A Practical Guide to Managing Irrigations on Turfgrass

Agricultural Science Center - Farmington

College of Agriculture and Home Economics

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Dan Smeal, Certified Irrigation Designer and Landscape Irrigation Auditor

New Mexico State University, Agricultural Science Center at Farmington

More than half of the total water used in urban areas of the southwest during the summer months is used for irrigating landscapes, primarily turfgrass. Recurring droughts and ever-increasing demands for the limited water supplies in the region may decrease the volumes available for this purpose in the future. By carefully scheduling irrigations, potential adverse effects of these reduced water supplies on landscape quality can be mitigated. To efficiently schedule irrigations on turfgrass, you must be familiar with your irrigation system, the water requirements of your grass, and your soil. Your goal should be to maintain an acceptable quality landscape while minimizing water waste through runoff or deep percolation below the root zone. Presented here are some simple guidelines that can be used to accomplish this goal.

The Irrigation System

Irrigations cannot be scheduled effectively without knowing the water output of your irrigation system, whether that system is an elaborate sprinkler or drip system, a solitary sprinkler, or an open hose. This requires an irrigation-system audit. The first steps of the audit include the inventory, evaluation, and maintenance of the system's components.

Sprinkler Systems

A sketch of the system should be drawn showing the location of sprinkler heads, valves, gauges, and controls. Distances between these components, along with pipe sizes, if known, should be indicated. Identify the make, model, and size of all components, including the orifice diameter of sprinkler nozzles, if possible. The make and model should be stamped on the upper surface of pop-up sprinklers and nozzles are commonly color-coded for size. Turn the system on and evaluate its operation. Insure that all sprinklers are operating properly and that all nozzles are adjusted to water only turf areas (not sidewalks, driveways, streets or structures). Normally, sprinkler patterns should be smooth and even and, if the system is properly designed, the spray from each sprinkler should just reach the neighboring sprinkler. Clean out clogged nozzles and screens and remove obstructions, such as tall grass, weeds, etc. that disrupt water distribution. Repair or replace all broken or leaking water pipes, sprinklers, risers, valves, or other faulty components. If you need assistance, contact the sprinkler manufacturer or dealer.

http://www.rainbird.com/landscape/index.htm
http://www.hunterindustries.com/homeowners.html
http://www.toro.com/sprinklers/index.html

After making the necessary repairs and adjustments, the system's output (or precipitation rate) can be determined. Each zone (sprinklers controlled from a single valve) should be evaluated separately. Conduct the evaluation at the same time of day you normally irrigate. Preferably, this would be when winds and evaporation rates are low. Place empty tuna, soup, or other short, straight-sided cans in a grid-like or random pattern within the irrigated area. The more cans the better. Draw the approximate locations of each can on a copy of your system diagram. Operate the system for a measured time period (i.e. 15 to 30 minutes). Measure the depth of water in each can with a ruler and record the measurements at the appropriate can locations on the diagram. To calculate an average water application depth, divide the sum of all measurements by the number of measurements. To calculate the average precipitation rate in inches per hour, divide the average application depth by the number of minutes the system was operated and then multiply by 60. To determine the application uniformity of the system, compare the depth measurements from each can to the average depth. Ideally, no single measurement should deviate from the average depth by more than 20%. For more information see:

City of Albuquerque Irrigation Audit Manual: An Irrigation Management Field Guide By Frank, Luke and Kevin Bean. Request copy from: City of Albuquerque Public Works Dept., Water Conservation Office P.O. Box 1293 Albuquerque, NM 87103 1-505-768-3655, 1-505-768-2477 TTY, or Relay NM 1-800-659-8331.
http://aggie-horticulture.tamu.edu/greenhouse/hortgardens/conservation/agentdemo1.pdf

If all system components appear to be working properly but repeated tests indicate poor application uniformity, the system may have design flaws or inadequate pressure to operate all sprinklers on the zone properly. If a pressure gauge is not already installed at the zone valve, available water pressure can be determined by connecting a water-pressure gauge (available from local plumbing or irrigation dealer) to an outdoor faucet near the irrigation system valve. Open the faucet completely but do not allow water to flow (including from faucets inside house). This will provide a reading of the 'static' water pressure. Water-meter pressures generally fall within a range of 35 to 95 pounds per square inch (psi). For more details see:

http://www.jessstryker.com/sprinkler03.htm

If possible, replace the sprinkler farthest away from the irrigation supply valve with a pressure gauge (may require specialized fittings) and take a pressure reading at this location while the system is operating. A significant drop in pressure (15-20%) from the main valve to the farthest sprinkler may indicate pipe leakage or system design flaws. You, your dealer, or the sprinkler manufacturer should be able to identify design flaws of the system by referring to the sprinkler specifications.

