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Reduced Irrigation of St. Augustinegrass Turfgrass in the Tampa Bay Area [1]

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Irrigation in the urban landscape, especially for turf areas, requires substantial amounts of water. This situation combined with rapid growth of population in some areas of the State, has resulted in stress of local water resources.

This publication provides recommendations for irrigation of St. Augustinegrass. These are based on research that studied the relationship between turfgrass quality and water use in addition to the way in which irrigation strategy affects the total amount of water used in irrigation.

How Are Water and Turf Quality Related?

Water is essential for turfgrass growth. A steady supply of water must be available to the turfgrass to maintain its health and quality. Water acts as a vehicle for nutrients into the plant, maintains a temperature balance, and is an important component of plant tissue.

Water flow through the plant is driven primarily by weather conditions. Factors such as temperature, wind, relative humidity and radiation affect the amount of water in the soil that is used by the plant. When water is not available in the soil, the plant goes into stress, which affects metabolic processes and growth rates. These in turn affect the quality of the turfgrass.

Figure 1 shows a research plot where turfgrass has been subjected to different levels of water stress. Note the texture, color and the density of the different treatments.

Figure 1. Turfgrass grown at different reduced irrigation rates. Turfgrass is grown in closed containers with an automated rain shelter so only irrigation water is used by the plant.

In general, as water availability decreases, the quality of the turfgrass decreases. In areas where water is scarce, a balance must be attained between

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quality of the turfgrass and the amount of water used to maintain it. Figure 2 shows the relationship between water use and turfgrass quality.

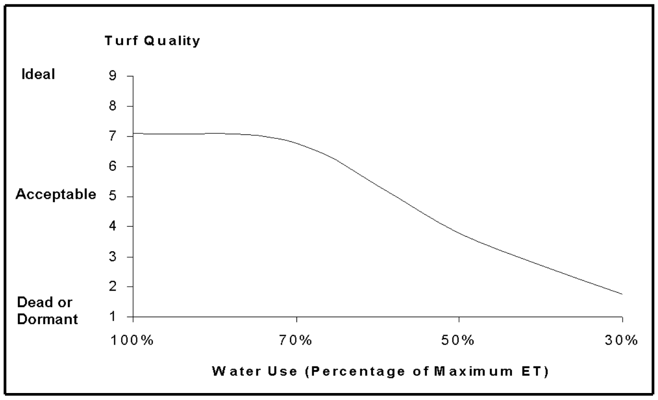

Figure 2. Relationship between turfgrass quality and water used.

A group of independent evaluators rated a turf quality index of 5 as acceptable. The best quality obtained averaged a rating of 7 over a one-year period. Note that in the research done on turfgrass quality and water use, no substantial increase in quality is achieved beyond applying 75% of the maximum ET capacity of the turfgrass. Furthermore, applying about 60% of the maximum ET capacity of the turfgrass will yield acceptable quality. Irrigating to achieve an acceptable quality is highly recommended.

In the remainder of this document high water savings will refer to achieving an acceptable turfgrass quality while minimizing water use for irrigation. Low water savings refers to irrigating the turfgrass to meet its maximum water demands.

What Factors Affect Water Use in Turf Irrigation?

Water use is affected by many factors. The most important are the plant itself, weather, the soil and the availability of water.

The Plant

Different plants use different amounts of water in response to climate conditions. In addition, they will behave differently when water is scarce. For example, when there is an unlimited supply of water, Bahiagrass uses about 11% more water than St. Augustinegrass. However, when water is scarce, Bahiagrass has developed mechanisms that will cause the grass to become dormant. As a result, under extreme water deficit conditions St. Augustinegrass may be stressed beyond the point of recovery while Bahiagrass may recover when water becomes available.

The selection of a turfgrass is based on other factors in addition to to water use, such as homeowner preference, cost and availability of sod or plugs. Regardless of the turfgrass selected, it is desirable to apply the minimum amount of water that insures a quality that is acceptable to the homeowner. The quality requirements may vary from location to location depending on the use of the turfgrass. A major step in water conservation is to select appropriately the type of plant material or cover to be used in a given area. It all starts with a good conception of how the landscape is to be used.

The Soil

The soil plays a very important role in the way water is used in an irrigated system. Water is only available to the turfgrass if it is in contact with the roots. As a result, only the water that is stored in the soil occupied by the root system is available to the turfgrass. The root depth determines the volume of soil available for storing water and rainfall. Figure 3 shows how root depth affects the total amount of water used in a year for turfgrass irrigation in Tampa, FL. Note that the deeper the roots are the less irrigation water is needed. This is because a deeper root (greater soil volume) has more capacity to store rainfall.

