Determining Irrigation Needs: Monitoring Soil Moisture

An Advanced and Innovative Irrigation Scheduling System

Implemented by

The Brace Centre for Water Resources Management

McGill University

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Canada Ontario McGill Brace WIN Weather INnovations Incorporated

Leamington
Ways of Monitoring Soil Moisture

- Volumetric
  - Gravimetric Sampling
  - Portable FieldScout TDR
  - Campbell Reflectometers (TDR)
  - Gro-point Sensors

- Soil Tension
  - Manual Tensiometers
  - Watermark Sensors
  - Hortau Sensors

- C-Probe (can be translated into vol.)

- Echo Probe (can be translated into vol.)

Gravimetric Sampling at Palichuk's ME site

soil= sand

(Surface and Buried Drip)

Soil Samplers

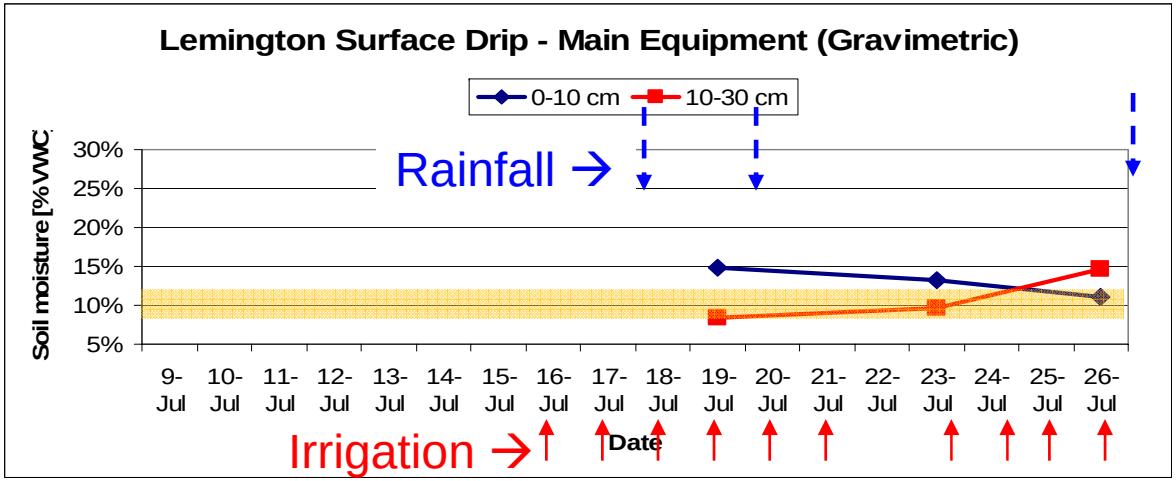
COST: Low

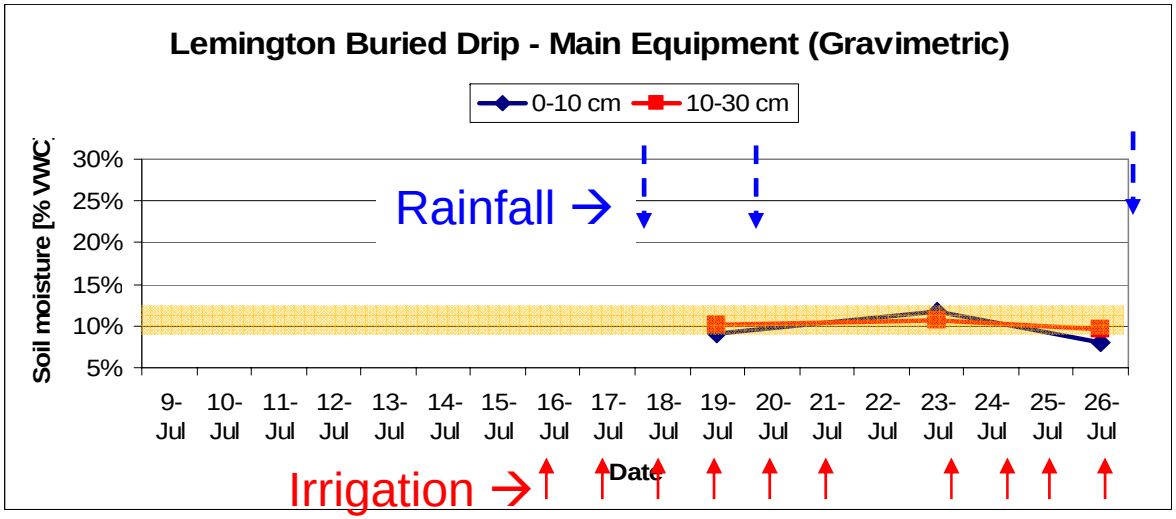
+

- Ease of Use
- Low cost
- Range of soil types

-

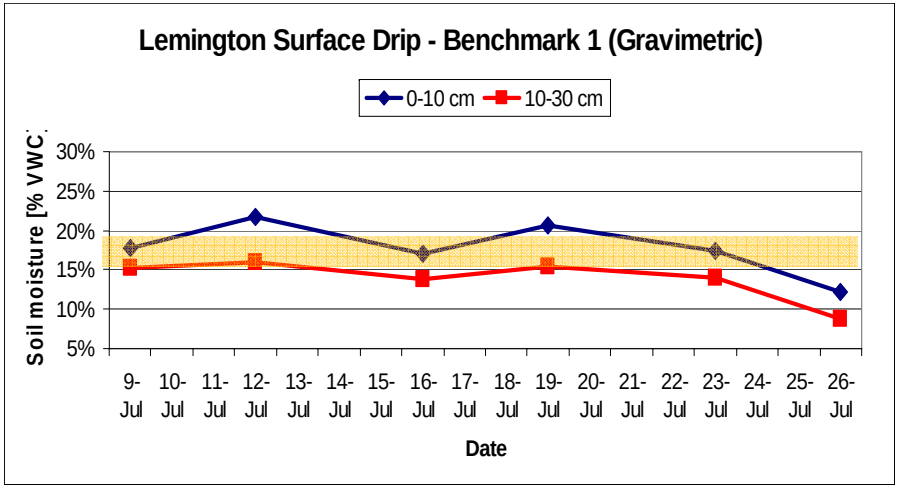
- Lab analysis needed
- Slow, time-intensive

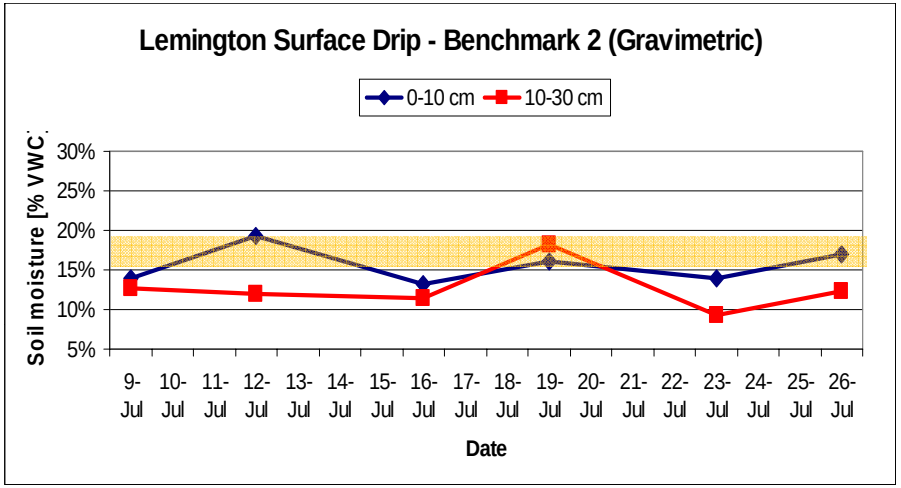


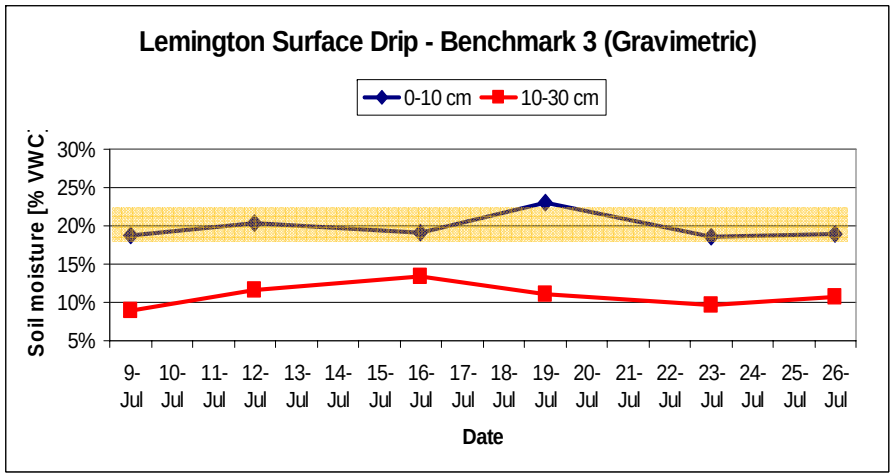


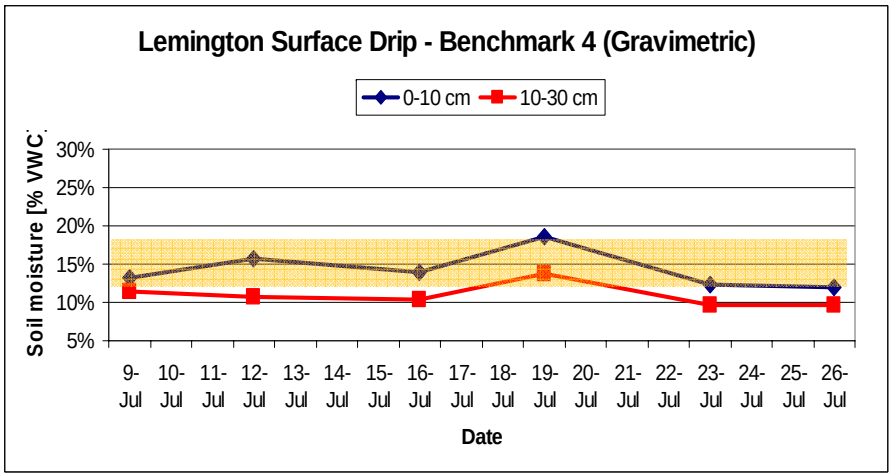
Irrigation target range (65% - 85% of FC); FC at this site = 14% volumetric moisture

