SL 247

UF UNIVERSITY of FLORIDA
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Improving Citrus Nitrogen Uptake Efficiency: Effective Irrigation Scheduling[1]

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This document addresses citrus irrigation scheduling and its relationship to both nutrition and fertilizer management. The objectives of this document are:

1. Describe the three citrus production areas, factors affecting irrigation depth, and methods of irrigation scheduling.

2. Describe the impact of irrigation scheduling on nutrient management and available irrigation scheduling tools.

The target audience for this series dealing with citrus nutrition includes Certified Crop Advisers, citrus producers, irrigation system designers, fertilizer dealers, and other parties interested in citrus fertilization and irrigation practices.

Competition for Water Resources

The competition for water supply is increasing throughout Florida. Increasing demands from residential and commercial users are often met at the expense of agricultural and environmental water supplies. As the number of Floridians continues to increase, water resources will decrease for agriculture. One way that citrus producers can address this trend is by reducing the amount of water consumed in commercial groves. Irrigation managers must reduce grove water consumption while avoiding tree damage or fruit yield/quality loss due to insufficient irrigation applications. The key to water management efficiency is to satisfy crop demands, addressing the various growth stages of the tree, and including both soil characteristics and weather into decisions regarding irrigation.

Citrus Production Areas and Soil Characteristics

The production of citrus throughout Florida currently covers a large area within the peninsula. Because of the differences in soils and related water regimes, management techniques for irrigating commercial citrus groves must take these differences into consideration. For that reason, areas with similar soils and subsequently production practices are described below to make the discussion of irrigation and nutrient management more relevant.

Soils in the following citrus production areas have been classified and mapped. This information

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can be found in the Natural Resource Conservation Service (NRCS) county soil survey maps (http://websoilsurvey.nrcs.usda.gov/app/). Soils are first classified based upon their **Soil Order**, which we shall use as the fundamental unit for irrigation management. Soil type is a further division of soils within soil orders. Soils of the same type have similar characteristics such as water and nutrient holding capacities. Soil types will be given as examples of soil orders from each of the production areas. A more detailed description of the selected soil types are provided in SL193 "Common Soils Used for Citrus Production in Florida" (http://edis.ifas.ufl.edu/SS403).

Ridge

The **Florida Ridge** (Figure 1) lies in a generally north and south direction through the center of the peninsula, and is characterized by deep, well-drained soils comprised mostly of sand (Figure 2). The soil taxonomic order that dominates Ridge soils is the Entisols soil order.

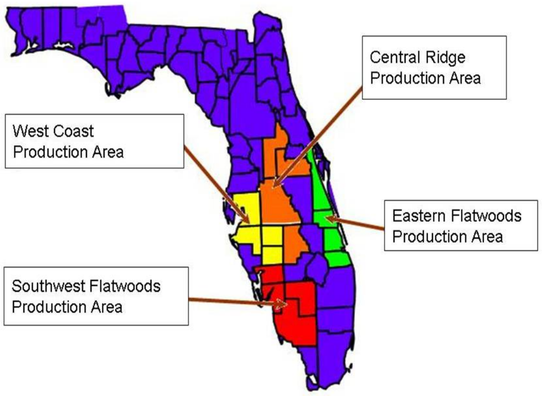

Figure 1. Florida citrus production areas by county.

Entisols (Astatula, Archbold, Candler, Satellite, Tavares)

Soil types in this soil order are relatively newly formed soils without layers or diagnostic horizons (Figure 3). These soils are characterized by rapid infiltration of rain and irrigation water, as well as low water and nutrient holding capacities. The **water holding capacity** of a soil is defined by the difference between **soil wilting point** and **soil field capacity**. For Entisols, water holding capacity is usually quite small, often on the order of 4% to 8% (Figure 4).

