UNIVERSITY of CALIFORNIA
Agriculture & Natural Resources

University of California Cooperative Extension

1754 Walnut Street, Red Bluff, CA 96080
(530)-527-3101
http://cetehama.ucdavis.edu

A publication from the University of California Cooperative Extension seeking to support wise and judicious use of limited water and land resources in the Northern Sacramento Valley.,

Homeowner's Guide to Turf Grass Irrigation

Maintaining an Attractive Lawn while Conserving Water and Reducing Energy Costs

(Publication can be accessed and printed from web site at http://cetehama.ucdavis.edu)

Allan E. Fulton
Prepared by Allan Fulton
Irrigation/Water Resource Advisor
Tehama, Shasta, Glenn and Colusa Counties

Introduction

Irrigation is possibly the most important cultural practice that a homeowner can manage to achieve a healthy and long-lasting lawn. It is usually the most expensive aspect of yard care after the lawn is established.

Errors in lawn irrigation commonly lead to secondary problems. Common problems are increased fungal diseases due to over-watering or irrigating during the wrong time of the day, nutritional deficiency from leaching of nutrients such as nitrogen, and aggressive weed competition due to loss of turf stand either from over or under-irrigation.

This guide provides information specific to the northern Sacramento Valley on the water requirements of turf. It compares these needs to seasonal rainfall patterns and clarifies the extent that supplemental irrigation is needed. Guidelines and techniques are described to determine how well an existing sprinkler system is applying water. The effect of other lawn care practices such as mowing height, nitrogen fertilization on irrigation needs are discussed.

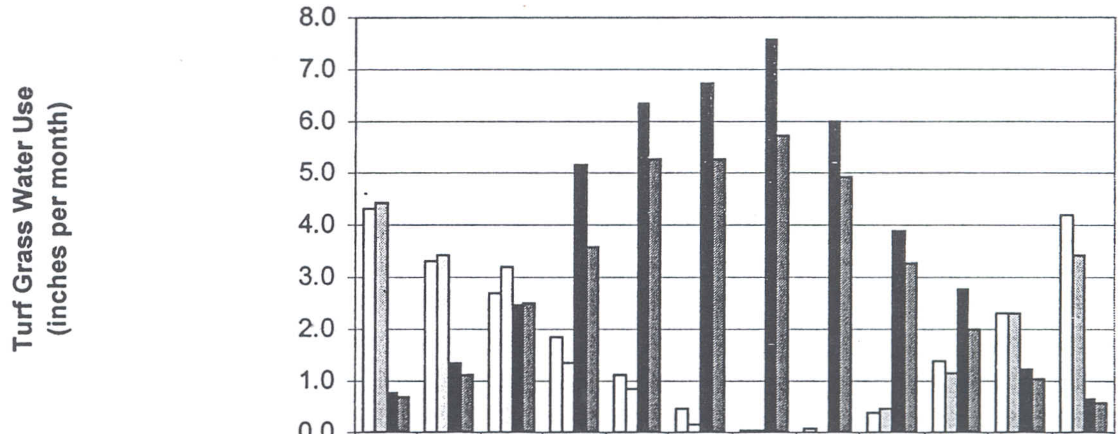
Water Use by Warm-Season and Cool-Season grasses

Warm-season grasses grow best in latter May through August. Common examples are hybrid and common Bermudagrasses, Zoysiagrass, and St. Augustinegrasses. Cool-season grasses grow best in the spring (March – May) and fall months (September and October). Some species tolerate the hot summer months reasonably well. Examples of cool-season grasses are tall fescue, perennial ryegrass, Kentucky bluegrass, and creeping bentgrass.

Figure 1 shows average monthly water use by cool-season and warm-season grasses, respectively, and compares their water use to historic monthly rainfall for Red Bluff and Corning, CA. Cool-season grasses require 20 to 30 percent more water than warm-season grasses. More grass shoots, narrower leaves, and lower growing, horizontal leaf orientation are key factors resulting in less water use by warm-season grasses.

Annual water use averages 45 and 36 inches for cool-season and warm-season grasses, respectively. Monthly water use is highest for both warm-season and cool-season grasses from April through August.

Figure 1. Average Monthly Water Use by Cool Season and Warm Season Turf Grasses Compared to Historic Rainfall in the Northern Sacramento Valley.