Gravimetric Sampling at Palichuck's Benchmarks
(Surface Drip)





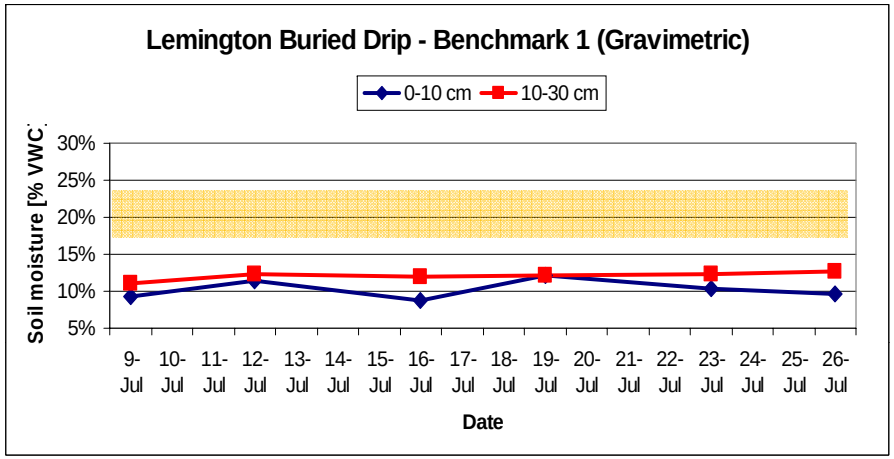


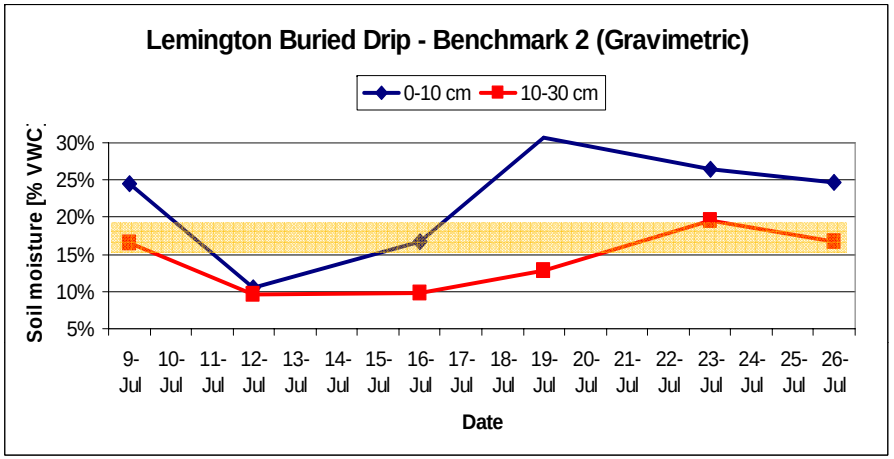


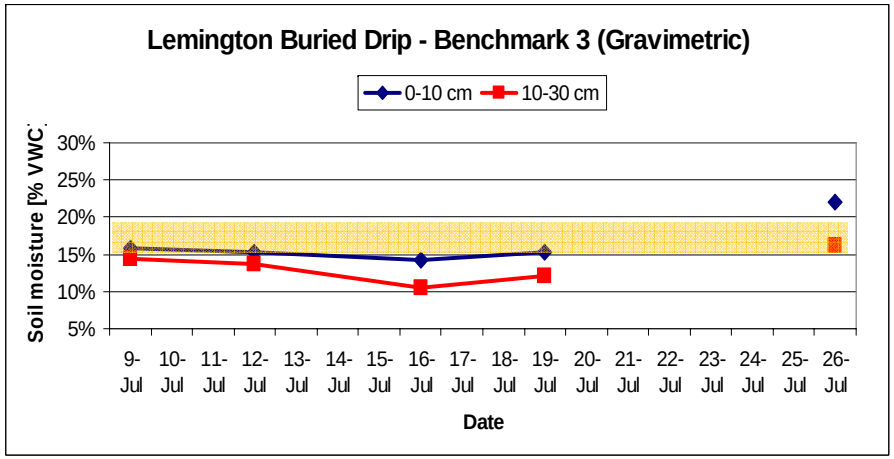
Samples taken at 4 benchmarks to identify variability in soil (BM1…4) 0-10 cm and 10-30 cm depth

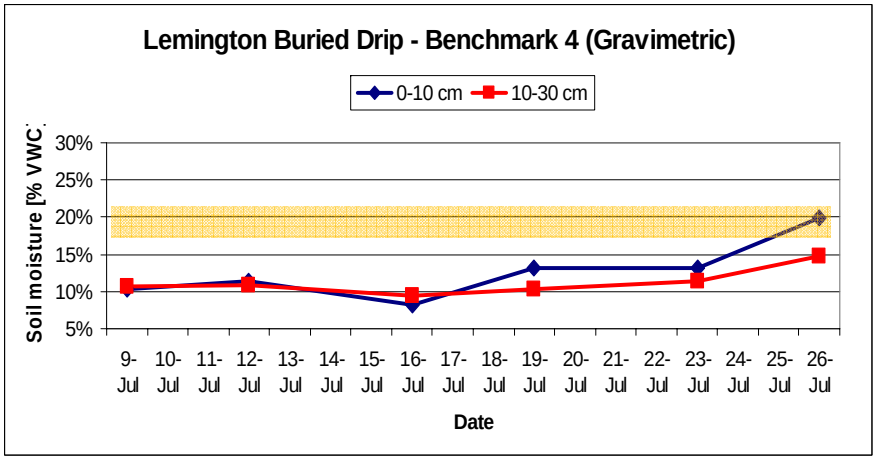
Irrigation target range (65% - 85% of FC); average FC of benchmarks = 14% volumetric moisture

Gravimetric Sampling at Palichuck's Benchmarks
(Buried Drip)









Samples taken at 4 benchmarks to identify variability in soil (BM1…4) 0-10 cm and 10-30 cm depth

Irrigation target range (65% - 85% of FC); average FC at benchmarks = 14% volumetric moisture

FieldScout TDR Readings at Palichuk's

Surface Drip (M1) site

Benchmarks (BM1…4) and Main Equipment (ME)

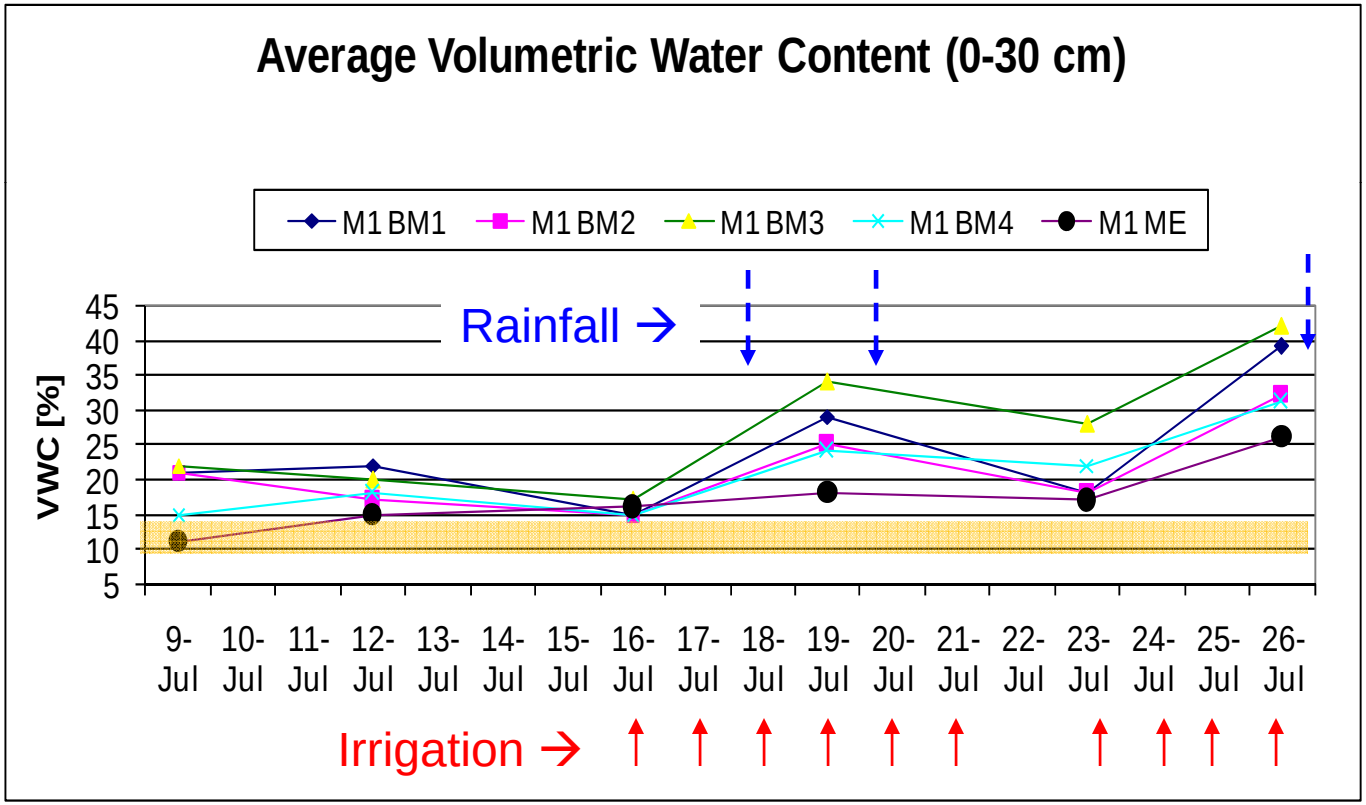
COST:
Low to medium

+

- Portability
- Easy to use
- Reliable

-

- Calibration for different soils may be required



Irrigation target range (65% - 85% of FC); FC at the ME site = 14% volumetric moisture

FieldScout TDR Readings at Palichuk's

Buried Drip (M2) site

Benchmarks (BM1…4) and Main Equipment (ME)

