Nursery Irrigation

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September 2018

Southern Container Nurseries

- Fixed Irrigation System;
  - Oscillating impact head irrigation
  - Pop-up sprinklers

- Moving Irrigation System
  - Center Pivot Irrigation
  - Horizontal Boom Irrigation


Stainless Steel Falcon

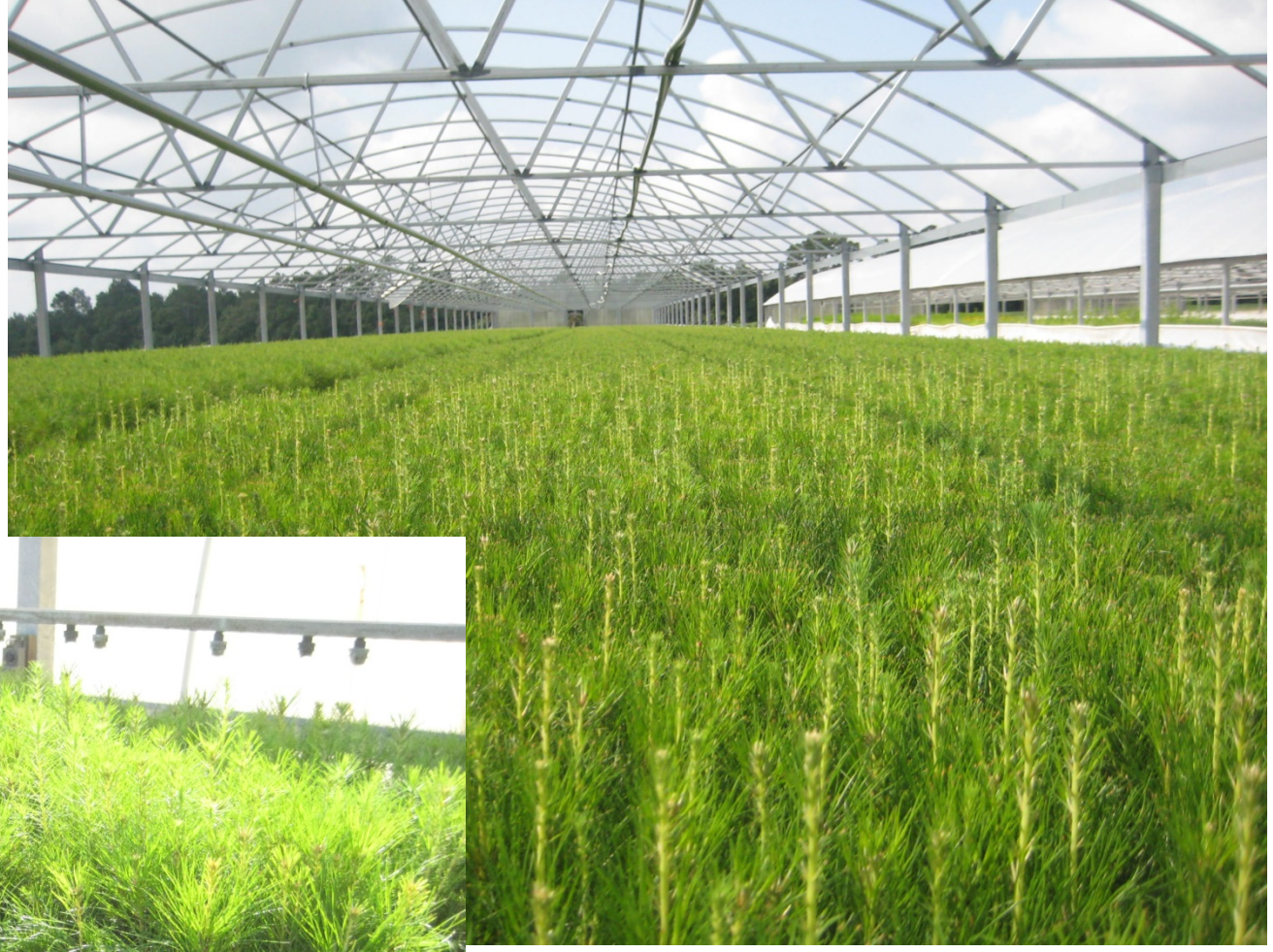
International Forest Company
Moultrie, GA