	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
□ Historic Rainfall - Red Bluff	4.3	3.3	2.7	1.8	1.1	0.5	0.0	0.1	0.4	1.4	2.3	4.2
▩ Historic Rainfall Corning	4.4	3.4	3.2	1.3	0.8	0.2	0.0	0.0	0.5	1.1	2.3	3.4
■ Water Use - Cool-season Grasses	0.8	1.3	2.5	5.1	6.3	6.7	7.6	6.0	3.9	2.8	1.2	0.6
▩ Water Use - Warm-season Grasses	0.7	1.1	2.5	3.6	5.3	5.3	5.7	4.9	3.3	2.0	1.0	0.6

□ Historic Rainfall - Red Bluff ▩ Historic Rainfall Corning
■ Water Use - Cool-season Grasses ▩ Water Use - Warm-season Grasses

Historic Rainfall Compared to Turf Grass Water Use

Long-term annual rainfall for Red Bluff and Corning averages about 22 and 20 inches, respectively. The comparison in Figure 1 shows that when water use by turf grass is high from April through September, rainfall is low or absent, thus, creating a need to supplement with irrigation water. Rainfall typically exceeds water use during the months of November through February, so irrigation is seldom needed during these months. During March and October rainfall will likely provide much of the lawn's water needs and irrigation should be needed sparingly.

Supplementing Rainfall with Sprinkler Irrigation

Based upon the average monthly water use and the historic monthly rainfall shown in Figure 1, irrigation is necessary to supplement rainfall during the months of April through October. The shortfall in rain during this seven-month period averages about 33 and 26 inches for cool-season and warm-season grasses, respectively.

Sprinkler Irrigation: A Substitute for Rainfall

Sprinkler irrigation is a substitute source of precipitation when rainfall is short or absent. Homeowners are usually familiar with reports of rainfall in "inches of rainfall" from a storm or rainfall intensity in "inches of rain per hour". Similarly, the homeowner needs to understand the rate of precipitation applied with their sprinklers. Knowing the hourly precipitation rate for a sprinkler system is most useful. Once known, the precipitation rate for the sprinkler system can be matched to the estimates of water use by turf grass and used to plan how often and how long to run the sprinklers.

Common Water Application Rates for Lawn Sprinkler Systems

Rotary (pivoting) sprinklers and non-rotating spray heads are the most common types of sprinkler heads used for irrigating lawns. Both types have specific operating features. Rotary sprinklers operate at high pressures, usually 40 to 60 pounds per square inch (psi) and cover large areas (30 to 50 foot radius or 700 to 2000 square feet). Typical rates of precipitation are between 0.2 and 0.4 inches per hour. Non-rotating spray heads operate at lower pressures, 15 to 35 psi, and cover smaller areas (usually 10 to 20 foot radius or 75 to 300 square feet). Common rates of precipitation for non-rotating spray heads are between ¾ and 2 inches per hour.

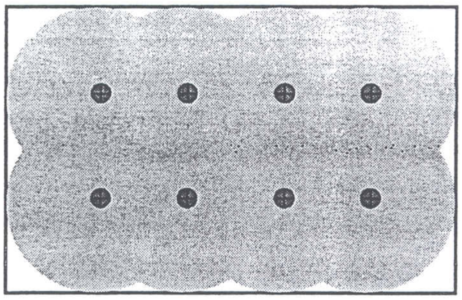
Sprinkler Uniformity

With sprinkler irrigation, homeowners must be concerned with spray overlap. Poor sprinkler overlap will result in areas of a lawn being under-irrigated and possibly other areas of the lawn being over-irrigated. Sprinkler spacing, plugged nozzles, wind, and pressure losses in pipelines, and a mix of sprinkler heads or nozzle sizes are all factors that may reduce the uniformity of sprinkler irrigation. Figure 3 illustrates the importance of proper sprinkler overlap and the consequences of too little overlap between sprinklers. Proper sprinkler overlap is especially important to counter the effects of wind on the sprinkler pattern. A maximum sprinkler spacing of one-half of the spray diameter for a specific sprinkler type is recommended to handle wind speeds of up to about 10 mph.

