AE472

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Frequency of Residential Irrigation Maintenance Problems[1]

Thomas R. Olmsted and Michael D. Dukes[2]

Introduction

An improperly functioning residential in-ground irrigation system may result in some areas of the landscape showing stress while other areas are well watered. Alternatively, the poorly functioning irrigation system may be applying excess water, resulting in damage to landscape plants and loss of nutrients from the soil. The causes of the poorly functioning irrigation system may be from an inefficient design, improper installation and/or inadequate system maintenance over time.

A poorly designed irrigation system or one installed improperly may not have head-to-head sprinkler spacing, matched application rates of rotor sprinkler nozzles, or spray heads in the same zone. It could also have plants with different water requirements located in the same irrigation zone (Smith 1997). Improper maintenance issues may include clogged or leaking sprinklers, sprinklers obstructed by plant material, and misadjusted sprinklers that over-spray onto sidewalks or streets (*Basic Repairs and Maintenance for Home Landscape Irrigation Systems* found at http://edis.ifas.ufl.edu/ae451).

Irrigation system audits or inspections provide a method of determining the condition of the components and the application uniformity of coverage. In Florida, a fleet of Mobile Irrigation Labs (MILs) provide auditing services to analyze irrigation systems and educate property owners on how to improve water use and promote conservation. The MILs give recommendations on the improvement of existing irrigation systems and equipment, and educate their customers and the general public on water conservation, irrigation planning, and irrigation management. Originally developed for agricultural purposes, now Urban Mobile Irrigation Labs (UMILs) perform the same service for residential clients. The service areas covered by an MIL or UMIL in Florida can be located from the Florida Department of Agriculture and Consumer Services' website at: http://www.floridaagwaterpolicy.com/MobileIrrigationLabs.html.

An UMIL has three levels of evaluation (Palm Beach Soil & Water Conservation District 2008):

1. visual inspection

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2. Thomas R. Olmsted, graduate research assistant, and Michael D. Dukes, associate professor, Agricultural and Biological Engineering Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, 32611.

2. pressure and flow check
3. catch can test (optional)

First, visual inspections are conducted to determine if the system is in disrepair (leaks, broken sprinkler heads, etc.) or has poor coverage. If the system is found to be in poor condition, the other levels of evaluation are not carried out until the repairs are made. Pressure and flow checks on individual sprinkler heads or emitters are carried out next. Catch can tests can be used to measure irrigation uniformity and the application rate (how fast the sprinklers apply water) of an irrigation zone. In the urban setting, the catch can test for distribution uniformity is rarely done by the auditors because it is very time consuming. In a typical residential irrigation system with 4 zones, it would take a significant amount of time to complete the steps for the test (laying out the small cans in each zone, running the irrigation for the set amount of time, and then recording all the volumes). Experienced auditors can visually assess poor distribution caused by maintenance issues or inadequate irrigation design. Another way the auditors calculate the application rate of an irrigation zone is to run the zone for a set time and record the volume observed from the water meter converted to depth over the zone's irrigated area.

Under the visual inspection, the technician has a list of 34 codes to describe the problems seen in the irrigation system as shown in Table 1 (the same codes are used for agricultural audits). Any one residence may have multiple problem codes.

Analyzing the frequency or number of times an irrigation maintenance problem occurs will provide a list of the most common irrigation maintenance problems in the residential irrigation system. Knowing the most common problems should increase awareness, which will lead to prevention or corrective action of these problem areas and help reduce water wasted with in-ground irrigation systems.

Procedure

Urban Mobile Irrigation Lab audit information was obtained from the Florida Department of Agriculture and Consumer Services. It consisted of the problem codes per UMIL audits from about 2003 to 2007. After removal of incomplete and corrupted data, the problem codes of 3,416 audits of urban irrigation systems remained.

The frequency of occurrence of each code in all 3,416 audits was tabulated and then the codes were ranked from the most frequent occurrence to the least.

The UMIL audits were concentrated mainly in south Florida.

Results

In the sample of 3,416 residential irrigation systems evaluated by the Florida UMILs, the quantity of problems per audit (or home) ranged from 1 to 18. There were no homes that did not have at least one problem. The first eleven most frequent problem areas represent 80% of all the problems recorded and are listed in Table 2.

Five problem areas represent half of all recorded problems. They are as follows:

1. Turf and landscape area irrigated in the same zone
2. Mixed sprinkler/emitter sizes & unmatched application rates in the same zone
3. Stream of water blocked by vegetation
4. Operating time too frequent
5. Operating time too long

Turf and landscape area irrigated in the same zone

In 70% of the residential systems evaluated, the turf and landscape (ornamental beds) areas were irrigated by the same zone. This means that ornamentals and turfgrass are irrigated simultaneously because an irrigation zone covers both types of plant material (Figure 1). In most cases, ornamentals need less frequent irrigation than turfgrass. If the zone is programmed with a run-time for the water requirement of the turfgrass, the result could be over-irrigation of the ornamentals.