Another important factor is the capacity of the soil to store water. Different types of soils have different capacity to hold water. In general, sands will hold much less water than clays. Because Florida soils are generally sands, they tend to hold small amounts of water (about 8-12% of their volume.) Note that the water holding capacity of the soil can be greatly increased by amending the soil, such as adding composted materials.

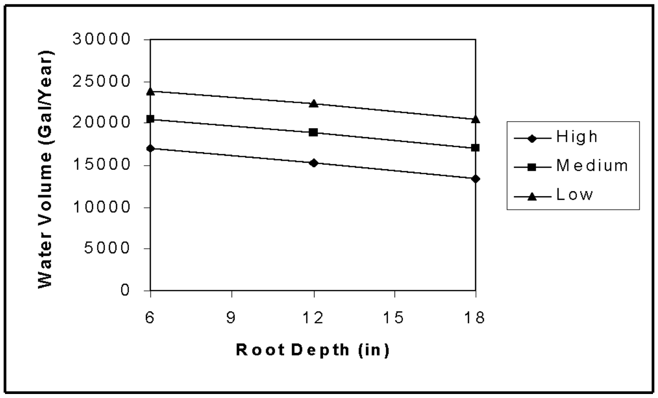

Figure 4. Relationship between yearly water use in a 1000 sqf turgrass area for different water saving levels.

The Weather

Weather is the most important factor influencing water use of a healthy turfgrass. The total amount of water transpired by the plant and evaporated from the soil is called evapotranspiration (ET.) If water is available in the soil, ET will depend mainly on solar radiation, humidity, temperature and wind. Because the combination of these factors changes from day to day and seasonally, ET follows daily and seasonal changes. Figure 4 shows how ET varies over a one year period year.

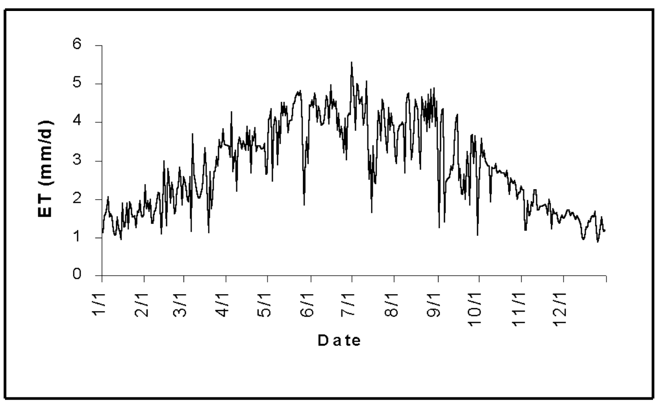

Figure 3. Variation of daily evapotranspiration.

What is the Best Way to Irrigate Turfgrass

The purpose of irrigation is to meet the water needs of the turfgrass. Because water of good quality is an important natural resource that needs to be conserved, water must be applied in such a way that:

1. The water supply to the turfgrass is the minimum necessary to maintain a reasonable turfgrass quality.
2. Water is applied efficiently, meaning that irrigation water is used by the turfgrass for ET, and does not result in percolation, runoff, or excessive evaporation.

To be efficient in irrigating turfgrass, irrigation systems are designed in such a way that water is applied uniformly over the irrigated turf area. If the system is not uniform, it is difficult to irrigate efficiently and satisfy water needs.

In addition, having a well designed and maintained irrigation system that applies water uniformly does not insure by itself efficient use of water. The way that irrigation is conducted is also very important. This includes the amount of water that is applied as well as when it is applied.

How Much Water Should I Apply per Irrigation?

There is a simple answer to this question. Apply only the amount of water that can be stored in the soil volume occupied by the root system. Because soils can hold only a limited amount of water, any water that is applied in excess will be lost as seepage or runoff.

Although this is simple in concept, it is difficult to quantify accurately. It requires knowledge of the soil's maximum capacity to hold water and the amount of water in the soil at the time of irrigation. The difference between these two is what needs to be restored to the soil at any given time.

Under typical conditions (for a well maintained and managed turfgrass in a Florida soil) the irrigation depth applied is about 3/4" to 1" of water per every foot of root depth.