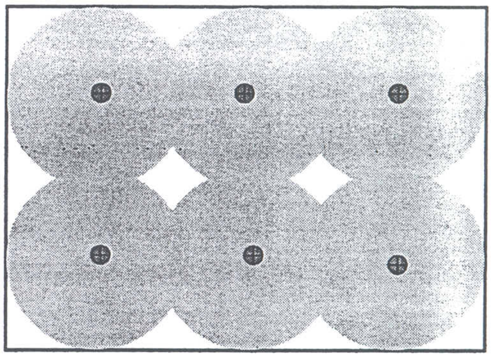
If sprinklers are spaced to provide approximately 50 percent overlap, homeowners can expect sprinkler distribution uniformity to be about 80 percent. This means that some areas of the lawn will receive 20 percent less and 20 percent more water than the average application rate for the entire sprinkler set. For instance, if a zone of non-rotating spray type sprinklers apply water at an average rate of 1 inch per hour, some portions of the sprinkler set will receive about 0.8 inches of water per hour while other areas may receive up to 1.2 inches per hour. When the sprinkler spacing is too wide and overlap is poor, the sprinkler distribution uniformity of water will be much lower (50 percent or less). In this situation, this means that some areas of the sprinkler set receive 50 percent more and 50 percent less than the average precipitation rate. To a certain extent, sprinkler run times can be increased to compensate for non-uniform sprinkler irrigation, but if the sprinkler distribution uniformity is too low, it will result in severely over-irrigating some areas of the lawn while attempting to irrigate other portions of the lawn enough.

Sprinkler precipitation rates and distribution uniformity are site specific, making general characterizations difficult. They may actually be quite different between irrigation sets within the same homeowner's yard. A "catch can" test is recommended for homeowners who really care about their landscape and their utility bill. It involves placing a grid of flat sided and flat bottom containers amidst several sprinklers in a set and using them as rain gauges to catch the sprinkler precipitation for a specific amount of time. Then the depth of water is measured in each can and an average precipitation rate can be determined. The

Figure 3. Illustration of desirable and undesirable precipitation patterns resulting from proper and improper sprinkler overlap.



Properly spaced sprinklers allow about 50 percent overlap and minimize areas that are not irrigated (indicated by white areas), especially if it is windy.



Sprinkler spacing that is too wide results in too little over lap causing dry zones (indicated by white areas) within the lawn, especially noticeable if it is windy.

range and consistency of the measurements are used as an indicator of sprinkler uniformity. Usually, one sprinkler set can be tested with a dozen containers in about 20 minutes. Sources of more information on "catch can" tests are cited at the end of this guide.

Estimating Monthly Hours of Irrigation Needed

Table 1 outlines approximate hours of monthly sprinkler operation needed for both rotary and non-rotating spray type sprinklers. A range of common sprinkler precipitation rates are presented in the table to acknowledge that the actual precipitation rate will depend not only on sprinkler type but also on the available flow rate of water from the municipal service or well and the system pressure. These estimates are for a well designed lawn sprinkler system that has about 50 percent overlap in spray pattern and, therefore, high sprinkler distribution uniformity (75 to 80 percent). The estimates in Table 1 are for cool-season grasses since tall fescue is one of the more popular turf grasses grown in the local area. The monthly estimates in the table should be adjusted downward about 20 to 30 percent if warm-season grasses such as hybrid or common Bermudagrass are of interest. The estimates represent the minimum time a homeowner needs to operate their sprinklers to sustain a healthy lawn and minimize utility costs.

Table 1. Approximate hours of monthly sprinkler operation for cool-season turf grasses based on estimates of water use for the northern Sacramento Valley.

Month	Rotary Type Sprinklers			Non Rotating Spray Type Sprinklers			
	0.2 in/hr	0.3 in/hr	0.4 in/hr	0.75	1.0 in/hr	1.5 in/hr	2.0 in/hr
	(Monthly Hours of Sprinkler Operation [1])						
April	20	13	9	6	4	3	2
May	31	21	16	8	6	4	3
June	38	24	19	10	8	5	4
July	46	30	23	12	9	6	5
August	36	24	18	10	7	5	4
September	21	14	10	6	4	3	2
October	9	6	4	2	2	1	1
Total	201	132	99	54	40	27	21

[1]Estimate of monthly hours of sprinkler operation are based on an 80 percent sprinkler distribution uniformity.

