

# California Turfgrass Culture

Volume 34, Number 4, 1984

## Selecting the Best Turfgrass<sup>1</sup>

M. Ali Harivandi, William Davis, Victor A. Gibeault, Michael Henry, John Van Dam, and Lin Wu.<sup>2</sup>

The information presented herein is based on the 1984 revision of the publication, Which is the Best Turfgrass?

Selecting a turfgrass successfully requires knowing how the turf will be used, where it will be grown, and what appearance and maintenance level will be acceptable. Because each turfgrass species has good and bad features, one must learn the strengths and weaknesses of each of the species in order to choose the one best suited to a particular situation.

The following lists rank common turfgrass species according to important characteristics and requirements and their relation to each other. Within a category a given grass may differ little from the one listed immediately above or below it; it may, however, differ greatly from one further up or down on the list. The precise position of a turfgrass in a list may change slightly as more is learned about it or improved varieties are developed, but its location (high, low or intermediate) is not likely to change, and therefore, can be usefully reviewed when preparing to plant.

The "warm season" turfgrasses listed bermudagrass (common and hybrid), dichondra, kikuyugrass, seashore paspalum, St. Augustinegrass, and zoysiagrass - generally lose their green color and are dormant in winter if the average air temperature drops below 50° to 60°F (10° to 15.5°C). Some may die if exposed to subfreezing temperatures for extended periods.

The "cool season" turfgrasses - bentgrass, bluegrass, ryegrass, tall fescue, ryegrass and weeping alkaligrass ordinarily do not lose their green color unless the average air temperature drops below 32°F (0°C) for an extended period; they turn green again as soon as temperatures rise above freezing and are not usually damaged by subfreezing temperatures.

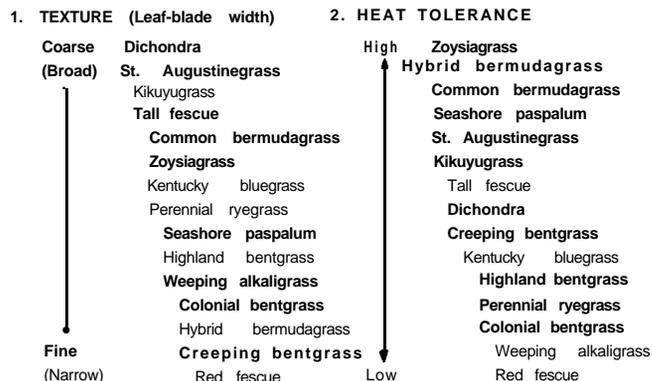
Turfgrasses are listed here alphabetically by common name. Names can vary among locations, so refer to the accompanying

### TURFGRASSES

Common Name	Scientific Name
Annual Ryegrass*	<i>Lolium multiflorum</i>
Bermudagrass (common)	<i>Cynodon dactylon</i>
Bermudagrass (hybrid)	<i>Cynodon</i> spp.
Colonial bentgrass	<i>Agrostis tenuis</i>
Creeping bentgrass	<i>Agrostis palustris</i>
Dichondra	<i>Dichondra micrantha</i>
Highland bentgrass	<i>Agrostis</i> spp. cv "Highland"
Kentucky bluegrass	<i>Poa pratensis</i>
Kikuyugrass	<i>Pennisetum clandestinum</i>
Perennial ryegrass	<i>Lolium perenne</i>
Red fescue	<i>Festuca rubra</i>
Seashore paspalum	<i>Paspalum vaginatum</i>
St. Augustinegrass	<i>Stenotaphrum secundatum</i>
Tall fescue	<i>Festuca arundinacea</i>
Weeping alkaligrass	<i>Puccinellia distans</i>
Zoysiagrass	<i>Zoysia</i> spp.

\*Annual ryegrass is both annual and inferior in generally recognized turfgrass characteristics; therefore, it is not ranked here with other turfgrass species. It is, however, commonly used to overseed winter-dormant warm season turfgrass or where a temporary vegetative cover is needed.

-Although considered a perennial "broadleaf" and not a "grass," dichondra can be maintained as a lawn in regions where warm season turfgrasses are adapted.



<sup>1</sup>From Leaflet 2589, Cooperative Extension University of California Division of Agricultural and Natural Resources.