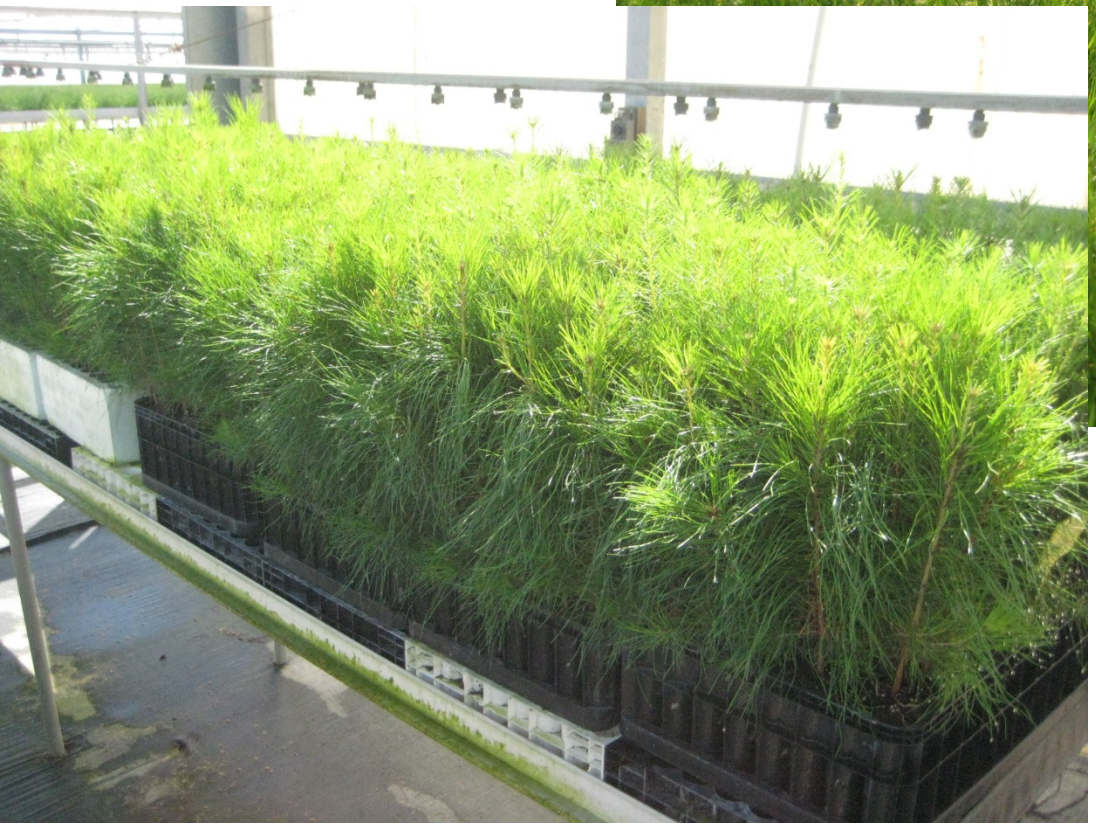
14 center pivots

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

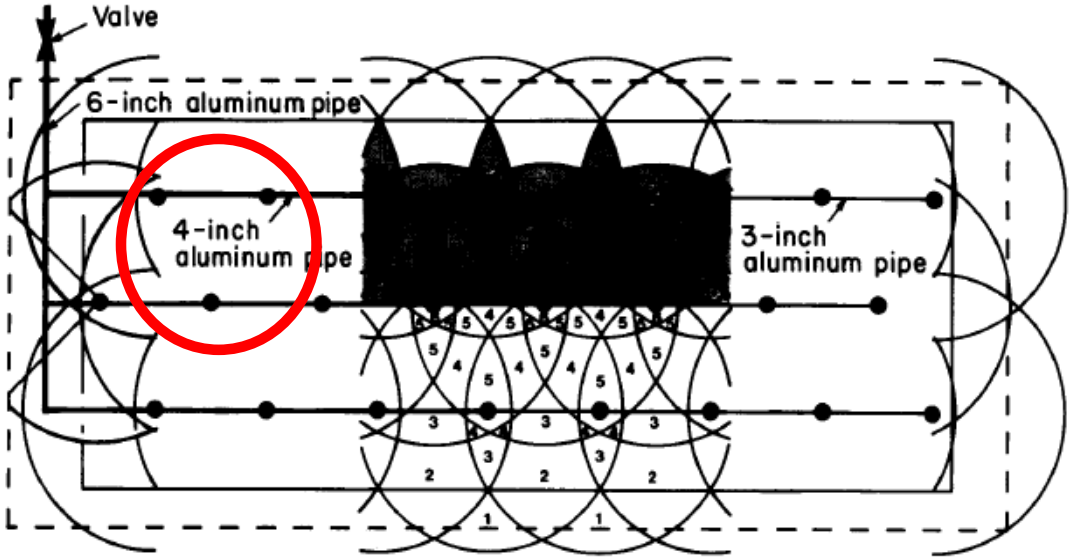
  – Advantages:
    - Amount of water can be calibrated to soil conditions and nursery layout
    - Nozzles/orifice can be changed

Bareroot irrigation – Oscillating impact head sprinklers

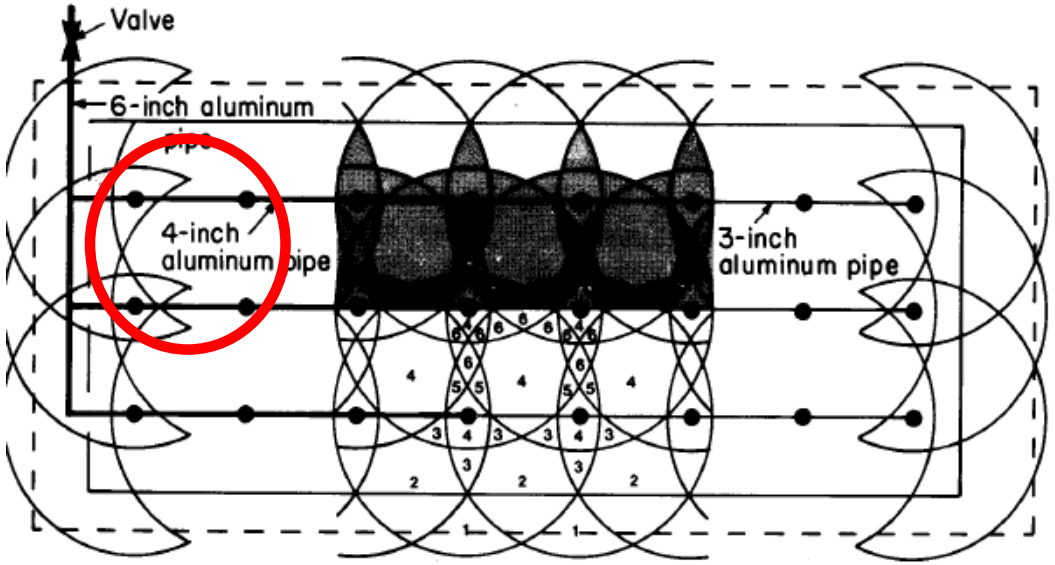
- Disadvantage:
  - Costly to install
  - Water application rates are low
  - Distribution affected by wind
  - Pipes in field either permanently or must be removed after each crop
  - Machinery damage to the risers Repair of ruptured lateral lines or damaged risers is slower and more expensive because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

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 varible to allow for more/less water
     - Water distribution is more uniform (5-10% more)
     - Can apply water soluble fertilizers much easier