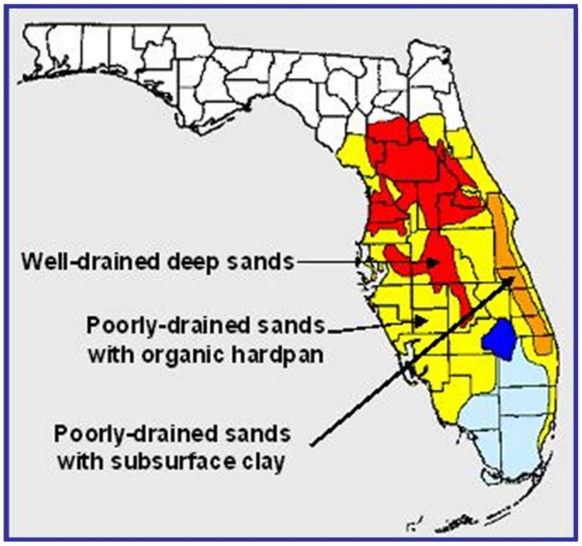

Figure 2. Soils in citrus production areas of Florida (Obreza et al., 2006).

Figure 3. Entisols: Candler fine sand (Entisols) is a typical Ridge soil. Notice that there are no discernible diagnostic horizons throughout the soil profile. The darker gray color at the soil surface is caused by the addition of organic matter from plant growth (Source: Obreza et al., 2006).

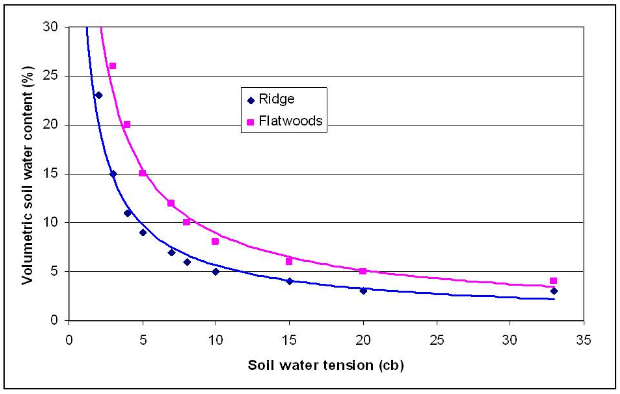

Figure 4. Average soil-water characteristic curves representing Flatwoods (Spodosols) and Ridge (Entisols) soil from the root zone (Obreza et al., 1997). Note that Flatwoods soils contain somewhat more plant-available water than the Ridge soils.

Flatwoods

The so-called **flatwoods** soils are found in both the southwest flatwoods (Gulf Coast) and eastern flatwoods (Indian River) citrus production areas (Figures 1 and 2). Because these soils are sandy, nutrient and water holding capacities are quite low. Many of these soils have a confining soil horizon that may permit a perched water table and reduced risk of nutrient leaching. Both the Indian River and the Gulf Coast production areas enjoy a somewhat reduced risk of nitrogen movement off-site because of denitrification, due in part to high water table conditions that are often present in these groves. Denitrification is the biological process of converting nitrate-nitrogen into nitrogen gas by bacteria in water-saturated soils. Thus, flatwoods soils typically do not have water quality problems due to nitrate nitrogen. However, because drainage is required, water quality problems may be experienced in drainage waters/runoff from phosphorus and potassium. The soil taxonomic orders that dominate flatwoods soils are the Alfisols and Spodosols soil orders.

Alfisols (Holopaw, Malabar, Pineda, Riviera, Winder)

The soil order, Alfisols (Figure 5), plays an important part in citrus production, dominantly in the west coast, eastern flatwoods, and to a lesser extent in the southwest flatwoods regions. This soil order commonly is either somewhat poorly drained or poorly drained, and has a texture diagnostic layer within the profile. This diagnostic horizon is characterized by a slight build up in clay/organic matter, and may support a perched water table. Water holding capacity of the Alfisols above this layer is only slightly better than that of the Entisols found on the ridge.

Figure 5. This Alfisol, a Riviera sand, shows the typical diagnostic horizons. The build up of the clay layer in the lower one third of the profile is quite evident (Source: Obreza et al., 2006).

