UNIV. of MISSOURI EXTENSION PRESENTATION OCTOBER 2012

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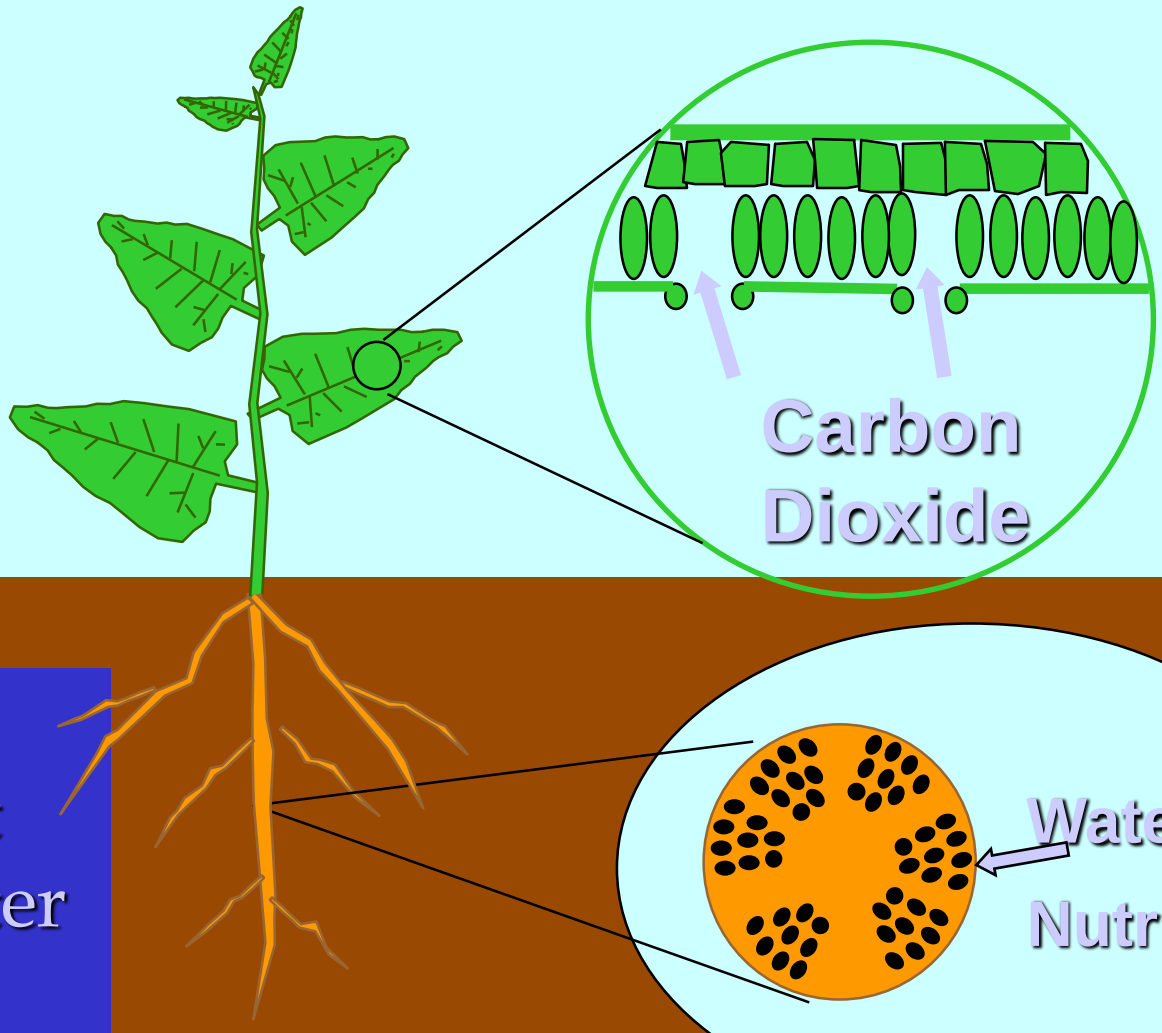
Crop Needs