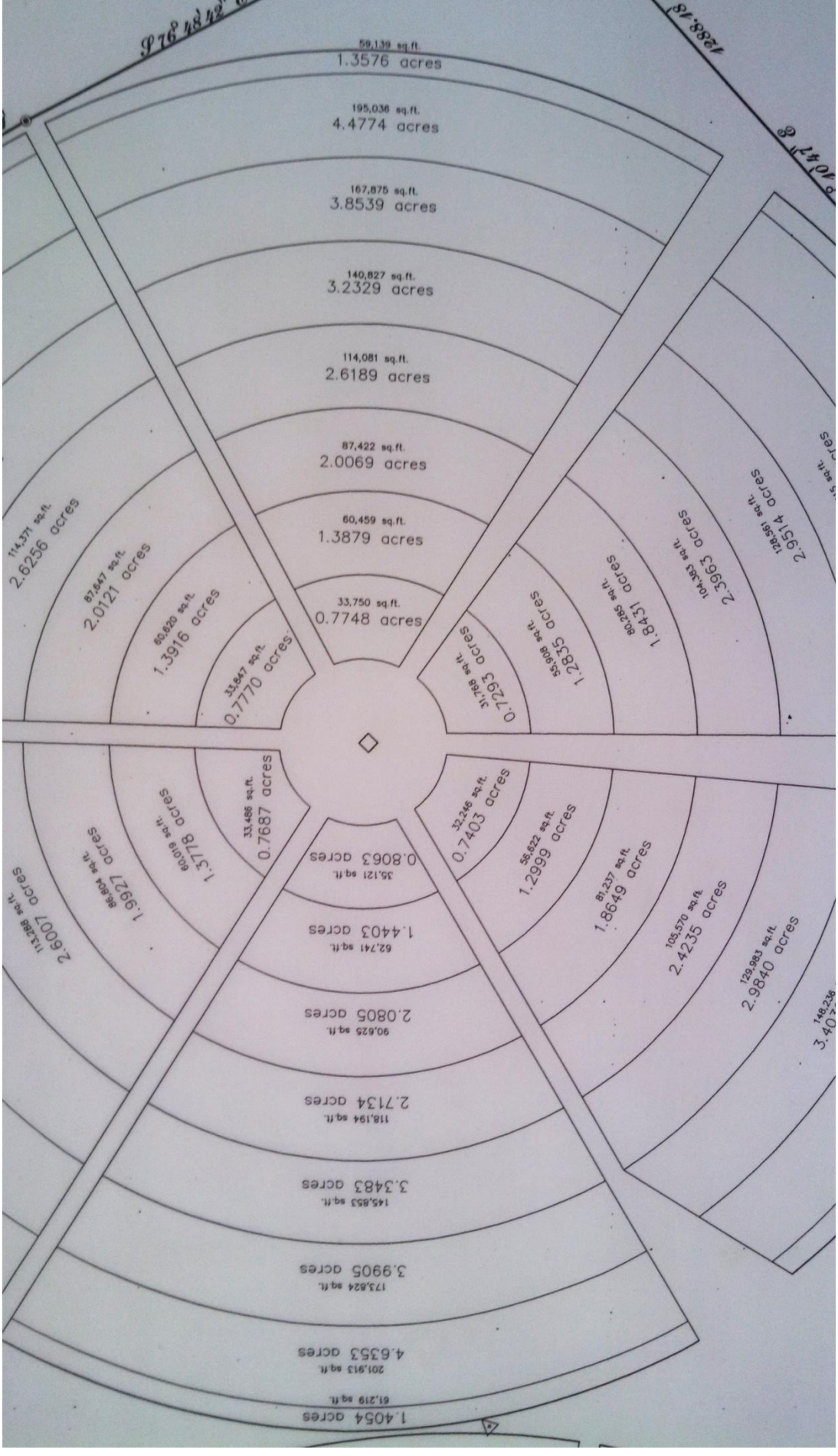
Bareroot irrigation – center pivot irrigation

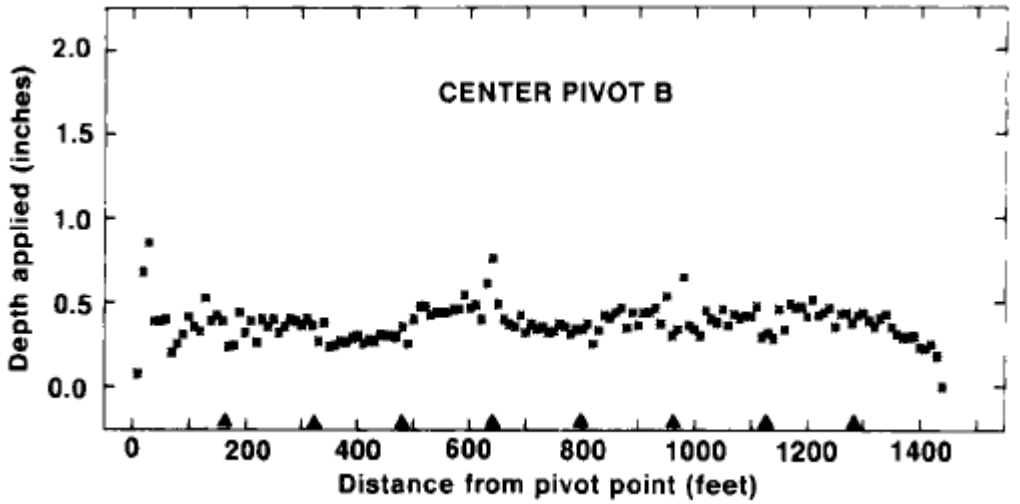
1. Center Pivot Irrigation
   - Disadvantages
     - Layout of nursery beds in circular pattern
     - Water distribution in wind
     - Quick water – cooling – not possible
     - Water while applying hot fertilizers not possible

