



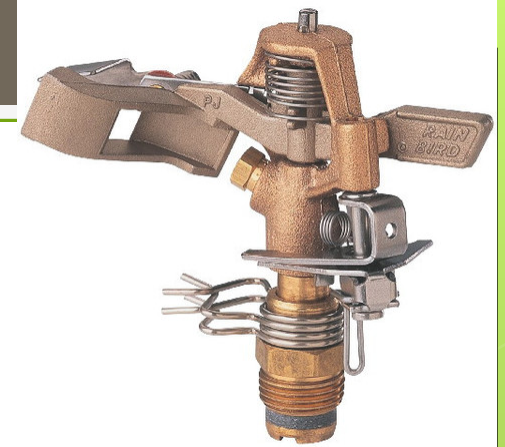
Nursery Irrigation

Tom Starkey
September 2015



Southern Container Nurseries

- Fixed Irrigation System;
 - Oscillating impact head irrigation
 - Pop-up sprinklers
- Moving Irrigation System
 - Center Pivot Irrigation
 - Horizontal Boom Irrigation









International Forest Company Moultrie, GA

14 center pivots

Radius of each center pivot is 205'

Area of each center pivot is 3 acres

16,500 gal/revolution @100% speed
~1/4" depth wet



Southern Bareroot Nurseries

- Fixed Irrigation System;
 - Oscillating impact head irrigation
- Moving Irrigation System
 - Center Pivot Irrigation







Bareroot irrigation – Oscillating impact head sprinklers

- Most Common
- Advantages:
 - Amount of water can be calibrated to soil conditions and nursery layout
 - Nozzles/orifice can be changed

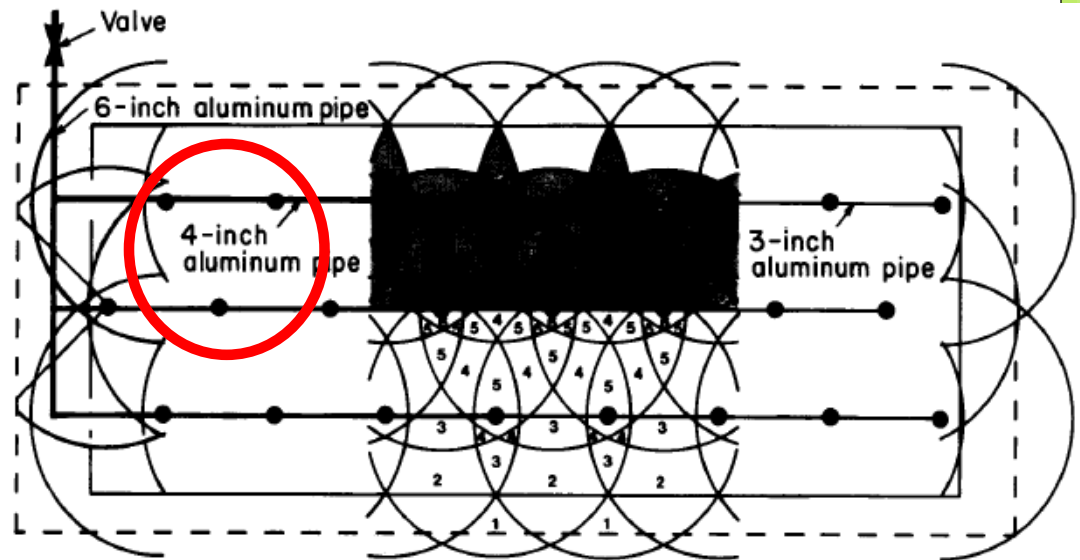
Bareroot irrigation – Oscillating impact head sprinklers

- Disadvantage:
 - Costly to install
 - Water application rates are low
 - Distribution affected by wind
 - Generally bed 5 suffers in a drought (center bed)
 - Pipes in field either permanently or must be removed after each crop
 - Machinery damage to the risers Repair of ruptured lateral lines or damaged risers is slower and more expensive because excavation is required.
 - Sprinkler risers (and heads) tilt unless staked disrupting the uniformity of the irrigation pattern.

2 layouts

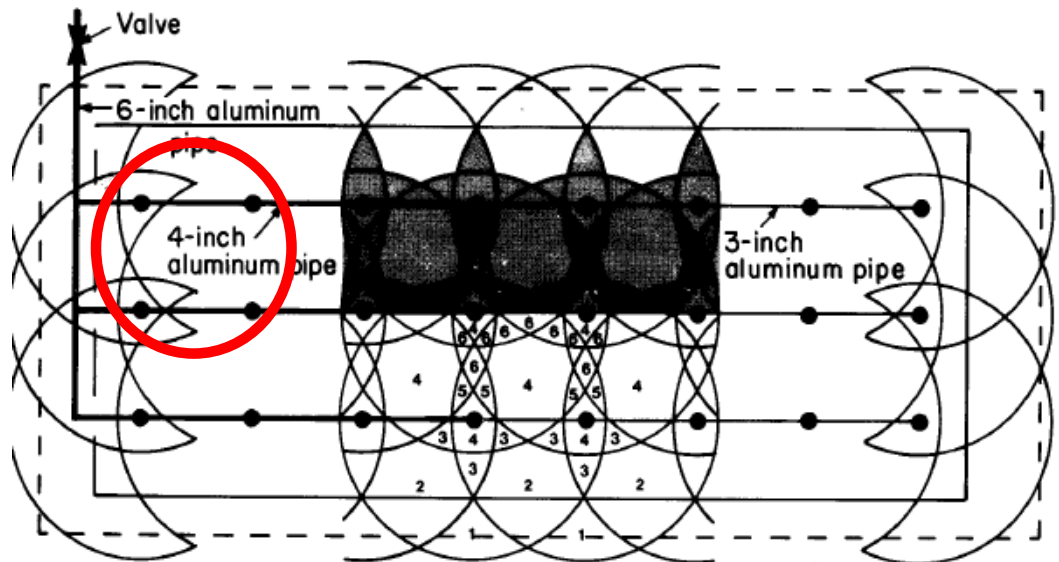
Staggered

1. 20' + 40'
2. 40' + 40'



Square*

1. 40' + 40'
2. 40' + 40'



How long does it take to apply ¼" of irrigation (Impact Head) (BR)?

