CIR1421

Operation of Residential Irrigation Timers[1]

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Introduction

Automatic landscape irrigation systems have become common in Florida in recent years. Electronic irrigation timers (controllers) are often used to control these irrigation systems; however, it is not always obvious how to program these timers to apply the desired amount of irrigation water. Newer technologies such as smart irrigation timers also must be programmed properly to ensure efficient irrigation (https://edis.ifas.ufl.edu/collections/series_smart_irrigation_controllers). The purpose of this publication is to familiarize irrigation managers, contractors, Extension agents, homeowners, and other interested persons with programming guidelines for an irrigation timer in Florida.

Irrigation Timers

In general, commercially available timers are mechanical, electromechanical, electronic, computer based (Zazueta et al. 2008), or, more recently, cloud based. Regardless of the type of timer, all of them have at least some basic settings in common: the current day of the week and time, day(s) of the week when irrigation will be allowed, the time when the irrigation will start, different irrigation zones (or stations) that will be watered consecutively (one at a time), and the watering time per zone. Details and additional features are discussed below.

Electronic timers are commonly installed in residential and small commercial landscape irrigation systems. We will discuss the general operation common to most residential irrigation timers. For details specific to a given controller, the reader should refer to the owner's manual.

Electronic Timer Operation

Generally, electronic timers allow flexible scheduling of irrigation systems (Figure 1).

Figure 1. Typical residential irrigation timer.
Credits: Bernard Cardenas, UF/IFAS

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Some scheduling options provided by timers are listed below.

Days of the Week

Timers may be set for irrigation every day, every second day, every third day, etc. Typical timers will allow for selection of certain days of the week in a "custom" option or frequency, such as "every Monday," for setting frequency of irrigation. The "custom" option is the one normally used during times of water restrictions, when irrigation is limited to one or two days each week. Always follow local water restrictions when programming a timer.

Run Time

The amount of time that each zone runs may be set from several minutes to several hours. Generally, run time should be less than 60 minutes for Florida's sandy soils. The exact time depends on the system application rate, which can be determined as discussed in the next section. Irrigating longer will lead to movement of water below the root zone, which wastes water.

Percentage Adjustment

Most timers have percentage settings so that the relative run time may be adjusted. For example, if the controller is set to run 60 minutes per cycle, the controller may be set to water at 75%. This will result in 60 minutes × 0.75 = 45 minutes of run time. Likewise, the run times in the other zones will be reduced to 75% of the current zone time setting. This is helpful in Florida when winter begins and the turfgrass is dormant or not actively growing, and irrigation can be cut back.

Program

Timers usually have the capacity to run multiple programs. For example, on program "A," the controller may be set to water six rotor zones for 60 minutes, twice each week. If new plants are planted in a landscape bed, they may need more frequent watering to become established. In this case, program "B" can be used to water that zone every day of the week, until established.

Application Rates

The application rate is the amount of water applied over an area (such as a yard with landscape plants and turfgrass) in a given amount of time. Usually, this is expressed as inches per hour (in/hr) and implies an even application of water. The application rate of an individual irrigation zone must be known to properly set the run time in the irrigation controller.

There are several ways to find the application rate of an irrigation zone. It may be:

1. given by the designer or contractor,
2. calculated from system and/or sprinkler specifications,
3. calculated based on measurements of flow from a water meter, or
4. measured directly by placing catch containers in the irrigated zone of interest.

Application Rate Given by the Designer or Contractor

Although application rates of each individual zone should be calculated by the designer, in practice this is rare.

Application Rate Calculated from System or Sprinkler Specifications

Application rate may be calculated from the system specifications according to the total area method (Equation 1) or from the sprinkler specifications (assuming they are all alike) according to the sprinkler spacing method (Equation 2). Actual application rates may not match calculated rates due to misadjusted sprinklers, wind drift, pressure problems, etc. For these reasons, it is preferred that the actual application rate be verified by measurement as described in the next two sections.