Spodosols (Basinger, Immokalee, Myakka, Oldsmar, Pomona, Wabasso)

Another soil order commonly found in the flatwoods and west coast production areas are soils classified as Spodosols (Figure 7). Spodosols are poorly drained and exhibit a stained layer, known as the spodic horizon, within 1 to 3 feet of the soil surface. This horizon will support a perched water table; however, citrus roots do not readily grow within this diagnostic horizon primarily because of the elevated aluminum and iron concentrations present.

Figure 7. This Immokalee fine sand has the typical profile of a Spodosol. Note the dark stained layer, the spodic horizon, in the lower portion of the picture caused by a buildup of iron, aluminum, and organic matter (Source: Obreza et al., 2006).

As with Alfisols, citrus production requires some form of drainage. Typically, the formation of beds provides an acceptable moisture regime for a healthy root system that is limited in depth by the spodic layer.

Factors Affecting Irrigation Scheduling

As can be seen from the discussion of the citrus production areas within Florida, soil characteristics pose considerable restraints on irrigation practices. The water holding and drainage characteristics of these soil types greatly influence root distribution, the presence of a water table, and the need for drainage. Irrigation practices must address these characteristics to effectively irrigate the trees without leaching nutrients into surface or groundwater.

Root Distribution

Irrigation decisions are affected by citrus root development and root patterns within the soil profile (shallow or deep). Root development changes with both age and soil characteristics. Thus, irrigation management changes should be based upon knowledge of the root system and should not be the same from planting to mature tree production.

Ridge

Entisols are often well-drained allowing citrus roots to penetrate deeply into the soil. This root distribution pattern anchors the tree and provides a large volume of soil from which the tree may extract both nutrients and water. Citrus root zones on Entisols are typically 36 inches or more in depth (Morgan et al., 2006a).

Flatwoods

Drainage, the presence or absence of soil diagnostic horizons, and whether or not the citrus grove is bedded all have considerable influence on citrus root distribution (e.g., Figure 6). Because of drainage conditions, these soils are bedded for commercial citrus production, often with additional ditching to remove excess water. The shallow root system is restricted to the upper 12 to 18 inches of soil with approximately one-third of the root system extending out to the edge of the bed. The remainder of the root system is located toward the center of the bed (Figure 6). A detailed description of root distribution in these soils can be found in HS894, “Some Practical Matters Related to Riviera Soil, Depth to Clay, Water Table, Soil Organic Matter and Swingle Citrumelo Root Systems” (http://edis.ifas.ufl.edu/HS146).

Furthermore, depth to the water table influences the volume of soil that citrus roots can explore for both water and nutrients. Should the water table rise suddenly into the root zone, drainage must be applied (typically within 6 to 10 hours after flooding) or the affected roots will die (Ford, 1968; 1972). Root

Figure 6. Citrus root growth in a Riviera sand, an Alfisol, is mostly in the surface few inches (Source: Mace Bauer).

dieback due to a raised water table may adversely affect citrus fruit production as well as the health of the tree, possibly lowering resistance to pests or pathogens. In some groves with habitually high water tables, roots may occupy only the surface few inches of the soil resulting in trees that may not withstand wind from the ever present Florida thunderstorms (Figure 8). These groves are especially susceptible to hurricane wind damage. Likewise, trees with reduced root zones due to high water table tend to grow poorly and must be irrigated more often to obtain adequate water and nutrients. If managed incorrectly, these short irrigation intervals can result in increased nutrient leaching.

Figure 8. Roots of citrus trees with shallow and weak system on the left, and a normal strong root system on the right (Source: K.T. Morgan).

