Fact sheet

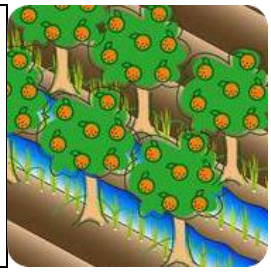
Citrus: Irrigation Scheduling

About Irrigation Scheduling

The timing and amount of water needed by a citrus crop is strongly affected by the length of rainfall season and the rainfall retained in the root zone. Irrigation scheduling requires estimating tree water use and replacing that amount. There are three primary Irrigation Scheduling Methods

1. Plant-based
2. Soil-based
3. Weather-based.

Timing and amount of irrigation are critical for high yields.



1. Plant-based Scheduling Methods

Plant-based scheduling is theoretically ideal as it integrates plant and soil water loss. It is useful when it indicates the time of stress when current or potential yield will be affected. The method is primarily for research as it is expensive and hard to adapt. The method involves the use of 1) a pressure chamber or Scholander, 2) trunk diameter, 3) stem flow gauge, 4) porometer and infrared thermometers.

2. Soil-based Scheduling Methods

The general rule for soil based scheduling is to irrigate when 50% of available soil water is depleted.

By feel: To check the water content in the soil, take a trowel, shovel, or soil tube and dig down 8 to 16 inches. A soil that has about 50% available water will feel as follows:

Soil texture	Soil feeling at 50 % available moisture
Coarse/sandy	appears almost dry, will form a ball that does not hold shape
Loamy	forms a ball, somewhat moldable, will form a weak ribbon when squeezed between fingers, dark color
Clayey	Forms a good ball, makes a ribbon an inch or so long, dark color, slightly sticky.

By tensiometer; tensiometers are water filled tubes with a pressure gauge that accurately reflect energy plant needs to extract soil water. Pressure gauges measure "tension values" in centibar units (cbars). Thirty (30) cbars indicates time to irrigate. Place tensiometers in the root zone between trunk and emitter.

Other methods of measuring soil water.

Method	Cost	Ease of Use	Accuracy	Reliability	Salt-affected	Stationary
Gypsum block	L	H	H	H	L	YES
Tensiometer	L	M	H	M	L	YES
Portable tensiometer	M	M	H	M	L	NO
Solid-state tensiometer	M	H	H	H	L	YES
Time domain reflectometer	H	M	H	H	M	Both
Neutron probe	H	L	H	H	L	YES
Feel (soil probe)	L	H	H	H	L	NO
Gravimetric (oven)	L	M	H	H	L	NO
Conductance	L	H	M	M	H	Both
Capacitance	M	H	M	H	M	Both

H, high; M, medium; L, low

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3. Weather-based methods of irrigation scheduling

Weather based methods use weather data converted to estimated crop water use. The system is only used with micro irrigation systems; drippers and micro sprinklers. The method involves:

- Estimating evapotranspiration (ET) of the crop. ET is the water lost by leaves (transpiration) and evaporation from soil surface.
- Replacing the water lost by ET to ensure tree water status is optimum
- Water budget method or checkbook scheduling.
    - Requires reference evapotranspiration (ETo) weather station;
        - evaporation pan; open system evaporation
            - cheap but hard to maintain; animals and algae
        - atmometer; closed system evaporation
            - more expensive, easier to maintain
    - Measure water lost from a well-watered field of grass; ETo.
    - ETo is modified for specific crops with a crop coefficient (kc).
    - The formula for converting ETo to crop ET is:

$$ETo \times kc = ETcrop.$$

    - For a full-grown citrus orchard kc = 0.65. Use kc = 0.56 in deserts.
    - For young, smaller trees kc = 0.05; As the young tree size increases to shade 65% of soil surface, increase kc 10% per year through years until year 8.

Converting application depths to volume

Application rates of low-flow systems can be confusing because scheduling and water-use information is often presented in depth (e.g., inches per day), while discharge from low-flow emitters is often in volume (e.g., gallons per hour).

To convert inches per day to gallons per day:

Water use by the plant = Tree spacing X Tree water use X 0.623 gal/(in.- ft^2)

(gal/day) (ft^2) (in/day)

Example: fully-grown trees

Tree spacing = 20 ft. X 20 ft. = 400 (ft^2)
Tree water use = 0.1 in./day
water use by trees = 400 (ft^2) X 0.1 in./day X 0.623 = 25 gal/day

With smaller trees, the area of the canopy should be used in lieu of the plant spacing.

References and Resources

The Irrigation Association: http://www.irrigation.org/
USDA Irrigation Information: http://www.wcc.nrcs.usda.gov/nrcsirrig/
Center for Irrigation Technology: http://cati.csufresno.edu/cit/
Irrigation Training and Research Center: http://www.itrc.org/
Farm Water Quality Management: http://groups.ucanr.org/signup/Fact_Sheets/

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