Figure 1. Ornamentals and turfgrass being irrigated from the same irrigation zone. Note: the spray head in the background is irrigating the ornamentals and the rotary sprinkler is irrigating the turfgrass in the foreground (photo by Michael Gutierrez).

How this is "fixed" depends on the severity of overlap. A few nozzles hitting the ornamentals will probably not justify changing the system. However, if there are rotor sprinklers or spray heads designed for turf irrigation irrigating ornamentals beds instead, they probably should be replaced with a lower flow-rate sprinkler or removed altogether.

On newly installed irrigation systems, this overlapping of two different plant materials should be avoided. The irrigation contractor should have the landscape plans and install the irrigation system zones according to plant type. Correcting this problem has a potential to save water, depending on how many spray heads or rotor sprinklers are removed (Table 3).

Mixed sprinkler/emitter sizes & unmatched application rates in the same zone

Mixing sprinkler types with different flow rates or application rates in the same zone was found to be the next most frequently occurring problem (Figure 2). For pictures of the different sprinkler types see *Operation of Residential Irrigation Controllers* at http://edis.ifas.ufl.edu/ae220. The result of this problem could be either over- or under-irrigation of part of the zone. If the rotor or spray head has a higher application rate than designed, the plant may not effectively use the excess water. If the application rate of an individual rotor sprinkler or spray head is less than designed, the homeowner may see that area is drier than the rest of the zone and increase the run-time to compensate, over- irrigating the other areas of the zone.

Figure 2. Mixed sprinkler types. Note: rotary sprinkler in foreground and spray heads in background (photo by Bernard Cardenas).

Unmatched application rate rotor sprinklers or spray heads can easily be fixed by changing out the incorrect nozzle and installing the correct one. The size of the mismatch will determine the quantity of water saved. Changing out the nozzles should involve only a moderate investment of time and money (Table 3).

Stream of water blocked by vegetation

The next most often occurring problem is the water stream from the sprinkler is deflected or blocked by vegetation (Figure 3). When the water hits vegetation close to the sprinkler, it is concentrated in certain areas and prevents spray uniformity. In older homes, either the vegetation could have grown substantially since the irrigation system installation or the system was installed without the proper risers to clear the vegetation. If the stream of water is being blocked, then the plant material on the other side is not receiving the water the system was designed to deliver. This could stress the plant material or possibly result in an ill-advised decision to increase run-times to try to compensate for the lack of water in those areas.

If vegetation is blocking a stream of water from a nozzle, the options to fix it include cutting or trimming the vegetation, installing a new sprinkler with a higher riser, moving or removing the offending sprinkler or spray head, or replacing vegetation in the area not receiving water with drought-tolerant plants. Any water savings after fixing the problem may be minimal and depend on the area being blocked and the type of vegetation not receiving the full coverage. If the water blockage is

Figure 3. Blocked water spray (photo by Bernard Cardenas).

causing turf stress, then one of the repair options should be considered (Table 3).

Operating time too frequent and Operating time too long

Two issues occurring in about 50% of the homes audited dealt with the irrigation timer. Either the timer was set to run (irrigate) too frequently and/or too long (longer than necessary run-time per zone). These homes were probably not following the days of the week watering restrictions set by the water management district or the local water utility. Given the same run-times, irrigating 3, 5, or 7 days a week will result in more water usage and over-irrigation than irrigating with the same run-time 1 or 2 days a week. When the irrigation timers are set for a longer duration or run-time per zone than necessary the irrigation water will probably exceed the water-holding capacity of the soil. The excess water will either runoff or be lost to deep drainage.

These problems can easily be changed by re-programming the irrigation time clock. A properly set irrigation time clock can reduce irrigation water use by 30% (Haley et al. 2007). This change has the potential to quickly save a significant amount of water. Instructions on programming the irrigation time clock can be found in *Operation of Residential Irrigation Controllers* at http://edis.ifas.ufl.edu/ae220. Changing the time clock settings may be the most cost-effective change to save irrigation water (Table 3).

Smart irrigation controllers

To lessen the need for homeowners to worry about the settings on their irrigation controller/timer, the irrigation industry has developed "smart" irrigation controllers. The two types are as follows:

- evapotranspiration-based controllers
- soil moisture sensor controllers

(For more information on the application of these "smart" controllers in the residential irrigation system see: *Smart Irrigation Controllers: What Makes an Irrigation Controller Smart?* found at http://edis.ifas.ufl.edu/ae442.)

The evapotranspiration-based controllers operate using weather data and site specific inputs such as sprinkler and plant type. The controllers calculate the water requirement of the plants during a time period and adjust or operate the irrigation system to replenish the water lost by the plant (evapotranspiration). See: *Smart Irrigation Controllers: Operation of Evapotranspiration-Based Controllers* found at http://edis.ifas.ufl.edu/ae446.