Water Table

The location of a water table in the grove defines the lower limit of the volume of soil in which citrus roots can grow. When the water table is close to the surface, the soil volume for root growth is decreased compared with a situation where the water table is several feet below the soil surface or the bed top. Thus, the first step in developing good irrigation practice within the grove is to know the depth to the water table using some form of monitoring. Current publications on water table monitoring are listed below:

- CIR 1409, “Water Table Measurement and Monitoring for Flatwood Citrus” (http://edis.ifas.ufl.edu/CH151).
- CIR 731, “Manual Monitoring of Farm Water Tables” (http://edis.ifas.ufl.edu/AE130).

If the water table is close to the soil surface or bed top, it stands to reason that irrigation volume should be reduced. Correctly managing the volume of water in each irrigation cycle has a strong effect on roots and their proper development, leading to a healthy and productive citrus tree. In recent research (Morgan et al., 2006b), trees ranging from 2 years old to mature had approximately three times as much weight in branches and leaves as roots (Figure 9). This root to shoot ratio will be maintained by the tree in the event of damage to the above ground parts or the roots. In situations where roots have been damaged, either by inappropriate irrigation or by a flooding event, the reestablishment of the root to shoot ratio should be attempted as soon as possible. In cases where damaged roots are extensive (Figure 10), managers should establish appropriate drainage to provide a soil volume into which roots may recover and grow. In more drastic situations, managers should consider canopy pruning to match the canopy volume with the recovering root system (Figure 9).

Drainage

Flatwood soils are often poorly drained and relatively easily flooded. For citrus production, some form of drainage or surface relief must be provided. Adequate soil drainage must be maintained for proper tree growth and root system development. Many

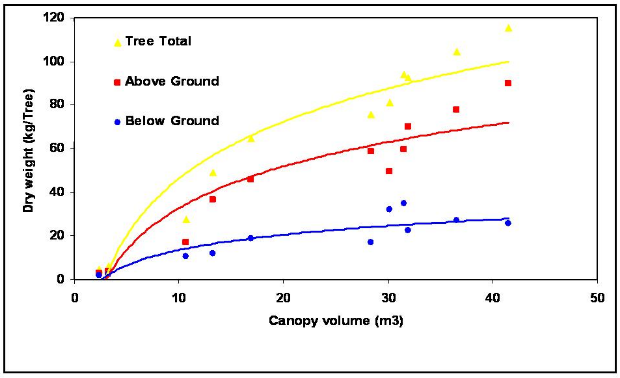

Figure 9. Root/Shoot Ratios of citrus trees (Morgan et al., 2006b).

Figure 10. Citrus roots damaged by excessive water in the soil profile (left); and citrus roots recovering after appropriate drainage has been established (right) (Source: K.T. Morgan).

EDIS publications have been produced describing proper drainage system design, maintenance, and management:

- CIR 1405, "Detention/Retention for Citrus Storm Water Management" (http://edis.ifas.ufl.edu/AE216).
- SL196, "Flatwoods Citrus Best Management Practice: Riser-Board Structures" (http://edis.ifas.ufl.edu/SS409).
- CIR 1412, "Drainage Systems for Flatwoods Citrus in Florida" (http://edis.ifas.ufl.edu/CH165).
- CIR 1419, "Water and Environmental Considerations for the Design and Development of Citrus Groves in Florida" (http://edis.ifas.ufl.edu/CH163).

Irrigation Depth and Duration

Irrigation duration and flow rate determine the volume of water that is added to the grove. Gravitational forces move the water downward through the soil until the soil has reached **field capacity**. Any additional irrigation water either continues through the soil profile below the root zone, or reaches the water table. In both cases, water above the amount required to refill the soil in the root zone is wasted and potentially contributes to nutrient leaching. This simplified model of water movement has been called "piston flow" because water entering the soil from irrigation or rainfall forces water in the soil deeper into the soil profile. This process also describes the flow of nutrients in the sandy soils of central and south Florida, making them vulnerable to nutrient leaching.