Hard to manage air and sunlight

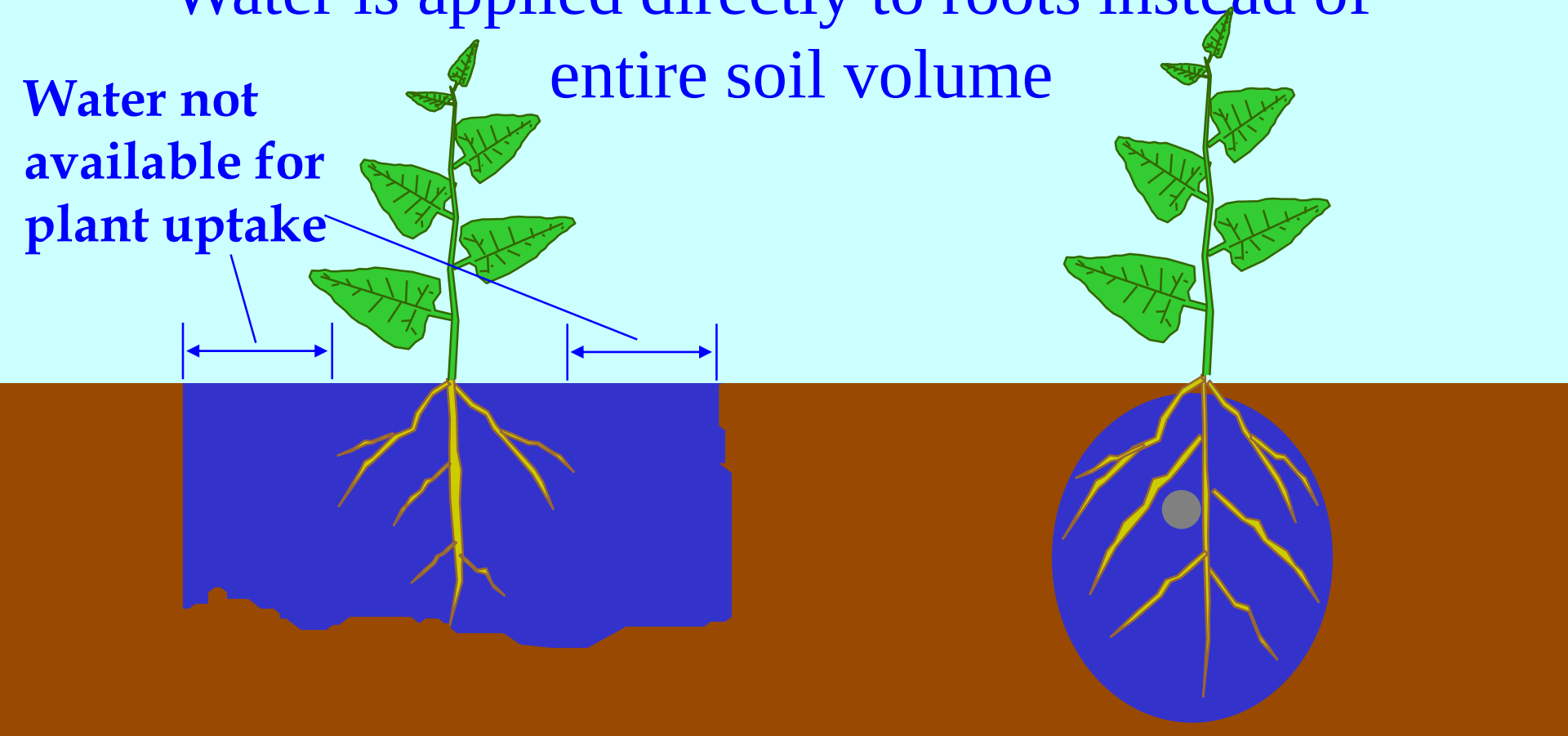


Drip gives a grower the most control over water and nutrients

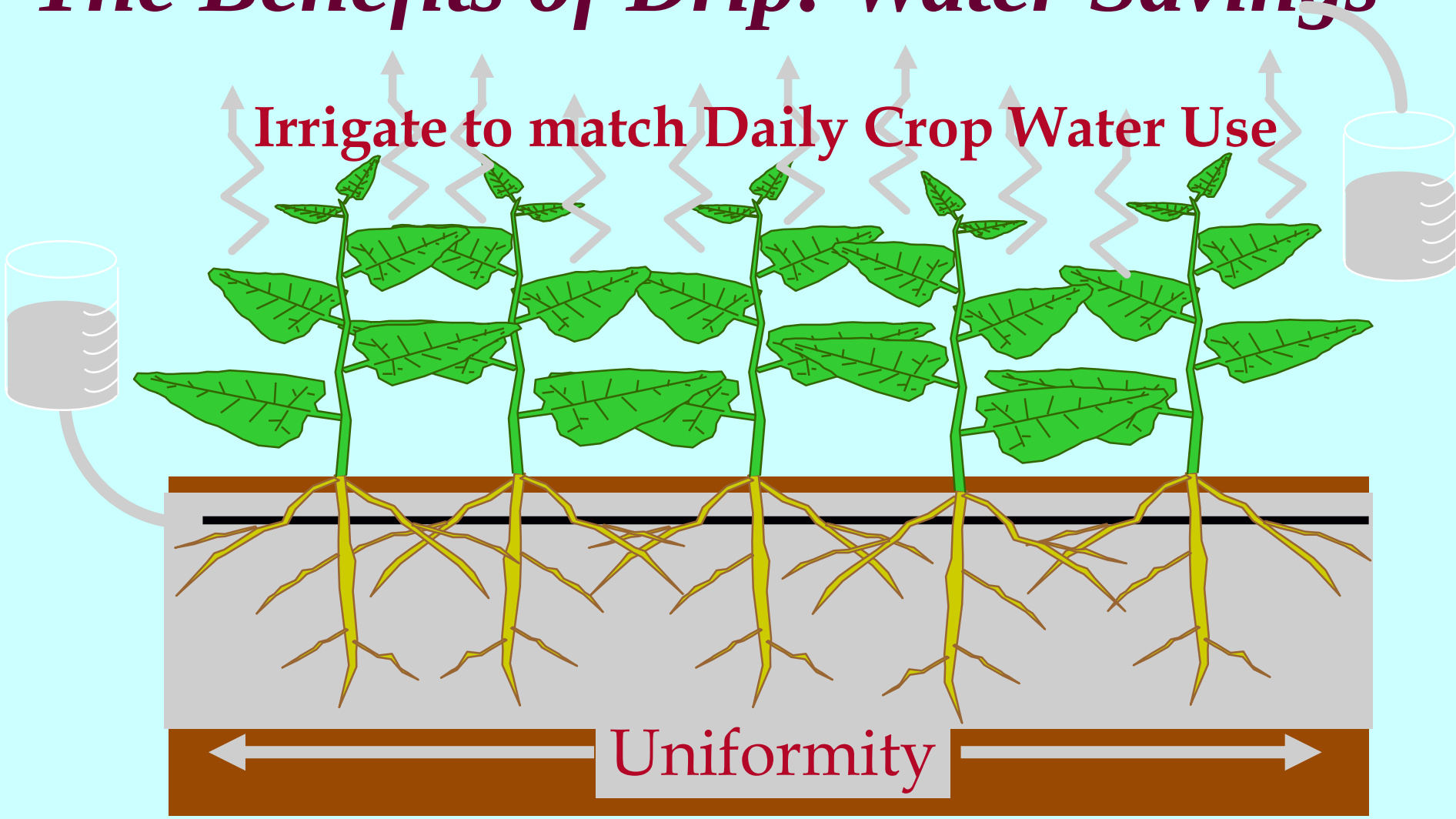
Misconceptions

"I can't apply enough water with drip"

