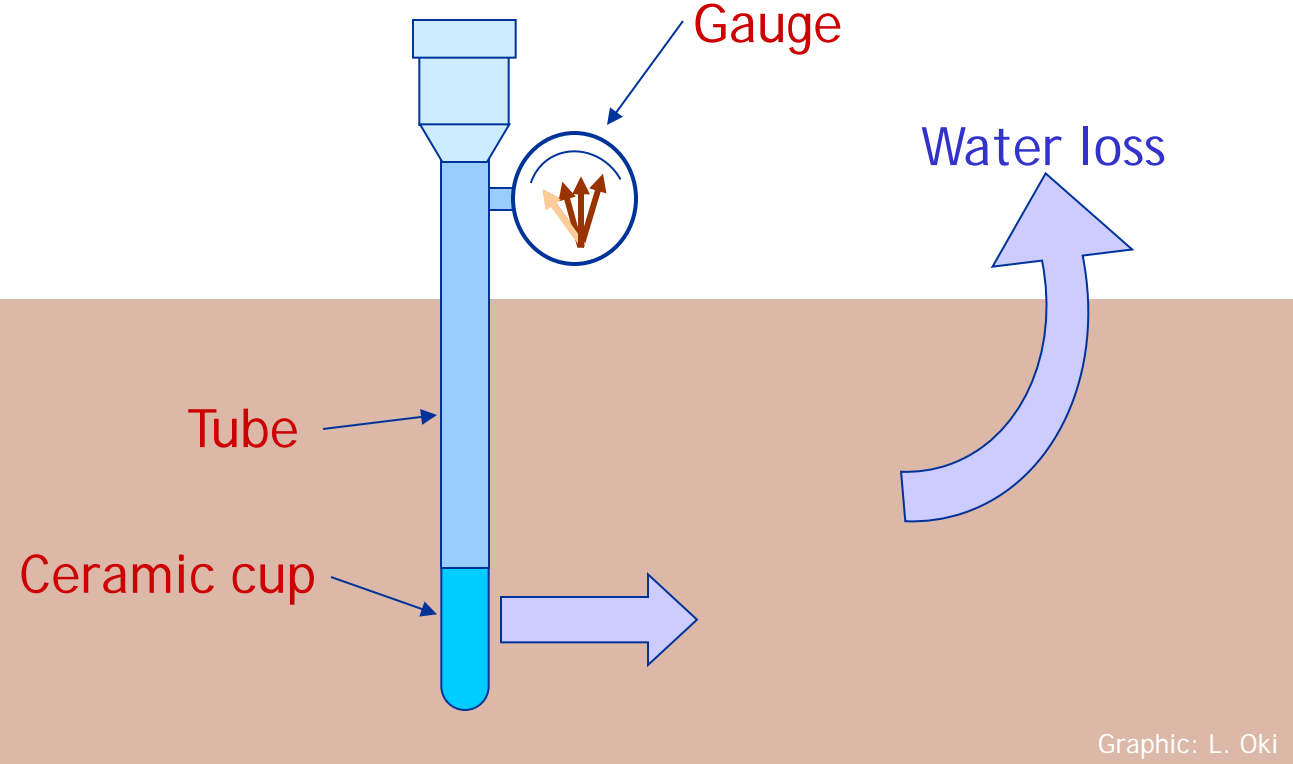
Granular
matrix



Photo: L. Oki

Soil moisture measurement

Tensiometers



Graphic: L. Oki

Soil moisture measurement

Tensiometers