<sup>2</sup>The authors are M. Ali Harivandi, Farm Advisor, Alameda/Contra Costa/Santa Clara counties; William B. Davis and Victor A. Gibeault, Environmental Horticulturists, Cooperative Extension at Davis and Riverside, respectively; Michael J. Henry and John A. Van Dam, Farm Advisors, Orange and San Bernardino counties, respectively; Lin Wu, Associate Professor, Department of Environmental Horticulture, University of California, Davis.

3. COLD TOLERANCE

(Winter Color Persistence)

High	Creeping bentgrass
	Kentucky bluegrass
	Red fescue
	Colonial bentgrass
	Highland bentgrass
	Perennial ryegrass
	Tall fescue
	Weeping alkaligrass
	Dichondra
	Zoysiagrass
	Common bermudagrass
	Hybrid bermudagrass
	Kikuyugrass
	Seashore paspalum
Low	St. Augustinegrass

7. DROUGHT TOLERANCE

High	Hybrid bermudagrass
	Zoysiagrass
	Common bermudagrass
	Seashore paspalum
	St. Augustinegrass
	Kikuyugrass
	Tall fescue
	Red fescue
	Kentucky bluegrass
	Perennial ryegrass
	Highland bentgrass
	Creeping bentgrass
	Colonial bentgrass
	Weeping alkaligrass
Low	Dichondra

11. RECOVERY FROM MODERATE WEAR

Fast	Hybrid bermudagrass
	Kikuyugrass
	Common bermudagrass
	Seashore paspalum
	Tall fescue
	Perennial ryegrass
	St. Augustinegrass
	Kentucky bluegrass
	Dichondra
	Highland bentgrass
	Creeping bentgrass
	Red fescue
	Weeping alkaligrass
	Zoysiagrass
Slow	Colonial bentgrass

4. MOWING HEIGHT ADAPTATION

High cut	Tall fescue
	Red fescue
	Kentucky bluegrass
	Perennial ryegrass
	Weeping alkaligrass
	St. Augustinegrass
	Common bermudagrass
	Dichondra
	Kikuyugrass
	Colonial bentgrass
	Highland bentgrass
	Zoysiagrass
	Seashore paspalum
Low cut	Hybrid bermudagrass

8. DISEASE INCIDENCE

High	Dichondra
	Creeping bentgrass
	Weeping alkaligrass
	Colonial bentgrass
	Highland bentgrass
	Kentucky bluegrass
	Red fescue
	Perennial ryegrass
	St. Augustinegrass
	Seashore paspalum
	Hybrid bermudagrass
	Tall fescue
	Zoysiagrass
	Common bermudagrass
Low	Kikuyugrass

12. RECOVERY FROM SEVERE INJURY

Partial	Common bermudagrass
	Hybrid bermudagrass
	Kikuyugrass
	Common bermudagrass
	Seashore paspalum
	Zoysiagrass
	Creeping bentgrass
	Highland bentgrass
	Kentucky bluegrass
	Dichondra
	St. Augustinegrass
	*Tall fescue
	*Perennial ryegrass
	*Red fescue
	*Colonial bentgrass
	*Weeping alkaligrass

\*Tends to become bunchy

5. NITROGEN REQUIREMENT

High	Creeping bentgrass
	Hybrid bermudagrass
	Dichondra
	Perennial ryegrass
	Kentucky bluegrass
	Seashore paspalum
	Colonial bentgrass
	Highland bentgrass
	Weeping alkaligrass
	Common bermudagrass
	St. Augustinegrass
	Tall fescue
	Red fescue
	Zoysiagrass
Low	Kikuyugrass

9. SHADE TOLERANCE

High	Red Fescue
	St. Augustinegrass
	Zoysiagrass
	Seashore paspalum
	Dichondra
	Kikuyugrass
	Creeping bentgrass
	Colonial bentgrass
	Highland bentgrass
	Tall fescue
	Kentucky bluegrass
	Perennial ryegrass
	Weeping alkaligrass
	Hybrid bermudagrass
LOW (Sun)	Common bermudagrass

13. ESTABLISHMENT RATE

(Time needed to cover)

Fast	Perennial ryegrass
	Tall fescue
	Common bermudagrass
	Dichondra
	Red fescue
	Highland bentgrass
	Colonial bentgrass
	Creeping bentgrass
	Kentucky bluegrass
	Weeping alkaligrass
	Hybrid bermudagrass
	Kikuyugrass
	Seashore paspalum
	St. Augustinegrass
S M	Zoysiagrass