Water is applied directly to roots instead of entire soil volume



The Benefits of Drip: Water Savings

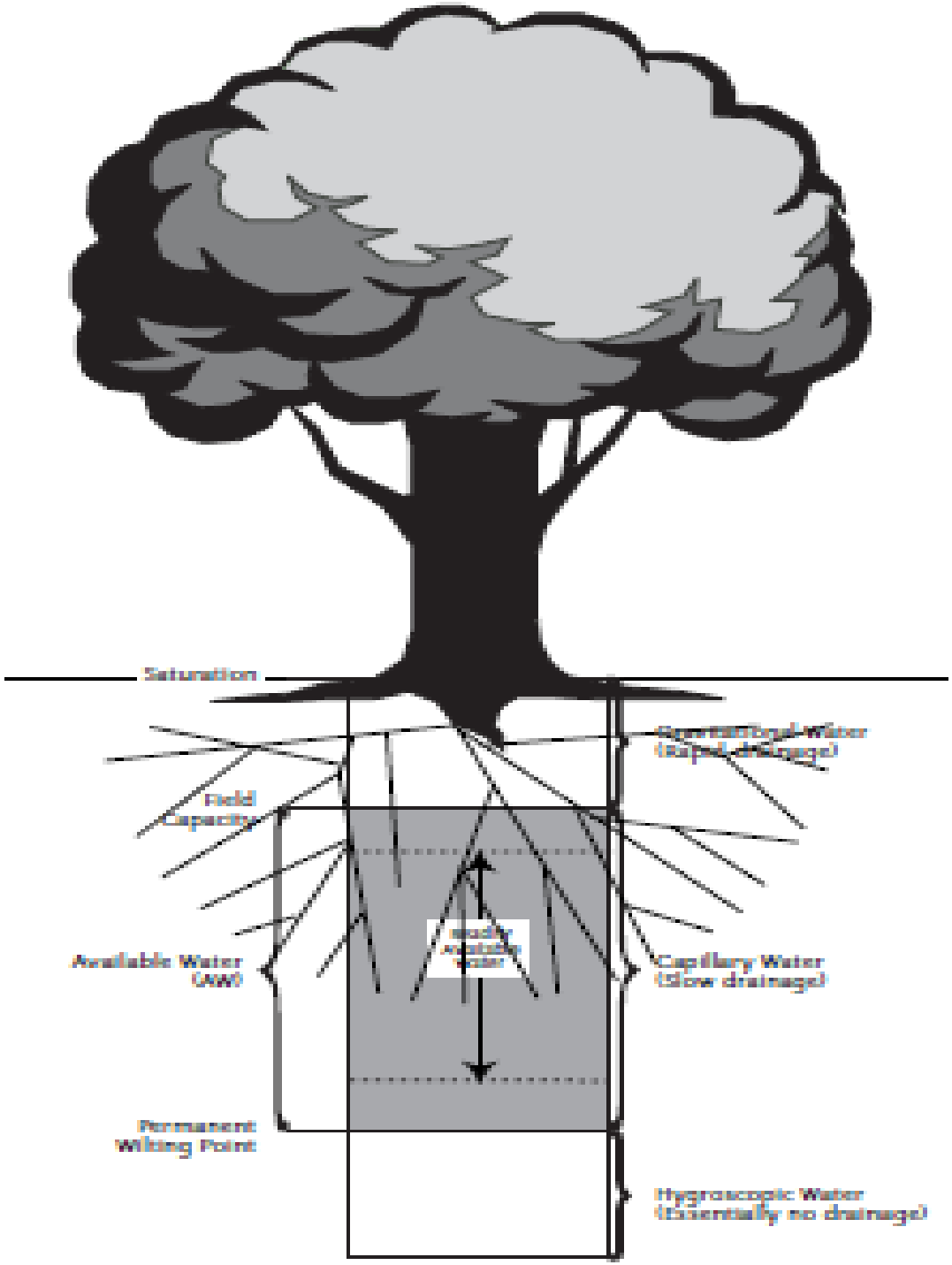


Minimize deep percolation

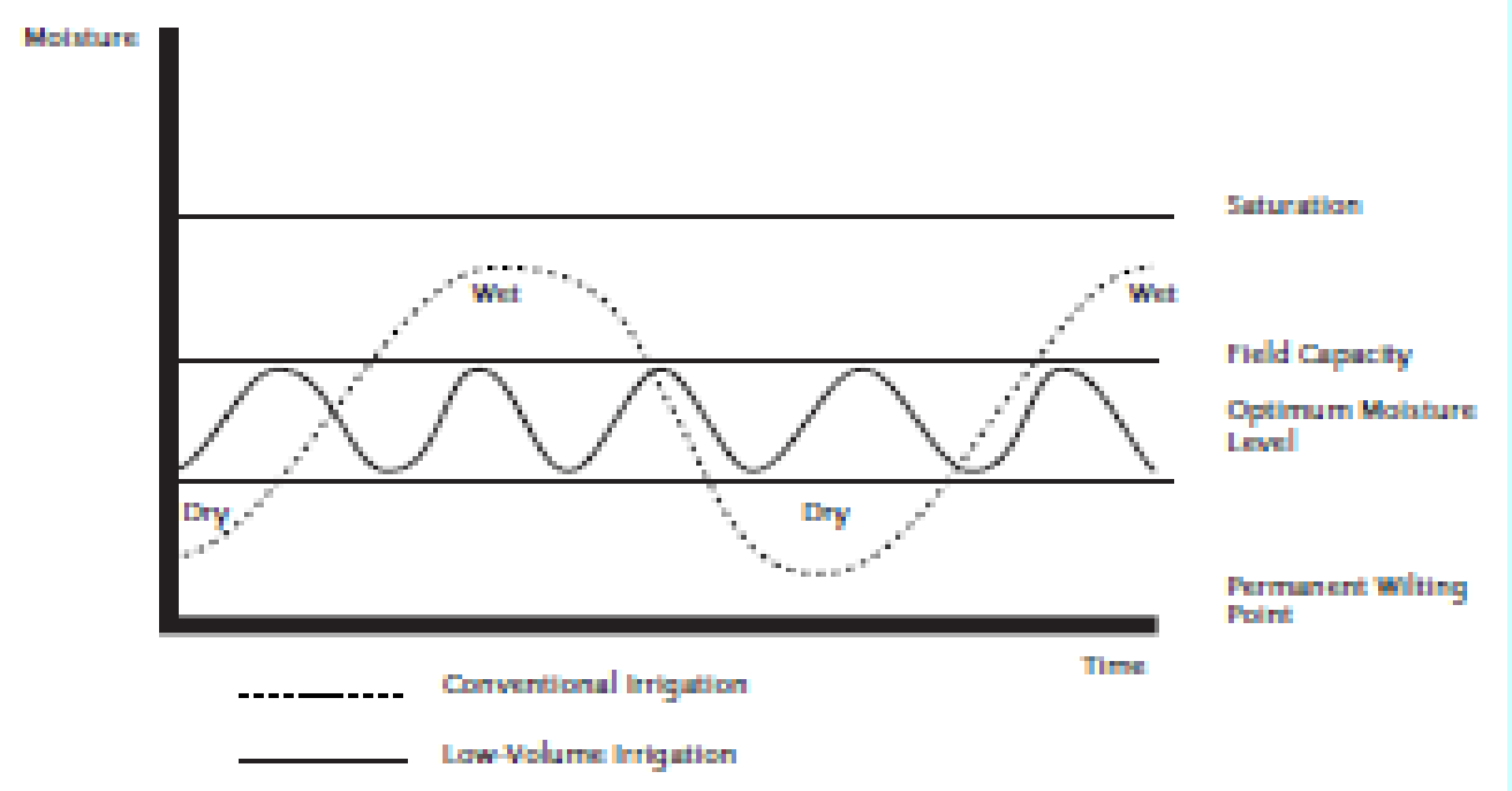
AVAILABLE WATER

- The water must be in the plant root zone.

- The soil water holding capacity must be between Field Capacity and the Permanent Wilting Point.



Drip irrigation is the only way to keep soil moisture at an Optimum Moisture Level.



Advantages of a Properly Designed Drip Irrigation System

- Labor savings
- Increases Yields
- Improves Water Penetration
- Water Savings
- Equipment Cost Savings
- Power Saving
- Most Efficient Means of Fertilization
- Promotes Better Growth on Slopes

Information Needed Before a System Can Be Designed

- Water Source
  - Lake/Pond/River
  - Well
  - Municipal Water Supply
- Water Quality
  - A Water Test Will Be Needed to Determine Water Quality
- Water Quantity
  - 15 to 20 GPM per Acre

Information Needed Before a System Can Be Designed

- Layout Schematic
  - Number of Rows
  - Distance Between Rows
  - Distance Between Plants
  - Distance of Water Source from Field
  - Elevation Differences

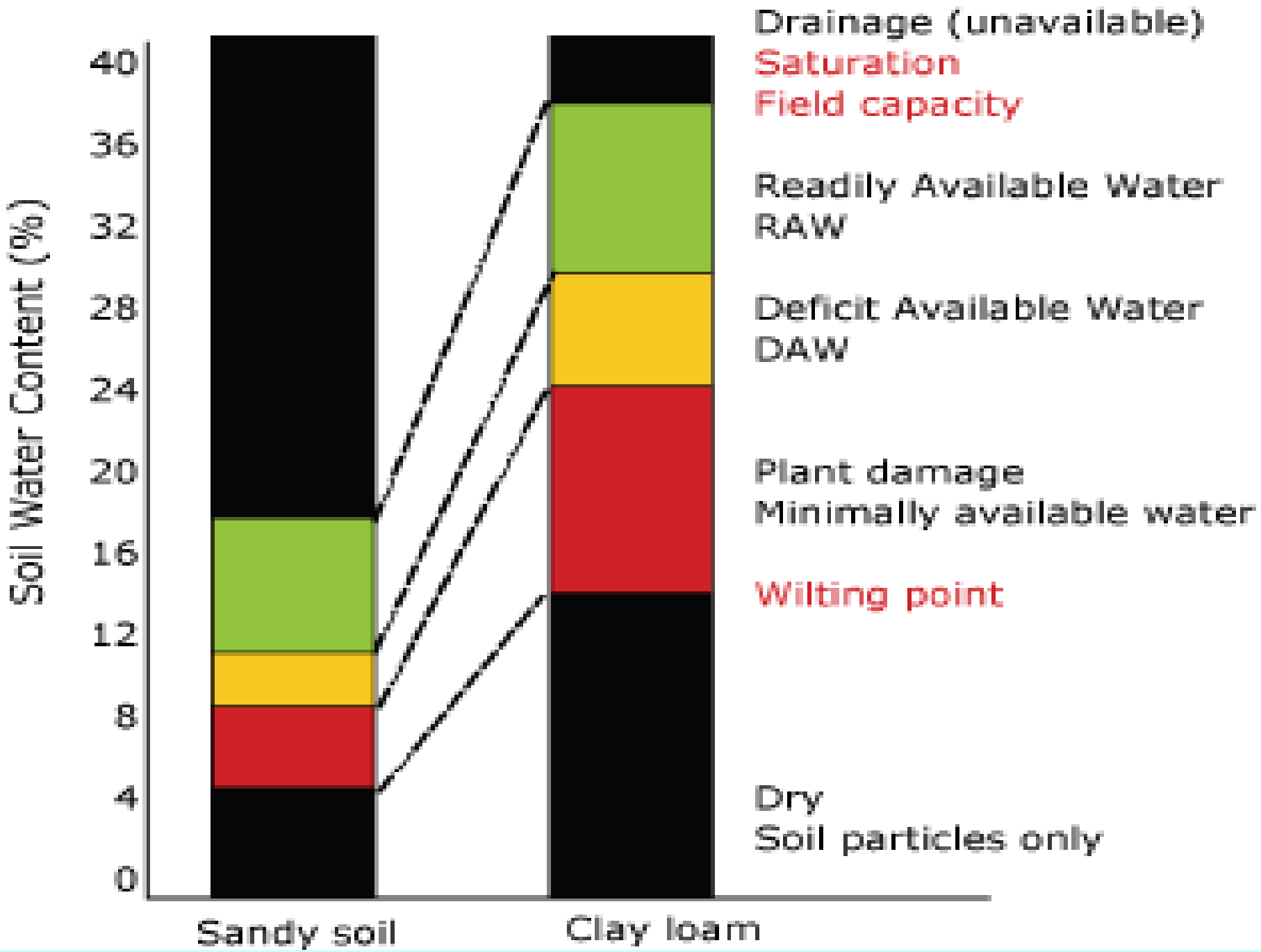
Information Needed Before a System Can Be Designed

- Power
  - Is Electrical Service Available?
  - 110v, 220v ?
  - If 220v, is it 1Phase or 3 Phase
  - Gas or Diesel
  - PTO
  - Gravity (not usually a good option)
  - SOLAR

Information Needed Before a System Can Be Designed

- Soils
  - Clay
  - Loam
  - Sandy

SOIL TEXTURE	MAXIMUM PRECIPITATION RATES: INCHES PER HOUR (MILLIMETERS PER HOUR)							
	0 to 5% slope		5 to 8% slope		8 to 12% slope		12%+ slope	
	cover	bare	cover	bare	cover	bare	cover	bare
Course sandy soils	2.00 (51)	2.00 (51)	2.00 (51)	1.50 (38)	1.50 (38)	1.00 (25)	1.00 (25)	0.50 (13)
Course sandy soils over compact subsoils	1.75 (44)	1.50 (38)	1.25 (32)	1.00 (25)	1.00 (25)	0.75 (19)	0.75 (19)	0.40 (10)
Light sandy loams uniform	1.75 (44)	1.00 (25)	1.25 (32)	0.80 (20)	1.00 (25)	0.60 (15)	0.75 (19)	0.40 (10)
Light sandy loams over compact subsoils	1.25 (32)	0.75 (19)	1.00 (25)	0.50 (13)	0.75 (19)	0.40 (10)	0.50 (13)	0.30 (8)
Uniform silt loams	1.00 (25)	0.50 (13)	0.80 (20)	0.40 (10)	0.60 (15)	0.30 (8)	0.40 (10)	0.20 (5)
Silt loams over compact subsoil	0.60 (15)	0.30 (8)	0.50 (13)	0.25 (6)	0.40 (10)	0.15 (4)	0.30 (8)	0.10 (3)
Heavy clay or clay loam	0.20 (5)	0.15 (4)	0.15 (4)	0.10 (3)	0.12 (3)	0.08 (2)	0.10 (3)	0.06 (2)


Soil Water Content (%)
40
36
32
28
24
20
16
12
8
4
0
Sandy soil
Clay loam
Drainage (unavailable)
Saturation
Field capacity
Readily Available Water
RAW
Deficit Available Water
DAW
Plant damage
Minimally available water
Wilting point
Dry
Soil particles only

DESIGN PARAMETERS

- HOW MANY INCHES PER WEEK?
  - COST vs UTILITY
  - EMITTER FLOW RATE vs ROW LENGTH vs DIAMETER OF DRIPPERLINE vs PRECIP RATE
  - PUMP SIZE vs RUN TIME
  - ROW WIDTH vs ROOT ZONE WIDTH
  - MANUAL RUN TIME vs AUTOMATIC RUN TIME