Soil moisture sensor controllers measure the actual soil moisture where plant roots are located. When the soil moisture goes below a certain value (measured by how dry the soil is) the irrigation system is allowed to irrigate. Conversely, if the soil moisture is above that value, then there is sufficient moisture in the soil for plant growth and the irrigation system will not be allowed to irrigate. See: *Smart Irrigation Controllers: How Do Soil Moisture Sensor (SMS) Irrigation Controllers Work?* found at http://edis.ifas.ufl.edu/ae437.

Both of these types of "smart" irrigation controllers can save water over conventional irrigation time clocks with no control device. Once set up properly these controllers can relieve the burden of changing the irrigation controller/timer to match the changing landscape water needs (*Energy Efficient Homes: The Irrigation System* found at http://edis.ifas.ufl.edu/fy1043).

Conclusion

The majority of Florida in-ground irrigation systems have some type of maintenance problem that could be causing excessive water use. Inspections should be done on a regular basis. The Florida UMILs are qualified to do these inspections and will provide them free of charge. Homeowners not in a UMIL service area but who would like to have their irrigation system inspected should call their local water utility. They may offer a similar program or can recommend some qualified irrigation contractors.

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Table 1. UMIL Problem Codes (Palm Beach Soil & Water Conservation District 2008)

Code	Description of Problems
	Pressure / Application Rate
1	Under-sized pump for number and type of sprinkler heads or emitters
2	Pressure loss between pump and sprinklers/emitters due to inadequate pipe size
3	Higher pressure than manufacturer's specifications
4	Lower pressure than manufacturer's specifications
5	Low pressure due to water supply
6	Different pressure between manifolds
7	Small wetted area
8	Application rate > soil infiltration rate (ponding)
9	Air in pipelines
10	Turf and landscape area irrigated in the same zone
11	Pressure variation due to elevation differences
	Emitters / Sprinklers
20	Mixed sprinkler/emitter sizes & unmatched application rates in the same zone
21	Mixed sprinkler/emitter brands or types in the same zone
22	Poor emitter/sprinkler uniformity due to worn orifice
23	Poor overlap due to improper sprinkler/emitter alignment or spacing
24	Various riser heights in same zone
25	Emitter/sprinkler spacing varies in same zone
26	Missing/malfunctioning emitters or sprinklers
27	Missing/malfunctioning pressure gauge/regulator/filter
	Maintenance - Irrigation System
30	Leaks and broken valves, pipe, laterals lines (Poly-tubing), emitters, sprinklers
31	Clogged filter or filter screen
32	Sprinkler heads not properly adjusted, causing overflow on paved areas
33	Clogged emitters/nozzles (due to biological, chemical, or physical factors)
34	Leaning sprinklers/emitters causing non-uniform distribution
35	Malfunctioning valves
	Maintenance – Landscape
40	Stream of water blocked by vegetation
41	Variable crop spacing and stage of growth
42	Poor drainage, requiring water control
	Operation / Management
50	Operating time too long
51	Operating time too short
52	Operating time too frequent
53	No rain shut-off device
54	No soil moisture measuring device or rain gauge
55	No irrigation water management plan

Table 2. Eleven Most Frequent Problems in Residential Evaluations of 3,416 Homes.

Code/ Problem	Frequency of Occurrence	On Percent of Homes Evaluated	As a Percent of Total Problems	Cumulative Percent of Total
10/ Turf and landscape area irrigated in the same zone	2,419	70.8	11.7	11.7
20/ Mixed sprinkler/emitter sizes & unmatched application rates in the same zone	2,246	65.7	10.9	22.6
40/ Stream of water blocked by vegetation	2,029	59.4	9.8	32.5
52/ Operating time too frequent	1,827	53.5	8.9	41.3
50/ Operating time too long	1,773	51.9	8.6	49.9
32/ Sprinkler heads not properly adjusted, causing overflow on paved areas	1,333	39.0	6.5	56.4
21/ Mixed sprinkler/emitter brands or types in the same zone	1,252	36.7	6.1	62.4
53/ No rain shut-off device	1,076	31.5	5.2	67.7
30/ Leaks and broken valves, pipe, laterals lines (Poly-tubing), emitters, sprinklers	971	28.4	4.7	72.4
55/ No irrigation water management plan	782	22.9	3.8	76.2
23/ Poor overlap due to improper sprinkler/emitter alignment or spacing	729	21.3	3.5	79.7

Table 3. Estimated Effort, Cost, and Water Savings of the Top 5 UMIL Problem Areas.

Irrigation Problem	Effort Required to Repair	Average Cost to Repair	Expected Water Savings
Turf and landscape area irrigated in same zone	moderate	high	moderate
Mixed sprinkler sizes and unmatched application rates in the same zone	moderate	moderate	moderate
Stream of water blocked by vegetation	moderate	moderate	low
Operating time too frequent	low	low	high
Operating time too long	low	low	high