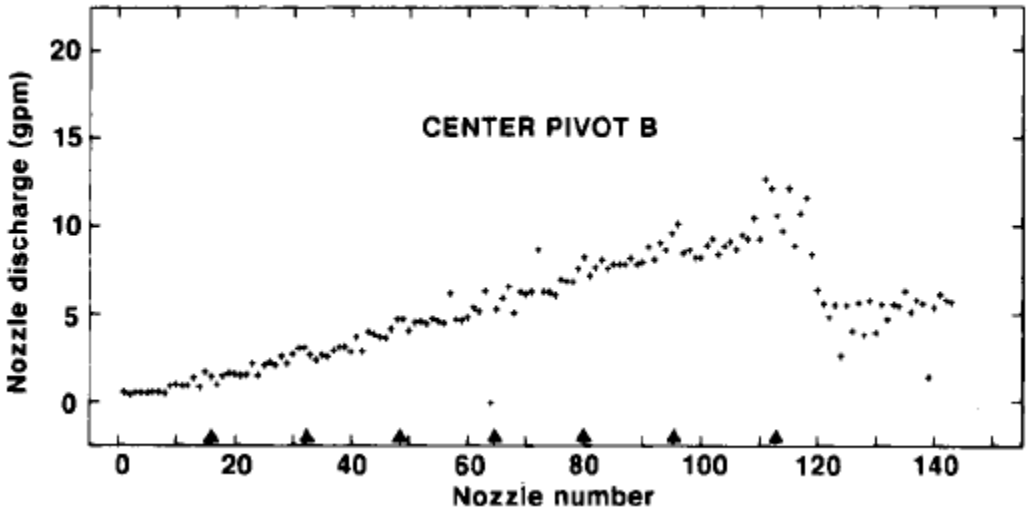
Tennessee Nursery

K&L Nursery
Buena Vista, GA

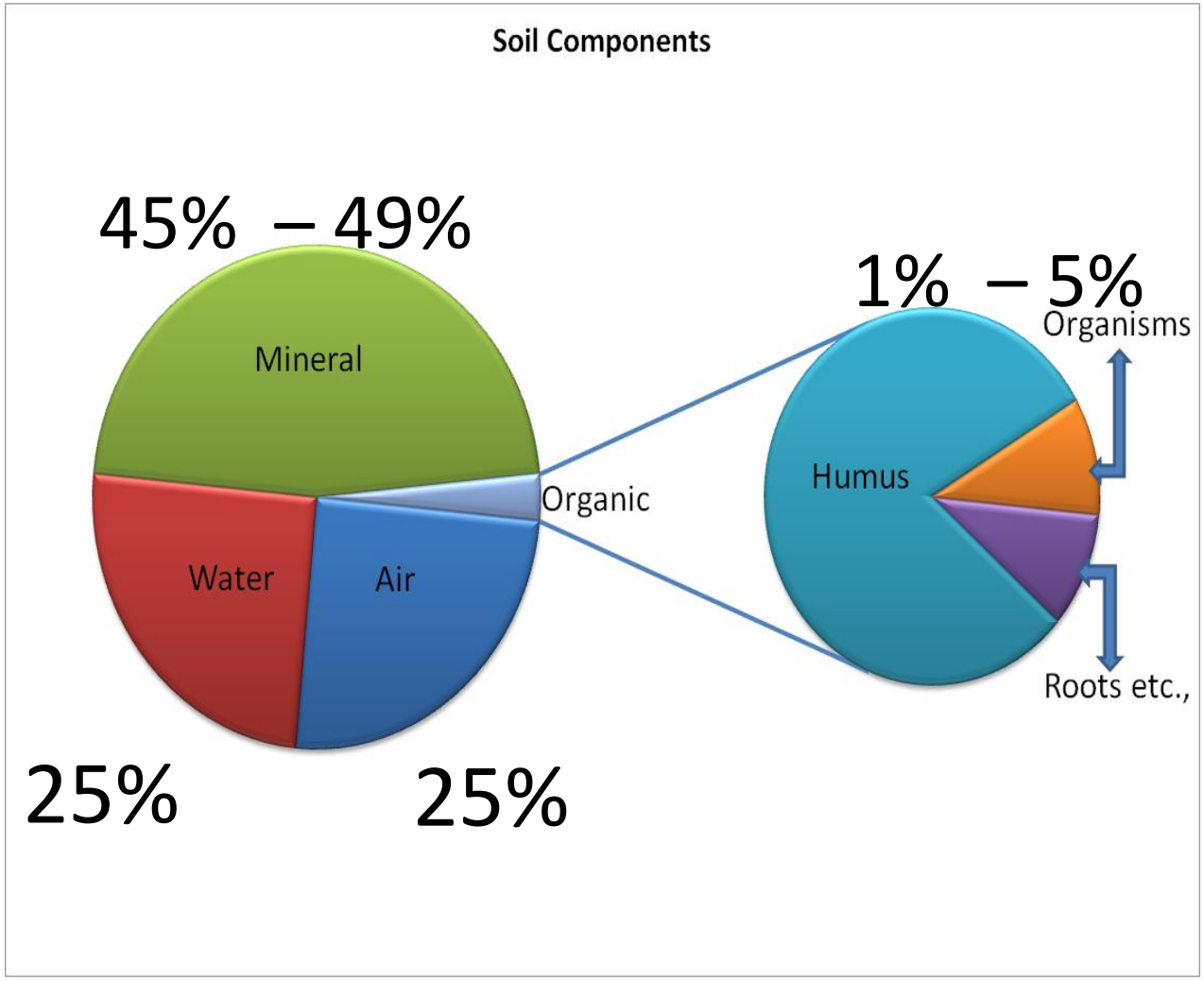
Weyerhaeuser Aiken , SC Nursery

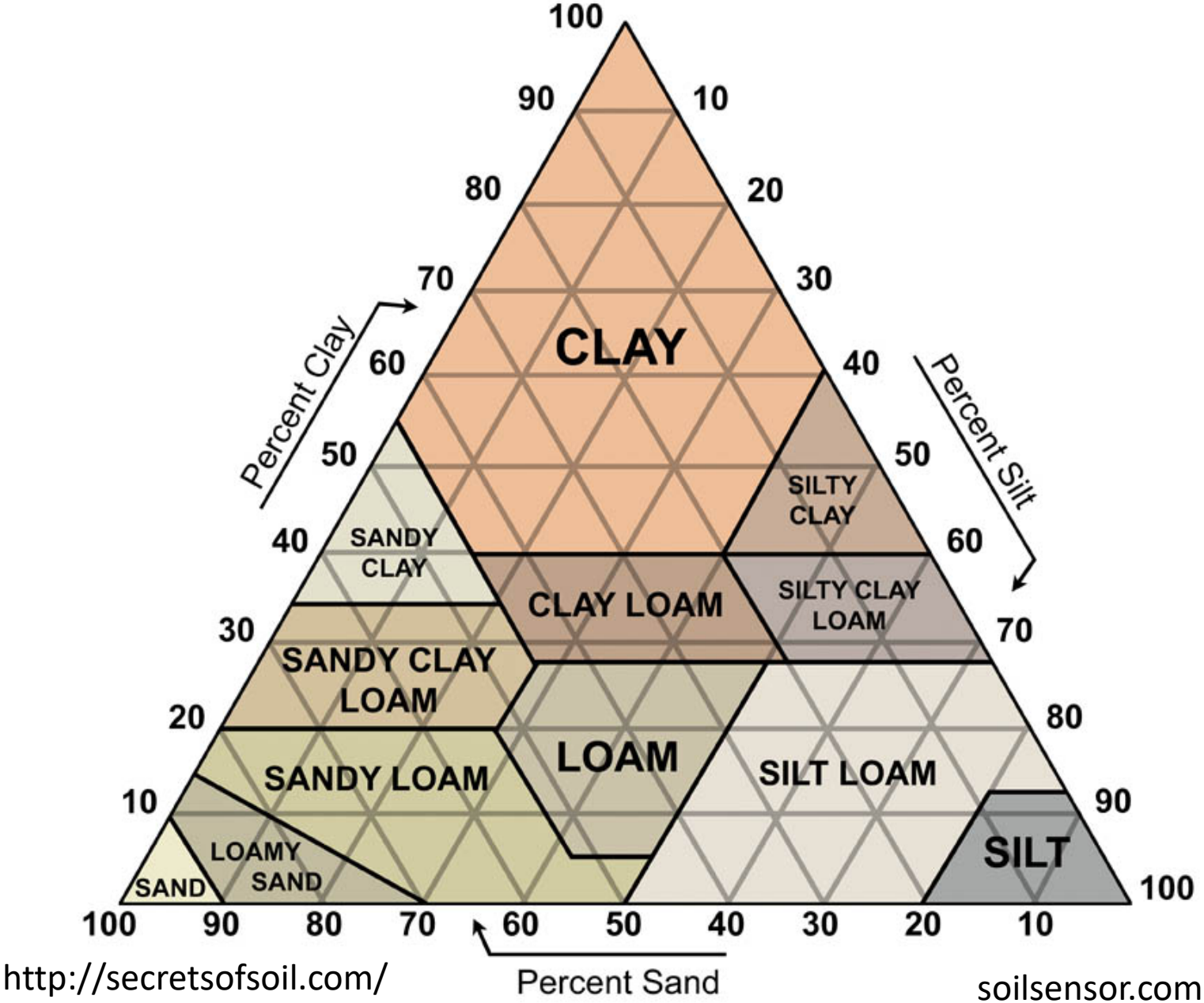

59,139 sq.ft.
1.3576 acres
195,036 sq.ft.
4.4774 acres
167,875 sq.ft.
3.8539 acres
140,827 sq.ft.
3.2329 acres
114,081 sq.ft.
2.6189 acres
87,422 sq.ft.
2.0069 acres
60,459 sq.ft.
1.3879 acres
33,750 sq.ft.
0.7748 acres
114,371 sq.ft.
2.6256 acres
87,647 sq.ft.
2.0121 acres
60,820 sq.ft.
1.3916 acres
33,847 sq.ft.
0.7770 acres
31,768 sq.ft.
0.7293 acres
53,908 sq.ft.
1.2375 acres
80,285 sq.ft.
1.8431 acres
104,383 sq.ft.
2.3963 acres
128,581 sq.ft.
2.9514 acres
33,486 sq.ft.
0.7687 acres
60,019 sq.ft.
1.3778 acres
86,804 sq.ft.
1.9927 acres
113,288 sq.ft.
2.6007 acres
32,246 sq.ft.
0.7403 acres
56,822 sq.ft.
1.2999 acres
81,237 sq.ft.
1.8649 acres
105,570 sq.ft.
2.4235 acres
129,983 sq.ft.
2.9840 acres
35,121 sq.ft.
0.8063 acres
62,741 sq.ft.
1.4403 acres
90,625 sq.ft.
2.0805 acres
118,194 sq.ft.
2.7134 acres
145,853 sq.ft.
3.3483 acres
173,824 sq.ft.
3.9905 acres
201,913 sq.ft.
4.6353 acres
61,219 sq.ft.
1.4054 acres


CENTER PIVOT B
Depth applied (inches)
2.0
1.5
1.0
0.5
0.0
0
200
400
600
800
1000
1200
1400
Distance from pivot point (feet)


CENTER PIVOT B
Nozzle discharge (gpm)
20
15
10
5
0
0
20
40
60
80
100
120
140
Nozzle number