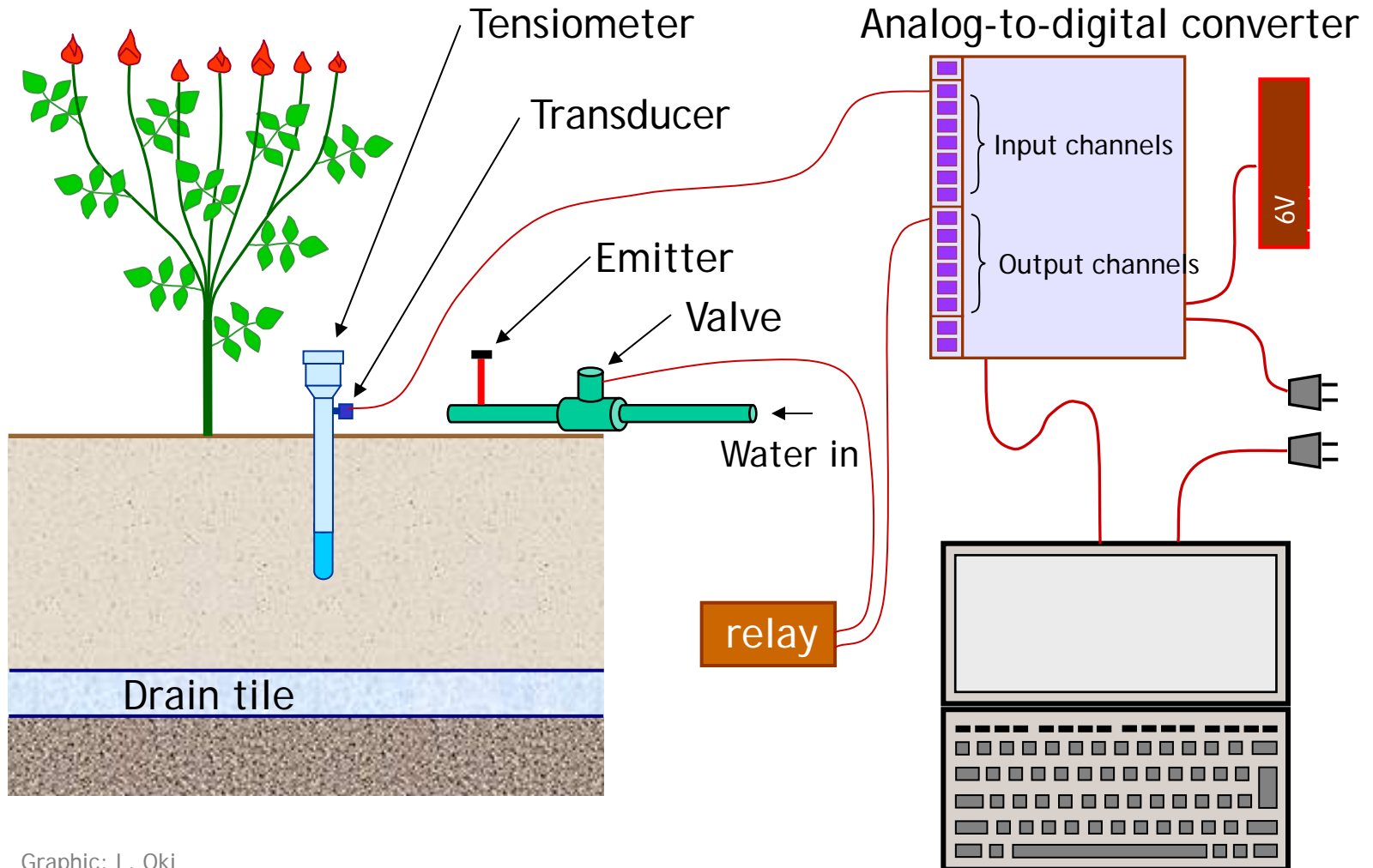


Photo: Soilmoisture Equipment



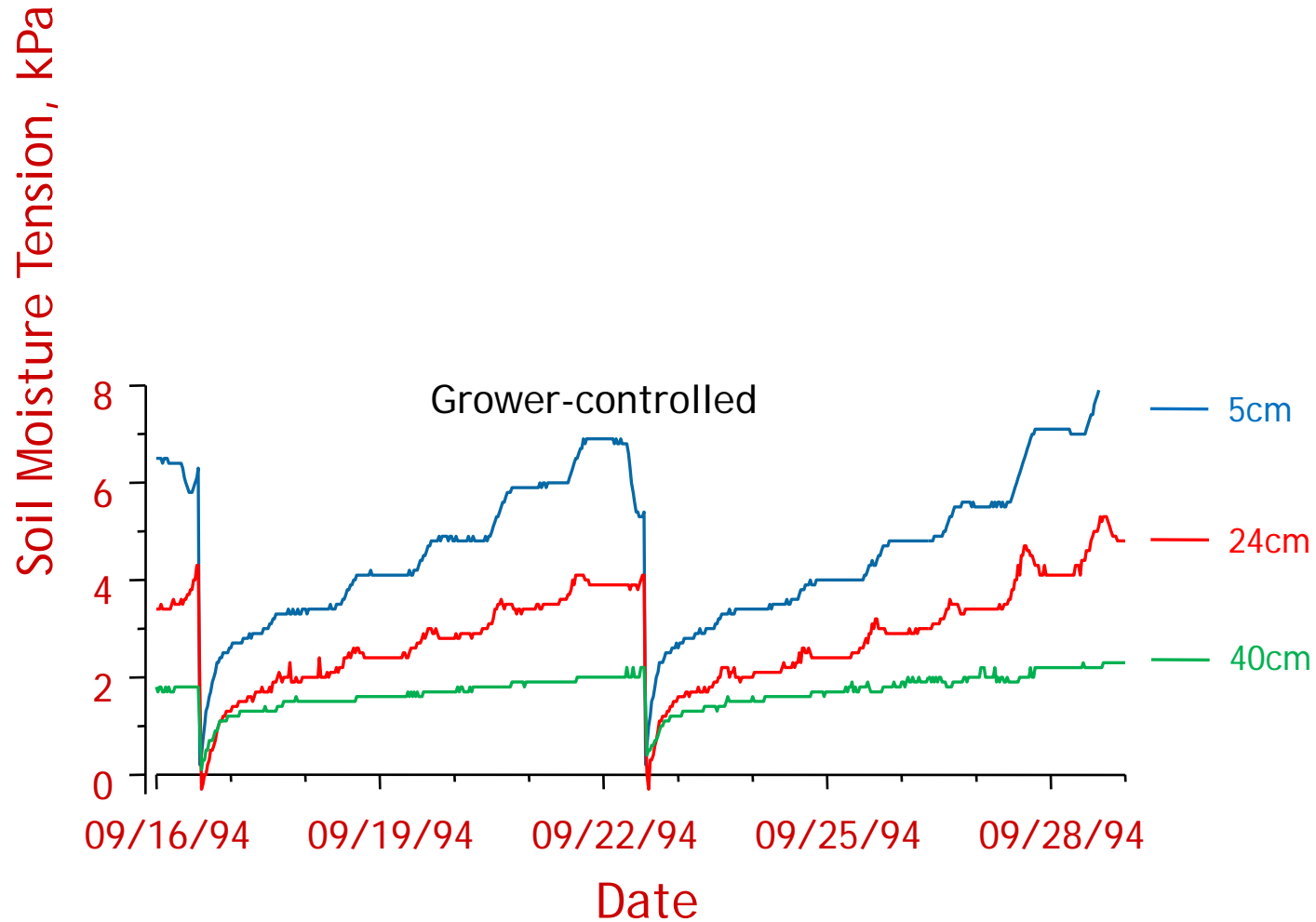
Photo: L. Oki

Irrigation based on soil moisture

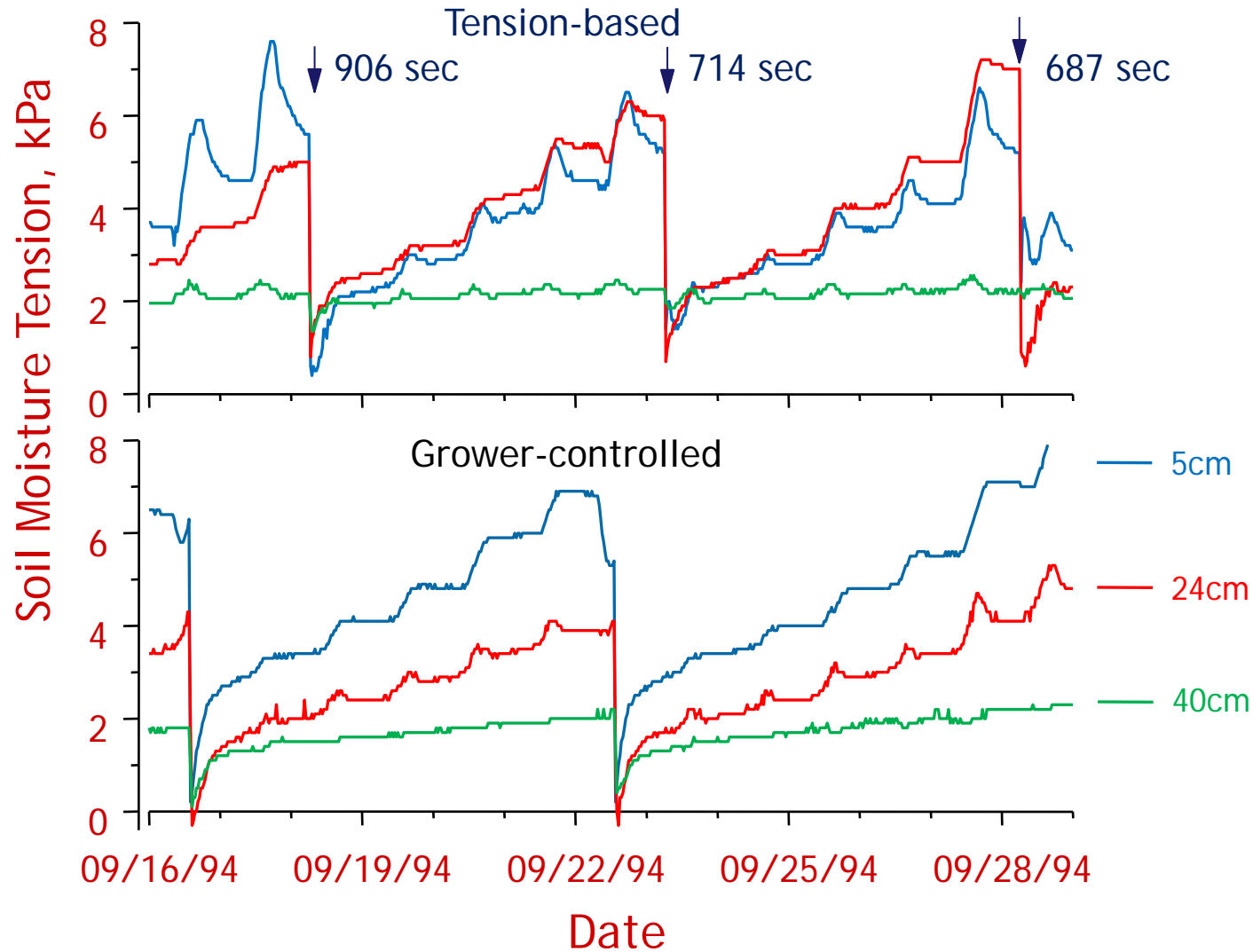


Graphic: L. Oki

Tension-based v. grower controlled irrigation



Tension-based v. grower controlled irrigation



Water use efficiency

Rose Production

	Grower	Test
	L/m ²	L/m ²
During test	993	730
<hr/>		
	Difference during test -26%	

Water use efficiency

Rose Production

	Grower		Test	
	L/m ²	stems/m ²	L/m ²	stems/m ²
During test	993	87	730	145
Difference during test			-26%	67%