6. SALINITY TOLERANCE

High	Seashore paspalum
	Weeping alkaligrass
	Hybrid bermudagrass
	Zoysiagrass
	St. Augustinegrass
	Common bermudagrass
	Kikuyugrass
	Creeping bentgrass
	Tall fescue
	Perennial ryegrass
	Kentucky bluegrass
	Red fescue
	Highland bentgrass
	Colonial bentgrass
Low	Dichondra

10. WEAR RESISTANCE

High	Zoysiagrass
	Kikuyugrass
	Hybrid bermudagrass
	Tall fescue
	Common bermudagrass
	Seashore paspalum
	Perennial ryegrass
	Kentucky bluegrass
	Red fescue
	St. Augustinegrass
	Highland bentgrass
	Colonial bentgrass
	Creeping bentgrass
	Weeping alkaligrass
Low	Dichondra

14. MAINTENANCE COST AND EFFORT\*

High	Creeping bentgrass
	Dichondra
	Hybrid bermudagrass
	Kentucky bluegrass
	Colonial bentgrass
	Seashore paspalum
	Perennial ryegrass
	St. Augustinegrass
	Highland bentgrass
	Zoysiagrass
	Tall fescue
	Common bermudagrass
Lo	Kikuyugrass

\*Not applicable to Red fescue and Weeping alkaligrass because of their limited use.

# Tall Fescue Turf Performance Under a Tree Shade Gradient

Lin Wu, David Huff and William B. Davis<sup>1</sup>

New turf type, tall fescue cultivars recently have become popular in California. Because they show more desirable characters for turf than the older cultivars, they have been used for parks, sports fields, and apartment complex and home lawns. Many such plantings are shaded to varying degrees by trees. A study based on visual assessment of tall fescue adaptation to shade was conducted in Texas and indicated that turf quality differences under shade exist between cultivars. However, no direct comparison between shade- and sun-grown tall fescue has been reported.

We examined tall turf performance of four cultivars ('Alta', 'Falcon', 'Rebel', and 'Houndog') under a tree shade gradient and open sun. Turf characters including turf verdure dry weight, tiller density, chlorophyll index and turf quality were examined. The four cultivars were planted in a 45 by 69 foot- area on the University of California, Davis campus. Three, 18-year-old Chinese hackberry (*Celtis chinensis* L.) trees grow in the east half of the test site. The height of the trees was about 45 feet, and the diameter of the tree canopies was about 42 feet, shading two-thirds of the turf. In addition, the lawn was surrounded by one-story buildings. The deciduous Chinese hackberry rapidly develops a dense canopy in mid-April and sheds its leaves in mid-November. Its shade development corresponds with the active growth period of tall fescue.

The experimental plots were set at three locations in the lawn and parallel to its width. The sun site was located 12 feet from the western edge of the turf. The partial shade site was located in the middle portion of the lawn, 30 feet from its western edge. The full shade site was located 12 feet from the east edge. The light intensity was measured in July 1981. The degree of shading on these three sites are presented as 100,30, and 10 percent of full sunlight.

The four cultivars were seeded in September 1980. Six replications of 3 ft. x 6 ft. quadrates per cultivar were used and randomized in each site. The tall fescue turf became established in April 1981 and was mowed at a 2-inch height. Ammonium sulfate was applied at a nitrogen rate of 4 lb/1,000 ft/year. During the dry summer the turf was irrigated once or twice weekly to prevent severe drought. Turf performance was evaluated in August of 1981, 1982 and 1983.

The turf verdure dry weight and tiller density are presented as overall cultivar performance for the three years at each of the sites (Fig. 1). Turfs grown in full shade had only 30 percent of the turf verdure dry weight of those grown in sun, and those in partial shade had 50 percent of that in full-sun. Between years within site, the turf verdure dry weights were very similar. There are statistically significant differences between years, but these did not show any trend of continuous decline through the three years. Tiller density estimated as number of tillers per square foot between sites and years was very similar (Fig. 2).