Soil characteristics also pose problems for irrigation and nutrient management. Scheduling must be such that irrigation avoids exacerbating loss of nutrients, especially nitrogen, from the citrus root zone. Scheduling decisions are further confounded by rainfall. For example, irrigation just before a rain event wastes both the irrigation water and likely some fertilizer-supplied nutrition, since the rain fills the surface soil causing nutrient filled water to be pushed past the rooting zone, leaching nutrients from these well-drained, sandy soils. The wetted portion of the soil profile can be controlled by irrigation managers. If the volume of irrigation water is excessive, then this over-watering can induce the same problems discussed above concerning drainage and excess water from rainfall.

Depth of Irrigation

A good way to know if the irrigation water is being used correctly, avoiding too wet or too dry conditions, is to estimate the depth of wetting and the total depth of soil that will be filled to **field capacity**. A simple estimate can be generated using easily available information and making some assumptions. The estimate is described in more detail in Appendix 1, and is used in the following examples. More powerful estimation methods have and are being made available. For example, one estimation model is available through the FAWN weather system (www.fawn.ifas.ufl.edu/citrus irrigation scheduler), a web-based weather reporting system for agricultural uses.

From Appendix 1, Table 6, the Candler soil will wet to **field capacity** to a depth of approximately 22 inches, given the original soil-water content in the example equivalent to 1/3 depletion, and the addition of 1 inch of irrigation water. Of course, a wetter soil at the beginning of the irrigation cycle would result in soil being brought to **field capacity** to a greater depth. Based upon grove rooting depths, the implication is that much more than a 1-inch water application may extend **field capacity** conditions below the rooting depth of the citrus trees in Candler sand. Please see Appendix 1 for another example using a different soil.

Goals of Irrigation Scheduling

A grove manager may have several objectives for using irrigation. The following list of objectives, though not complete, contains some typical reasons for the use of irrigation. Increased profits through the effective use of irrigation to produce high quality citrus are the overall goal. The economics driving these objectives are left to the individual grower; however, this publication provides some decision-making information regarding irrigation use, scheduling, and duration.

Maximum Yield Per Acre

While many growers state this objective, irrigation may not be the most cost-effective way to maximize yields, and often contribute to off-grove pollution. Environmental impact is due to increased fertilizer applications to counter balance the excessive irrigation required for maximum production resulting in reduced nutrient uptake efficiency.

Maximum Yield Per Amount of Water Applied (Water Uptake Efficiency)

This objective requires good control of water delivered to the tree, and results in conservation of water, as well as the energy used to move water from its source to the tree. In this case, both the delivery system to get the irrigation water to the tree and the tree response are considered.

Maximum Yield Per Unit of Fuel (Fuel Efficiency)

Similar to the objective above, fuel or energy is the focal point. With rising fuel costs, this objective addresses water consumption from the standpoint that pumping of water to the tree takes energy, which requires a system that is as energy efficient as possible.

Maximum Nutrient Uptake (Nutrient Uptake Efficiency)

As water moves into the tree, selected nutrients (e.g., nitrate-nitrogen) move with the water and enter the tree. Nutrient use increases if the optimum amount of both nutrient and water are used, resulting in increased nutrient uptake efficiency. Because nutrients are also energy-intensive, this objective integrates management of nutrients, water, and energy. Irrigation practices to improve nutrient use efficiency are given in SL246, “Improving Nutrient Uptake Efficiency: Linking Citrus Irrigation Management to Citrus Fertilizer Practices” (http://edis.ifas.ufl.edu/SS466).

Minimize Nutrient Leaching

This objective attempts to hold nutrients, especially the mobile nutrients such as nitrate-nitrogen, in the root zone via measured irrigation events. Irrigation timing and duration are based upon crop need and soil-moisture content. In addition to addressing plant water needs, changes in the soil volume containing the root zone is also included, as well as irrigation delays for rainfall events.

Methods of Irrigation Scheduling

The following are two methods of irrigation scheduling that will improve the likelihood of obtaining the irrigation goals above. Generic irrigation schedules can be reduced to a tabular format, as described in HS958, “Management of Microsprinkler Systems for Florida Citrus” (http://edis.ifas.ufl.edu/HS204). All of the information required to produce a table similar to Table 5 can be found in reference materials such as the county soil survey, measurement of rooting depth in each of the groves, and following UF/IFAS guidelines for soil-water depletion percentages.