Soil composition



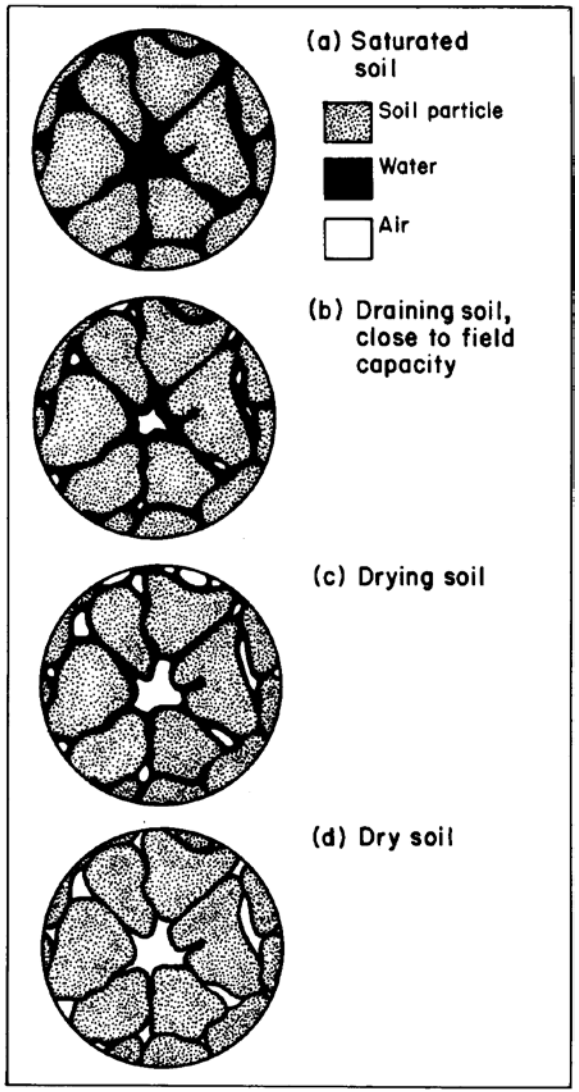


http://secretsofsoil.com/

soilsensor.com

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



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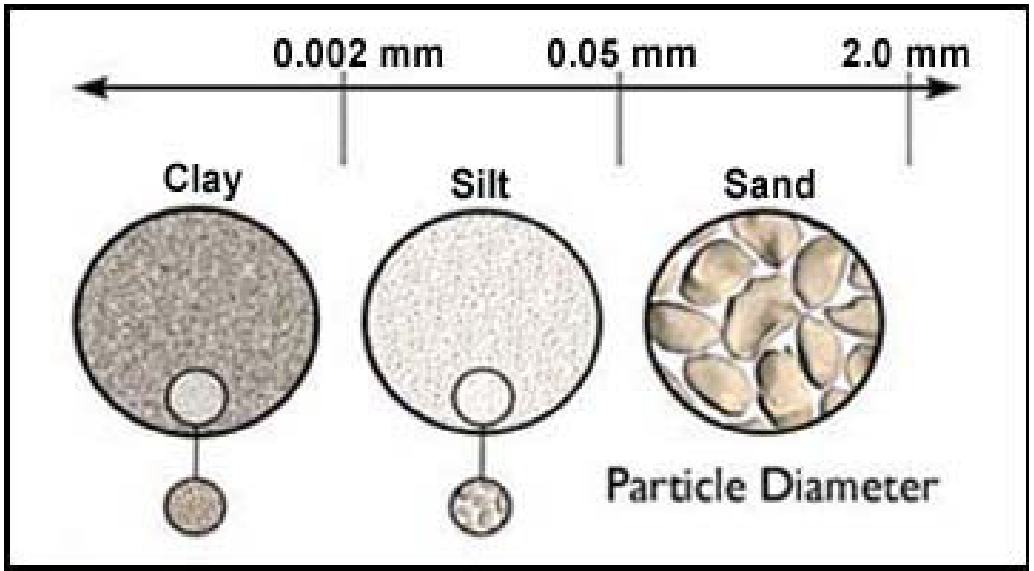
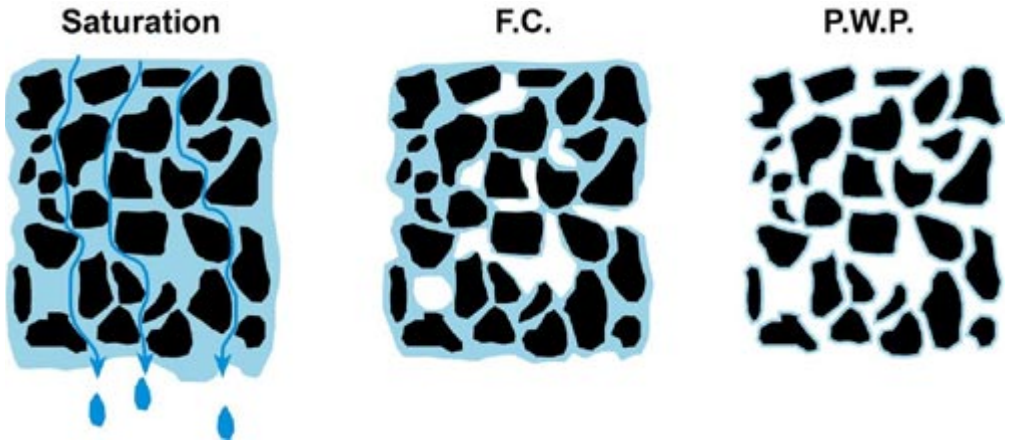
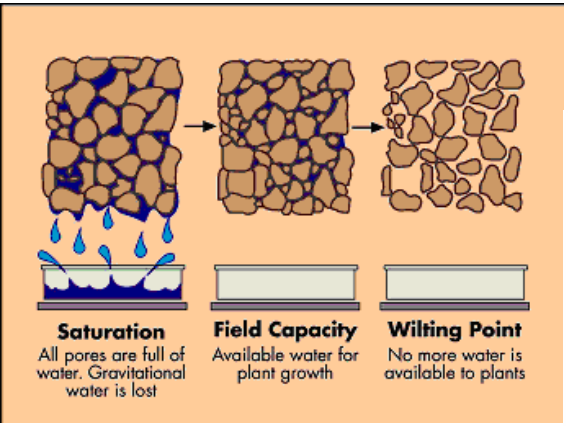
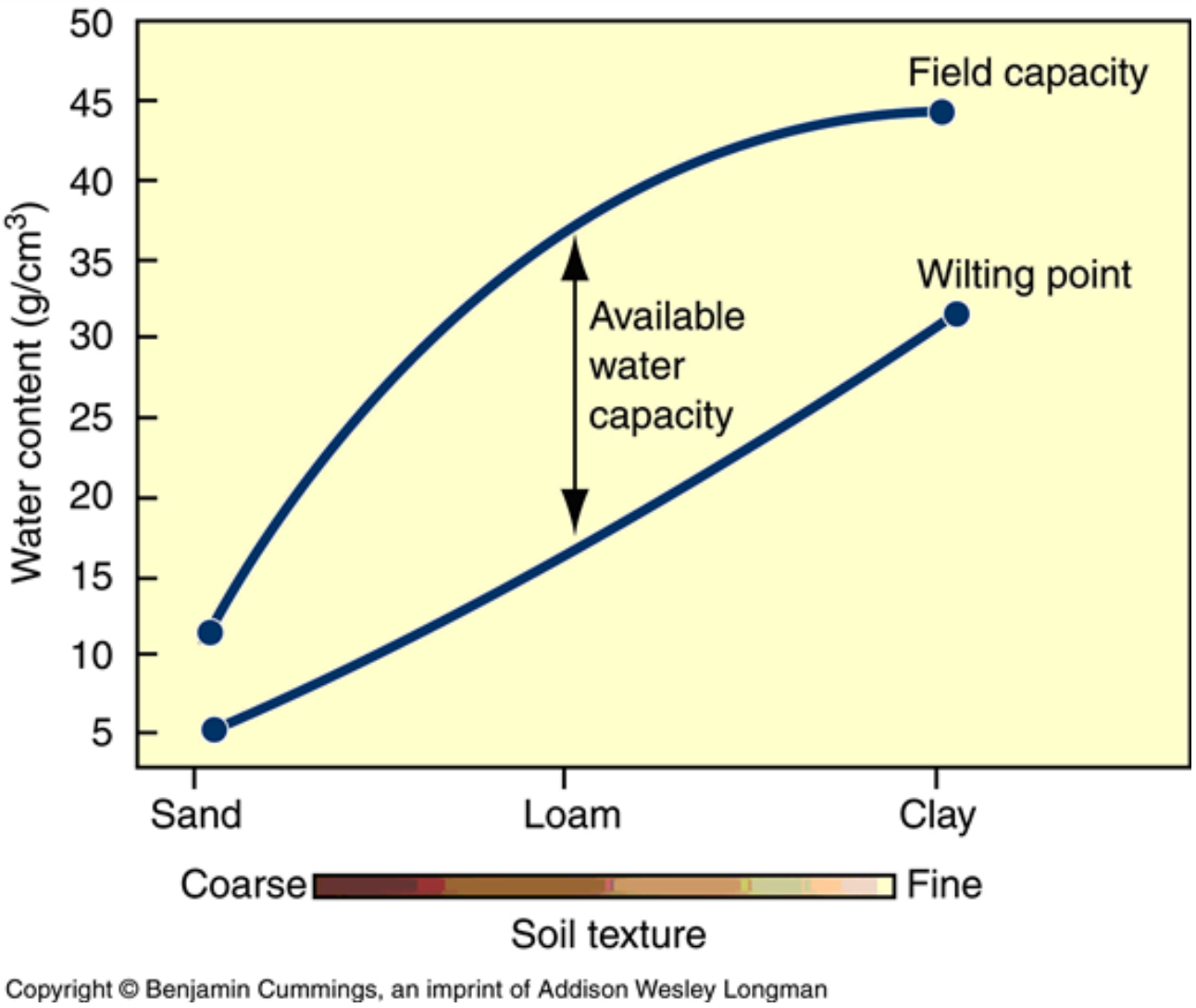