TOTAL WATER DESIGN ZONE #	ROW CROP 12" TAPE DRIPPERLINE	BERRIES 18" DRIPPERLINE	BERRIES 24" DRIPPERLINE	BERRIES 36" DRIPPERLINE
AVERAGE ROW LENGTH (FT)	500	500	500	500
NUMBER OF ROWS	1	1	1	1
WIDTH OF ROW (feet)	3	4	4	4
Inches Per Week	1	1	1	1
Crop Factor	1	1	1	1
Gallons Per Day Per Field	1038.33	1384.44	1384.44	1384.44
Gallons Per Day Per Row	1038.33	1384.44	1384.44	1384.44
Tubing Amount (ft)	**500**	**500**	**500**	**500**
WATER PER HOUR				
Emitter Spacing(inches)	12.00	18.00	24.00	36.00
Emitter Output (gph)	0.24	0.55	0.55	0.55
Output Per Row (gph)	120.00	183.33	137.50	91.67
Output Per Row (gpm)	2.00	3.06	2.29	1.53
Output Per Field (gph)	120.00	183.33	137.50	91.67
Output Per Field (gpm)	**2.00**	**3.06**	**2.29**	**1.53**
ZONE ANALYSIS				
Zone Run Time (hours)	**8.65**	**7.55**	**10.07**	**15.10**
PRECIP RAT E (in/hr)	**0.128**	**0.147**	**0.11**	**0.074**

TOTAL WATER DESIGN ZONE #	ROW CROP 12" TAPE DRIPPERLINE	BERRIES 18" DRIPPERLINE	BERRIES 24" DRIPPERLINE	BERRIES 36" DRIPPERLINE
AVERAGE ROW LENGTH (FT)	500	500	500	500
NUMBER OF ROWS	1	1	1	1
WIDTH OF ROW (feet)	3	4	4	4
Inches Per Week	2	2	2	2
Crop Factor	1	1	1	1
Gallons Per Day Per Field	2076.67	2768.89	2768.89	2768.89
Gallons Per Day Per Row	2076.67	2768.89	2768.89	2768.89
Tubing Amount (ft)	**500**	**500**	**500**	**500**
WATER PER HOUR				
Emitter Spacing(inches)	12.00	18.00	24.00	36.00
Emitter Output (gph)	0.24	0.55	0.55	0.55
Output Per Row (gph)	120.00	183.33	137.50	91.67
Output Per Row (gpm)	2.00	3.06	2.29	1.53
Output Per Field (gph)	120.00	183.33	137.50	91.67
Output Per Field (gpm)	**2.00**	**3.06**	**2.29**	**1.53**
ZONE ANALYSIS				
Zone Run Time (hours)	**17.31**	**15.10**	**20.14**	**30.21**
PRECIP RAT E (in/hr)	**0.128**	**0.147**	**0.11**	**0.074**

ZONE #	BLUEBERRIES	BLUEBERRIES	BLUEBERRIES	BLUEBERRIES
AVERAGE ROW LENGTH (FT)	200	200	200	200
NUMBER OF ROWS	20	20	20	20
WIDTH OF ROW (feet)	4	8	4	8
Inches Per Week	1	2	1	1
Crop Factor	1	1	1	1
Gallons Per Day Per Field	11075.56	44302.22	11075.56	22151.11
Gallons Per Day Per Row	553.78	2215.11	553.78	1107.56
Tubing Amount (ft)	**4,000**	**4,000**	**4,000**	**4,000**
WATER PER HOUR				
Emitter Spacing(inches)	24.00	24.00	24.00	24.00
Emitter Output (gph)	0.55	0.55	0.91	0.91
Output Per Row (gph)	55.00	55.00	91.00	91.00
Output Per Row (gpm)	0.92	0.92	1.52	1.52
Output Per Field (gph)	1100.00	1100.00	1820.00	1820.00
Output Per Field (gpm)	**18.33**	**18.33**	**30.33**	**30.33**
ZONE ANALYSIS				
Zone Run Time (hours)	**10.07**	**40.27**	**6.09**	**12.17**

Maximum Lateral Lengths (0% Slope)

16 mm (0.630 x 0.540) Aqua-line™ PC

GPH	PSI Inlet	Emitter Spacing (inches)							
		12	18	24	30	36	42	48	60
0.42	25	314	437	546	647	741	829	913	1069
	35	404	562	703	832	953	1066	1174	1375
	45	469	651	815	965	1104	1236	1361	1594
	55	521	723	904	1071	1226	1372	1511	1770
0.57	25	269	371	462	546	624	697	766	895
	35	346	477	595	702	802	896	985	1152
	45	401	553	689	814	930	1039	1142	1335
	55	445	614	765	904	1032	1153	1268	1482
0.9	25	195	270	338	401	459	513	565	662
	35	251	348	435	516	590	661	727	852
	45	290	403	505	597	684	765	843	987
	55	322	448	560	663	759	850	936	1096

18 mm (0.720 x 0.620) Aqua-line™ PC

GPH	PSI Inlet	Emitter Spacing (inches)							
		12	18	24	30	36	42	48	60
0.53	25	360	496	619	730	834	932	1025	1198
	35	463	639	796	940	1074	1199	1319	1542
	45	536	740	922	1089	1244	1390	1528	1787
	55	595	822	1024	1209	1381	1543	1697	1984
0.9	25	257	355	442	522	597	667	733	857
	35	331	457	569	672	768	858	943	1102
	45	383	529	659	779	890	994	1093	1277
	55	426	588	732	865	988	1103	1213	1418

20 mm (0.800 x 0.700) Aqua-line™ PC

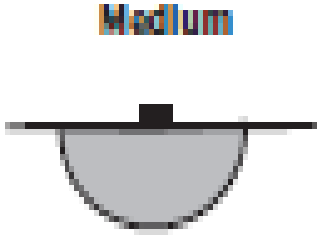
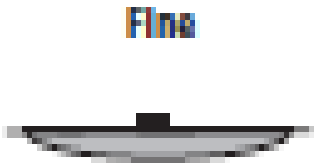
GPH	PSI Inlet	Emitter Spacing (inches)							
		12	18	24	30	36	42	48	60
0.42	25	519	713	887	1045	1192	1331	1462	1707
	35	668	918	1141	1345	1534	1712	1881	2196
	45	774	1064	1322	1558	1778	1984	2180	2545
	55	859	1181	1468	1730	1974	2203	2420	2826
0.57	25	453	616	760	891	1013	1127	1235	1438
	35	583	793	978	1147	1303	1450	1589	1850
	45	676	919	1133	1329	1510	1681	1842	2144
	55	751	1020	1258	1475	1677	1866	2045	2380
0.9	25	321	442	549	647	739	824	905	1057
	35	413	569	707	833	950	1060	1165	1360
	45	479	659	819	965	1101	1229	1350	1576
	55	532	731	909	1072	1223	1364	1499	1750