Water use efficiency

Rose Production

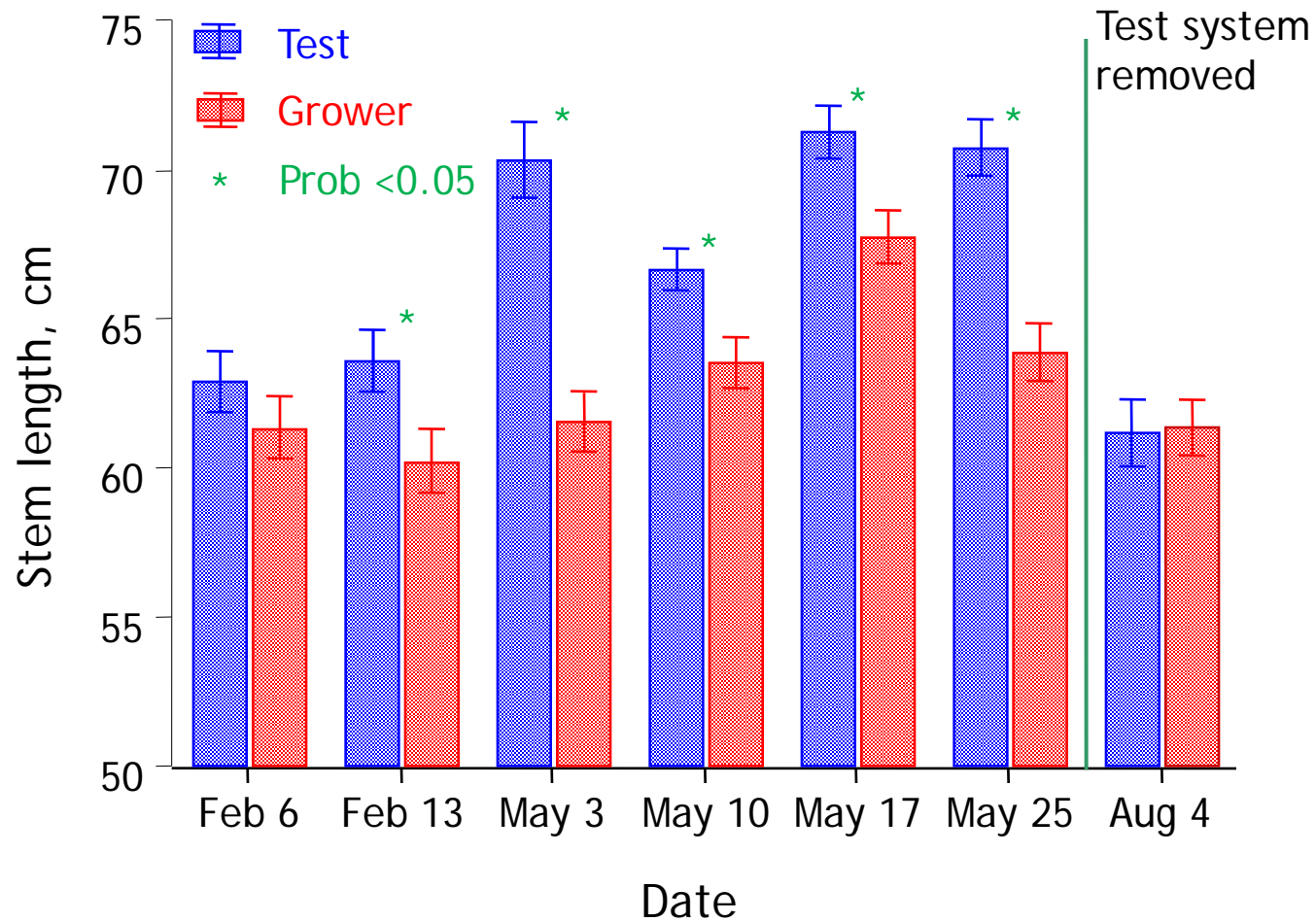
	Grower			Test		
	L/m ²	stems/m ²	stems/L	L/m ²	stems/m ²	stems/L
During test	993	87	0.09	730	145	0.20
Difference during test				-26%	67%	122%

Water use efficiency

Rose Production

	Grower			Test			
	L/m ²	stems/m ²	stems/L	L/m ²	stems/m ²	stems/L	
During test	993	87	0.09	730	145	0.20	
After test	450	66	0.11	455	83	0.13	
Difference during test				-26%	67%	122%	
Difference after test					1%	26%	18%