For rotary type sprinklers where the average precipitation rate usually ranges from 0.2 to 0.4 inches per hour, the monthly hours of sprinkling needed to meet water use may range from 4 to 21 hours per month during the cooler months of the year. During the warmer months of May through August, the monthly hours of operation may range from 16 to 46 hours depending on available flow into the sprinkler system, the operation pressure, and sprinkler sizes. Since non-rotating, spray type sprinklers normally have higher precipitation rates of ¾ to 2 inches per hour, the monthly hours of sprinkling are reduced accordingly.

Sprinkler systems that have a wider sprinkler spacing and less spray overlap will require longer operating times than suggested in Table 1 to compensate for less uniform water applications. If the actual hours of operation of a lawn sprinkler system more than double those indicated in the table and the turf grass shows symptoms of over and/or under-irrigation, it may be an indicator that the sprinkler system is performing poorly. In this case, the problem can not be corrected by simply increasing the operation time. The solution may require improving the irrigation system. If the hours of operation in Table 1 do not agree well with the hours of actual operation yet the lawn is healthy, this may reflect that precipitation rates presented in the table do not represent those for a specific sprinkler system (a catch can test will confirm this).

Deciding on Sprinkler Frequency and Set Time

Turf grasses have shallow fibrous root systems primarily found in the top 6 to 12 inches of soil. Since lawns thrive best when the soils do not become too dry between irrigation, reasonable soil moisture depletion levels between irrigation are 0.5 inches for sand and gravel soils and 1.0 inches for loam, silt and clay soils. By converting the monthly water use rates in Figure 1 to weekly rates of water use, water use will average about 1.4 and 1.0 inch per week for cool-season and warm-season grasses, during the months of May through August, respectively. This is equal to average daily water use at rates of 0.2 and 0.15 inches for cool-season and warm-season grasses, respectively. Therefore during mid-summer, irrigation every third day may be appropriate on sandy or gravel soils with low water holding capacity (0.5 inches between irrigation). Sprinkler irrigation may only be needed every four to six days on silt and clay soils because of their higher water holding capacity (1.0 inch between irrigation), if water permeability and runoff are not a problem.

The appropriate sprinkler set time during mid-summer will vary depending on the type of turf grass, precipitation rate of the sprinkler system, and the amount of depleted soil moisture that is being refilled since the last irrigation. For rotary sprinklers with lower precipitation rates (0.2 to 0.4 inches per hour), reasonable set times may range from 1 to 2 hours every third day up to 2 to 4 hours every four to six days. For non-pivoting, spray type sprinklers with higher precipitation rates (¾ to 2 inches per hour) as little as 15 to 30 minutes every third day or 30 to 60 minutes every four to six days may suffice.

After the homeowner has settled on a workable sprinkler frequency and set time, the best time of the day to sprinkle irrigate is the final consideration. Irrigation from predawn to shortly after sunrise (4:00 to 7:00 a.m) is the optimum time to irrigate. Irrigating during this period of time will avoid the turf remaining wet overnight (as would be the case with evening irrigation) and lessen infection by fungal diseases. Ending irrigation by early morning allows time for the water to infiltrate before the midday heat arrives and lessens evaporation.

Other Cultural Practices to Consider

Mowing height is another factor that can influence water use by turf grass. A cutting height of 1½ to 2 inches is ideal for cool-season grasses like tall fescue. Shorter cutting heights of ¾ inches are recommended for warm-season hybrid Bermudagrasses and a cutting height of 1 to 1¼ inches is recommended for common Bermudagrass. Allowing turf grasses to exceed these recommended cutting heights increases the irrigation requirement. Sometimes shorter mowing heights than those recommended here are advocated as a way to reduce water use and irrigation needs. However, studies have shown this practice to be only temporarily effective and risky to the stand. Frequent low mowing heights eventually cause the root zone to decrease because the turf grass does not have adequate time between cuttings to grow and sustain root growth. As the root zone becomes increasingly shallow the frequency of irrigation must be increased and the chance of sprinkler applied water escaping the root system becomes greater. A declining root system can result in a loss of turf grass stand.

