1 Water Relations

2 Water management (Contd.)
   • Citrus trees are water-conserving plants
   • Root hydraulic conductivity (Lp) is low
   • Lp is positively correlated with root temperature
     (Fig 4.1)

3 Water management
   • Young leaves are more likely to wilt than mature leaves
   • High VPD leads to decrease in stomatal conductance and reduce water loss from the leaf.

4 Water Stress (Contd.)
   • Manifestation: cessation of growth, leaf wilting or decrease in stomatal conductance (g_s), net CO2 assimilation (A) or root conductivity.
   • Rootstocks: high in Carrizo than rough lemon

5 Water Stress
   • As temp. increases and RH decreases during the day, VPD increases
     - g_s, transpiration and A increases (Fig 5.3)
     - Mid morning- Mid day: maximum g_s, and A
     - > 30C reduce A, and reduce RuBisco activity
   • Water stress is greatest in high VPD

6 Irrigation
   • 3-4 acre feet of water is needed on average / year.
     - acre foot = 325,851 gal
   • Too much water
     - O_2 depletion
     - Phytophthora
   • Temp. of water is important
   • Internal drainage is needed

7 Irrigation
   • Need to know water holding capacity
     - amount /irrigation
Frequency of irrigation

How to know when the trees needs water
- look at soil moisture status
- look at status of water
  - Pressure bomb
  - Estimate ET
  - Use pan

Guidelines for estimating soil moisture level by “feel” Contd.

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Guidelines for estimating soil moisture level by “feel” Contd.

Guidelines for estimating soil moisture level by “feel”

Irrigation
- Need to know water holding capacity
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Evapotranspiration (ET)
- ET = Class A X 0.7 X A X 27,158
- Class A Pan = Daily evaporation from Class A pan in inches.
- A = Area covered by one tree (in acres)
- ET = Daily water use in gal / tree.
- 1 Acre = 43,560 sg.ft

Water Use (inches/day)

Factors to consider when deciding irrigation system
- Source of water
- Topography of grove
  - Flood irrigation
• high volume needed, good leaching, but enhances phytophthora
• In young orchards (first 2 years) 12% of the water amount used for flood irrigation

• Soil water capacity

16 Factors to consider when deciding irrigation system

• Water quality
  – should the orchard be established?

  ppm total salts
  200-400  Excellent
  400-600  good
  600-800  fair
  1000+    plant something else

17 Water Quality Considerations

• Total Soluble Salts: 1000 ppm -1.5 dS/m
  1200 ppm -1.8 dS/m

• Boron Concentrations: 0.5 -0.75 ppm

• Chloride: < 350 ppm

• Sodium Adsorption Rates (SAR): <8

18 Water Quality Considerations

Rio Grande River

• Total Soluble Salts: 770 ppm -1.2 dS/m

• Boron Concentrations: Trace

• Chloride: 160 - 180 ppm

• Sodium Adsorption Rates (SAR): 3-4

19 Factors to consider when deciding irrigation system

• Method
  – Furrow
    » Need flat grove and uniform soil
Factors to consider when deciding irrigation system

- Sprinklers
  - permanent furrows vs cultivation
  - length
  - slope
  - labor intensive

- Factors to consider when deciding irrigation system
  - Sprinklers
    - permanent
    - high vol... ground level or overhead
      ‡ Over head- requires good water quality
      ‡ can cool trees
      ‡ washes trees (dust vs mites)
    - Drag line system
      ‡ splashing water vs phytophthora

- Factors to consider when deciding irrigation system
  - Drip System (low volume sprinkler)
    - Problems
      - Salts build up... need winter rains to leach
      - Soil type vs soil mass wet vs # needed / tree
      - minimize weed growth
      - Drip- when trees are small
      - microjet-once trees are large

Microirrigation

- Microsprinklers Drip
  - 10 % of the amount of water used in young orchards
  - 80% of the amount of water used in mature orchards

- Strip Irrigation
  - 50 % saving of water in young orchards compared to flood
  - Possibility of strip irrigating mature orchards as well

Scheduling Flood Irrigation (winter)

- Trees will extract water mostly from the top 4 ft layer.
- 1 ft of soil holds 2” of available water.
- Irrigations are scheduled when 60% of available water is depleted from the soil.
- 1 Irrigation supplies 6” water

Scheduling Flood Irrigation winter (contd.)

- with 60 % depletion of available water
• 1 ft of soil can hold 2” X 0.6=1.2“ of water
• 6” irrigation will wet 6/1.2 = 5 ft of soil
• 20 % of water percolates below the root system

winter
• In winter, grapefruit orchard uses 0.08“ of water / day.
• with 60% depletion, then there is 4 ft X 1.2“ = 4.8 of water to be used before the next scheduled irrigation.
• 4.8“/0.08 = 60 days is the interval between irrigations.

Summer (Contd.)
• with 60 % depletion of available water
• 1 ft of soil can hold 2” X 0.6=1.2“ of water
• 6” irrigation will wet 6/1.2 = 5 ft of soil
• 20 % of water percolates below the root system

Summer
• In summer, grapefruit orchard uses 0.18“ of water / day.
• with 60% depletion, then there is 4 ft X 1.2“ = 4.8 of water to be used before the next scheduled irrigation.
• 4.8“/0.18 = 27 days is the interval between irrigations.

Scheduling Drip Irrigation
\[ \text{INT} = \frac{S \times \text{AW} \times 0.623}{\text{Ir}} \]

S = Soil water storage capacity at 25 % depletion in inches
Aw = area wetted with emitters (sq. ft /tree)
Ir = Irrigation amount (gal / tree / day)

Soil water storage capacity at 25 % water depletion