Length of rose stems harvested



Sources of error

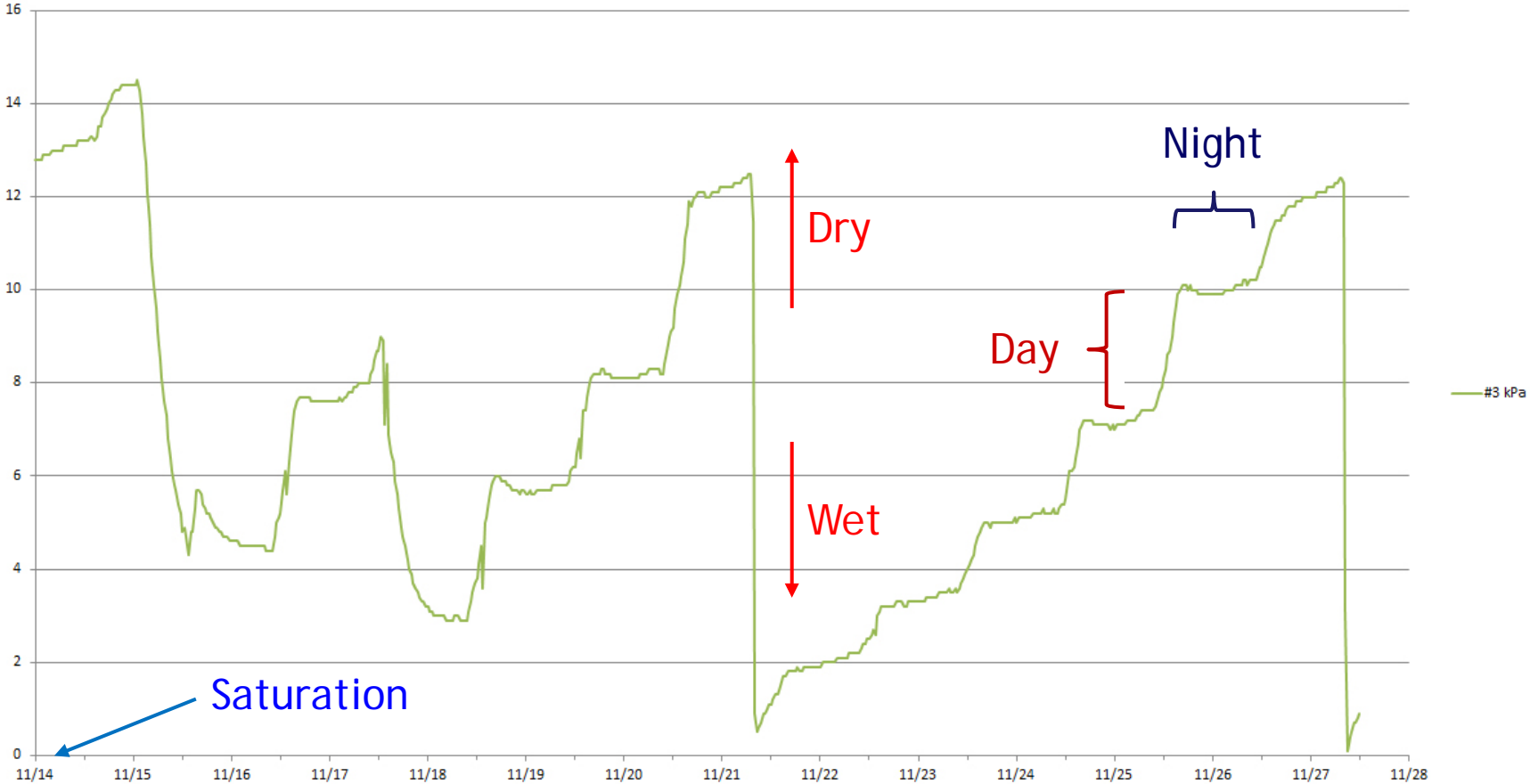
- Temperature variations
- Salinity
- Soil properties
 - Texture
 - Bulk density
 - Organic matter content