Soil Moisture Classification

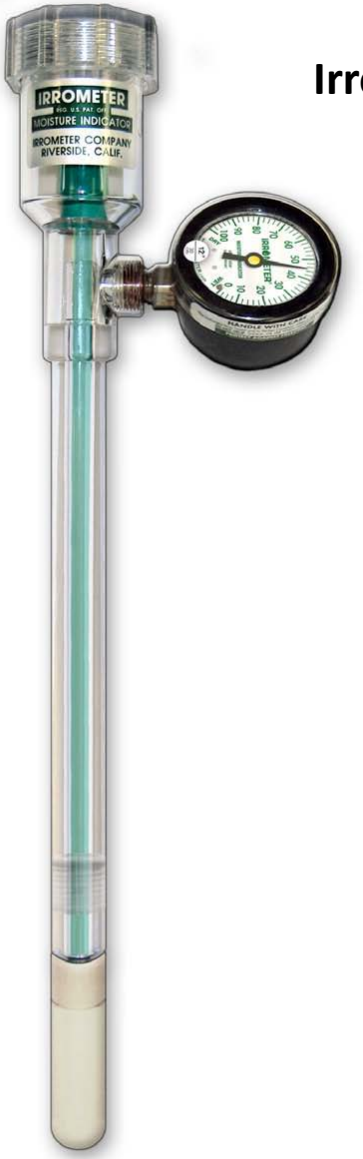
- Saturation – all pores filled with water
- Field Capacity (F.C.) – al gravitational water has drained
- Permanent Wilting Point (P.W.P.) – minimum soil moisture at which plants wilt and cannot recover