Nursery#	1/4" time		Nursery#	1/4" time
1	3-20 min cycles		11	2-45 min cycles
2	1 hr		12	2-25 min cycles
3	1 hr		13	94 min
4	1 hr		14	1 hr
5	3-20 min cycles		15	45min
6	1-2 hrs		16	45 min
7	2-20 min cycle		17	1 hr & 20 mins
8	40 min		18	1 hr
9	25 min		19	90 min
10	30 min		20	1 hr

Survey done 8/2015



<http://www.nespal.org/sirp/waterinfo/state/awd/background/images>









Bareroot irrigation – center pivot irrigation

1. Center Pivot Irrigation

● Advantages

- Less costly
- Nozzle/Sprinkler package can be tailored to seedling needs – germination vs mid summer
- Pivot speed is variable to allow for more water
- Water distribution is more uniform (5-10% more)
- Can apply water soluble fertilizers

Bareroot irrigation – center pivot irrigation

1. Center Pivot Irrigation

- Disadvantages

- Layout of nursery beds in circular pattern
- Water distribution in wind
- Quick water – cooling – not possible
- Water while applying hot fertilizers not possible

Tennessee Nursery

TN State Nursery

Jenkins Island

© 2013 Google
Image USDA Farm Service Agency

McClary Dr

Google earth

perimeter Rd

Eye alt 5762 ft

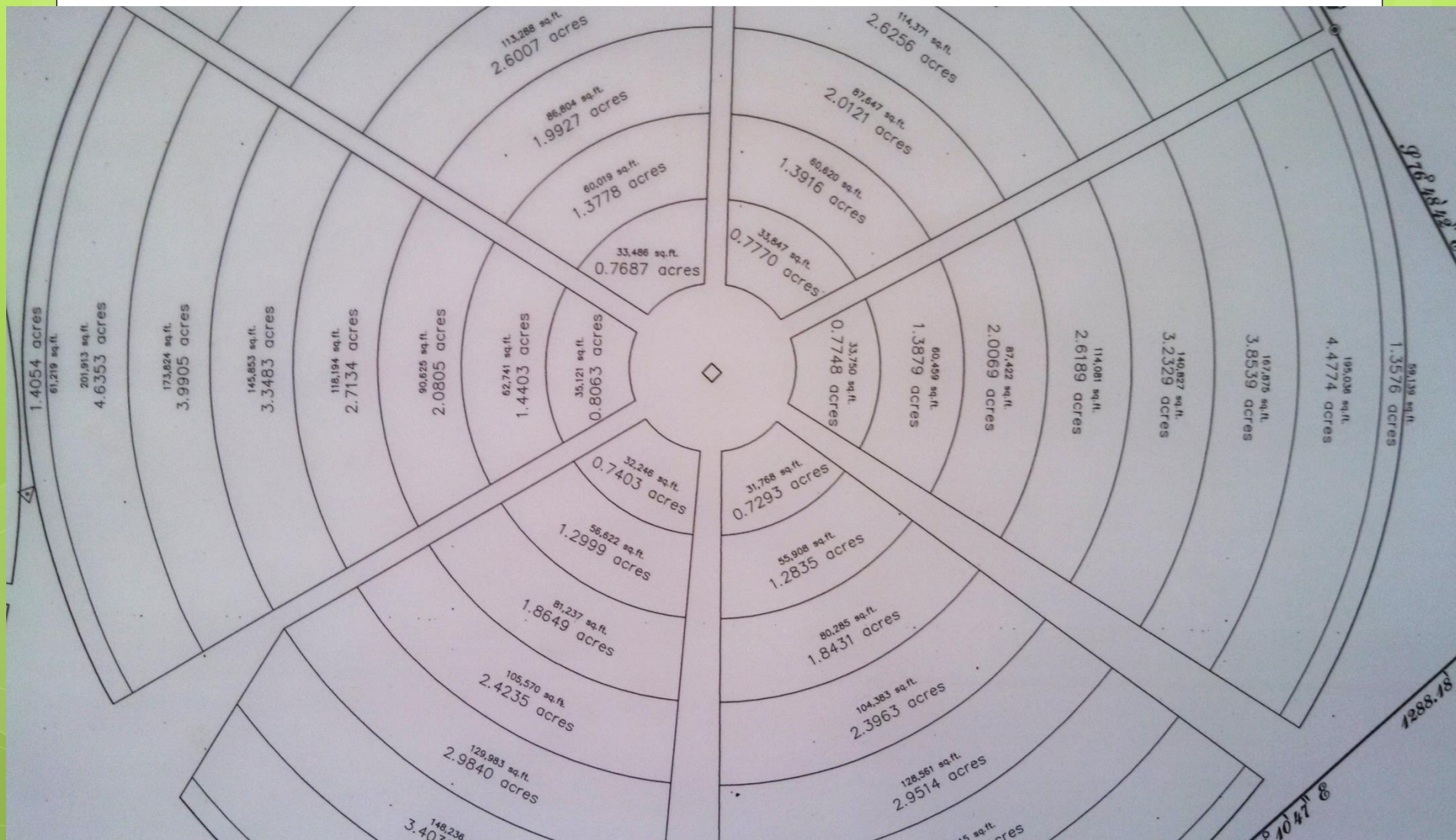
Imagery Date: 4/16/2008

35°14'41.13" N 84°34'22.68" W elev 725 ft

Weyerhaeuser Aiken , SC Nursery



Imagery Date: 12/17/2011 33°32'14.34" N 81°33'04.36" W elev



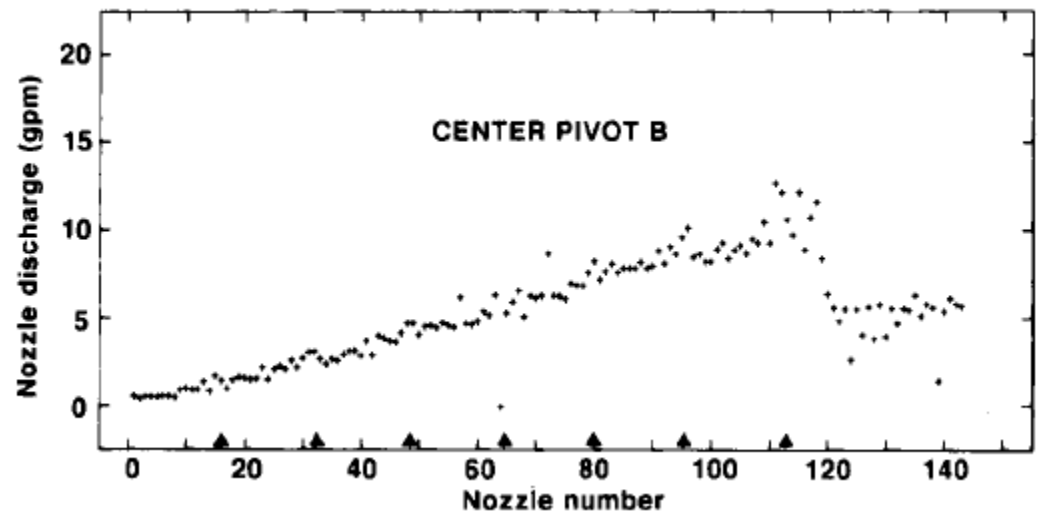
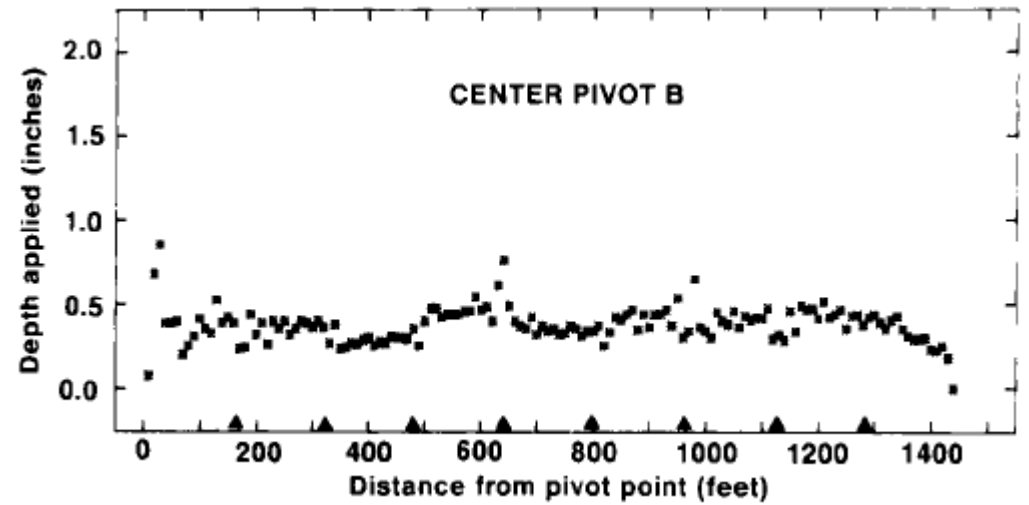
K & L Forest Nursery Buena Vista, GA

14 acres - CP

13 acres – Fixed
(Other location)