Water Budget Approach

When water is lost from the soil by evaporation and the citrus tree loses water through the transpiration process, water must be supplied to replace this crop evapotranspiration (ET_c). A reference evapotranspiration (ET_0, Figure 11) can be used as a basis for estimating the citrus grove evapotranspiration or irrigation demand. Reference ET is calculated on a daily basis using weather data or is available for the nearest FAWN site as (http://fawn.ifas.ufl.edu). The calculation of reference evapotranspiration using weather data is described in HS950, “Weather Data for Citrus Irrigation Management” (http://edis.ifas.ufl.edu/HS179).

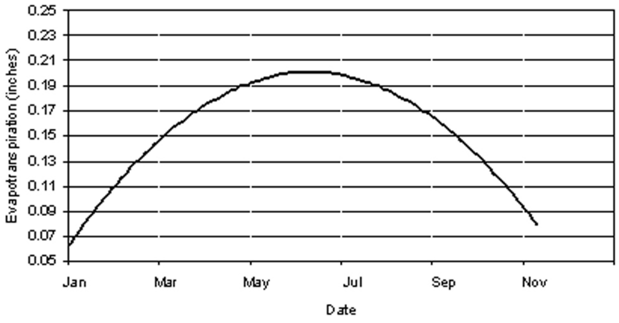

Figure 11. Reference Evapotranspiration (Morgan et al., 2006b).

Two factors must be used to convert the reference ET to one that addresses citrus growing in specific soils found in the grove of interest. The crop coefficient (K_c) for citrus changes throughout the year (Figure 12) and is low during the cooler months when water use is low and higher in the warm summer months when water use by the citrus trees is high. The soil-water extraction factor (K_s) is an estimate of the trees' ability to remove water throughout a range of water contents (Figure 13). As soils dry out, tree roots must expend more and more energy to take up water from the soil, the trees remove less water, and the K_s is reduced. Reduced water uptake by the tree can result in reduced tree growth and yield. Thus, growers are advised to keep above the recommended maximum allowable soil water depletions (discussed below) for the given time of the year so that the K_s factor remains as high as possible.

Detailed discussion of crop ET is available in:

- BUL 249, “Basic Irrigation Scheduling in Florida” (http://edis.ifas.ufl.edu/AE111).

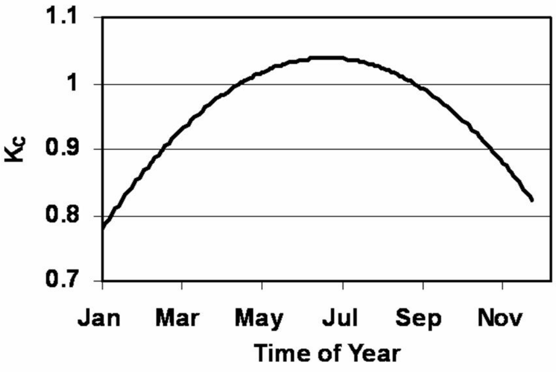

Figure 12. Crop coefficient (Kc) for citrus (Morgan et al., 2006b).

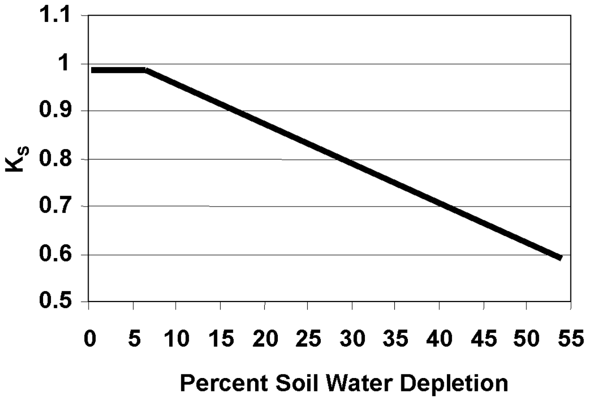

Figure 13. Soil-water extraction factor (Morgan et al., 2006b).