* Minimum of 15 psi at the end of the lateral

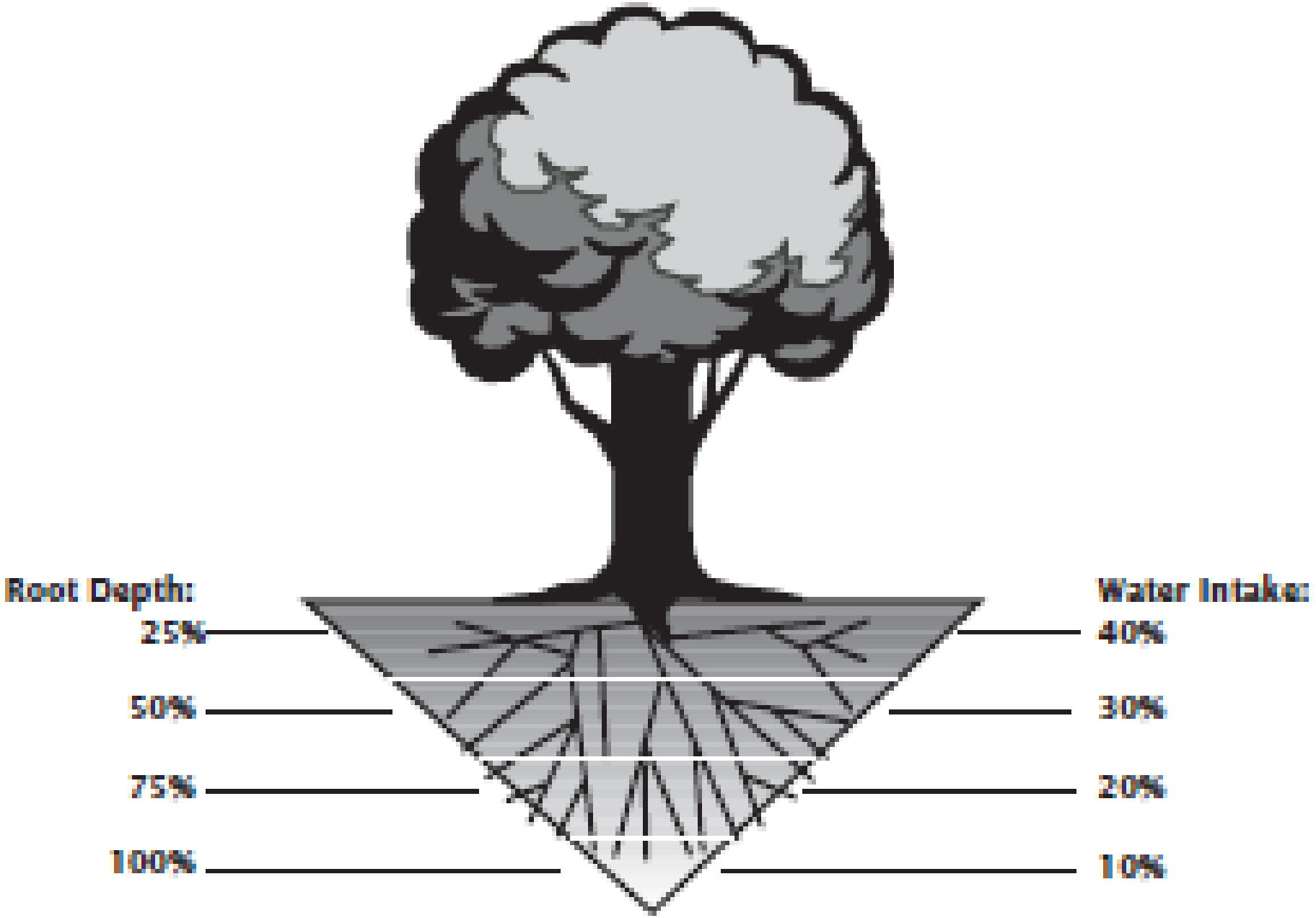
HIGH FREQUENCY SCHEDULING

- MORE START TIMES FOR SHORTER PERIODS OF TIME
  - NORMAL – Every other day for 5 consecutive hours
  - HIGH FREQUENCY – Every other day for 1 hour on then 1 hour off, repeated 5 times

TABLE 3-3: SOIL INFILTRATION AND WETTING PATTERN

Soil Type	Maximum Infiltration Rate	Wetting Pattern	Maximum Wetted Diameter	Available Water (AW)
Coarse (sandy loam)	.72 - 1.25 inches per hour		1.0 - 3.0 feet	1.4 inches per foot
Medium (loam)	.25 - .75 inches per hour		2.0 - 4.0 feet	2.0 inches per foot
Fine (clay loam)	.13 - .25 inches per hour		3.0 - 6.0 feet	2.5 inches per foot

70% of water is taken up in the top 50% of the root zone.



Water Movement in Soils

This discussion of water movement in soils is a summary of pages 70 through 74 in the text, *Irrigation* 5th Ed.

During irrigation, initial water movement at the point of entry is caused by gravity. Beyond that point, water moves in all directions due to capillary forces, and downward due to gravity.

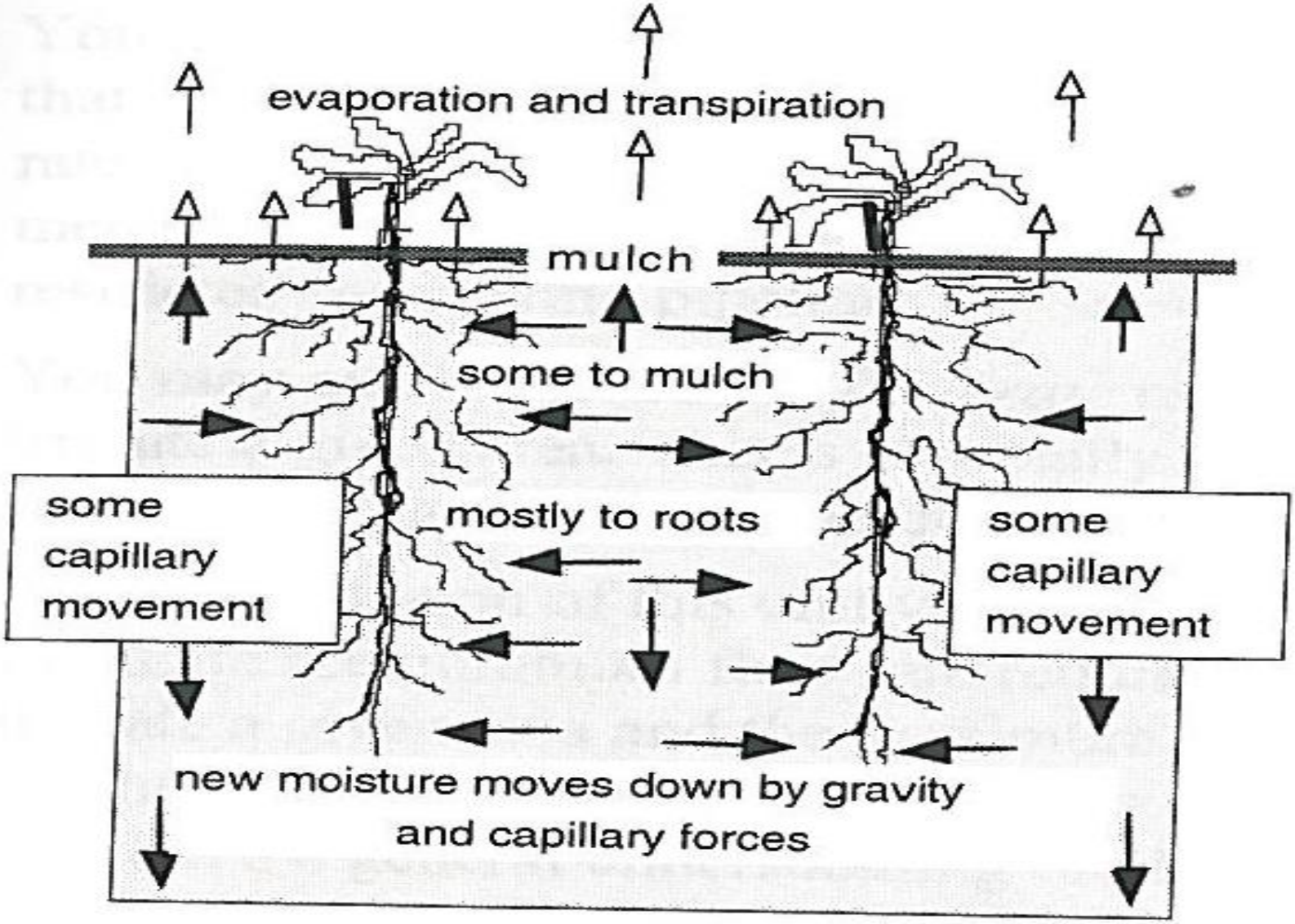
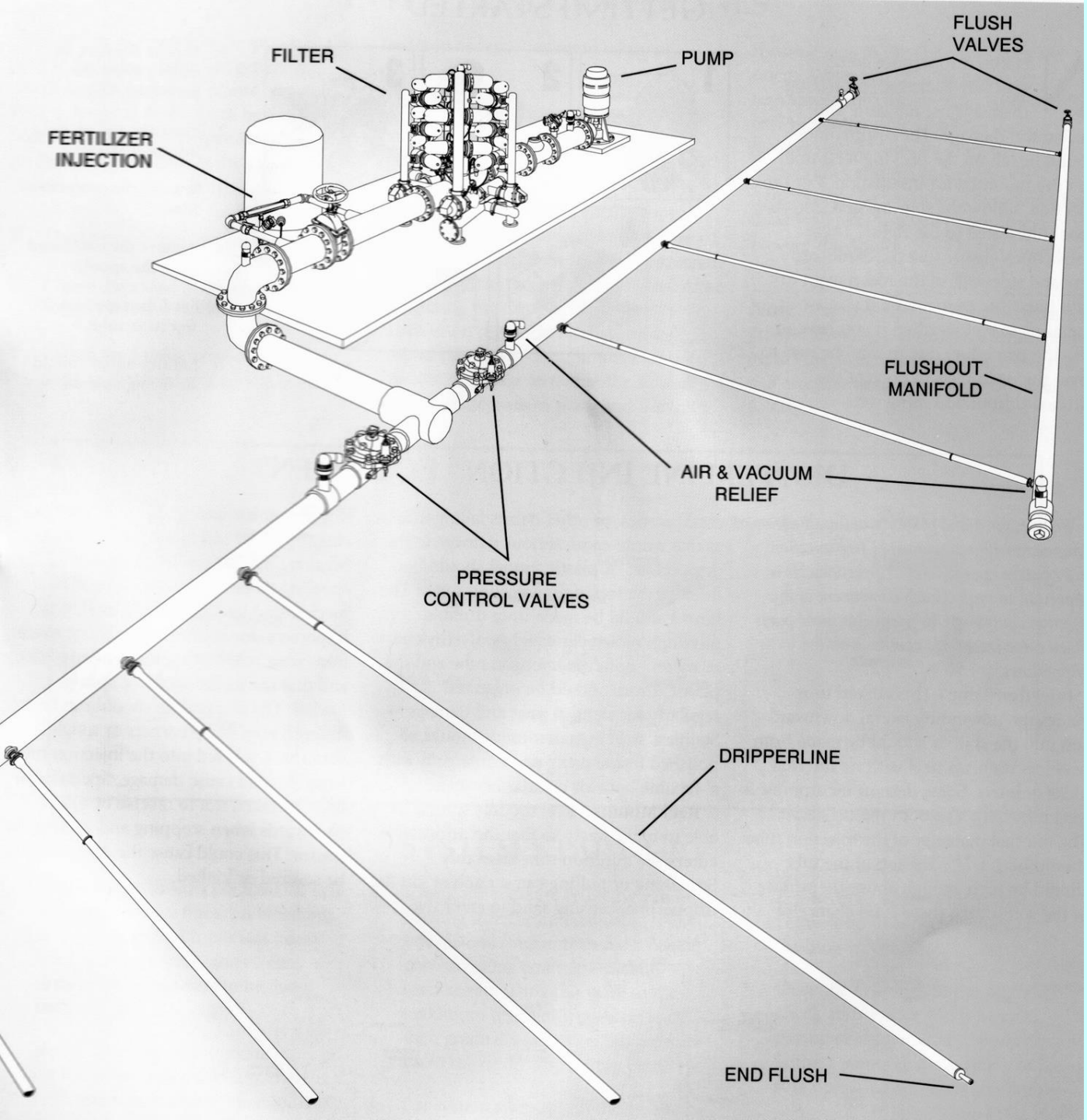