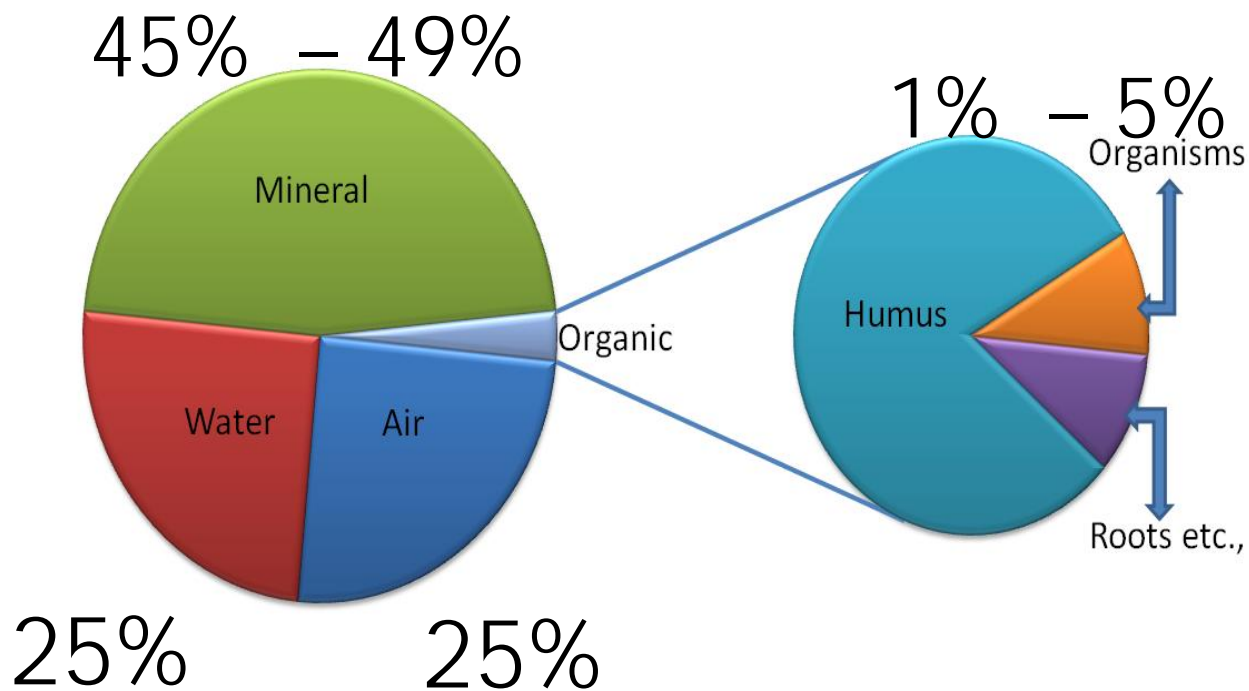


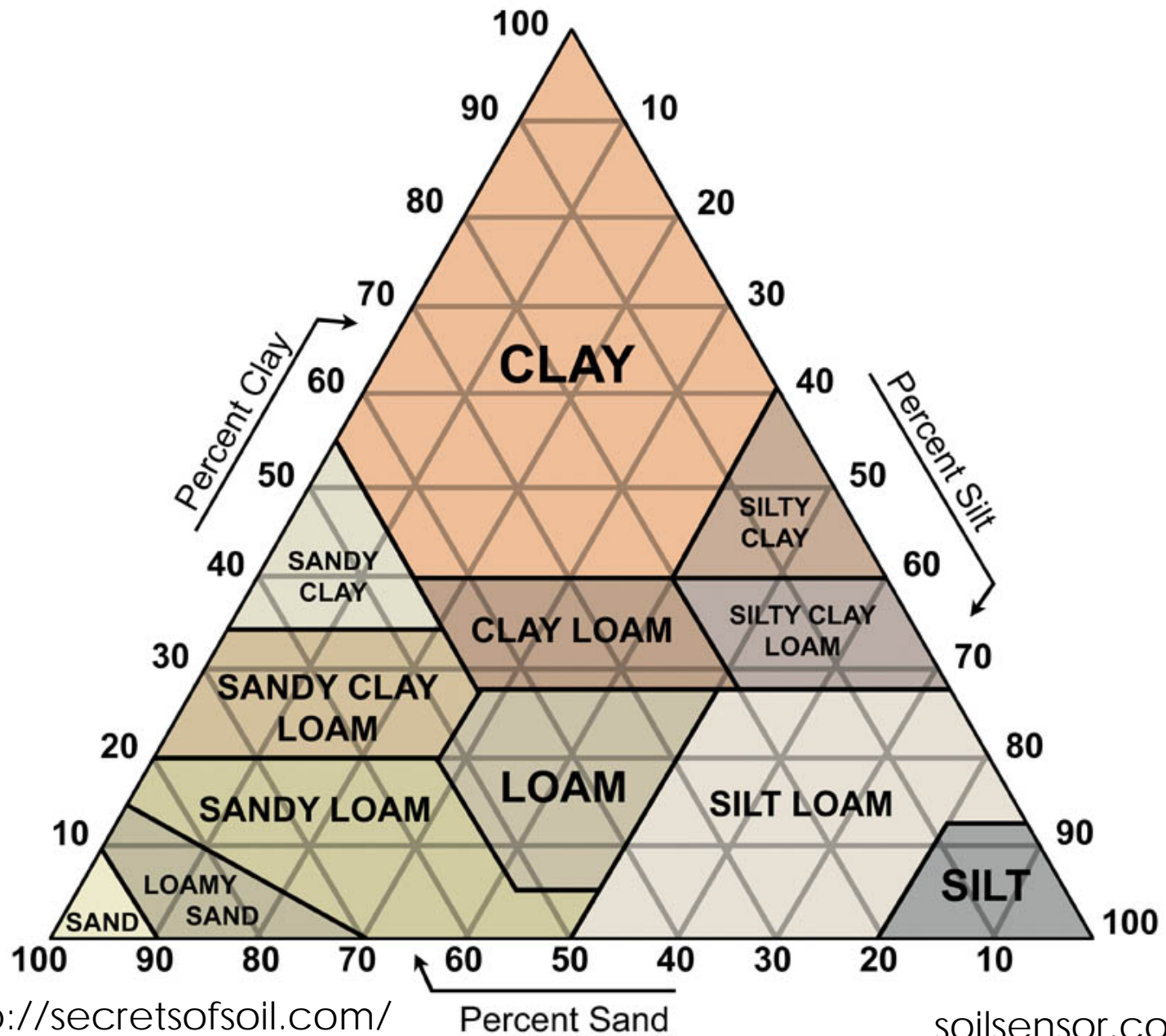
Pivot under construction



Soil composition

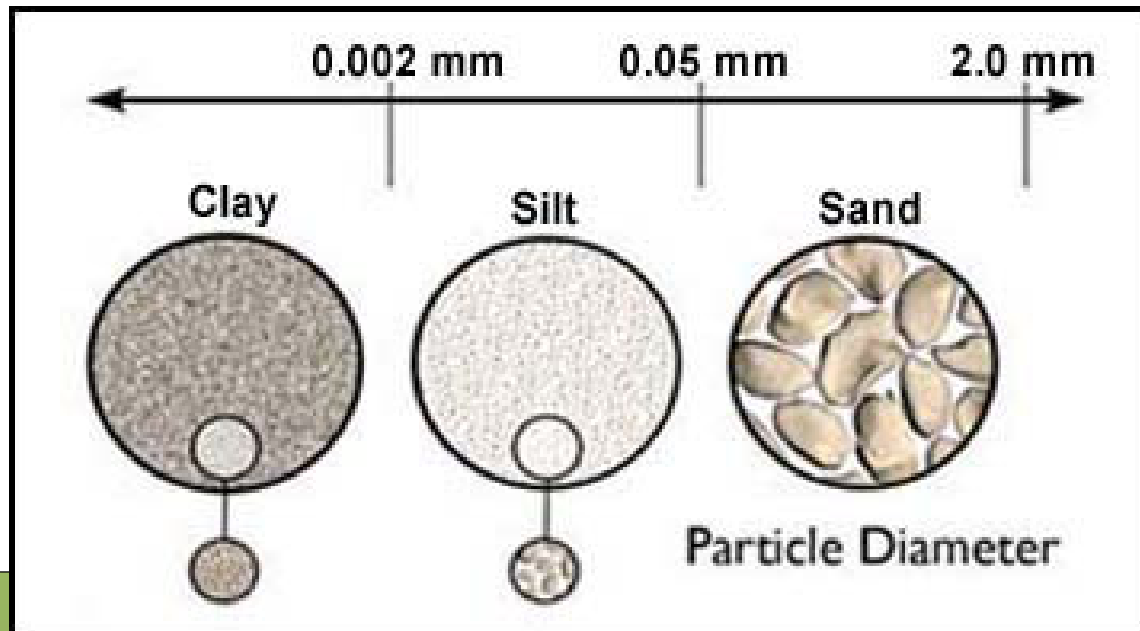
Soil Components





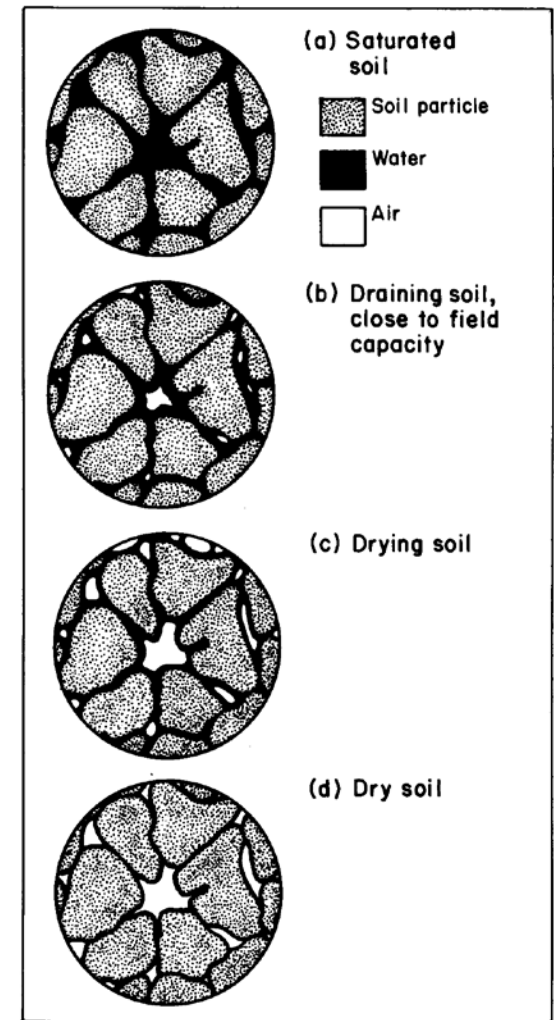
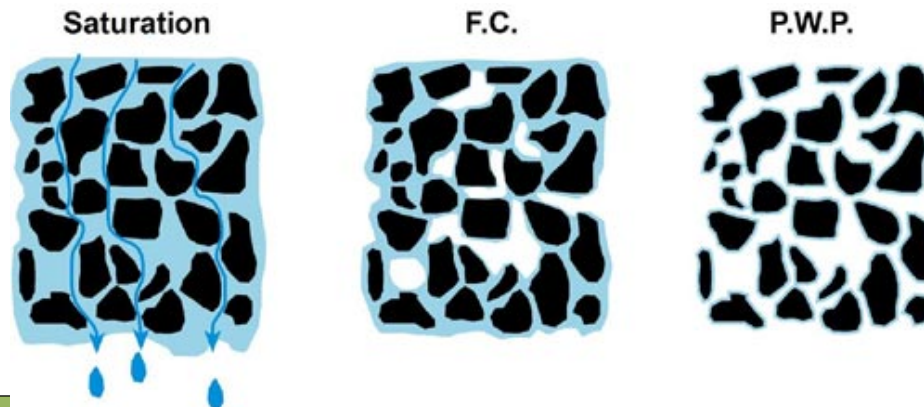
Soil/Water Relationships

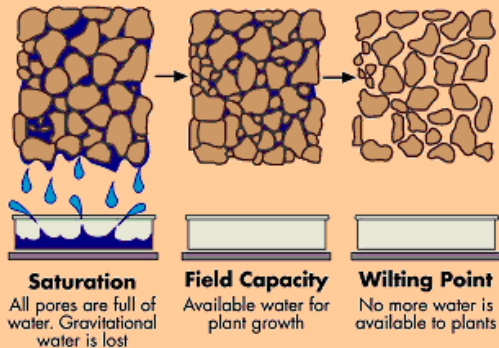
- Movement of water varies by soil texture, time and amount of water
- Coarse textured soils - large pores, few in number
- Fine textured soils – small pores, numerous pores