- BUL 254, “Irrigation Scheduling with Evaporation Pans” (http://edis.ifas.ufl.edu/AE118).

The equation: $ET_c = ET_o * K_c * K_s$ uses these components to estimate the crop ET (ET_c). However, once the crop ET is estimated, another simple set of calculations can be used to predict when irrigation should occur. This method utilizes current soil-water information and the ET_c in a simple water budget:

Current Soil-water = Yesterday's Soil-water - ET_c.

A decision should be made before using this equation. That is, what amount of depletion of the soil's available water should be used before irrigating? The UF/IFAS recommendation is to allow 25% to 33% soil-water depletion during February through May, and 50% to 66% depletion during June through January. These allowable depletions provide increased soil water in the spring of the year for blooming, fruit set, and growth flushes. The increased allowable soil water depletion in the summer and fall allows for the use of rainfall during our rainy season and adequate water for fruit expansion. The examples (Table 3) show the use of 25% and 50% soil-water depletion, one from each of recommended time periods.

Rooting depth adds another layer of precision to this irrigation budget model (Table 4). Notice that in the examples given in Table 4, the time between irrigation events is longer as the rooting depth increases. So long as roots are actually present within the entire volume, the plant has considerably more soil volume from which to draw water. Overestimating the actual rooting depth is ill advised, and may waste water and possibly leach nutrients below the root zone.

Note also that the ET changes during the year, affecting the time between irrigation events, as well as the irrigation duration. Lastly, notice that an increase in the allowable depletion (going from 25% to 50%) also increases both the time interval and the duration of irrigation events.

Soil Water Measurement Approach

The direct measurement of soil water has also been used for irrigation scheduling for many decades. Recent advances in soil water sensor technology and the proliferation of computers in production agriculture has made using these devices easier and more common place. The simplest device is a tensiometer, which measures the force or tension that water is held to the soil. As soils dry, the water remaining in the soil is held more tightly by the soil and is thus, less available to the tree. This increase in tension with decreasing soil-water content is particularly true of the sandy soils in Florida, and is the major consideration for the maximum level of soil water depletion allowed before irrigation. The soil can not be allowed to dry too much or the plant stress will increase affecting growth and yield. Discussion or the installation, maintenance, and use of these devices are described in CIR 487, “Tensiometers for Soil Moisture Measurement and Irrigation Scheduling” (http://edis.ifas.ufl.edu/AE146).

A wide range of electronic sensors are also available to citrus growers for measurement of soil water content or tension. These sensors are typically more expensive than the simple tensiometer but have the advantages of high accuracy, low maintenance, and most will connect directly to computers or irrigation controllers for data collection. These sensors are described in BUL 343, “Field Devices for Monitoring Soil Water Content” (http://edis.ifas.ufl.edu/AE266).

Conclusions

We have discussed the importance of soil characteristics on root development and irrigation scheduling. The use of soil maps provided by the NCRS will allow growers to determine the depth limitations for root growth at their grove. Understanding the depth of your root zone is key to determining the depth of irrigation. Growers can then use generic tables, soil water balance, or soil water sensors to determine when the next irrigation should occur. However, the grower needs to further understand that these irrigation schedules vary by the time of year due to irrigation demand (ET) and allowable depletions. The use of computer tools such as available at the FAWN web site or soil water sensors can simplify and automate the calculations required for proper irrigation scheduling. The proper scheduling of irrigation can provide adequate water for tree growth and fruit development, protect the environment through reduced leaching of fertilizer nutrients, and improve the growers bottom line by reducing costs or both water and fertilizer.

For More Information ...