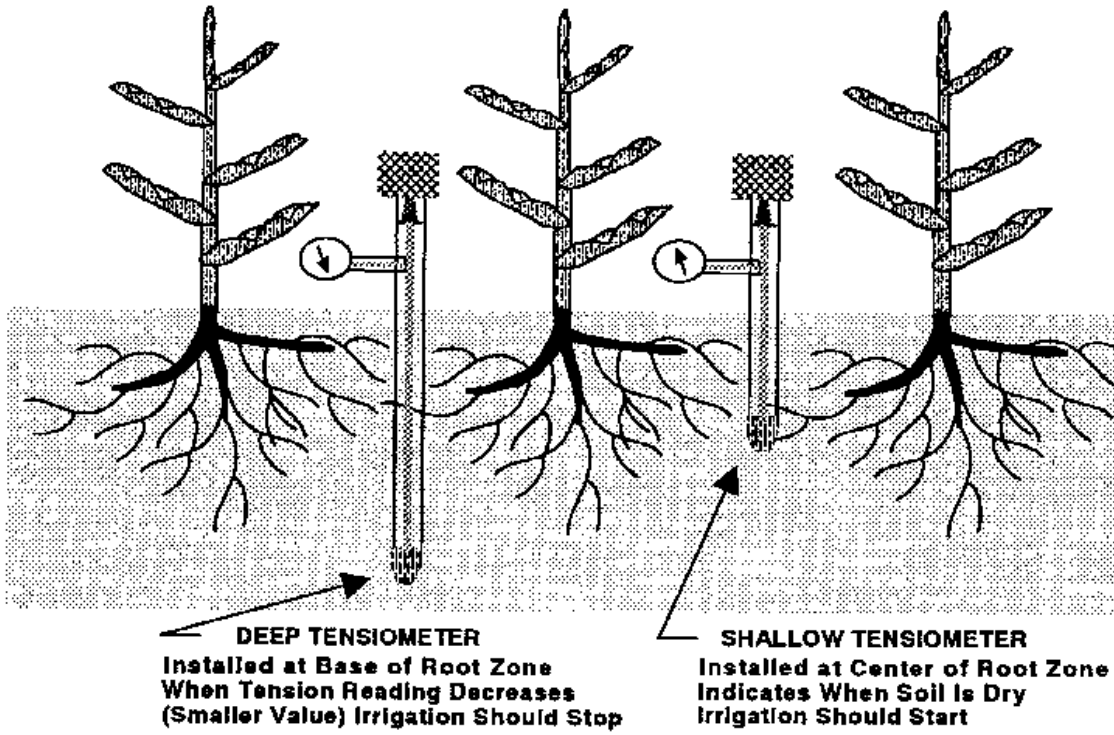


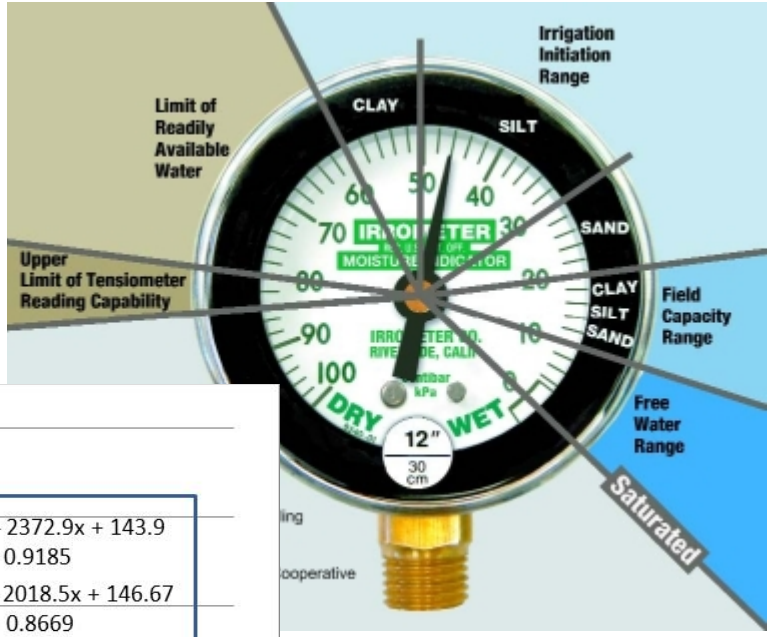


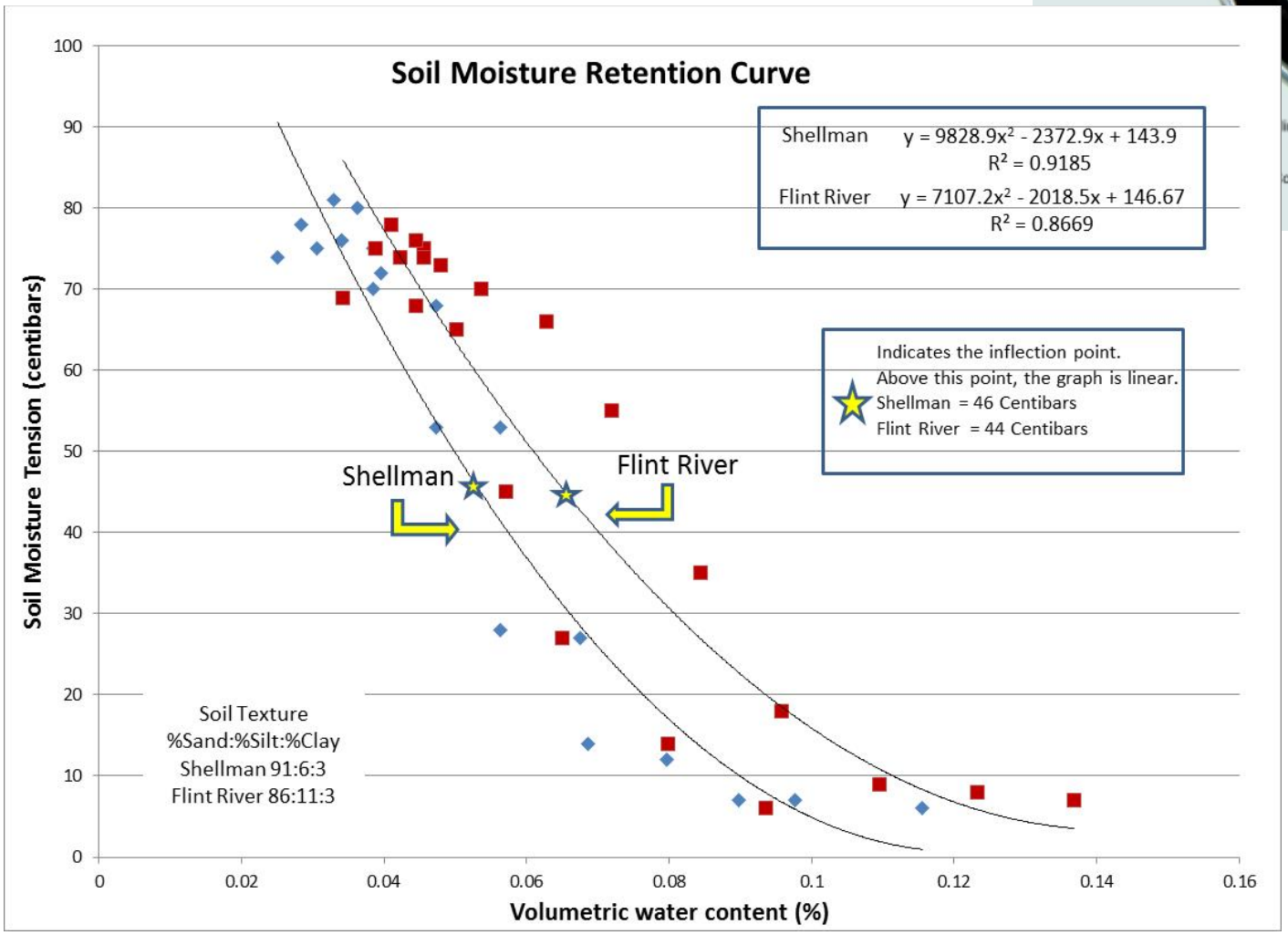
http://www.tankonyvtar.hu/



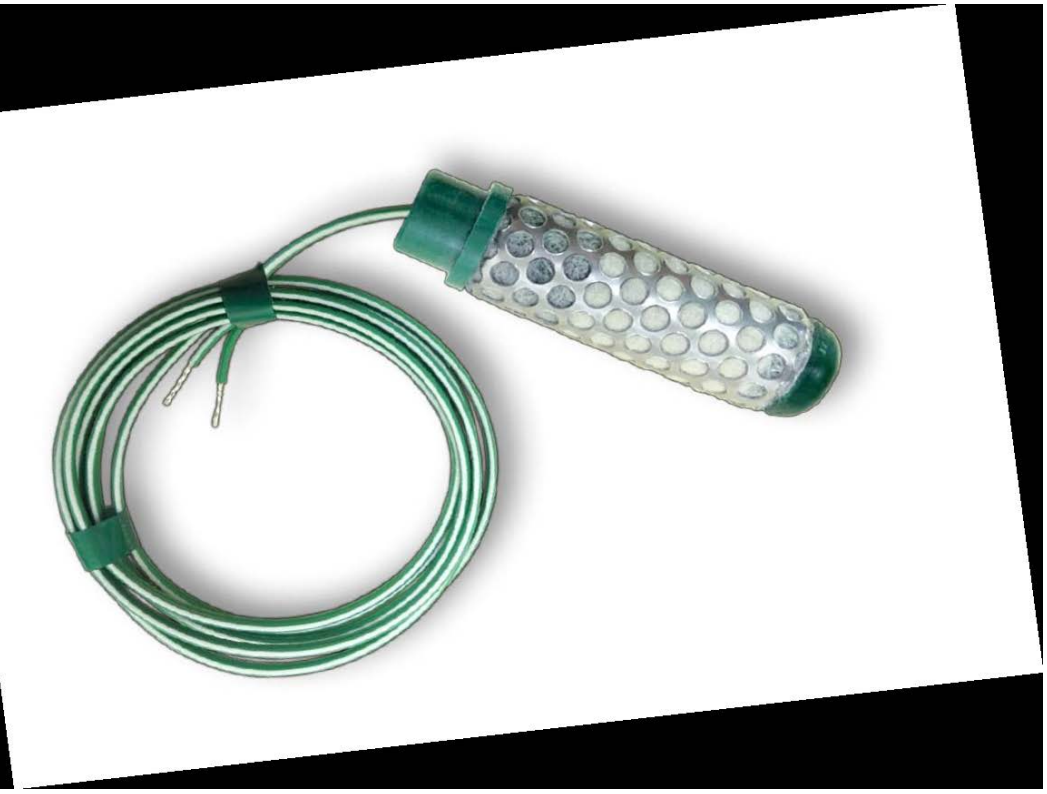
Irrometer Tensiometer
$78 - $81




Irrigation Initiation Range
Limit of Readily Available Water
CLAY
SILT
SAND
CLAY
SILT
SAND
Upper Limit of Tensiometer Reading Capability
Field Capacity Range
Free Water Range
Saturated
DRY
WET
12"
30 cm


Soil Moisture Retention Curve
Shellman y = 9828.9x² - 2372.9x + 143.9
R² = 0.9185
Flint River y = 7107.2x² - 2018.5x + 146.67
R² = 0.8669
Indicates the inflection point.
Above this point, the graph is linear.
Shellman = 46 Centibars
Flint River = 44 Centibars
Shellman
Flint River
Soil Texture
%Sand:%Silt:%Clay
Shellman 91:6:3
Flint River 86:11:3
Soil Moisture Tension (centibars)
Volumetric water content (%)
0
10
20
30
40
50
60
70
80
90
100
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16

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

- What is the best 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