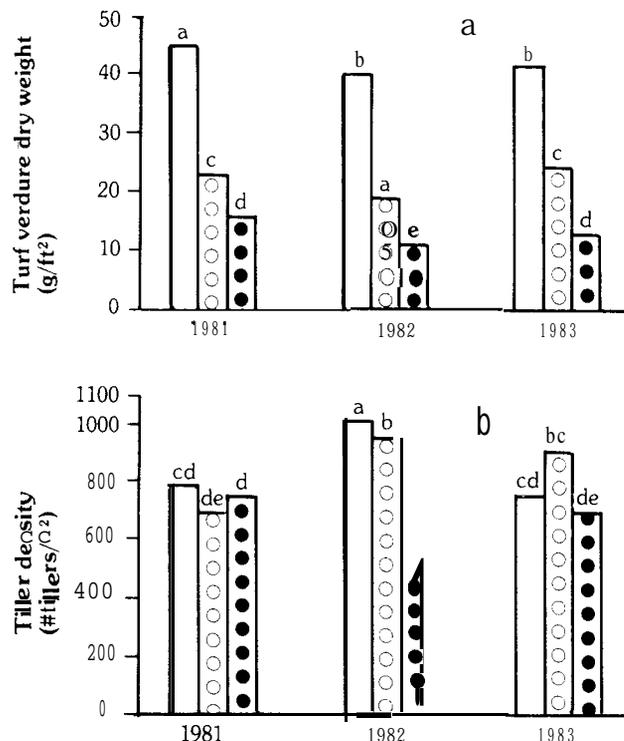


Fig. 1. Turf verdure dry weight (a) and tiller density(b) presented as overall cultivar performance over three years at each site along a tree shade gradient. Symbols represent the three sites under a tree shade gradient: sun □, partial shade ○, and full shade ●. Values followed by the same letter are not different at the 1% significance level determined by the new Duncan's multiple range test.

The results of turf quality evaluation (examined by six persons based on 1-least to 5-best scale) showed that 'Alta' consistently displayed quality inferior to that of the other cultivars in both sun and shade sites. 'Houndog,' and 'Rebel,' and 'Falcon' cultivars showed no significant difference in quality. Chlorophyll index between partial shade and full sun site was similar (Fig. 3). However, under the full shade, the chlorophyll index decreased to about 25 percent of the sun site. The turf quality between sites displayed a similar pattern of the sun site. The turf quality between sites displayed a similar pattern as the chlorophyll index character. The less desirable turf quality in 'Alta' cultivar under shade seems to be due to inferior turf quality of the cultivar per se rather than a difference in shade tolerance. No shade-related disease incidence was noted during this study.

The shade environment can be very complex. Turfgrass may respond to shade differently under different climates, tree species and soils. However, the shade environment used for this study involved most of the complexity of turf shade factors. The

<sup>1</sup>Associate Professor, Research Assistant and Environment Horticulturist, Environment Horticulture Department, University of California, Davis.

turf has been maintained as a lawn turf and subjected to traffic activity. Nevertheless, the nature of shade adaptation response and the turf quality differences between cultivars were not masked by the complex environment. Therefore, the following conclusions may be useful reference for turf management.

- 1) Among the four tall fescue cultivars, only 'Alta' showed inferior turf quality.
- 2) Shade reduced plant size more than plant density for the tall fescue cultivars tested.

- 3) All four tall fescue cultivars provided a reasonable turf coverage under 70 percent tree shade.
- 4) No shade-related disease problem was observed in any of the four tall fescue cultivars tested.

Acknowledgement: This work was partly supported by Elvenia J. Slosson Endowment Fund. We acknowledge Professor Jack L. Paul for helpful suggestions and comments throughout the experiment.