TOTAL AREA METHOD

$$AR = \frac{96.3 \times GPM}{Area}$$

Equation 1.

where:

AR = application rate (in/hr)

GPM = system or zone flow rate (gpm)

Area = total or zone irrigated area (ft^2)

SPRINKLER SPACING METHOD

$$AR = \frac{96.3 \times GPM}{Row \times Col}$$

Equation 2.

where:

AR = application rate (in/hr)

GPM = individual nozzle flow rate (gpm)

Row = spacing of sprinkler rows (ft)

Col = spacing of sprinklers within the rows (ft)

Application Rate Calculated Based on Measurements of Flow from a Water Meter

The quickest and simplest method to measure the actual application rate for each irrigation zone can be determined by running a zone for a specific amount of time, and measuring the area that is irrigated (see example below). If a separate irrigation meter is not installed (which is typical on most homes), the utility meter should be employed, but only when water is not being used in the home. If a separate irrigation meter is available, household water use will not affect the calculations. If a well is used to supply the irrigation system, then a meter must be installed after the pump to use this method.

EXAMPLE

The meter reading before irrigating a single zone was 1000 gallons and the meter reading after irrigating was 1080 gallons. The amount of water used during the irrigation cycle was 1080 – 1000 = 80 gallons. The irrigation time for the zone was 2 minutes. The irrigated area is approximately square and approximately 2000 ft^2. Now the average application rate for the irrigated zone can be calculated by Equation 3.

$$AR = \frac{96.3 \times Gal}{Area \times Time}$$

Equation 3.

where:

AR = application rate (in/hr)

Gal = total volume of water measured by the flow meter (gal)

Area = irrigated area (ft^2)

Time = total time that irrigation was run (min)

Then, according to Equation 3:

$$AR = \frac{96.3 \times 80\ Gal}{2000\ ft^2 \times 2\ min} = 1.9\ in/hr$$

Equation 3.

the application rate for that zone is 1.9 in/hr.

Note: Running a zone for two minutes is a reasonable amount of time to measure its application rate in a residential property.

This method is relatively easy, but unless it is performed for each zone, it will not give the accurate representation of individual zones needed to set the timer. For example, rotors (Figure 2) typically have application rates of 0.25–1.0 in/hr. Traditional or standard heads with fixed spray nozzles (Figure 3) have application rates of 0.75–2.0 in/hr. Meanwhile, standard heads with high-efficiency rotary nozzles (Figure 4) have application rates of 0.4–0.6 in/hr. Due to these wide-ranging application rates, each zone must be measured separately.

Figure 2. Gear-driven rotor irrigation heads.
Credits: Bernard Cardenas, UF/IFAS

Figure 3. Standard head with a fixed spray nozzle.
Credits: Bernard Cardenas, UF/IFAS

Figure 4. Standard head with a high-efficiency rotary nozzle.
Credits: Bernard Cardenas, UF/IFAS

Application Rate Measured Directly Using Catch Containers

Application rate can be measured directly by placing several containers in a given irrigation zone during an irrigation event (Trenholm et al. 2009). This is similar to evaluating the system uniformity (Smajstrla et al. 2005). The containers must be the same shape and size. Old coffee or tuna cans are examples of good containers for this purpose. The rim of the can should be above the turf and the cans should be level. At least six cans per zone should be used; they should be distributed randomly, at least one foot away from the sprinklers. Next, run the irrigation system over a normal cycle. Then, Equation 4 is used to calculate the application rate according to the following example.

EXAMPLE

One irrigation zone is to be tested. Several catch cans are positioned throughout the zone such that overlap from other zones does not contribute to those cans. The average depth of water measured in the cans was 1.25 inches after an irrigation run of 45 minutes.

$$AR = \frac{Depth \times 60}{Time}$$

Equation 4.

where:

AR = application rate (in/hr)

Depth = average depth of the collected water in the catch cans for any one zone (in)

Time = run time of irrigation zone tested (min)

Then, according to Equation 4:

$$AR = \frac{1.25 \times 60}{45} = 1.67\ in/hr$$

Equation 4.

the application rate for that zone is 1.67 in/hr.

Setting the Watering Time of an Irrigation Zone

Once the application rate of a zone is known, then the irrigation watering time can be set for a desired irrigation depth according to Equation 5, with the application rate calculated from Equation 4.

$$Time = \frac{60 \times Depth}{AR}$$

Equation 5.

where:

Time = run time to be programmed into controller (min)

Depth = desired application depth (in)

AR = application rate of that zone (in/hr)

Table 1 gives the calculated times according to Equation 5 based on desired application amount or depth and the application rate of the individual zone or system.