Figure 1.2-9. Soil water movement following irrigation or rainfall.

.18gph Emitter Flow rate @ 24” Emitter Spacing @ 14” deep

Anatomy of a Drip System



PUMP STATION

- Centrifugal – Lake or Pond
- Submersible – Well, Lake

FILTRATION

- Manual Clean or Automatic Backflush
- Disc Filter
- Screen Filter
- Media Filter
- 120 to 200 Mesh Filtration Needed Depending on Filtration Needs of Emitter.

Fertilizer-Chemical INJECTORS

- Electrical / Non-Electrical
- Venturi type
- Pump type
- Combination of Both

BACKFLOW PREVENTION

- Check Valves
  - Inline Check Valve to Prevent Water Flowing Back Through System.
- Chemical Backflow Preventers
  - Chemigation Check Valves
  - Atmospheric Vacuum Breakers
  - Double Check Assemblies
  - Reduced Pressure Backflow Preventor

MAIN LINE PIPING

- Main Line Valve
- Main Line Flush
- Main Line Drain
- Main Line Sizing is a Different Procedure Than Sub-main Line.

ZONE CONTROLS

- Valves
- Pressure Regulators
- Air Vents
- Disconnects
  - Unions
  - Flanges
  - Cam-loc
  - Grooved (vitaulic) fittings

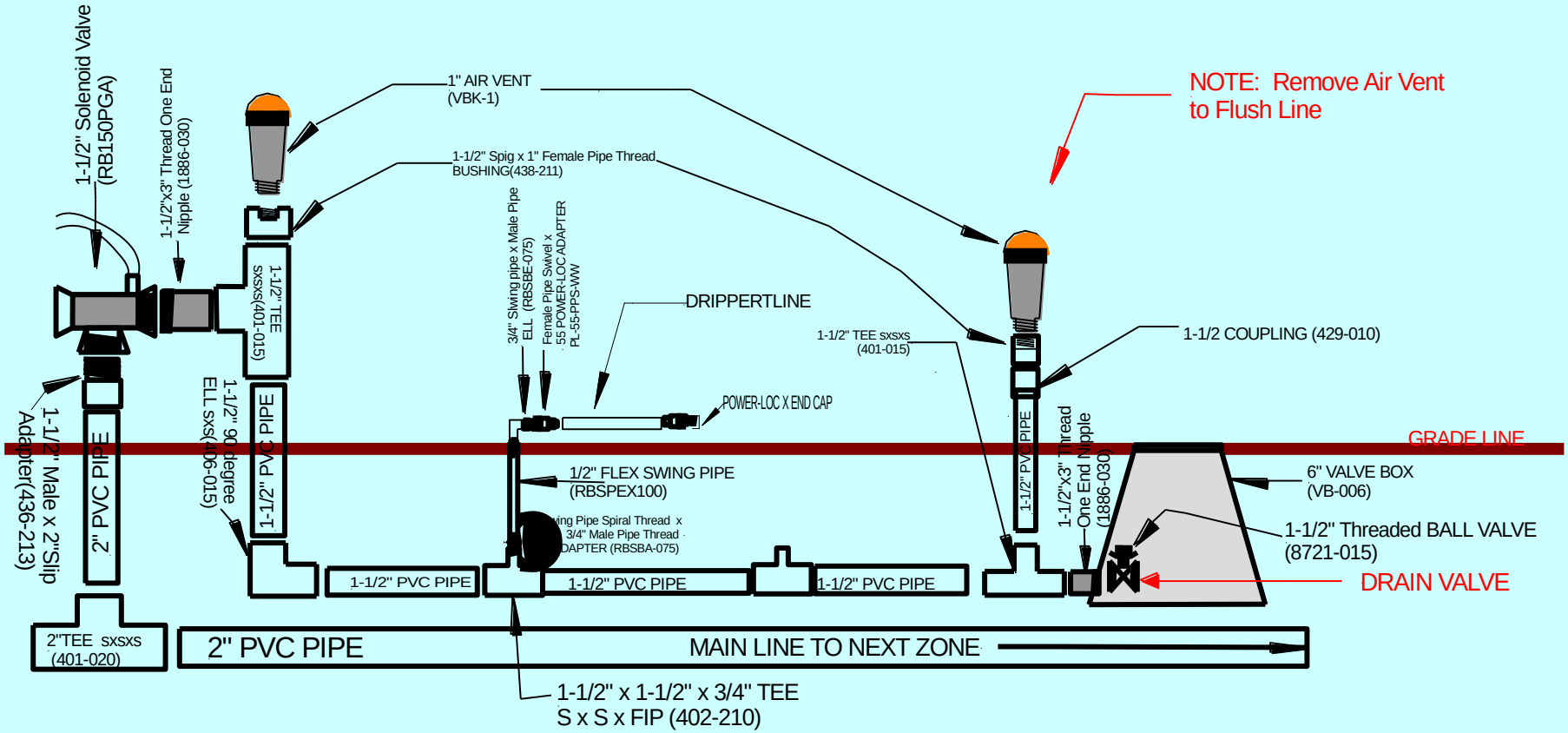
SUB-MAIN

- Risers
- Flush Valves
- Drain Valves
- Air Vents

ZONE DETAIL
20-40gpm
(Z-REV-ANGLE-20-40-3/4)

MPR Suppy Company
314-426-4838
Fax 314-426-1382
Prepared By Craig Pisarkiewicz

JOB _____
ZONE _____
DATE _____



DRIPPERLINE

- DRIP TAPE vs HEAVYWALL DRIPPERLINE
- Pressure Compensating vs Non-Pressure Compensating
- Inline vs Online