Soil Moisture Classification

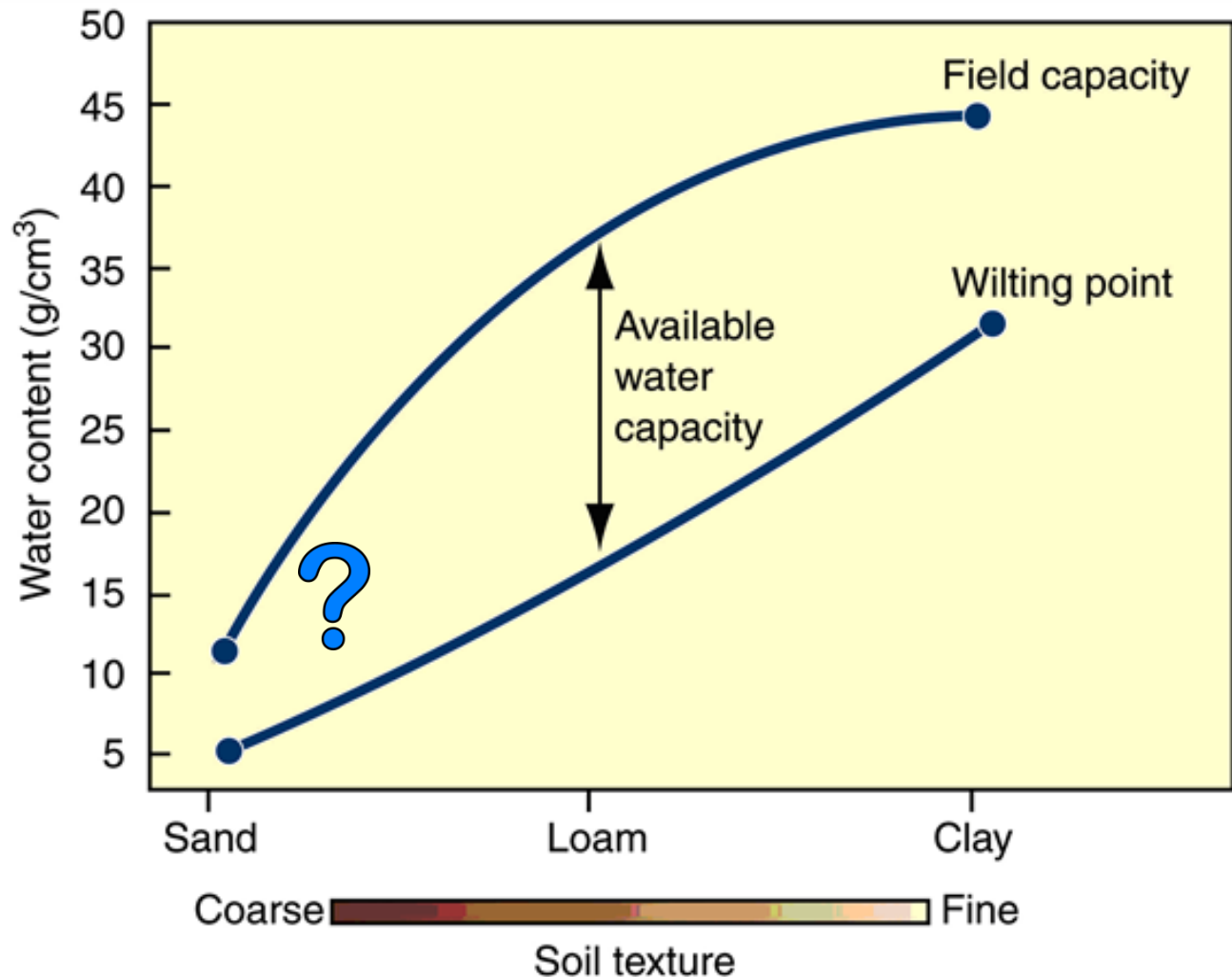
- Saturation – all pores filled with water
- Field Capacity (F.C.) – all gravitational water has drained
- Permanent Wilting Point (P.W.P.) – minimum soil moisture at which plants wilt and cannot recover



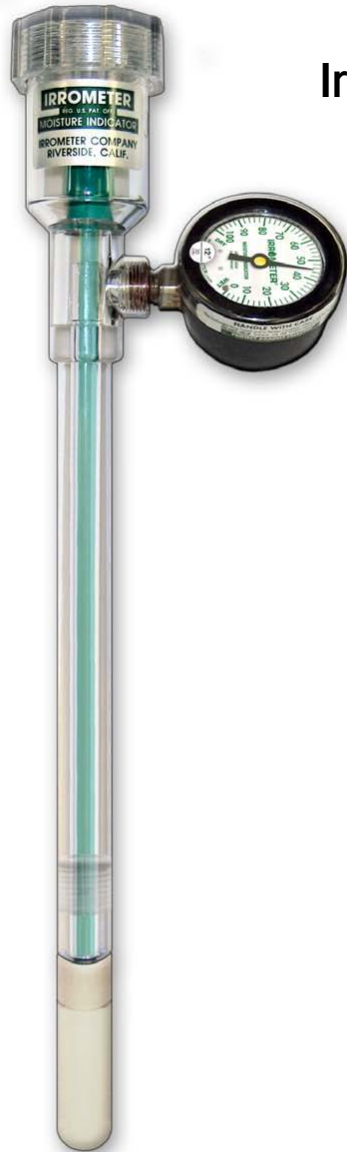


How do I know when to irrigate?

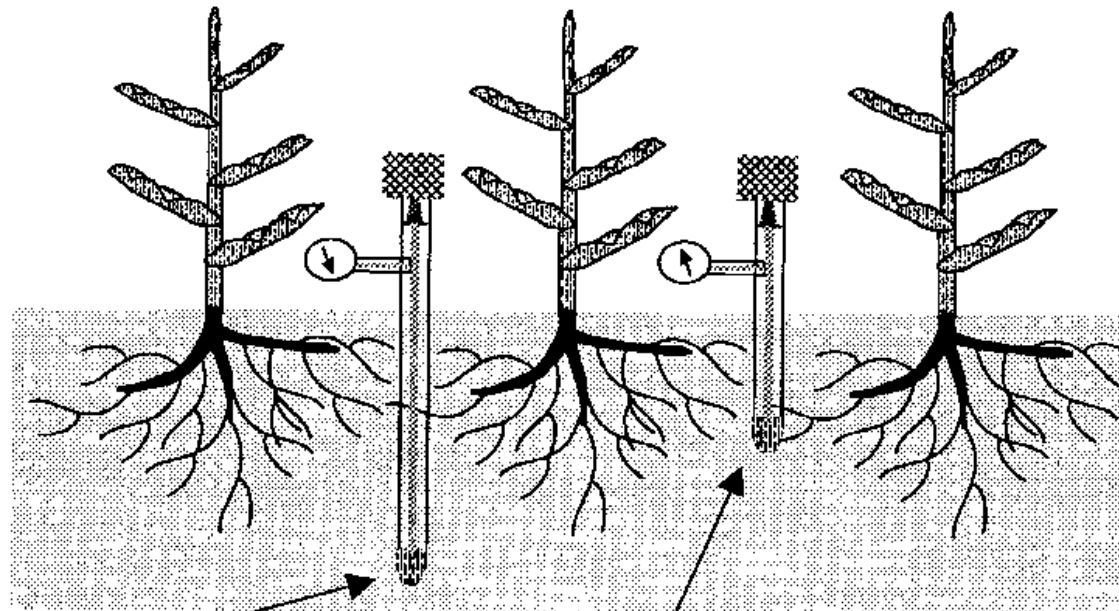
1. Touch & Feel
2. Tensiometers or electronic monitoring
3. Container weight