Table 1. Irrigation zone run time (min) for a given application rate and a desired application depth.

Application Rate (in/hr)	Desired Application Amount (in)			
	0.25	0.50	0.75	1.00
0.00	0	0	0	0
0.25	60	120	180	240
0.50	30	60	90	120
0.75	20	40	60	80
1.00	15	30	45	60
1.25	12	24	36	48
1.50	10	20	30	40
1.75	9	17	26	34
2.00	8	15	23	30

Seasonal Setting of Irrigation Timers

The objective of irrigation is to replenish the water in the plant roots to avoid excessive plant stress. For landscape plants, especially turf, where the objective is to maintain the appearance and not to produce the highest amount of biomass, it is usually sufficient to aim for 60% to 100% replacement of water in the root zone.

Augustin (2000) calculated the net irrigation requirement of turfgrass for several geographical areas and based on effective rainfall. Effective rainfall takes into account the low water-holding capacity of Florida's soils (Trenholm et al. 2013; Zazueta et al. 2021). Net irrigation requirement is the amount of irrigation water that must be delivered to the crop. This does not consider irrigation losses such as pipeline leakage, wind drift, non-uniform application, etc.

Tables 2–9 present a suggested irrigation controller time setting assuming two irrigation events per week, and an irrigation system efficiency of 60% for application rates of 0.25 in/hr, 0.50 in/hr, 0.75 in/hr, 1.00 in/hr, 1.25 in/hr, 1.50 in/hr, 1.75 in/hr, and 2.00 in/hr, respectively. Three regions are represented in Tables 2–9: north (Gainesville), central (Orlando), and south (Miami). In addition, three levels of replacement are presented. It is desirable to irrigate at the lowest possible level of replacement without causing an unacceptable decline in turf or landscape quality. Two irrigation events per week were assumed, since this is a common practice due to watering restrictions. Any irrigation time exceeding 60 minutes may result in water leaching below the root zone and should be split into two applications at least four hours apart (i.e., morning and evening) to allow plants to use part of the already-applied water. If the measured or calculated application rate does not exactly correspond to those given in the table, use the closest rate. For example, if a homeowner measures an application rate of 0.6 in/hr, the table with the 0.5 in/hr application rate (Table 3) should be used.

Setting Microirrigation Zones

Microirrigation zones, sometimes called "drip" irrigation, are becoming popular for landscape beds due to their ease of use and low use of water. There are several types of microirrigation emitters (Figures 5, 6, 7, and 8). More information on those emitters and how they are defined can be found in "Retrofitting a Traditional In-Ground Sprinkler Irrigation System for Microirrigation of Landscape Plants" (Haman et al. 2002). Typically, microirrigation does not wet the entire root zone; therefore, the application rate concept does not apply. These emitters have various emission rates, usually in gallons per hour. General guidelines on how many gallons are required for landscape plants can be found in "Fertilization and Irrigation Needs for Florida Lawns and Landscapes" (Klein et al. 2023). Once the gallons required are known, then the irrigation controller may be set according to Equation 6, assuming one emitter per plant. Application depth may be difficult to calculate if information on gallons of irrigation is not known for a particular plant type. In this case, microirrigation zones should be set initially for a one-hour run time, two times each week. These zones can be reduced 15 minutes each cycle every week until plants show stress.

$$Time = \frac{60 \times Gal}{GPH}$$

Equation 6.

where:

Time = microirrigation run time (min)

Gal = volume of irrigation water required for a plant (gal)

GPH = emission rate of a drip emitter (gph)

Figure 5. Individual drip emitters.
Credits: Dorota Haman, UF/IFAS

Figure 6. Drip tube or tape.
Credits: Dorota Haman, UF/IFAS

Figure 7. Bubbler.
Credits: Dorota Haman, UF/IFAS

Figure 8. Microjet or microspray.
Credits: Dorota Haman, UF/IFAS

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Abbreviations

in—inches

gal—gallons

hr—hour

gpm—gallons per minute

gph—gallons per hour

min—minutes

ft—feet

ft^2—square feet

Table 2. Irrigation controller run time (min) for each of two irrigation events per week at an application rate of 0.25 in/hr, assuming system efficiency of 60%, and considering effective rainfall*.