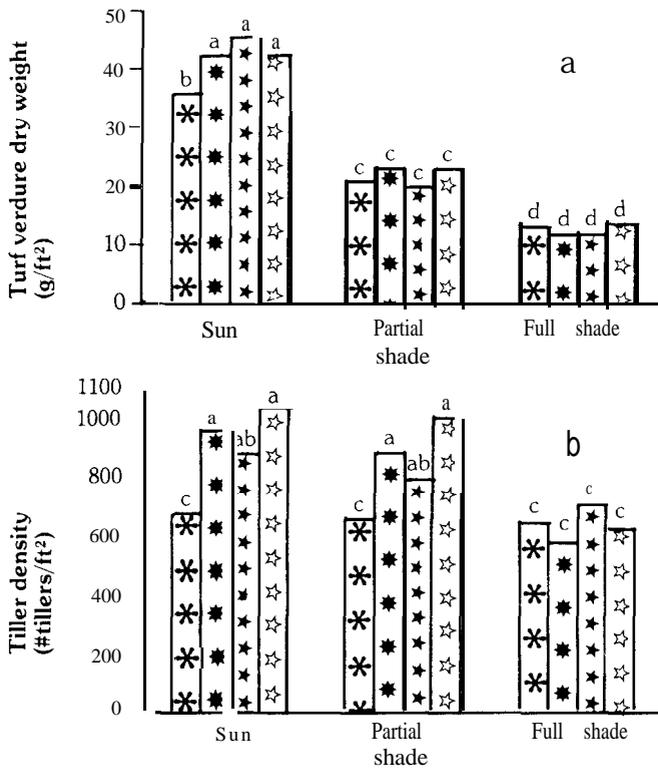


Fig. 2. Turf verdure dry weight (a) and tiller density (b) presented as variety means over three years at each site along a tree shade gradient. Symbols represent the four tall fescue cultivars: Alta\*, Houndog ☆, Falcon \*, and Rebel \* Values followed by the same letter are not different at the 1% significance level determined by the new Duncan's multiple range test.

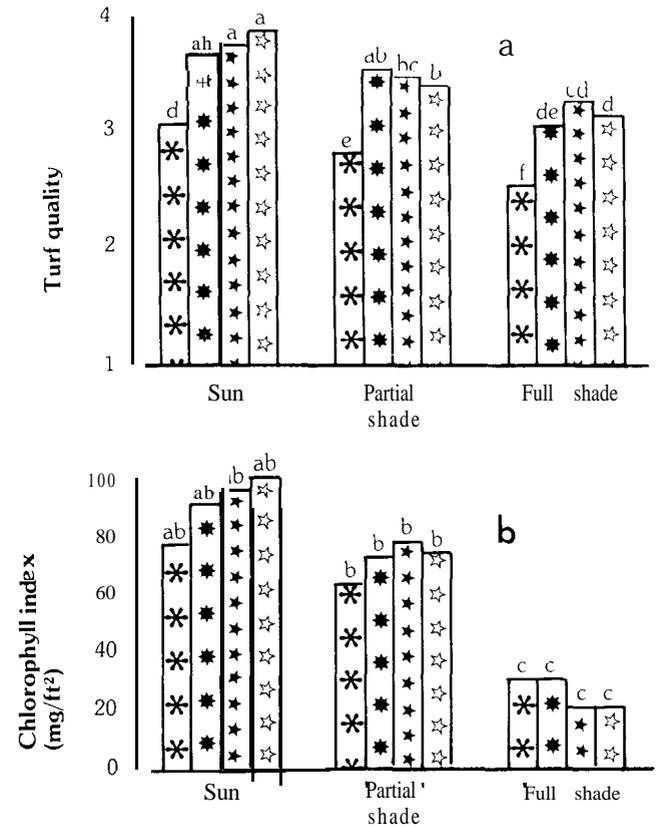


Fig. 3. Turf quality (a) and chlorophyll index (b) values of the four tall fescue cultivars under a tree shade gradient. Symbols represent: Alta\*, Falcon \*, Houndog ☆, and Rebel \* Values followed by the same letter are not different at the 1% significance level determined by the new Duncan's multiple range test.

# Turfgrass Irrigation Efficiency\*

M. Ali Harivandi\*\*

Turfgrasses need water from their seedling stage through maturity. Almost every physiological reaction requires water; without it, metabolism ceases and the turfgrass plant dies. Water also is essential for proper plant nutrition: mineral elements must dissolve in the soil solution before they can be absorbed by roots. Irrigation provides this "solution" which is absorbed by roots and translocated through the turfgrass plant, providing a constant supply of food for healthy growth.

Turfgrasses absorb water primarily through their root systems, and, after using a minute amount, release most of it through transpiration. If for any reason and to any degree water transpired exceeds water absorbed, growth is retarded. Transpiration in turf is determined almost entirely by temperature, humidity, wind and light. Thus, the need for water over a given period of time also depends on these factors. The turfgrass manager must consider these environmental factors when planning an efficient irrigation program.