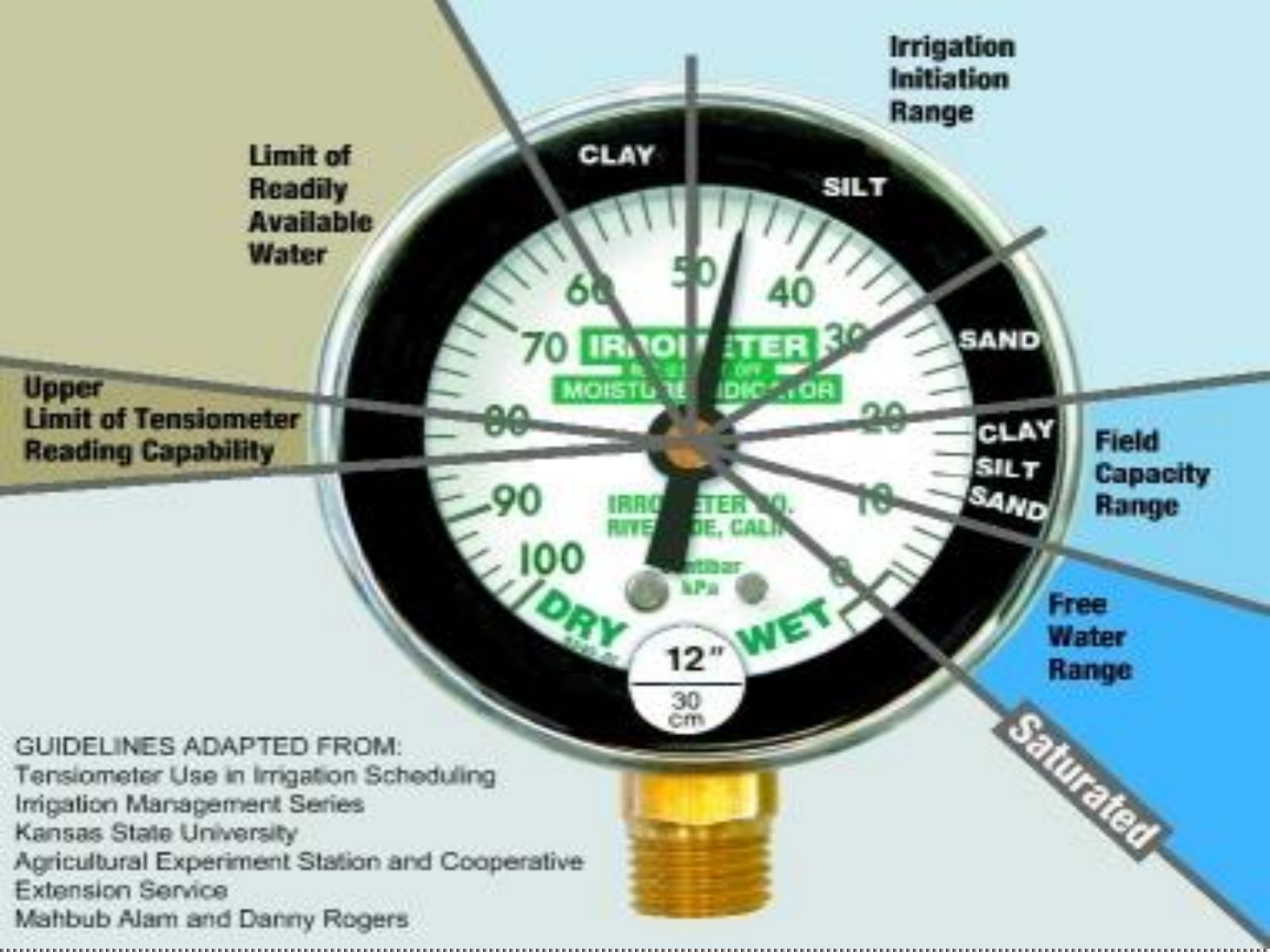
CONTROLLERS

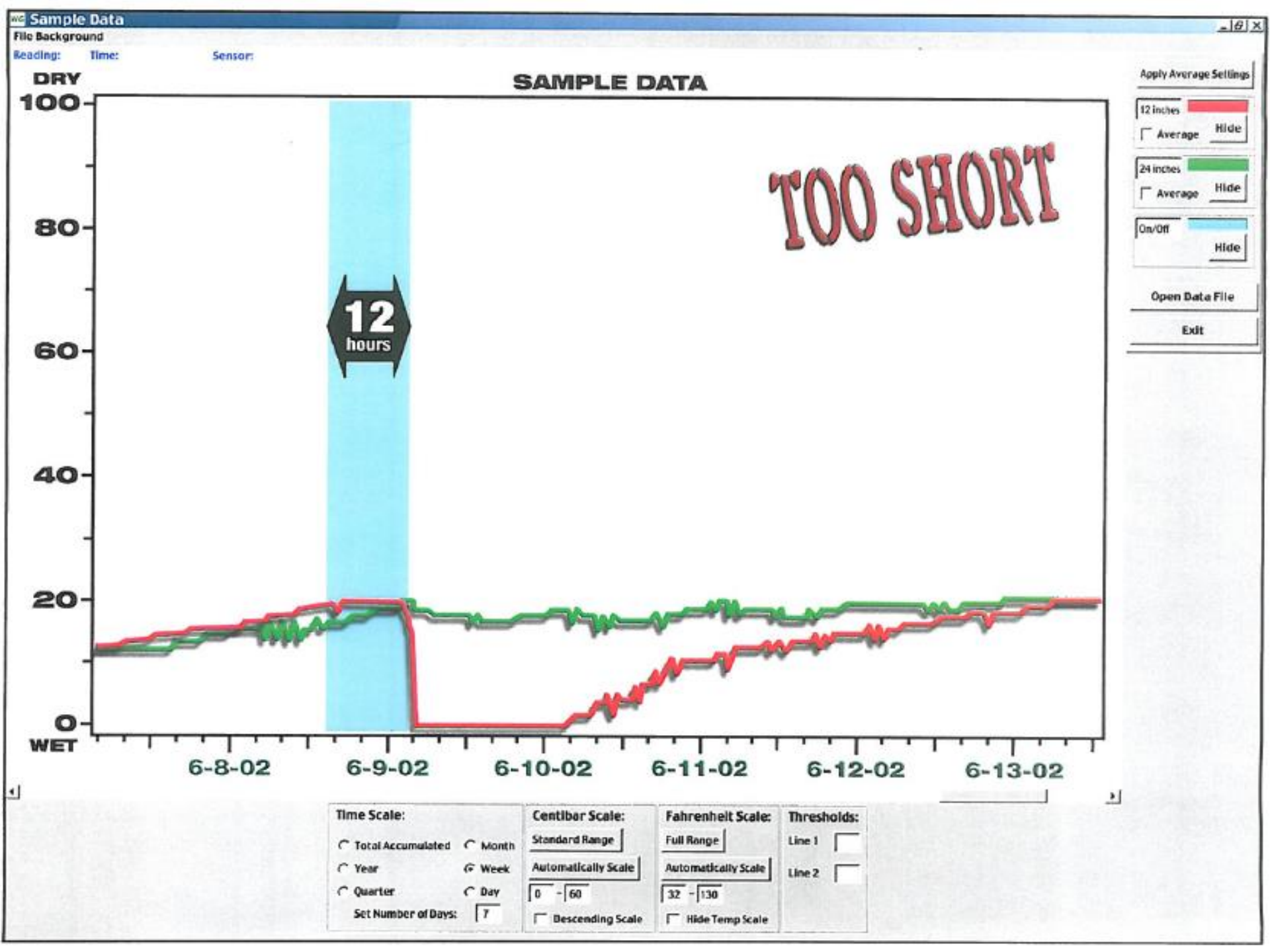
- Any Good Quality Outdoor Turf Controller
  - Electric
  - Battery operated
  - Radio or Modem operated