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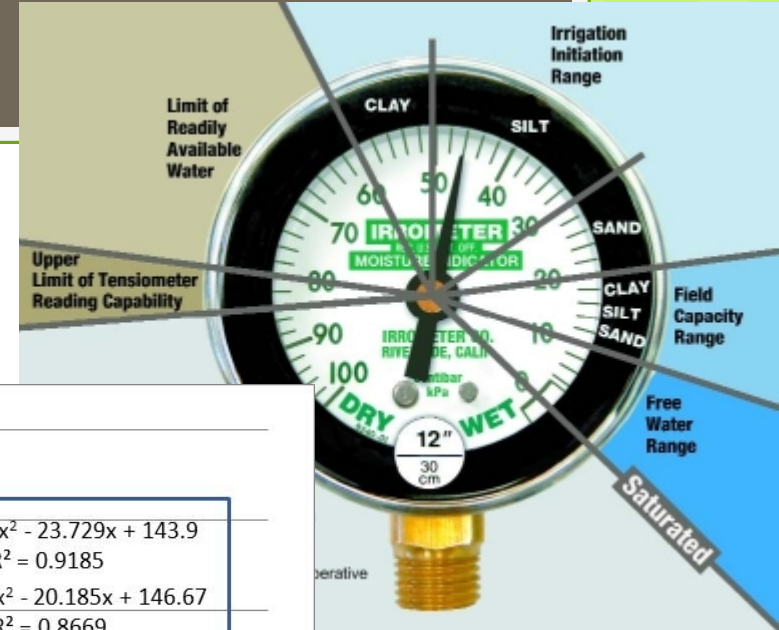
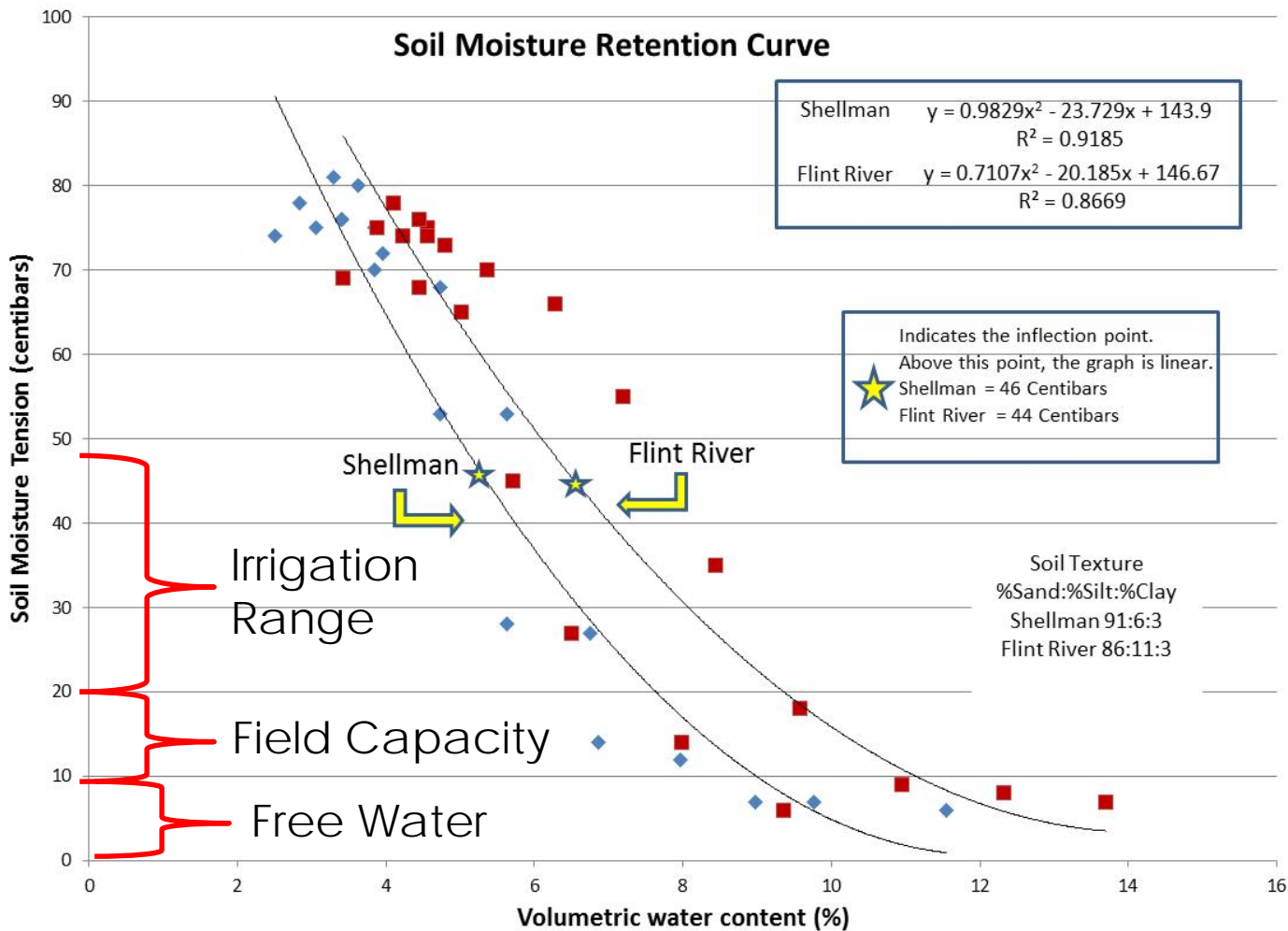


Irrometer Tensiometer
\$78 - \$81



DEEP TENSIO METER
Installed at Base of Root Zone
When Tension Reading Decreases
(Smaller Value) Irrigation Should Stop

SHALLOW TENSIO METER
Installed at Center of Root Zone
Indicates When Soil Is Dry
Irrigation Should Start



Has not been tested by
Nursery Cooperative



**WATERMARK Soil Moisture
Sensor — MODEL 200SS
\$30**

**Designed to be a permanent
sensor, placed in the soil to be
monitored and “read” as often
as necessary with a portable
or stationary device.**

OPERATING PRINCIPLE: The WATERMARK sensor is a resistive device that responds to changes in soil moisture. Once planted in the soil, it exchanges water with the surrounding soil thus staying in equilibrium with it. Soil water is an electrical conductor thereby providing a relative indication of the soil moisture status. As the soil dries, water is removed from the sensor and the resistance measurement increases. Conversely, when the soil is rewetted, the resistance lowers.