It's best if the value is calculated for each location locally. This requires measuring the water-holding capacity of the soil.

Figure 5 shows the average monthly turfgrass irrigation requirement for Tampa, FL. Values shown are gallons per month for a 1000 sqf area. These are the result of a 30-year simulation for a turfgrass of acceptable quality and maximum water savings.

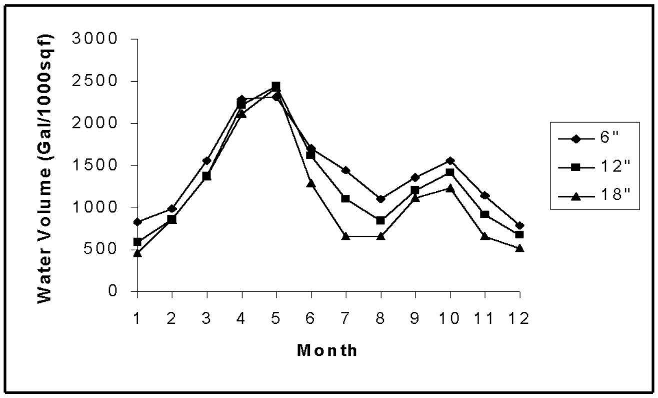

Figure 5. Monthly volume of water used for turfgrass irrigation for acceptable quality turfgrass for an irrigated area of 1000 square feet (sqf.)

Values in Figure 5 are show for root depths of 6, 12 and 18 inches. Note that irrigation amount is sensitive to root depth, particularly during the summer and fall.

How Often Should I Irrigate?

Generally speaking, irrigation should only be applied when water in the soil has reached a level that results in stress to the turfgrass. Because water in the soil used for ET depends on climate demands, it is not possible to forecast accurately when irrigation should occurr.

Two general strategies can be used to decide when irrigation should be applied. One strategy is based on the best estimate of what the soil-water conditions are at any time. A second strategy based on the long-term behaviour of the irrigated turfgrass.

Strategies based on current water status of the soil

Short-term strategies attempt to estimate the soil-water status as time elapses. They use an approach that "looks" at what the status of the soil is at any time. Based on this, water is applied in a timely manner to the turfgrass.

This can be achieved by:

- Using the plant as an indicator. When a sizable percentage of the turfgrass area (50% or more) shows visible symptoms of stress, initiate an irrigation.

- Use a tensiometer (or some other soil-moisture sensor) to initiate irrigation when the measured tension reaches a threshold value. The value of tension is best determined by observing visual stress symptoms in the turfgrass and setting the tensiometer accordingly. Sensors have the advantage that they can be used with irrigation timers to automate the system. However, they require maintenance.

- Use the water budget method. This method is similar to a "checkbook" balance of water in the soil. Starting after a heavy rain or irrigation, ET is substracted from the soil water. When soil water reaches a low value, irrigation is initiated.

Strategies based on historical behavior of the system

A different approach to irrigation is to analyze the behavior of an irrigated system over a long period of time. This is done using models. These models simulate how irrigation performs over a long historic record, which may be from 20 to 50 years of data, depending on the available weather databases. The technique applied in these models is a daily water balance that substracts from the soil water at the beginning of the day the daily evapotranspiration, and adds irrigation and effective rainfall. This is similar to substracting withdrawals and adding deposits in a checking account to determine the balance. Figure 6 shows the results of such a simulation for Tampa, FL.

Note that the simulation indicates for some months such as January that the irrigation interval is larger than 30 days. The meaning of this is that at the rate in which water is used during that month, irrigation is required with that frequency. In practice it translates into no irrigation, excepting during hot years when stress is observed.

Table 1 shows irrigation frequencies for the Greater Tampa area. This table can be used to set

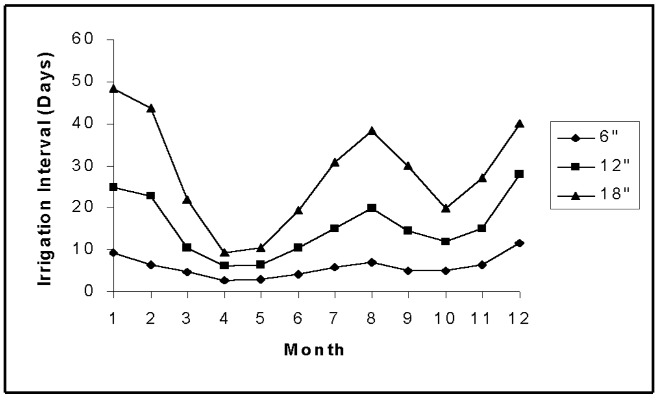

Figure 6. Average turfgrass irrigation interval in Tampa for acceptable turfgrass quality (high water savings.)

irrigation controllers. To use the table select the level of water savings desired (it is strongly recommended that a high water savings level is selected for home or commercial landscapes.) Under the water level, select the column corresponding to the root depth of the irrigated turfgrass. Table 2 shows monthly water use.