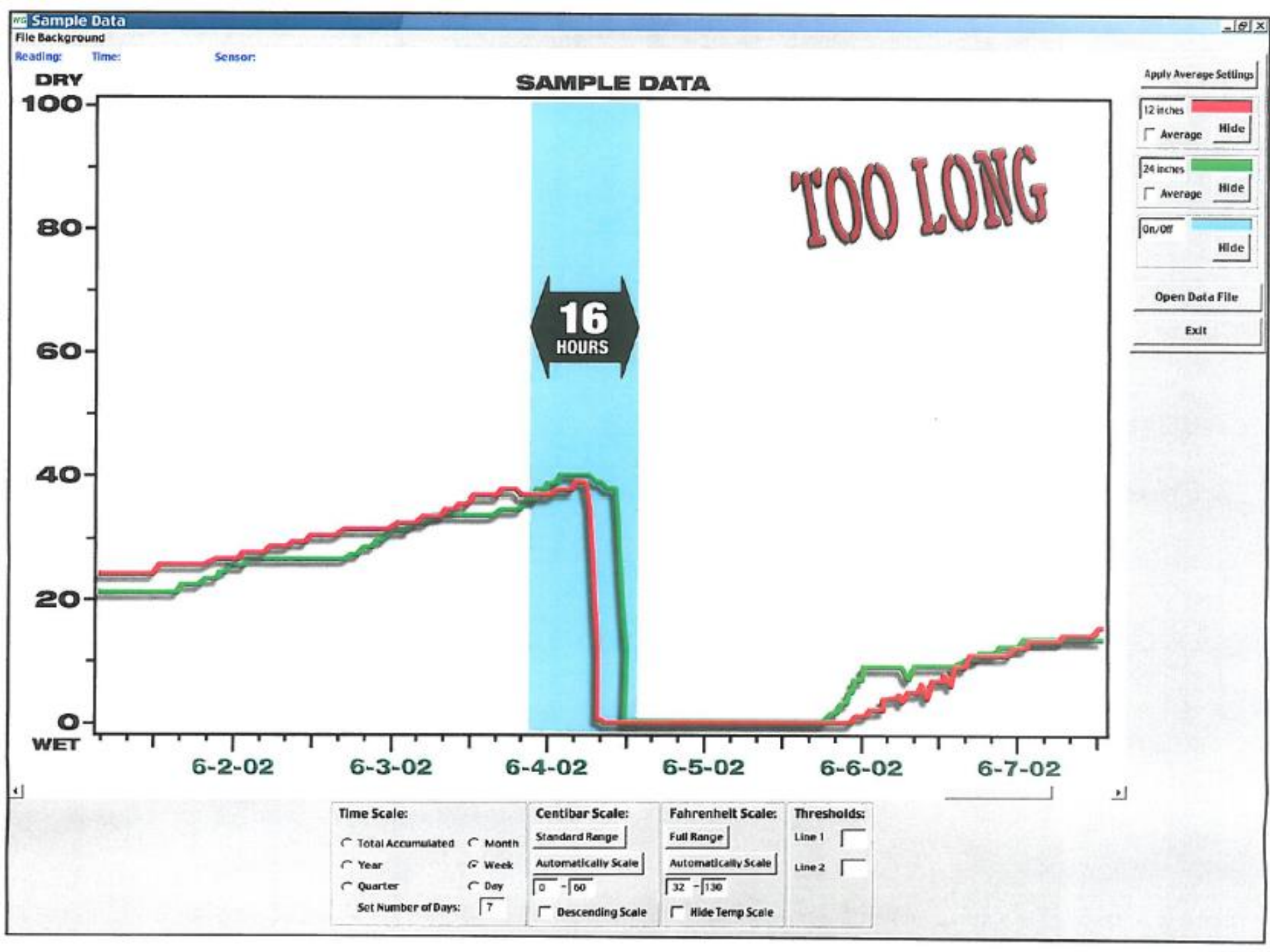

Zone
Blue Cro

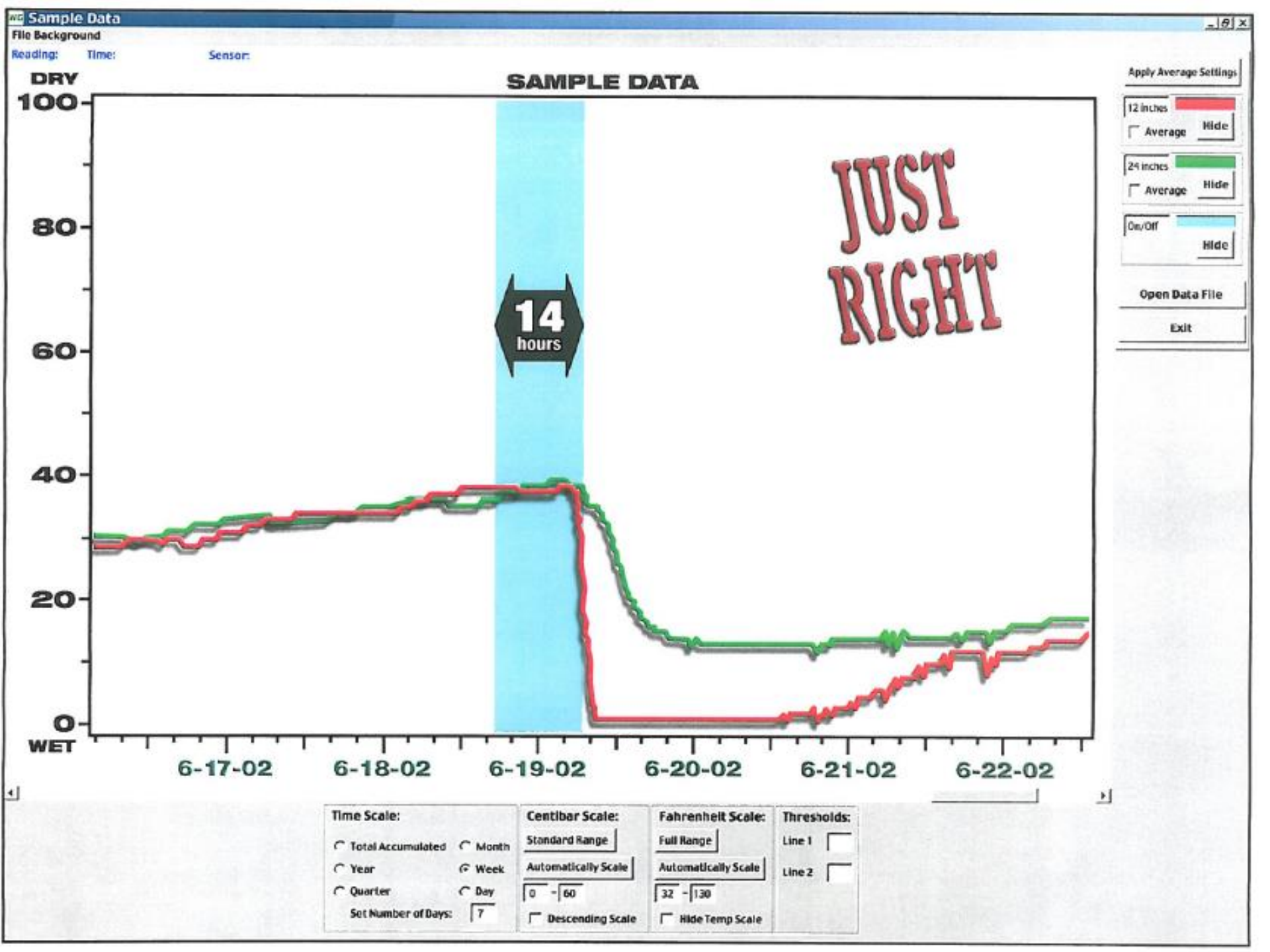
OTHER WAYS TO CONTROL SOIL MOISTURE

- Controllers that measure ET
- Soil moisture sensors


Irrigation Initiation Range
Limit of Readily Available Water
Upper Limit of Tensiometer Reading Capability
Field Capacity Range
Free Water Range
Saturated
CLAY
SILT
SAND
CLAY
SILT
SAND
60
50
40
70
30
80
20
90
10
100
0
DRY
WET
12"
30 cm
GUIDELINES ADAPTED FROM:
Tensiometer Use in Irrigation Scheduling
Irrigation Management Series
Kansas State University
Agricultural Experiment Station and Cooperative
Extension Service
Mahbub Alam and Danny Rogers


Sample Data
File Background
Reading:
Time:
Sensor:
SAMPLE DATA
DRY
100
80
60
40
20
0
WET
TOO SHORT
12
hours
6-8-02
6-9-02
6-10-02
6-11-02
6-12-02
6-13-02
Apply Average Settings
12 inches
Average
Hide
24 inches
Average
Hide
On/Off
Hide
Open Data File
Exit
Time Scale:
Total Accumulated
Month
Year
Week
Quarter
Day
Set Number of Days:
7
Centibar Scale:
Standard Range
Automatically Scale
0
60
Descending Scale
Fahrenheit Scale:
Full Range
Automatically Scale
32
130
Hide Temp Scale
Thresholds:
Line 1
Line 2


Sample Data
File Background
Reading:
Time:
Sensor:
SAMPLE DATA
DRY
100
80
60
40
20
0
WET
TOO LONG
16
HOURS
6-2-02
6-3-02
6-4-02
6-5-02
6-6-02
6-7-02
Apply Average Settings
12 inches
Average
Hide
24 inches
Average
Hide
On/Off
Hide
Open Data File
Exit
Time Scale:
Total Accumulated
Month
Year
Week
Quarter
Day
Set Number of Days:
7
Centibar Scale:
Standard Range
Automatically Scale
0
60
Descending Scale
Fahrenheit Scale:
Full Range
Automatically Scale
32
130
Hide Temp Scale
Thresholds:
Line 1
Line 2


Sample Data
File Background
Reading:
Time:
Sensor:
SAMPLE DATA
DRY
100
80
60
40
20
0
WET
14
hours
JUST
RIGHT
6-17-02
6-18-02
6-19-02
6-20-02
6-21-02
6-22-02
Apply Average Settings
12 inches
Average
Hide
24 inches
Average
Hide
On/Off
Hide
Open Data File
Exit
Time Scale:
Total Accumulated
Month
Year
Week
Quarter
Day
Set Number of Days:
7
Centibar Scale:
Standard Range
Automatically Scale
0
60
Descending Scale
Fahrenheit Scale:
Full Range
Automatically Scale
32
130
Hide Temp Scale
Thresholds:
Line 1
Line 2

COSTS?

- In Field Products: filter, main & sub-main piping, valves, pressure regulators, air vents, risers, dripperline, all fittings, etc
  - $500 - $1000 per acre
  - $1. 50 - $2.00 per vine

COSTS?

- Additional Costs
  - Labor / Installation
  - Electrical Service
    - Getting Electric Service to Field
    - Electrician
  - Pump Station
    - Well drilling
    - Pump house
    - Water tap

Irrigation, Sixth Edition is:

irrigation.org

- The cornerstone for promoting efficient irrigation technologies, products, and services for the production of food, fiber and fuel, and to help maintain the landscapes where we live.
- The most up-to-date compilation of irrigation topics. divided into 30 chapters, covering agricultural, landscape, turfgrass and other applications of irrigation systems.
- A must-have reference for all water managers and those interested in seeking certification or advancing their professional knowledge.

REFERENCE BOOKS

Drip and Micro Irrigation for Trees, Vines, and Row Crops				
Authors:	Charles M. Burt, PE, Ph.D,			
	Stuart W. Styles, PE			
Fertigation				
Authors:	C. Burt			
	K. O'Conner			
	T. Ruehr			
Copies may be ordered from:				
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