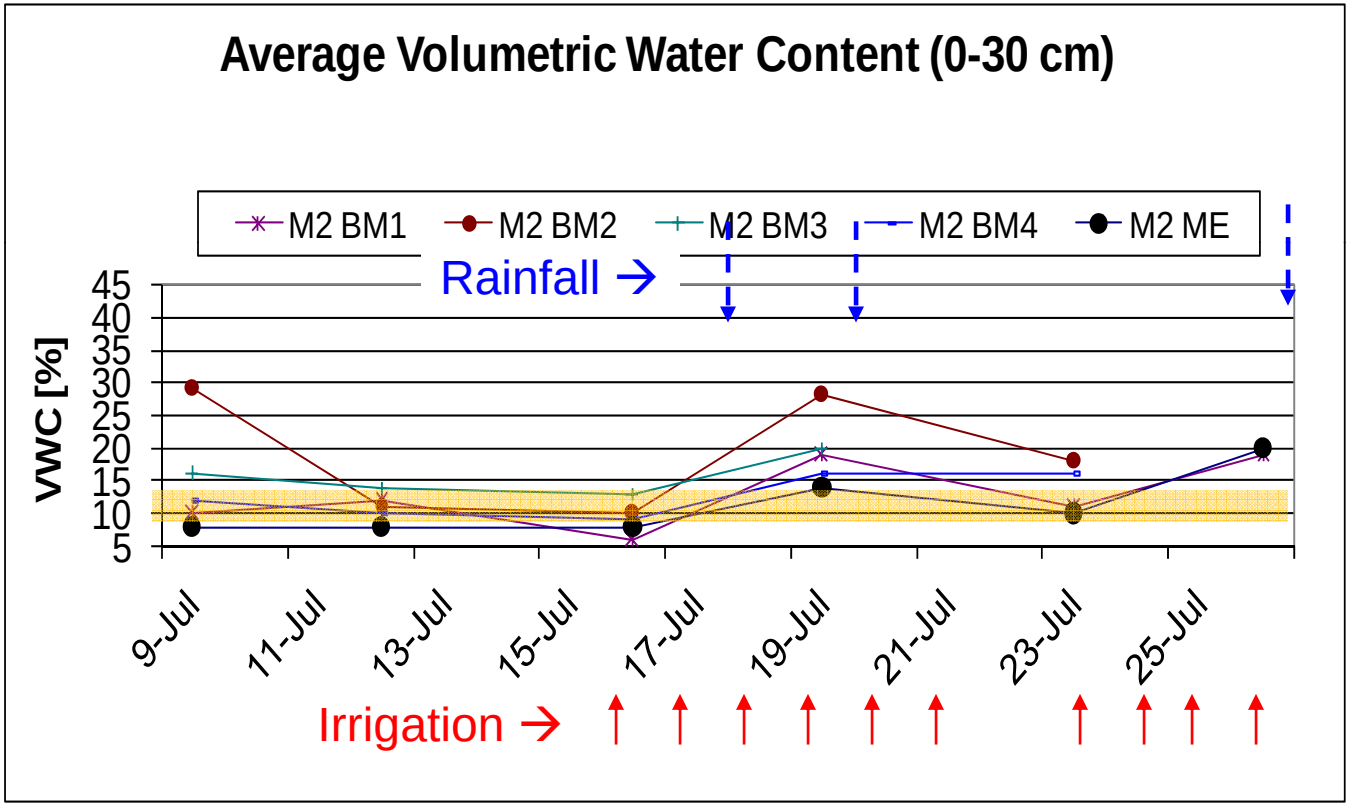
COST:
Low to medium

+

- Portability
- Easy to use
- Reliable

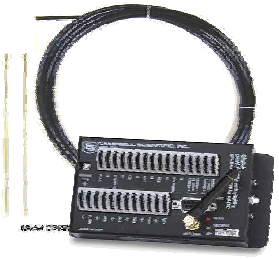
-

- Calibration for different soils may be required



Irrigation target range (65% - 85% of FC); FC at the ME site = 14% volumetric moisture

Campbell Reflectometers at Palichuck's (Surface Drip)



Permanent TDR and Datalogger

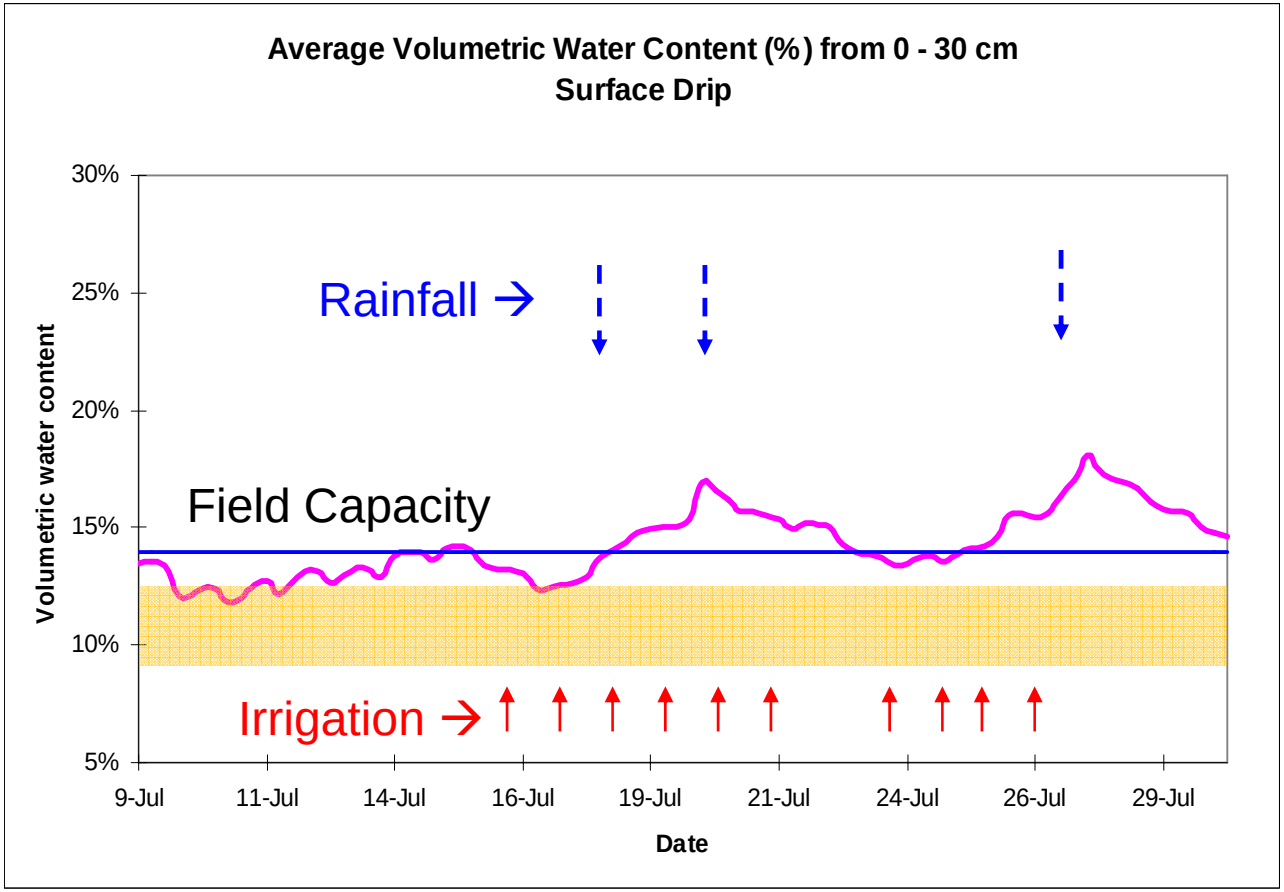
COST:
Medium High

+

- Continuous monitoring
- Wireless capability
- Reliability

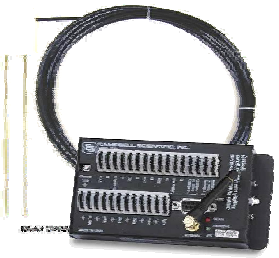
-

- May need calibration for different soils
- Cost
- Single point monitoring



Irrigation target range (65% - 85% of FC); FC at this site = 14% volumetric moisture

Campbell Reflectometers at Palichuck's (Buried Drip)



Permanent
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-

- May need calibration for different soils
- Cost
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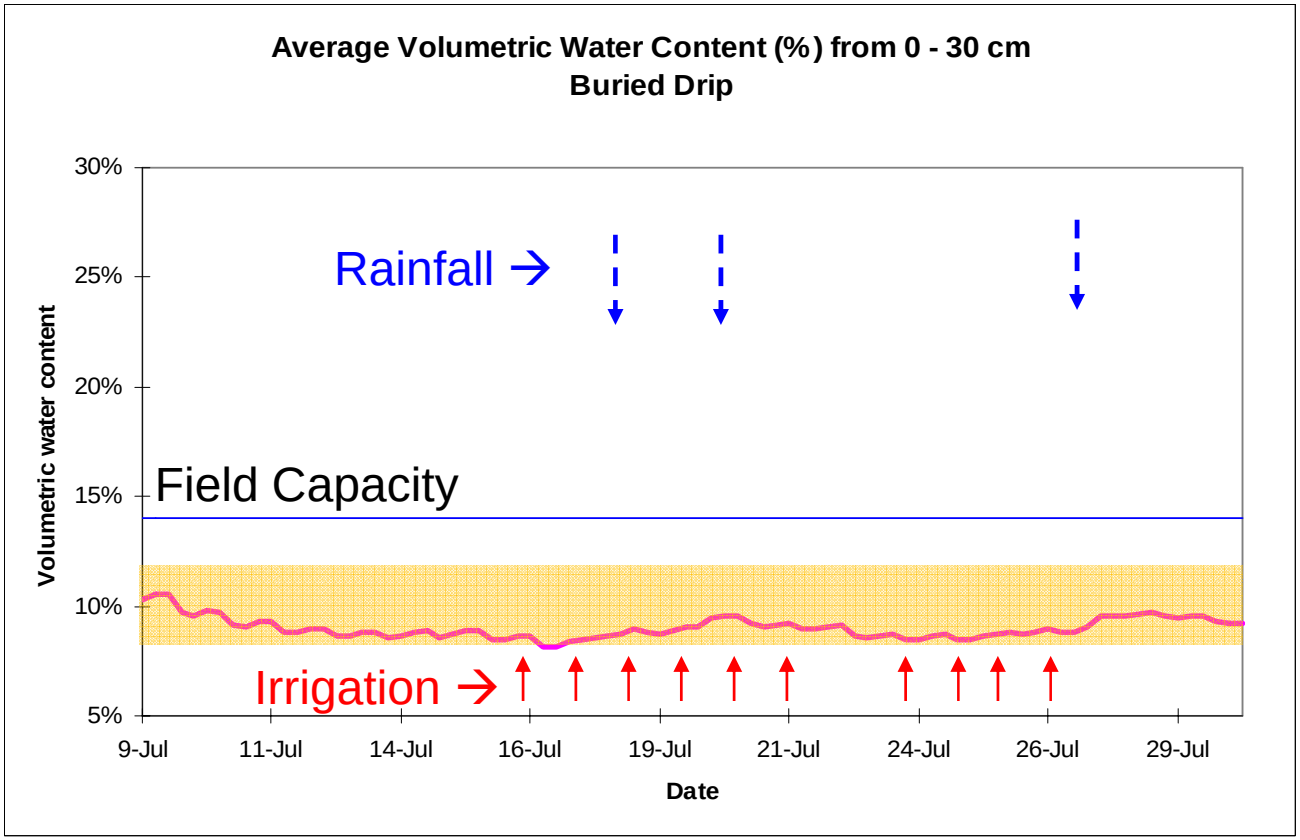