*Assuming the equipment is working properly

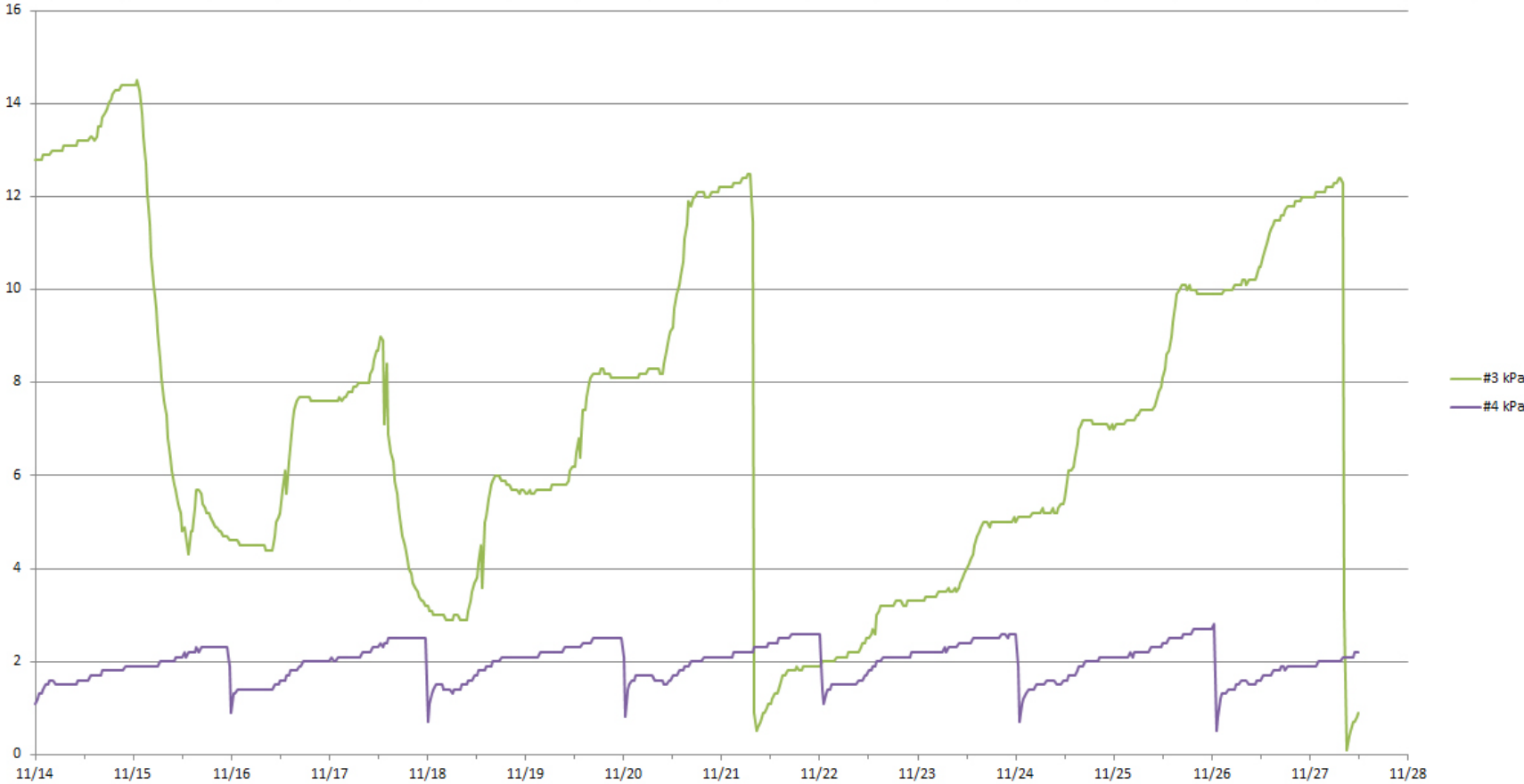
How to get started

1. Install your soil moisture monitoring system
2. Log data without irrigation control
3. Study the data
 - a. Understand what it says
 - b. Know your sensor
4. Turn on irrigation control
5. Repeat 3 and 3a above