	North Florida			Central Florida			South Florida		
	Percent Replacement								
	60%	80%	100%	60%	80%	100%	60%	80%	100%
Jan	0	2	0	23	31	38	57	76	94
Feb	0	2	0	17	22	28	61	80	100
Mar	10	14	17	34	46	57	85	113	141
Apr	59	79	99	81	108	134	91	121	151
May	100	134	167	128	171	214	83	110	138
Jun	90	120	150	100	133	167	75	100	126
Jul	84	112	140	97	130	162	117	156	195
Aug	77	103	129	127	169	211	129	172	215
Sep	98	131	164	95	127	159	77	102	128
Oct	64	86	107	86	115	143	31	41	51
Nov	40	54	67	64	85	106	80	106	133
Dec	16	21	26	32	43	54	71	94	118

*If the controller only allows 15-min incremental changes, use the increment closest to the numbers in the table.

Table 3. Irrigation controller run time (min) for each of two irrigation events per week at an application rate of 0.50 in/hr, assuming system efficiency of 60%, and considering effective rainfall*.

	North Florida			Central Florida			South Florida		
	Percent Replacement								
	60%	80%	100%	60%	80%	100%	60%	80%	100%
Jan	0	0	0	12	15	19	28	38	47
Feb	0	0	0	0	11	14	30	40	50
Mar	0	0	0	17	23	28	42	56	70
Apr	30	40	49	40	54	67	45	60	76
May	50	67	84	64	85	107	41	55	69
Jun	45	60	75	50	67	83	38	50	63
Jul	42	56	70	49	65	81	59	78	98
Aug	39	51	64	63	85	106	64	86	107
Sep	49	66	82	48	64	80	38	51	64
Oct	32	43	54	43	57	72	15	20	26
Nov	20	27	34	32	43	53	40	53	67
Dec	0	10	13	16	21	27	35	47	59

*If the controller only allows 15-min incremental changes, use the increment closest to the numbers in the table.

Table 4. Irrigation controller run time (min) for each of two irrigation events per week at an application rate of 0.75 in/hr, assuming system efficiency of 60%, and considering effective rainfall*.

	North Florida			Central Florida			South Florida		
	Percent Replacement								
	60%	80%	100%	60%	80%	100%	60%	80%	100%
Jan	0	0	0	0	10	13	19	25	31
Feb	0	0	0	0	0	0	20	27	33
Mar	0	0	0	11	15	19	28	38	47
Apr	20	26	33	27	36	45	30	40	50
May	33	45	56	43	57	71	28	37	46
Jun	30	40	50	33	44	56	25	33	42
Jul	28	37	47	32	43	54	39	52	65
Aug	26	34	43	42	56	70	43	57	72
Sep	33	44	55	32	42	53	26	34	43
Oct	21	29	36	29	38	48	10	14	17
Nov	13	18	22	21	28	35	27	35	44
Dec	0	0	0	11	14	18	24	31	39

*If the controller only allows 15-min incremental changes, use the increment closest to the numbers in the table.

Table 5. Irrigation controller run time (min) for each of two irrigation events per week at an application rate of 1.00 in/hr, assuming system efficiency of 60%, and considering effective rainfall*.

	North Florida			Central Florida			South Florida		
	Percent Replacement								
	60%	80%	100%	60%	80%	100%	60%	80%	100%
Jan	0	0	0	0	0	0	14	19	24
Feb	0	0	0	0	0	0	15	20	25
Mar	0	0	0	0	11	14	21	28	35
Apr	15	20	25	20	27	34	23	30	38
May	25	33	42	32	43	53	21	28	34
Jun	22	30	37	25	33	42	19	25	31
Jul	21	28	35	24	32	41	29	39	49
Aug	19	26	32	32	42	53	32	43	54
Sep	25	33	41	24	32	40	19	26	32
Oct	16	21	27	21	29	36	0	10	13
Nov	10	13	17	16	21	27	20	27	33
Dec	0	0	0	0	11	13	18	24	29

*If the controller only allows 15-min incremental changes, use the increment closest to the numbers in the table.