Irrigation target range (65% - 85% of FC); FC at this site = 14% volumetric moisture

Capacitance Probe at Palichuck's
(Surface Drip – month of July 2007)

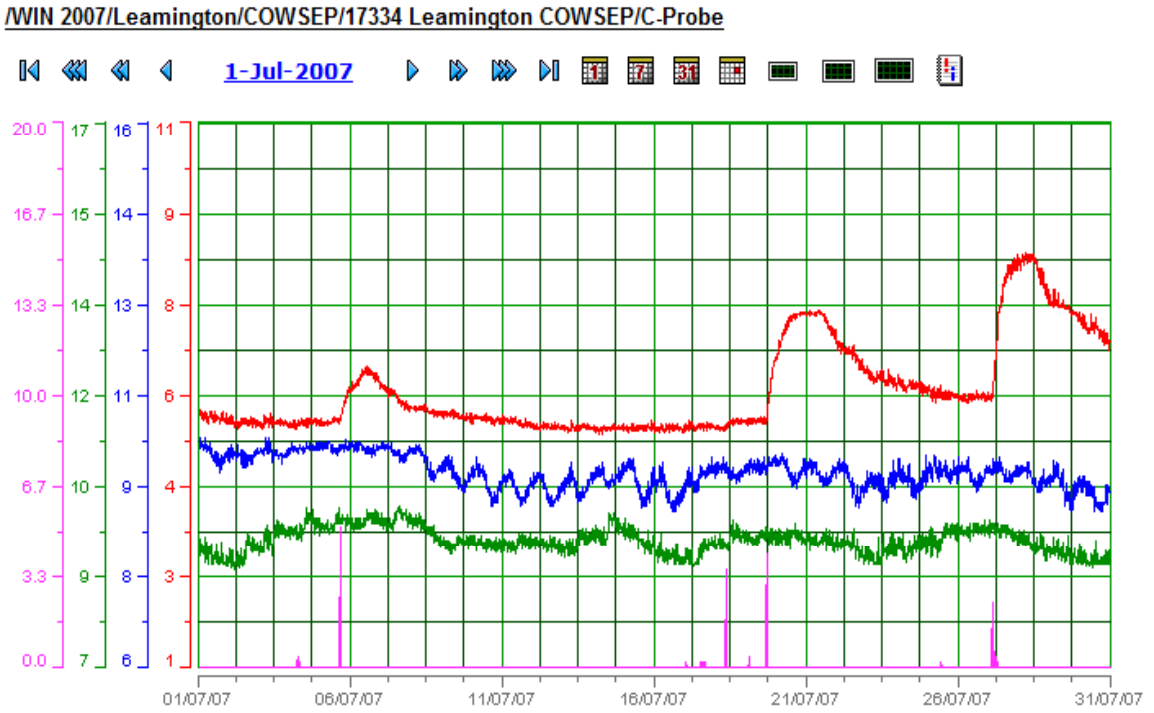
COST: High

+

- Web-based system
- Continuous monitoring
- Reliable
- Variable depths

-

- Installation
- High Cost
- Fixed monitoring location



Legend:

Color	Name	Last Value
	/WIN 2007/Leamington/COWSEP/17334 Leamington COWSEP/Soil Moisture/C-Probe 10cm (17334 Leamington COWSEP) (vol%)	7 vol% at 1-Aug-2007 7:20:53 AM
	/WIN 2007/Leamington/COWSEP/17334 Leamington COWSEP/Soil Moisture/C-Probe 30cm (17334 Leamington COWSEP) (vol%)	9 vol% at 1-Aug-2007 7:20:53 AM
	/WIN 2007/Leamington/COWSEP/17334 Leamington COWSEP/Soil Moisture/C-Probe 50cm (17334 Leamington COWSEP) (vol%)	9 vol% at 1-Aug-2007 7:20:53 AM
	/WIN 2007/Leamington/COWSEP/11028 Wayne P/11028 Wayne P/Precipitation (mm)	0.0 mm at 1-Aug-2007 8:40:47 AM

Capacitance Probe at Palichuck's
(Buried Drip – month of July 2007)

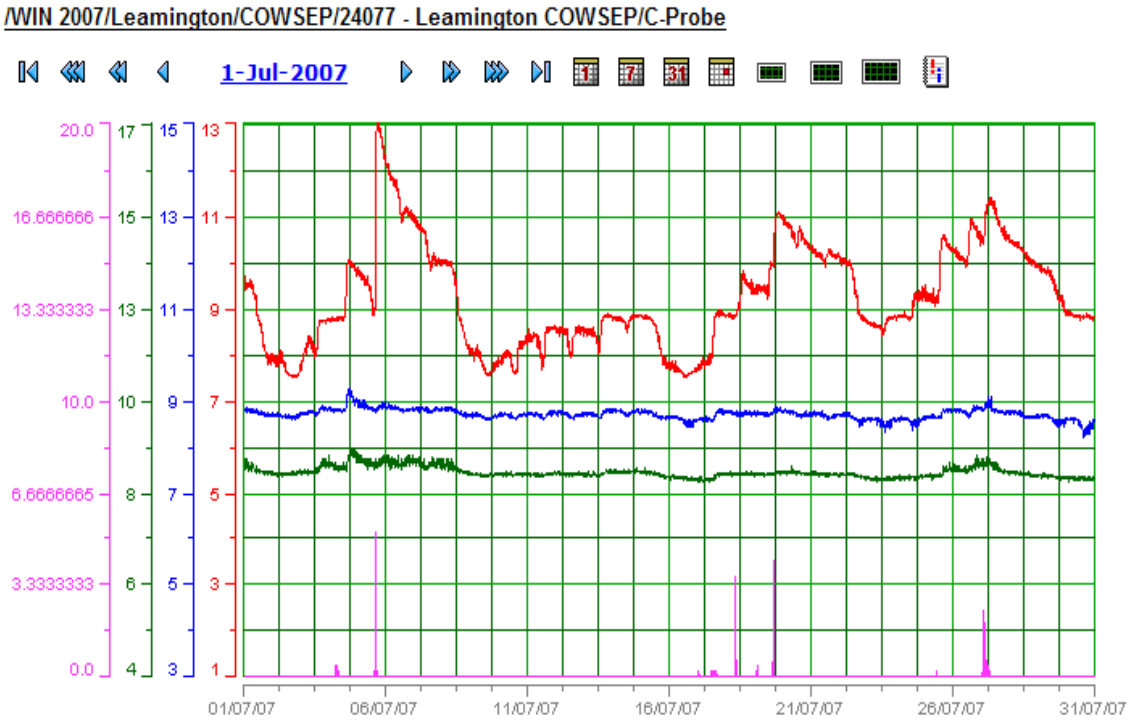
COST: High

+

- Web-based system
- Continuous monitoring
- Reliable
- Variable depths

-

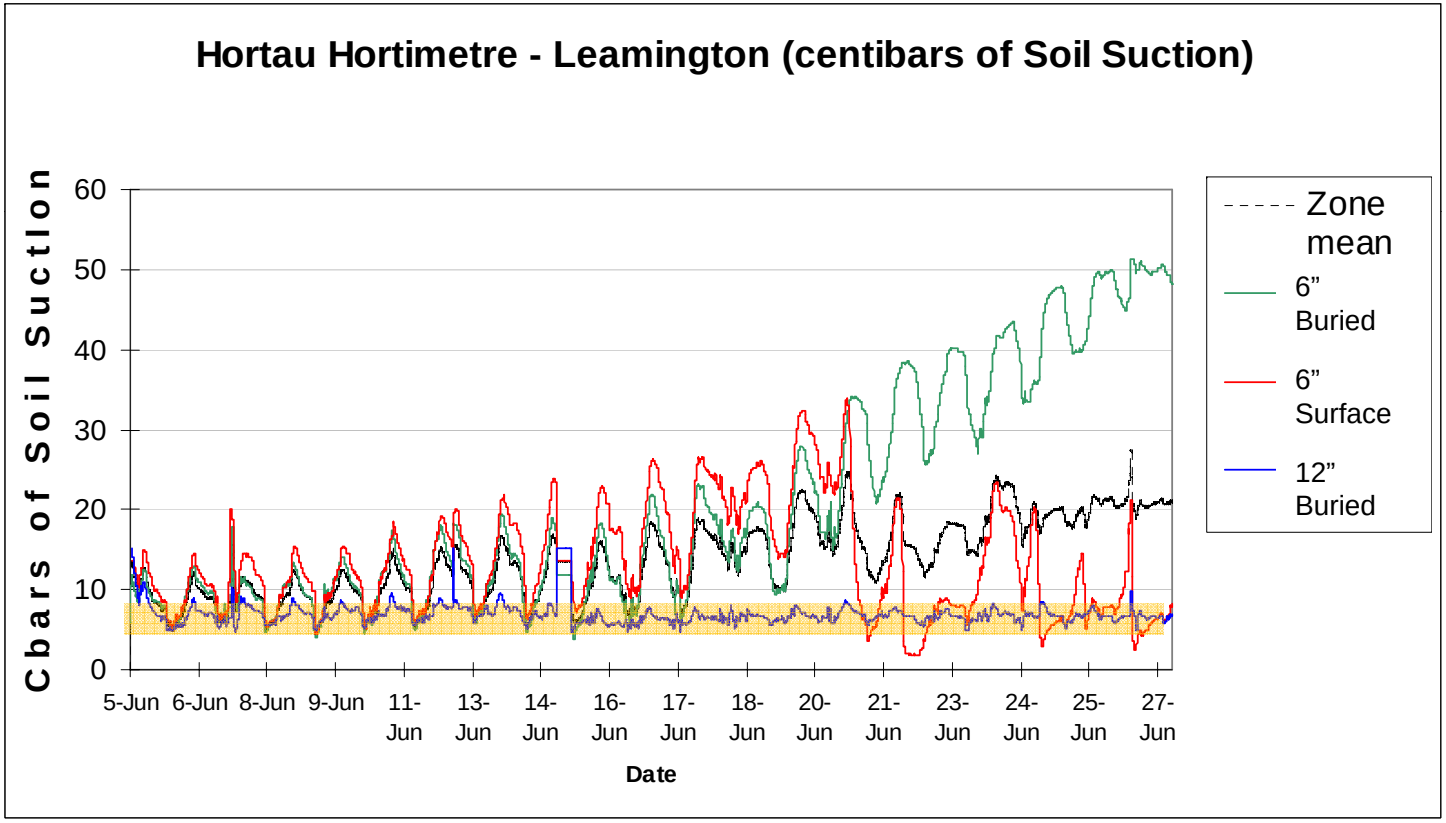
- Installation
- High Cost
- Fixed monitoring location