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Appendix 1

Depth of Water Infiltration[1]

Definition: $I = A/FC$

Where: I = Infiltration depth of applied water (inches)

A = Depth of water applied (inches)

FC = Field capacity of soil (in/in or % divided by 100)

Total Depth of Soil at Field Capacity[2]

Definition: $I_t = (A+W)/FC$

Where: I_t = Total water depth to field capacity (in)

A = Depth of water applied (in)

W = Depth of water to infiltration depth (in)

FC = Soil field capacity (in/in or % divided bt 100)

Table 1. Water-holding characteristics of flatwoods and ridge soils. (Available water-holding capacity = field capacity - permanent wilting point.)

Term	Soil water tension cb[1]	Flatwoods soil	Ridge soil
		Soil water content, in/ft	
Saturation	0	4.04	4.60
Field capacity	Flatwoods = 8 Ridge = 5	0.90	0.62
Permanent wilting point	1500	0.16	0.11
Available water-holding capacity		0.74	0.51

[1] Centibars are negative pressure.

Table 2. Effect of field capacity definition on soil water tension readings corresponding to typical soil water depletion levels used for citrus irrigation scheduling. Abbreviations: FC = field capacity, AWC = available water-holding capacity.

Available soil water depletion (%)	Soil water tension (cb)		Soil water content (%)	
	Flatwoods	Ridge	Flatwoods	Ridge
0 (FC)	8	5	8.7	8.0
33	15	9	6.2	5.6
50	30	15	4.5	4.5

Table 3. Using crop ET and selected soil-water depletion levels to estimate days between irrigation events at the given crop ET (ET_c) Depletion is the percentage of AW desired between irrigation events.

	Historic ET_c	Available water at field capacity (inches)	Depletion (inches)	Days between irrigations
25% Depletion	0.21	1.65	0.41	1.05
50% Depletion	0.21	1.65	0.83	3.95

Table 4. Three selected rooting depths, estimated available soil water, and resulting irrigation schedule (time between each irrigation event in days; irrigation operation time in hours).

Rooting Depth ==>	12 in. depth	18 in. depth	24 in. depth
Field Capacity (in/in)	0.09	0.09	0.09
		Available Soil Water (in)	
Feb. – June. (25%)	0.27	0.41	0.54
July – Jan. (50%)	0.54	0.81	1.08
		Irrigation Schedule	
Jan. (ET = 0.08)	6-7 days	10-11 days	13-14 days
	3-4 hours	5-6 hours	7-8 hours
May (ET = 0.20)	1-2 days	2-3 days	2-3 days
	1-2 hours	2-3 hours	3-4 hours
Aug. (ET = 0.22)	2-3 days	3-4 days	4-5 days
	3-4 hours	5-6 hours	7-8 hours

Table 5. Example of an irrigation schedule using the following assumptions: field capacity equals 0.08 to 0.10 in/in; rooting depth equals 18 inches; irrigation application rate equals 0.1 to 0.15 in/hr; allowable soil-water depletion was set at 25% during the spring and 50% during the summer and winter. (Source: http://edis.ifas.ufl.edu/HS204)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept	Oct.	Nov.	Dec.
ET (in/day)	0.07	0.11	0.13	0.18	0.20	0.21	0.20	0.19	0.16	0.12	0.09	0.06
Interval (days)	7-10	3-4	3-4	2-3	2-3	2-3	3-4	3-4	3-5	4-6	5-8	7-10
Duration (hours)	5-6	3-4	3-4	3-5	4-5	4-5	4-6	4-6	4-6	4-6	4-6	4-6

Table 6. Depth of water infiltration and depth of soil at field capacity using simple estimation methods for two soils and water additions (rainfall or irrigation source).

	Rainfall or Irrigation (inches)			
	0.5	1.0	0.5	1.0
Soil	Candler		Wabasso	
Field Capacity (%)	8	8	12	12
Soil water content at 1/3 depletion (%)	6	6	8	8
Infiltration depth[1] of applied water (inches)	6.3	12.5	4.2	8.3
Total depth[2] of soil at Field Capacity (inches)	10.9	21.9	8.4	16.6

[1] and [2] are defined above table in this Appendix.