Table 6. Irrigation controller run time (min) for each of two irrigation events per week at an application rate of 1.25 in/hr, assuming system efficiency of 60%, and considering effective rainfall*.

	North Florida			Central Florida			South Florida		
	Percent Replacement								
	60%	80%	100%	60%	80%	100%	60%	80%	100%
Jan	0	0	0	0	0	0	11	15	19
Feb	0	0	0	0	0	0	12	16	20
Mar	0	0	0	0	0	11	17	23	28
Apr	12	16	20	16	22	27	18	24	30
May	20	27	33	26	34	43	17	22	28
Jun	18	24	30	20	27	33	15	20	25
Jul	17	22	28	19	26	32	23	31	39
Aug	15	21	26	25	34	42	26	34	43
Sep	20	26	33	19	25	32	15	20	26
Oct	13	17	21	17	23	29	0	0	10
Nov	0	11	13	13	17	21	16	21	27
Dec	0	0	0	0	0	11	14	19	24

*If the controller only allows 15-min incremental changes, use the increment closest to the numbers in the table.

Table 7. Irrigation controller run time (min) for each of two irrigation events per week at an application rate of 1.50 in/hr, assuming system efficiency of 60%, and considering effective rainfall*.

	North Florida			Central Florida			South Florida		
	Percent Replacement								
	60%	80%	100%	60%	80%	100%	60%	80%	100%
Jan	0	0	0	0	0	0	0	13	16
Feb	0	0	0	0	0	0	0	13	17
Mar	0	0	0	0	0	0	14	19	23
Apr	0	13	16	13	18	22	15	20	25
May	17	22	28	21	28	36	14	18	23
Jun	15	20	25	17	22	28	13	17	21
Jul	14	19	23	16	22	27	20	26	33
Aug	13	17	21	21	28	35	21	29	36
Sep	16	22	27	16	21	27	13	17	21
Oct	11	14	18	14	19	24	0	0	0
Nov	0	0	11	11	14	18	13	18	22
Dec	0	0	0	0	0	0	12	16	20

*If the controller only allows 15-min incremental changes, use the increment closest to the numbers in the table.

Table 8. Irrigation controller run time (min) for each of two irrigation events per week at an application rate of 1.75 in/hr, assuming system efficiency of 60%, and considering effective rainfall*.

	North Florida			Central Florida			South Florida		
	Percent Replacement								
	60%	80%	100%	60%	80%	100%	60%	80%	100%
Jan	0	0	0	0	0	0	0	11	13
Feb	0	0	0	0	0	0	0	11	14
Mar	0	0	0	0	0	0	12	16	20
Apr	0	11	14	12	15	19	13	17	22
May	14	19	24	18	23	31	12	16	20
Jun	13	17	21	14	19	24	11	14	18
Jul	12	16	20	14	19	23	17	22	28
Aug	11	15	18	18	23	30	18	25	31
Sep	14	19	23	14	18	23	11	15	18
Oct	0	12	15	12	16	20	0	0	0
Nov	0	0	0	0	12	15	11	15	19
Dec	0	0	0	0	0	0	10	13	17

*If the controller only allows 15-min incremental changes, use the increment closest to the numbers in the table.

Table 9. Irrigation controller run time (min) for each of two irrigation events per week at an application rate of 2.00 in/hr, assuming system efficiency of 60%, and considering effective rainfall*.

	North Florida			Central Florida			South Florida		
	Percent Replacement								
	60%	80%	100%	60%	80%	100%	60%	80%	100%
Jan	0	0	0	0	0	0	0	0	12
Feb	0	0	0	0	0	0	0	0	12
Mar	0	0	0	0	0	0	11	14	18
Apr	0	0	12	10	13	17	11	15	19
May	13	17	21	16	21	27	10	14	17
Jun	11	15	19	12	17	21	0	13	16
Jul	10	14	17	12	16	20	15	20	24
Aug	0	13	16	16	21	26	16	21	27
Sep	12	16	20	12	16	20	0	13	16
Oct	0	11	13	11	14	18	0	0	0
Nov	0	0	0	0	11	13	0	13	17
Dec	0	0	0	0	0	0	0	12	15

*If the controller only allows 15-min incremental changes, use the increment closest to the numbers in the table.