Legend:

Color	Name	Last Value
	/WIN 2007/Leamington/COWSEP/24077 - Leamington COWSEP/Soil Moisture/C-Probe 10cm (24077 - Leamington COWSEP) (vol%)	9 vol% at 1-Aug-2007 8:26:21 AM
	/WIN 2007/Leamington/COWSEP/24077 - Leamington COWSEP/Soil Moisture/C-Probe 30cm (24077 - Leamington COWSEP) (vol%)	9 vol% at 1-Aug-2007 8:26:21 AM
	/WIN 2007/Leamington/COWSEP/24077 - Leamington COWSEP/Soil Moisture/C-Probe 50cm (24077 - Leamington COWSEP) (vol%)	9 vol% at 1-Aug-2007 8:26:21 AM
	/WIN 2007/Leamington/COWSEP/11028 Wayne P/11028 Wayne P/Precipitation (mm)	0.0 mm at 1-Aug-2007 8:40:47 AM

Hortau Wireless at Palichuck's
(Surface and Buried)
soil = sand



Irrigation target range (65% - 85% of FC); FC = 10 cbars

COST: High

+

Wireless
Continuous
Reliable
Variable depths

-

Installation Cost
Fixed location

Manual Tensiometer at Palichuck's

(Surface Drip and Buried Drip)

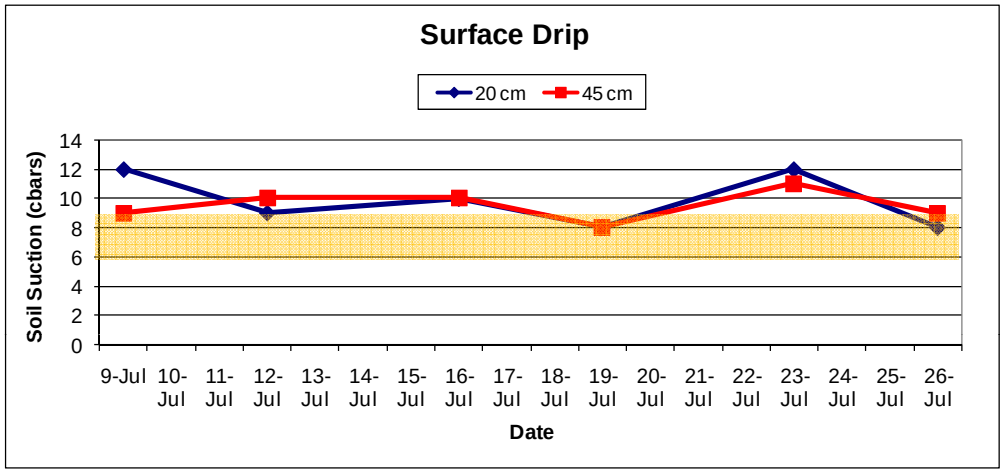
COST: Low

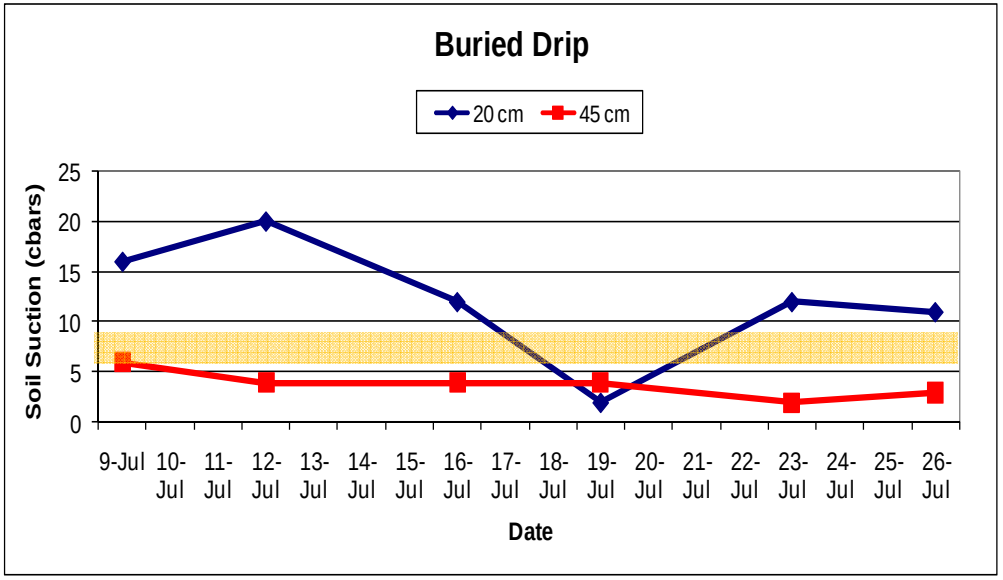
+

- Easy to use
- Cost
- Reliable in most soils

-

- Installation
- High Maintenance
- Fixed monitoring location





Irrigation target range (65% - 85% of FC); FC at this site = 10 cbars

Other Equipment

Gro-Point (TDR)

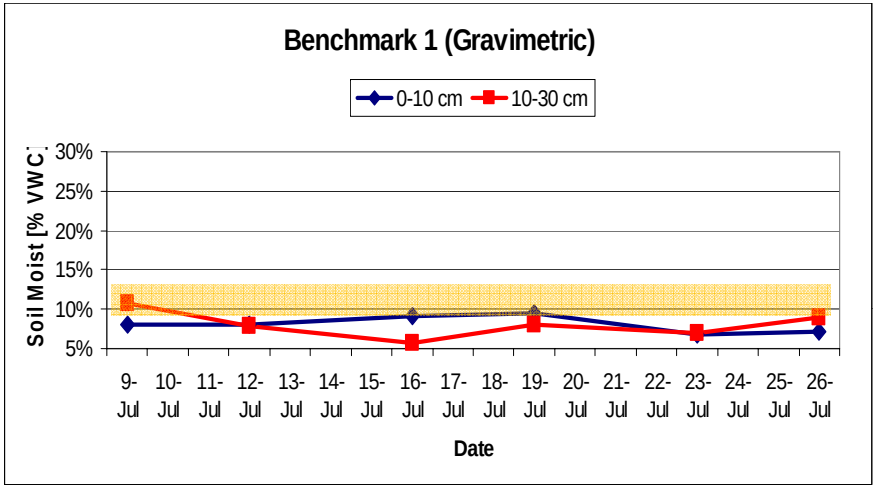
Echo Probe

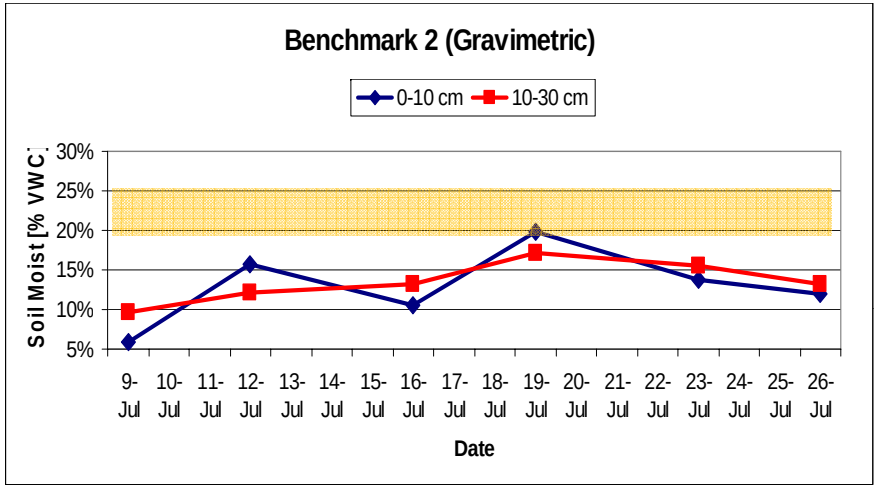
Watchdog 400 with Watermarks

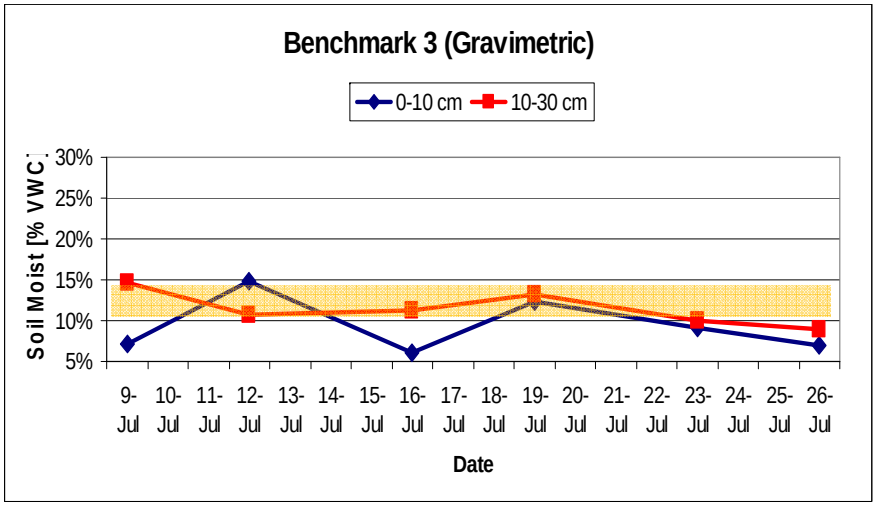
Equipment	Cost	+	-
Gro-Point	Medium	• Continuous • Reliable	• Fixed • Field download
Echo Probe	Mid-high	• Continuous • Wireless capable	• Cost • Fixed • Unit conversion
Watermark	Medium	• Continuous • Easy installation • Maintenance	• Variable sensitivity • May need calibration