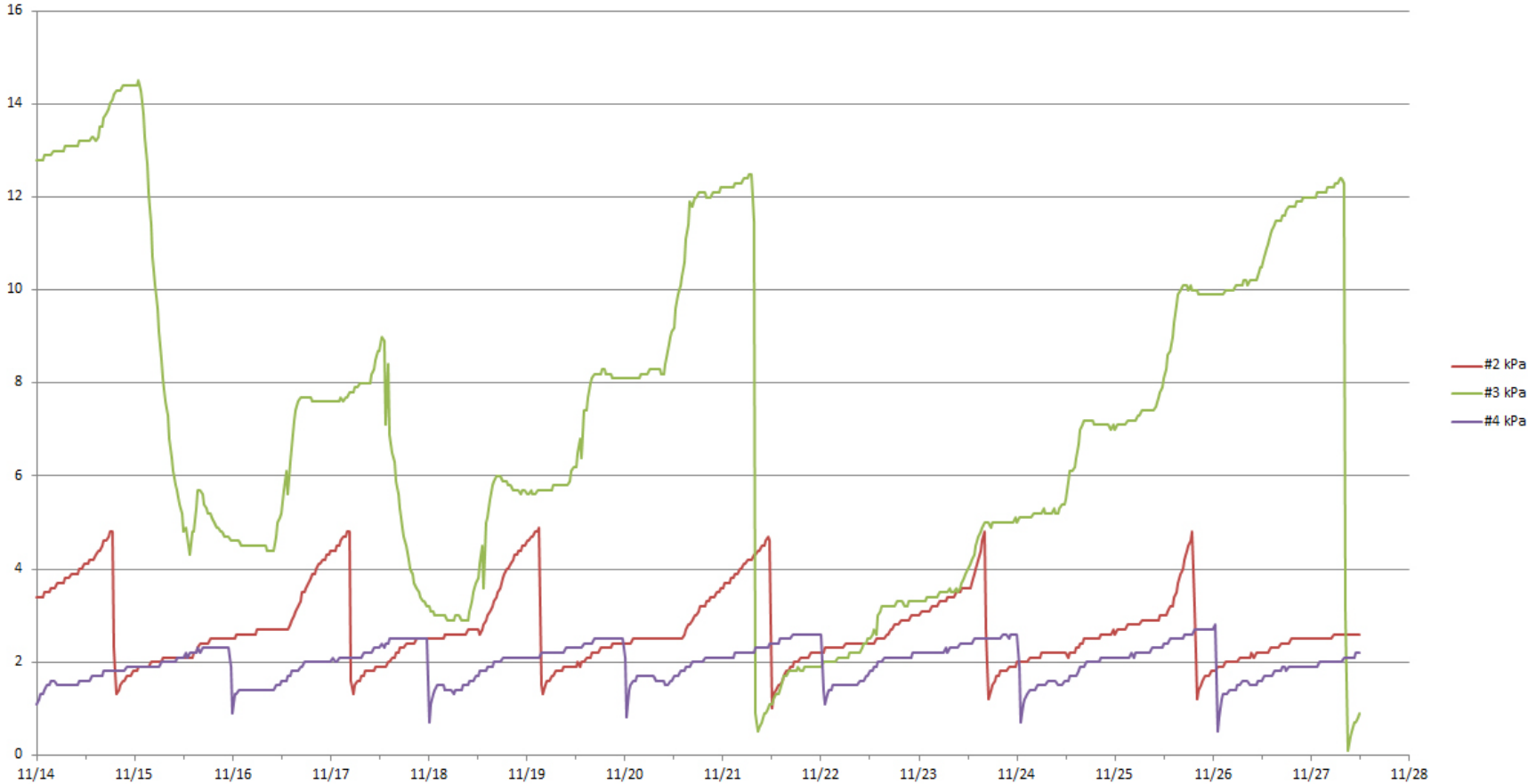
Soil Moisture Tension



Soil Moisture Tension



Soil Moisture Tension



Some resources

Soilmoisture Equipment Corp.
P.O. Box 30025
Santa Barbara, CA 93105 USA
Telephone: 805-964-3525
Email: sales@soilmoisture.com
Website: <http://www.soilmoisture.com>

Irrrometer Company, Inc.
1425 Palmyrita Ave.
Riverside, CA 92507
Phone: 951-682-9505
Email: sales@irrometer.com
Website: <http://www.irrometer.com/>

Decagon Devices
2365 NE Hopkins Court
Pullman, WA 99163
Phone: 1-800-755-2751
Email: sales@decagon.com
Website: <http://www.decagon.com/>

Vegetronix, Inc.
P.O. Box 583
Riverton, UT 84065
Telephone: 801-512-2957
Website: <http://www.vegetronix.com/>

Spectrum Technologies
3600 Thayer Court
Aurora, IL 60504
Phone: 800-248-8873
Email: info@specmeters.com
Website: <http://www.specmeters.com/>

Delta-T Devices Ltd
130 Low Road
Burwell
Cambridge
CB25 0EJ
United Kingdom
Email: sales@delta-t.co.uk
Website: <http://www.delta-t.co.uk>



Thank you
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