The average irrigation frequency for a typical soil varies with root depth. The amount of water required for irrigation decreases as the root depth decreases. This is a result of rainfall becoming more effective because more soil volume is available for storing rainwater. It is very important to irrigate turfgrass in such a way that deep root growth is encouraged. Frequent small applications should be avoided because they result in shallow roots.

Closing Remarks

Substantial amounts of water can be saved when irrigating turfgrass if the following conditions are met:

- The irrigation system is uniform
- Water is applied on a timely basis
- The amount of water applied does not exceed the volume of water that can be stored in the root zone.

Use Table 1 as a general guideline for irrigation. If you are using an irrigation timer use the frequencies in the table, changing the values in the clock according to the frequency shown.

In a very severe drought you may observe that the turfgrass goes into stress. If this is the case start an irrigation cycle only after the stress is visible. Delay irrigation if rainfall is forecasted in the next 2 days.

Recommendations here are based on a typical system where the soil water-holding capacity is 1 in and the irrigation efficiency is 65%.

if you wish to improve the accuracy of your irrigation schedule you can download simulation software from http://www.agen.ufl.edu/~fzazueta/TurfIrr/TurfIrr.htm

Table 1. Monthly Turfgrass Irrigation Volume (Gallons)

Water Savings		High			Medium			Low		
Month	Root Depth	6"	12"	18"	6"	12"	18"	6"	12"	18"
1		829	591	457	953	800	743	1124	1010	829
2		991	857	857	1134	953	1000	1229	991	1172
3		1562	1372	1372	1905	1715	1600	2038	2115	1886
4		2286	2210	2115	2448	2686	2686	2877	3048	3001
5		2315	2439	2429	2743	2858	2658	3315	3258	3172
6		1696	1619	1286	2286	2096	1858	2562	2381	2172
7		1438	1105	657	1886	1543	1143	2229	1810	1543
8		1095	838	657	1410	1124	800	1838	1543	1200
9		1362	1200	1115	1515	1486	1343	1858	1772	1657
10		1553	1410	1229	1886	1829	1572	2096	2153	1829
11		1143	914	657	1362	1105	972	1553	1372	1257
12		781	667	514	895	762	657	1095	972	829
Total		17051	15222	13345	20423	18957	17032	23814	22425	20547

Table 2. Irrigation Intervals for Turfgrass Irrigation in Tampa, FL (Days)

Water Savings		High			Medium			Low		
Month	Root Depth	6"	12"	18"	6"	12"	18"	6"	12"	18"
1		9.3	24.8	48.1	7.6	22.7	38.4	6.5	16.3	29.7
2		6.4	22.6	43.5	5.9	16.5	29.4	5.2	12.2	25.4

Table 2. Irrigation Intervals for Turfgrass Irrigation in Tampa, FL (Days)

Water Savings		High			Medium			Low		
Month	Root Depth	6"	12"	18"	6"	12"	18"	6"	12"	18"
3		4.5	10.3	21.8	3.6	8.3	14.6	3.3	7.1	11.2
4		2.7	6.1	9.2	2.4	5.2	8	1.9	4.4	6.8
5		2.9	6.4	10.4	2.2	5.3	8.7	1.7	4.5	7.7
6		4.1	10.4	19.1	2.9	8.1	14.9	2.5	6.9	11.5
7		5.7	14.9	30.8	4	11.1	20.3	3.2	9.3	16.4
8		6.9	19.9	38.3	5.3	14.2	31	3.7	10.4	19.6
9		4.9	14.3	29.8	4.2	9.7	20.8	3.5	7.9	16.4
10		4.8	11.8	19.7	3.8	9.5	14.8	3.2	7.7	13.4
11		6.4	15	27	5.5	13	22.3	4.8	10.7	18.3
12		11.6	27.8	39.9	9.3	21.6	32.3	7.5	20.2	28