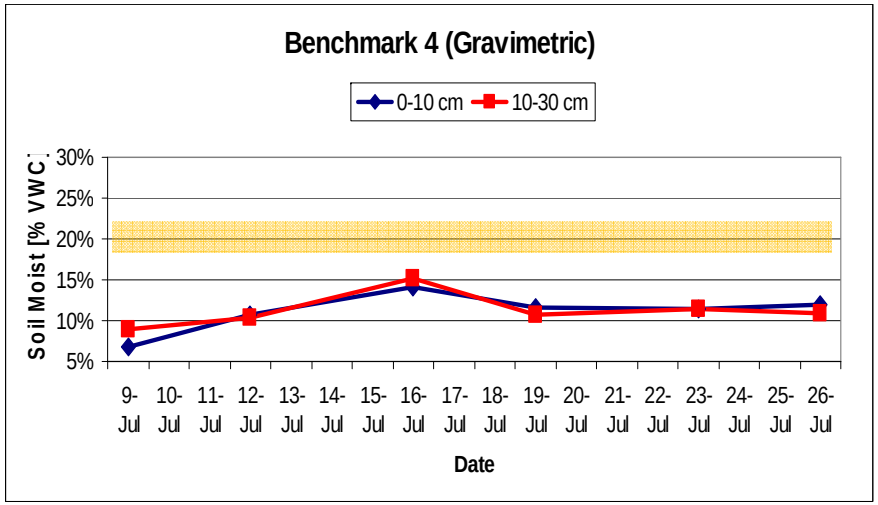

Satellite Sites
- Gravimetric Sampling
- TDR FieldScout

Satellite 1 (Gravimetric)





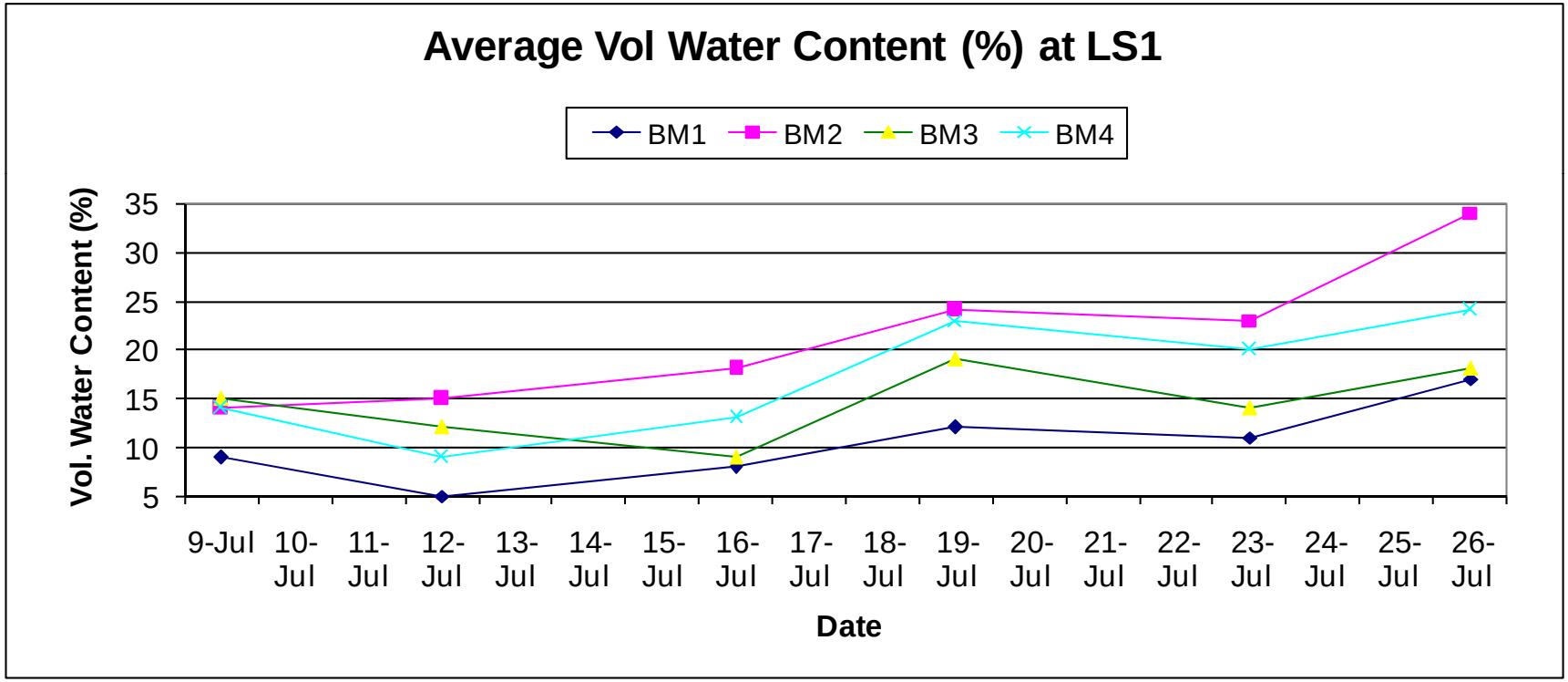




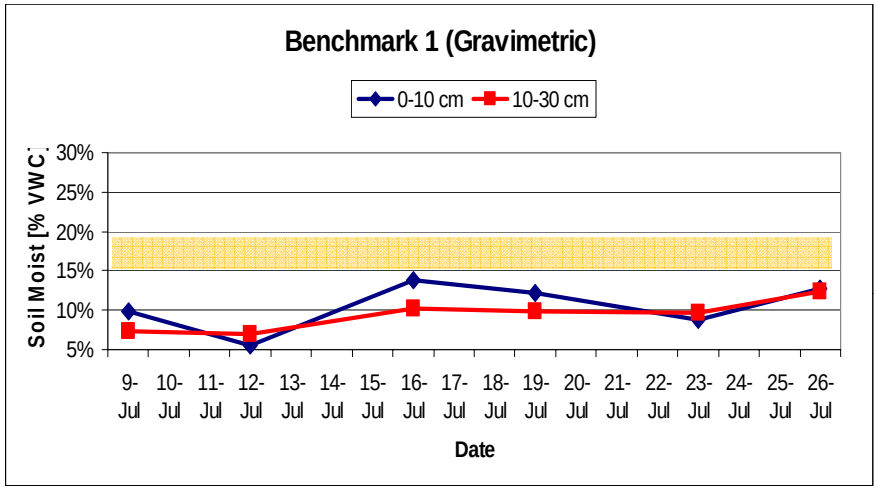
Irrigation target range (65% - 85% of FC); avg FC at this site = 23% volumetric moisture

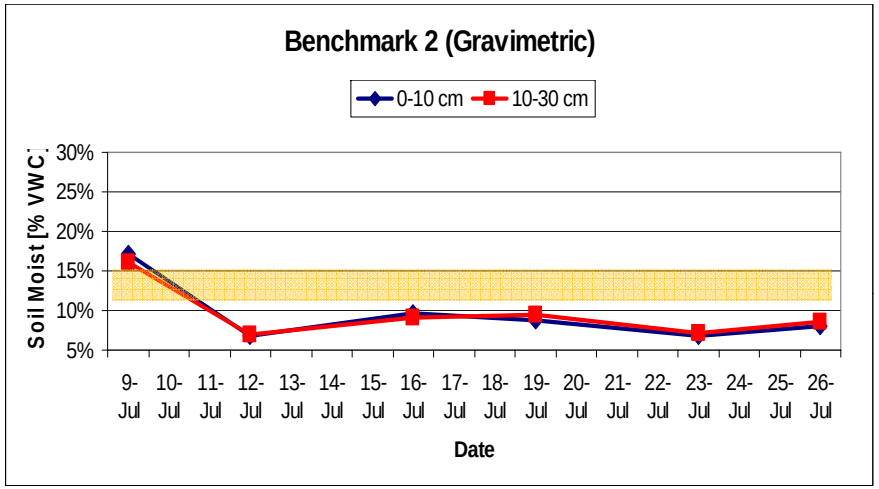
FieldScout TDR at Leamington

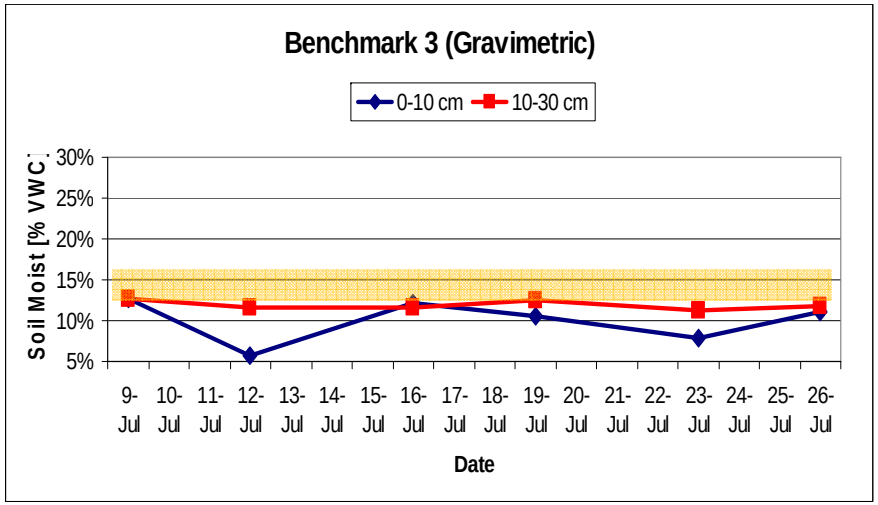
Satellite 1

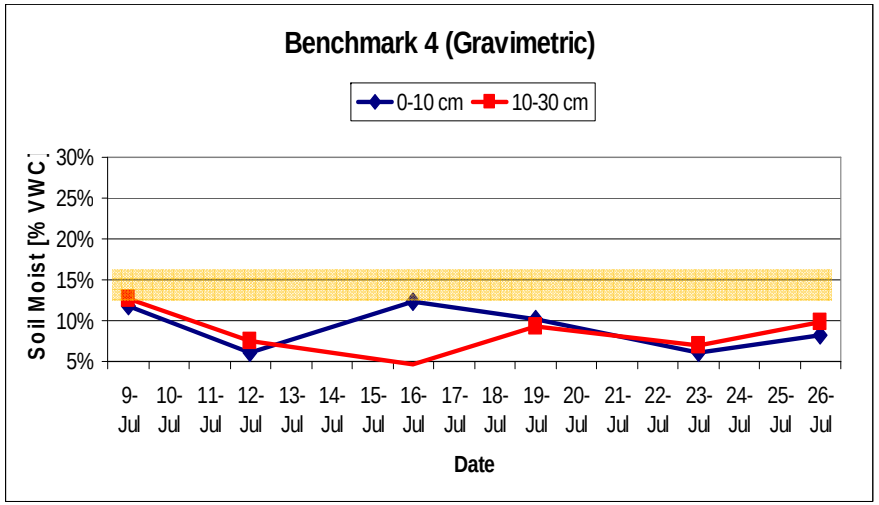


Satellite 2 (Gravimetric)