WATERMARK Digital Meter
~\$250

Why Irrigate and time of day to irrigate?

- 2 reasons to irrigate
 1. Growth - For nutrient and water uptake
 2. To cool down seedlings in summer heat
- When is the most efficient time to irrigate?
 - Advantage
 - Disadvantage

Irrigation is needed for....

- How irrigation is used in a nursery:
 1. Germination
 2. Growth
 3. Hardening
 4. Cooling of seedlings

Irrigation for Germination

- Why it is critical?
 - Too little or too much – germination failure
 - **Continuation of what was started with seed stratification**
- How Much?
 - Small (0.5" per wk), but frequent irrigations be applied to maintain adequate soil moisture
 - Prevents seed from drying out
- Complete?
 - When the taproot is approximately 4-5" or when the seedling has produced enough needle area to photosynthesize its own food.

Irrigation for Seedling Growth

- Commonly called the true growth stage
- Sufficient water is required to maintain cell turgidity and promote cell growth
- 1" per week general rule. Sandy soils should be irrigated with 0.5 inches every 2 to 3 days. Finer textured soils need to be irrigated less frequently, but with more water
- Amounts of irrigation should increase over time to cover the entire depth of root penetration
- The effects of water stress are the most common causes of reduced plant growth

Irrigation to Harden Seedlings

- Final stage of seedling growth in the nursery bed is "hardening-off"
- Excess irrigation later in the growing season can result in continued new growth
- It is necessary to reduce or withhold irrigation to induce moisture stress conditions at the end of the desired growth period.
- Seedlings that have previously been mildly water-stressed, may suffer less injury from outplanting and drought

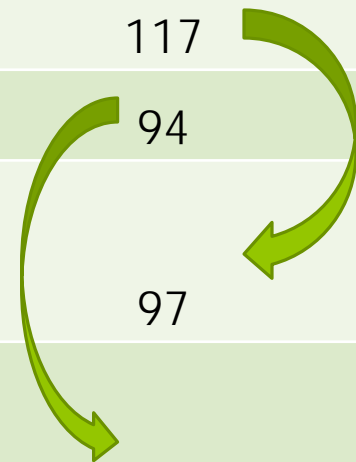
Irrigation to Cool Seedlings

- Most critical time – first few weeks following germination (April/May)
- Seedlings suffer excessive transpiration losses. They lose more water than they can take up
- The damage often occurs above the soil line where the tender cortical stem tissue is located.
- It manifests as a depressed area of necrotic tissue called a "heat lesion". Older seedlings are less susceptible to heat stress. Heat lesions may still occur, but the lignified stem provides insulation for the sensitive tissues.

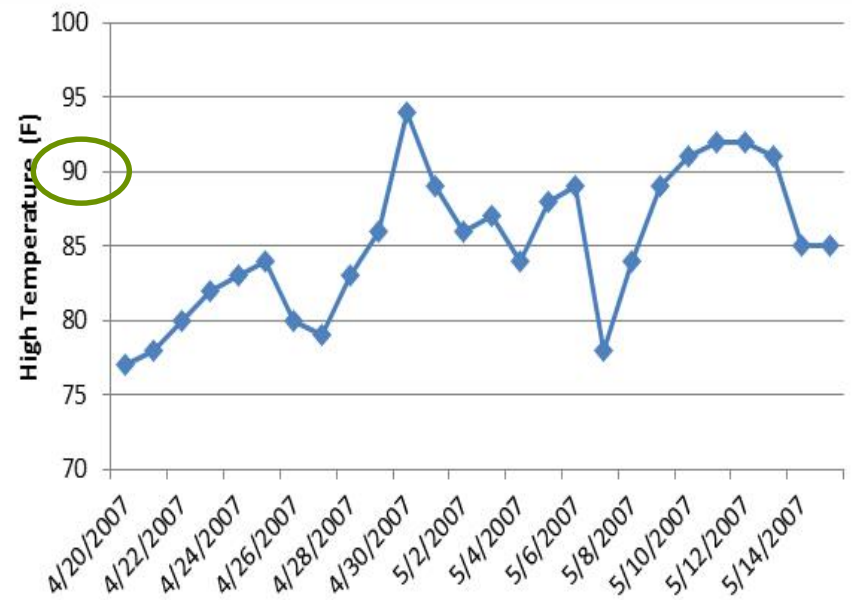
Irrigation to Cool Seedlings

- The killing temperature for the stem is about 104 F
- Most nurseries begin about 94F
- Irrigation can be applied in order to keep the stem below this critical temperature. Watering during the heat of the day can bring surface soil temperatures down 20°F and air temperatures down 10-15° F.
- Frequent, short irrigations are very effective to cool the soil surface

Nursery	Date	Time	Location	Bed Temperatures °F
A	22-Jun	1:30 PM	No shade	104
			Shade between drills	90
	22-Jun	3:30 PM	No shade	110
			Shade between drills	100
	22-Jun	3:30 PM	No shade	120
B	9-Aug	11:30 AM	No shade	117
			Shade between drills	94
	9-Aug	11:45 AM	No Shade following irrigation	97
			Shade between drills following irrigation	82



May 2007



May 2007