Nitrogen fertilization applications should be applied only during the spring and fall months. Adding nitrogen fertilizers in the summer will stimulate mid-summer growth and increase water use. Excessive nitrogen nutrition may also result in increased incidence of fungal diseases and weed pests. Reasonable annual rates are 4 to 6 pounds nitrogen per 1000 square feet (remember to adjust the application for the percentage of nutrient contained in the fertilizer). Apply ½ to 1 pound of nitrogen per 1000 square feet in a single fertilizer application. Other fertilizer nutrients possibly needed for a healthy lawn are phosphorus, potassium, and perhaps iron or zinc. Often these nutrients are not needed, however, to ensure that these nutrients are adequate along with nitrogen it may be desirable to make one application with a complete fertilizer containing nitrogen, phosphorus, and potassium annually. Other sources of information for turf grass fertilization are cited at the end of this publication.

Some silt and clay soils are infamous for slow permeability and increased runoff. In such cases, lighter more frequent irrigation similar to that for sandy soils may also be more effective for silt and clay soils. Surface applications of gypsum at a rate of about 25 pounds per 1000 square feet beginning in late May and repeated again in mid July may help improve infiltration of water and reduce runoff. Coring ("aerifying") or raking the turf to clear excess thatch, to break thin soil crusts, and to disturb compact subsoils prior to applying the gypsum will be more effective.

Attention to Lawn Irrigation Can Lessen Water Bills and Electricity Costs

In most cases a domestic source of groundwater is used to irrigate landscaping. Usually the water is provided by city, community or privately owned wells. The groundwater is commonly pumped using electrical motors. Efficient wells and pumping plants assure that groundwater is pumped to the land surface at the most affordable cost possible. However, this is not the final determinant of your water costs. The amount of your monthly water or electric bill is affected by your landscape irrigation practices. Sprinkler systems that apply water uniformly and that are operated at a reasonable frequency using appropriate set times will more efficiently apply water across the landscape, thereby reducing the total water demand from the municipality or private well. In short, if homeowners optimize landscape irrigation practices, they can lessen electric pump operating time and decrease electricity bills.

Looking for More Information

1. Managing Turfgrasses During Drought. Leaflet 21499. pp. 8. Cooperative Extension – University of California, Division of Agriculture and Natural Resources. Price: $1.50.

Description: This publication contains similar information to the one you just read. Two primary differences are that it is developed for audiences in California coastal climates not our interior valley climates. It does provide more detail on specific grass species, mowing effects, fertilization, and thatch removal.

2. Evaluating Turfgrass Sprinkler Irrigation Systems. Leaflet 21503. pp. 18. Cooperative Extension – University of California, Division of Agriculture and Natural Resources. Price: $2.50.

   Description: This publication gives all sorts of detail about how to evaluate your own sprinkler systems using "catch can tests".

3. Turfgrass Irrigation Scheduling. Leaflet 21492. pp. 15. Cooperative Extension – University of California, Division of Agriculture and Natural Resources. Price: $2.50.

   Description: This publication is for the technical oriented reader. It describes how real-time local weather measurements are used to determine turfgrass water use. This was the basis for Figure 1 in this publication.

4. Drip Irrigation for the Home Landscape. Publication 21579. pp. 28. 1999. University of California Agricultural and Natural Resources. Price: $5.00

   Description: This publication will be most useful to the new homeowner who is thinking about designing and installing their own landscape irrigation system. It discusses design, equipment, and management considerations for turf, shrubs, and trees.

5. Turfgrass Water Conservation. Publication 21405. pp. 155. 1985. Cooperative Extension – University of California, Division of Agriculture and Natural Resources. Price: $12.00.

   Description: For the serious reader who wants to know the details of how different grass species grow. Lots of research reported. A lot of sound concepts are taught.

6. UCIPM Pest Management Guidelines: Turf grass. Publication #3365-T. 2000. Hard Copy Price: $5.00. Print your own copies directly from the Web at http://www.ipm.ucdavis.edu/PMG/selectnewpest.turfgrass.html.

   Description: Stand alone articles for individual turf grass pests, usually 1 to 3 pages per article. Articles available for insects, mites, diseases, nematodes, and weeds. Contents provide description of each pest, their life cycle, and methods of control.

7. Practical Lawn Fertilization. Publication 21250. Pp. 7. 1997. University of California, Division of Agriculture and Natural Resources.

   Description: Brief but complete discussion of types of fertilizers available, understanding fertilizer formulations, and guidelines for how much, how often, and when to fertilize your lawn.