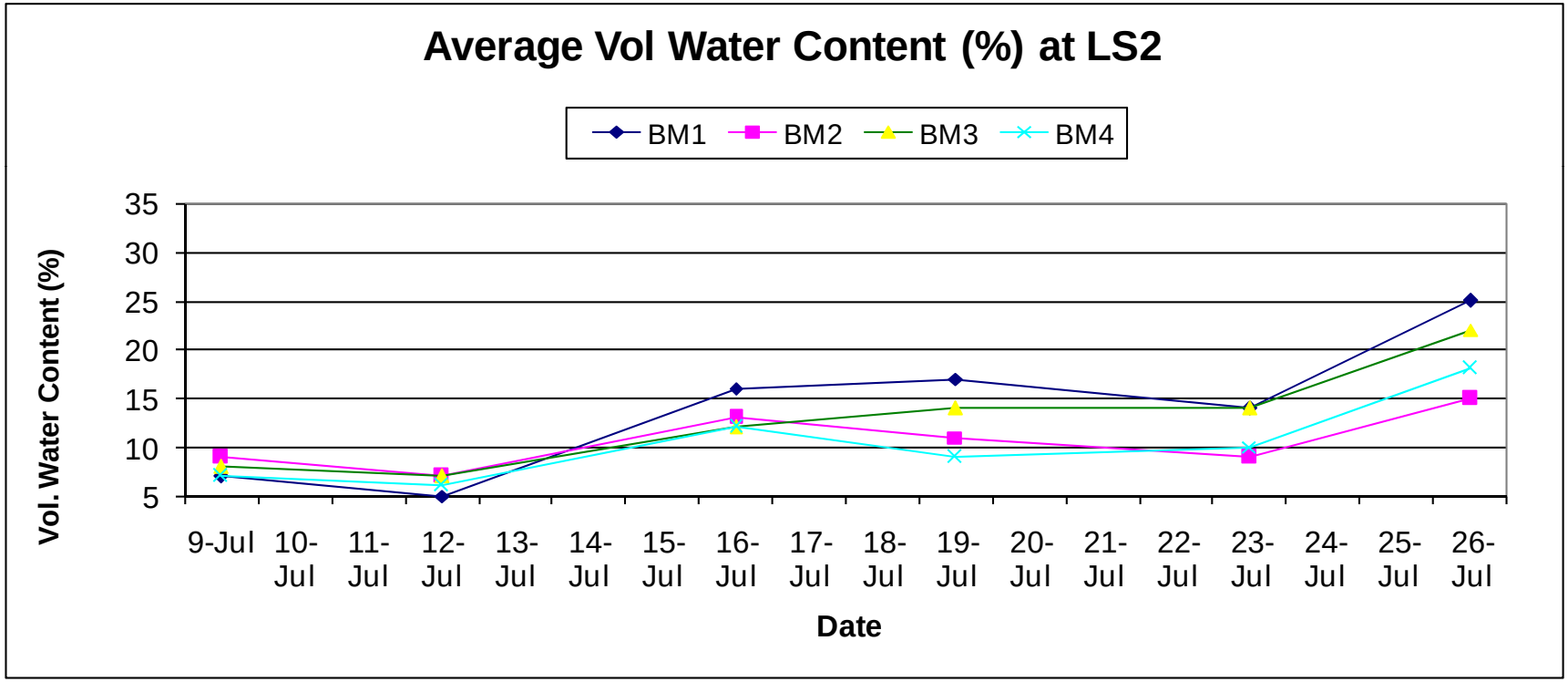




Irrigation target range (65% - 85% of FC); avg. FC at this site = 20% volumetric moisture

FieldScout TDR at Leamington

Satellite 2



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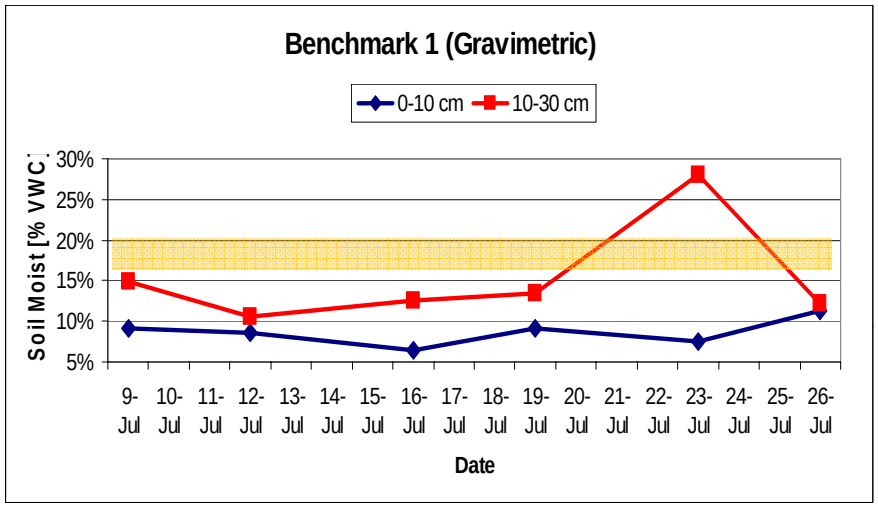
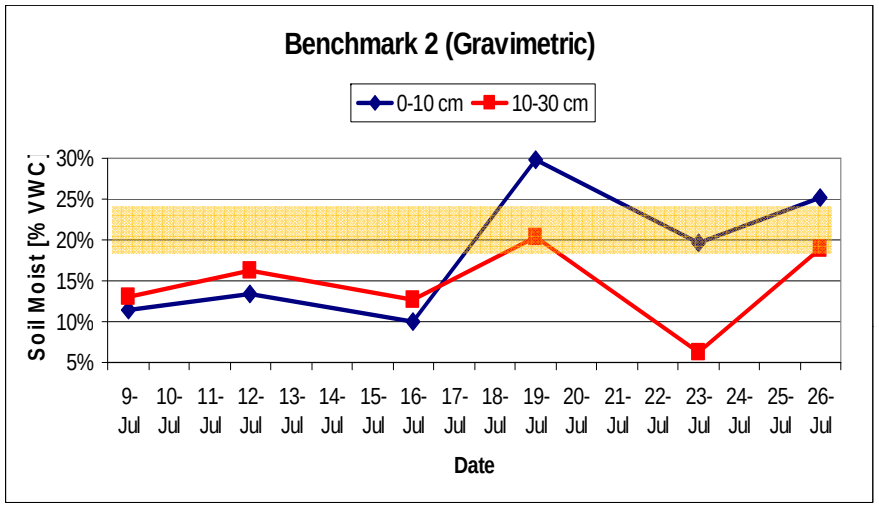
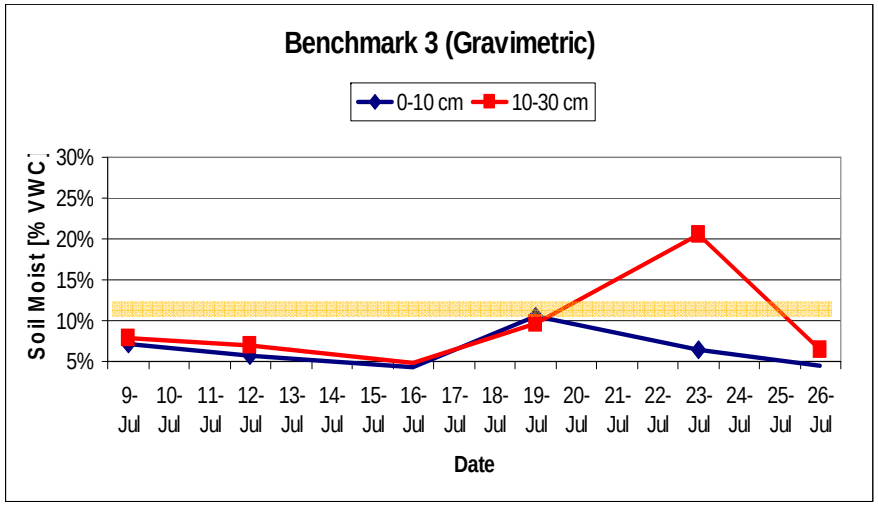
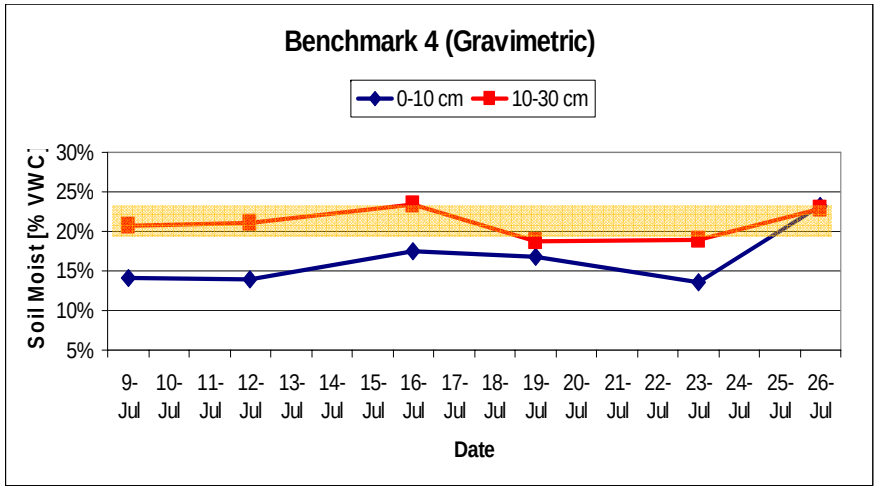