Other systems

The average gross precipitation rate (PR) can also be determined using the home's water meter or other flow meter. While this method is particularly useful for flood or drip irrigation, it provides no indication of your system's application uniformity. Prior to starting the irrigation system, make sure all other water valves downstream of the meter (i.e. sinks, toilets, showers, etc.) are closed, and remain closed during the test. Record the water meter reading. Operate the system for a measured number of minutes and take another meter reading. To calculate the flow rate in gallons per minute (FR), divide the total gallons used (2nd reading minus 1st reading) by the number of minutes of operation. Measure the turf area (A) wetted by the system in square feet (length [ft] x width [ft]). The average gross precipitation rate can then be computed using the following formula:

$$PR = (96.3 \times FR)/A$$

Where:

PR = gross precipitation rate in inches/hour
FR = gallons of water used per minute
A = area wetted by the sprinklers in square feet

If only a single sprinkler or open hose is used for irrigation. The flow rate can be simply determined by measuring the time it takes to fill a five gallon bucket full of water with the sprinkler or hose. Precipitation rate can then be calculated as above.

The Turf

Once you have determined the precipitation rate of the irrigation system, you can time your irrigations accordingly to satisfy the water needs or evapotranspiration (ET) rates of the grass. Table 1 shows the estimated average daily ET rates of cool season (Kentucky bluegrass, perennial ryegrass, and fescue) and warm season (buffalograss, bermudagrass, and blue gramagrass) turfgrasses in northwestern New Mexico throughout the growing season based on research conducted at New Mexico State University's Agricultural Science Center at Farmington over a three-year period. The first and second values shown in each column represent the average daily water-use during the first and second halves of the month, respectively. Note that warm season grasses used less total water during a typical season than cool season grasses (25 inches vs. 37 inches, respectively).

Table 1. Average daily water-use (ET) of cool season and warm season turfgrasses growing on a level, non-shaded area near Farmington, New Mexico. 1998-2000.

Turfgrass	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	Total
	inch/day (first half of month-last half of month)							
Cool Season	0.08-0.10	0.17-0.20	0.22-0.23	0.24-0.23	0.22-0.20	0.17-0.15	0.11-0.08	37
Warm Season	0-0.07	0.11-0.14	0.16-0.18	0.19-0.19	0.18-0.17	0.14-0.11	0.07-0	25

The Soil

While your irrigations should be timed to apply just enough water to replace the estimated ET since the previous irrigation, to prevent deep water drainage or runoff, the length of time between irrigations (irrigation frequency) and the length of each irrigation cycle (irrigation duration) should also be based on your soil type. This is due to variability in the water holding capacities and water intake rates (the maximum rate that a soil can absorb water) between different soil types (Table 2).

Table 2. Approximate available water-holding capacities and water intake rates of various soils.

SOIL TYPE	WATER HOLDING CAPACITY (inches/foot)	BASIC INTAKE RATE (inches/hour)
Sands and Sandy Loams	0.5 to 1.5	0.5 to 1.0
Loams	1.5 to 2.0	0.25 to 0.5
Clays	2.0 to 2.4	0.10 to 0.25

To prevent water stress and maintain turf quality in cool season turf, it is recommended that no more than 50% of available soil water be extracted from the top foot of soil before applying the next irrigation. In a sandy soil, having an available water holding capacity of 1 inch per foot, for example, ½ inch of water (50% of 1 inch) could be used before irrigating. If the ET rate was 0.17 inches per day, such as in early May, the grass would require a ½ inch irrigation about every three days (0.5/0.17 = 2.9). Because sandy soil has a relatively high intake rate, the entire 0.5 inch of irrigation could probably be applied in a single irrigation without causing runoff. In a clay soil, having a water holding capacity of 2.0 inches per foot, the next irrigation would be applied when 1 inch of soil water was extracted (50% of 2.0). At an estimated turf ET rate of 0.17 inch per day, irrigation frequency could be extended to about every 6 days (1.0/0.17 = 5.9). Due to the low intake rate of a clay soil however (Table 2), irrigations may have to be cycled on and off several times, depending on the precipitation rate of the irrigation system, to prevent runoff. Similar computations are used for warm season turf, but, due to the deeper root system and higher tolerance to water stress, evidence suggests that up to 60% of available water can be extracted in the top 18 inches of soil before applying subsequent irrigations.

The ET rates shown in Table 1 are for grasses grown on a level, open, non-shaded area. These baseline values should be adjusted for the microclimatic conditions at any specific site. In shady or protected areas, or on north slopes, for example, actual turf ET rates will be lower than those shown. On south facing slopes, or where heat is reflected from structures, pavement, etc. actual ET rates may be higher. A soil-sampling probe or other probing tool (i.e. long screwdriver) can be used to check the soil moisture at various locations throughout the landscape to identify potential trouble spots. If the probe easily penetrates the soil to a depth of 8 to 12 inches, soil moisture should be sufficient for turf growth. If obvious, recurring dry or wet spots are found that cannot be attributed to the uniformity of the irrigation system, the system may require modification (resizing of nozzles, adding or changing sprinklers, etc.) to more efficiently water these areas. Keep in mind that if you ‘irrigate for the dry spots’ you’ll be over-irrigating the rest of the lawn.

Other ways to conserve water in the landscape include installation of micro-irrigation systems in flowerbeds and other non-turf areas and selection of drought tolerant plants (xeriscaping). It's important to remember, however, that no matter how efficient the design of an irrigation system, water conservation depends upon the wise operation of that system.

Questions? Comments?
Contact Dan Smeal at dsmeal@nmsu.edu (phone: 505-327-7757).

* This guide is based on research and literature reviewed by the author who is wholly responsible for its content.