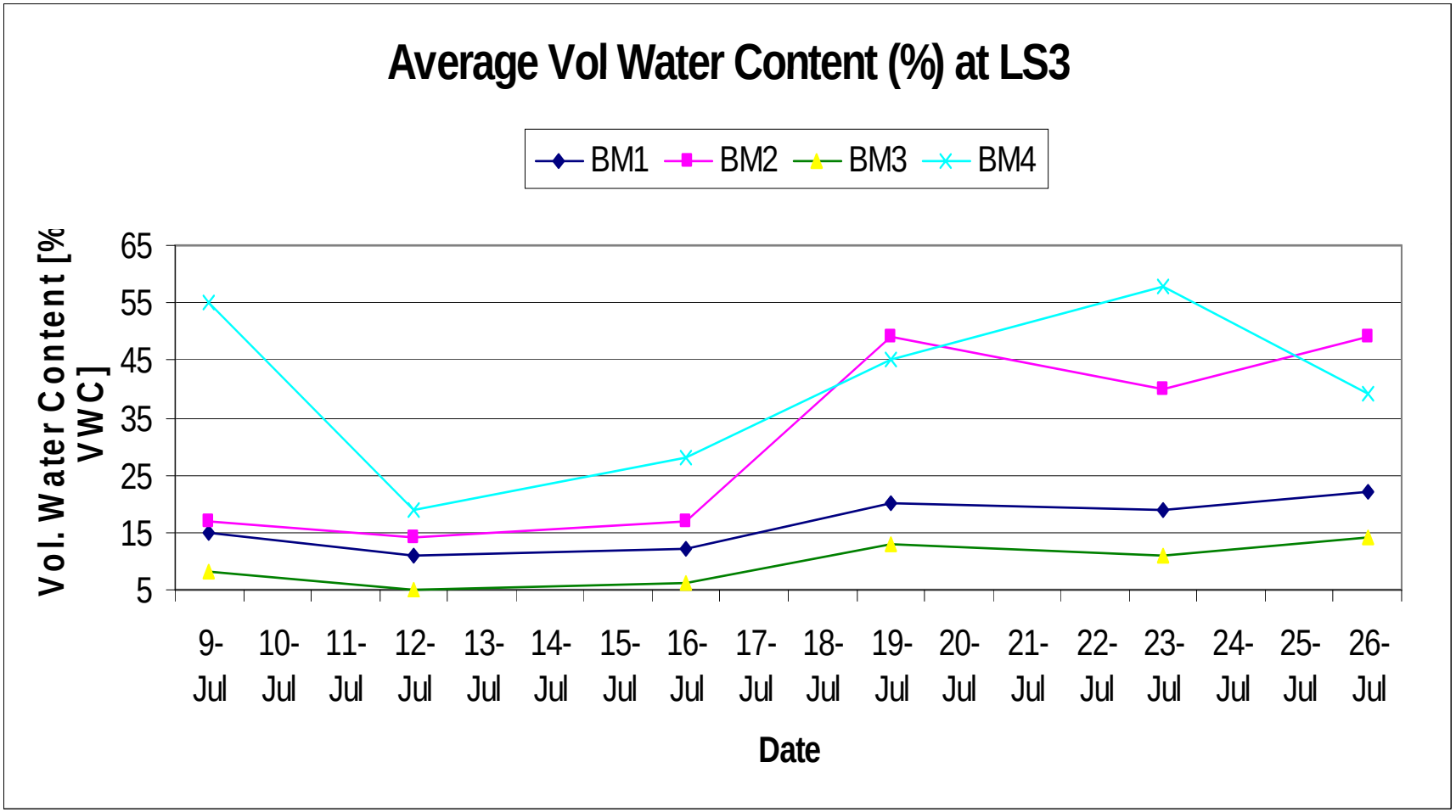




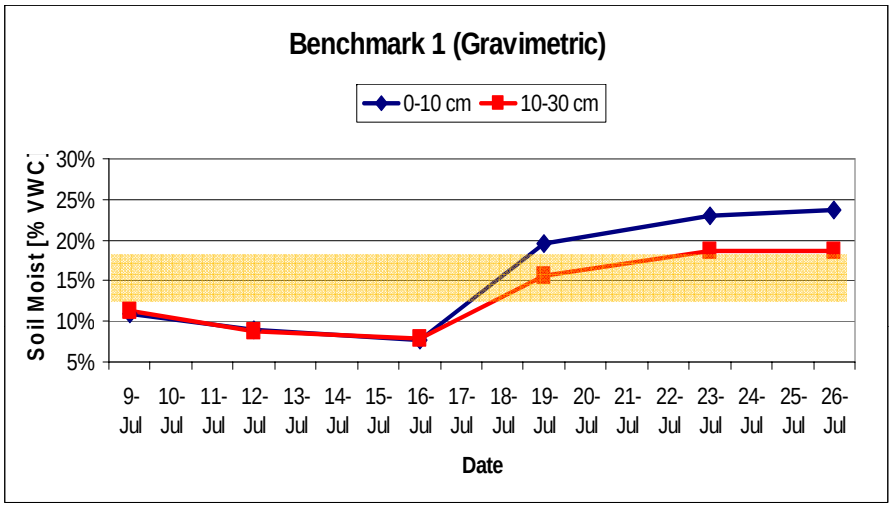
Irrigation target range (65% - 85% of FC); avg. FC at this site = 24% volumetric moisture

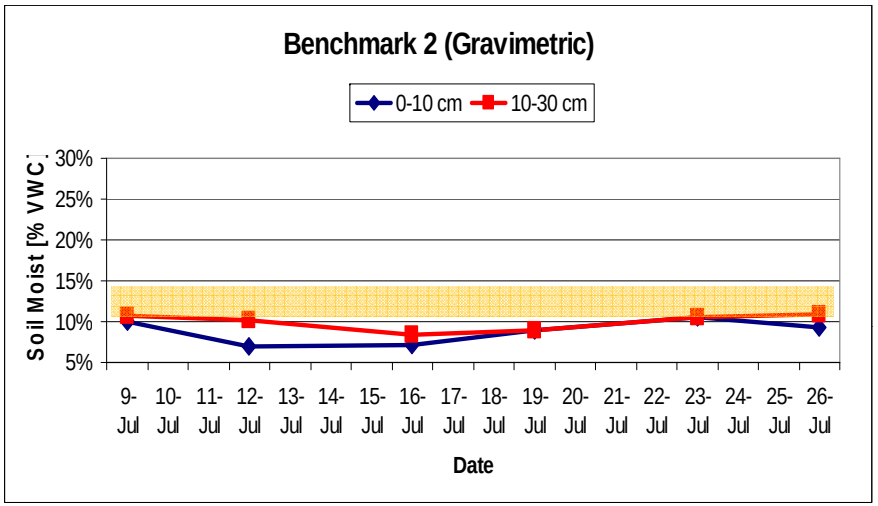
FieldScout TDR at Leamington

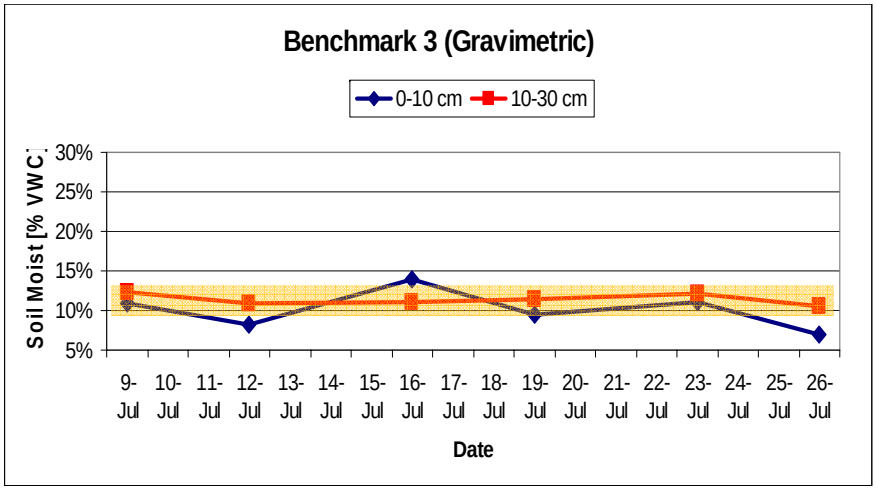
Satellite 3

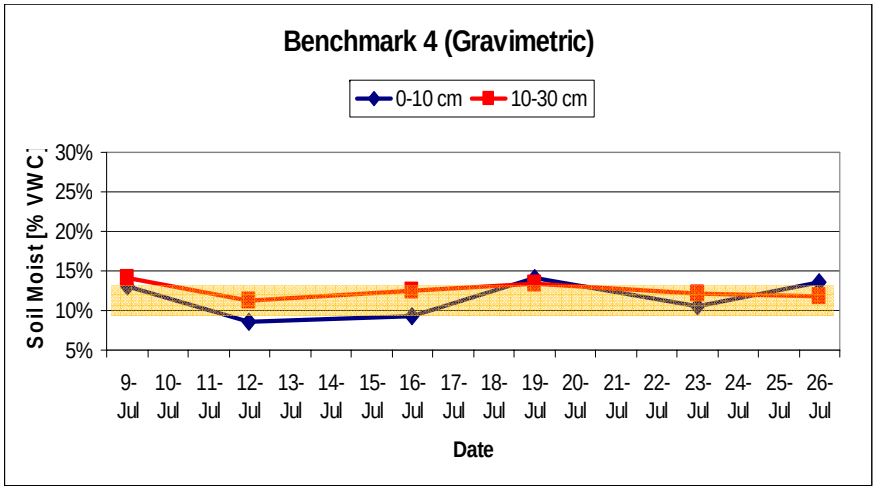


Satellite 4 (Gravimetric)









Irrigation target range (65% - 85% of FC); avg. FC at this site =16.5% volumetric moisture

FieldScout TDR at Leamington

Satellite 4