Inefficient irrigation programs, in addition to being wasteful, increase the incidence of diseases and weeds in turf. They also reduce the effectiveness of other turfgrass management practices such as fertilization, mowing, thatch and pest control. Due to the diversity of soil and climatic factors, however, a single set of recommendations defining irrigation efficiency cannot be given. In what follows, primary factors effecting irrigation efficiency are discussed with the hope that a thorough understanding of them will enable the turfgrass manager to develop an efficient irrigation program tailored to his/her individual conditions.

## CLIMATIC CONDITIONS

A thorough knowledge of climatic conditions is essential for maximum turfgrass irrigation efficiency. Water loss from turf is influenced primarily by climatic conditions. In general, water applied to turf is used/lost through (a) deep percolation due to gravitational force, b) runoff, caused primarily by improper application rates, c) evaporation from soil and/or leaf surfaces and d) metabolism and/or transpiration of the turf plant. Deep percolation and runoff can be reduced by applying the right amount of water at the proper rate. Evaporation and transpiration (the combination of which is known as "evapotranspiration" or ET) are influenced by temperature, humidity, wind, and to some extent by solar radiation. ET increases as temperature, wind and radiation increase and as humidity decreases. Recent studies also show that ET from a specific turfed site varies among turf species. Under similar climatic conditions evapotranspiration from sites planted to cool season turfgrasses is generally higher than those planted to warm season turfgrasses. In other words, cool season turfgrasses generally use more water than warm season turfgrasses.

Most turf specialists recommend water application equal to the ET at a given site. In a recent study by research here at the University of California, Riverside, however, cool season turfgrasses such as Kentucky bluegrass, perennial ryegrass and tall fescue showed no significant difference in quality when sprinkler irrigation equalled 100 and 80 percent ET. Warm season turfgrasses ('Adalayd' seashore paspalum, 'Santa Ana' hybrid bermudagrass, and 'Jade' Zoysiagrass) exhibited no significant difference in quality when sprinkler irrigation equalled 100, 80 and 60 percent irrigation. These results indicate that water savings of 20 percent for cool season and 40 percent for warm season turfgrasses can be realized without significantly affecting turf quality. Although ET can be measured with several types of evaporation pans, the U.S. Weather Bureau Class A above-ground pan is the most widely used. Turfgrass managers interested in more site-specific knowledge of daily turfgrass water use than they can get from local weather stations can install such a pan and measure their own daily evapotranspiration rates. Specifications for a Class A pan can be obtained from UC Cooperative Extension offices or the State Water Resources Department.

## SOIL WATER HOLDING CAPACITY

Waterholding capacity depends on soil texture. The heavier (more clayey) a soil is, the higher its water holding capacity.

All soils contain three water fractions when saturated. The first, "gravitational water," is that fraction which is lost through gravity to deep percolation and is unavailable to turfgrasses. Once this water fraction has drained, soil is described as at "field capacity" (FC). A second fraction of soil water, also unavailable to turfgrasses, is "hygroscopic water" and is very tightly held by soil particles. All water present in soil below the "wilting point" (WP) belongs to this fraction. The third water fraction, that which the turfgrass plant can absorb, is known as "available water." All plant present in the soil between the WP and FC falls in this category. The proportion of available to unavailable water differs among soil textures.

Table I shows the appropriate amount of water available under various soil textures at field capacity. Note that a fine-textured soil, such as clay, holds about twice as much water as coarse, sandy soil.

**Table 3. Available and unavailable water per foot of soil.**

Soil	Texture	Inches per Foot	
		Available	Unavailable
Sand		0.4	1.0
Sandy	Loam	0.9	1.3
Loam		1.3 ~ 2.0	1.4-2.0
Silt	Lodm	2.0	2.1
Clay	Loam	1.8 - 2.1	2.4 2.7
Clay		1.8	1.9

\*This paper was presented in January 1984 at 55th International Turfgrass Conference in Las Vegas and subsequently appeared in the periodical *Golf Course Management*.

So, the heavier a soil, the higher its waterholding capacity and, thus, the more water necessary to wet it to a given depth (compared to a sandy soil). As Figure 1 indicates, almost 1.5 inches of water are required to wet loam soil to a depth of 12 inches. The same amount of water wets clay soil to a depth of 7 inches and a sandy soil to a depth of 24 inches.

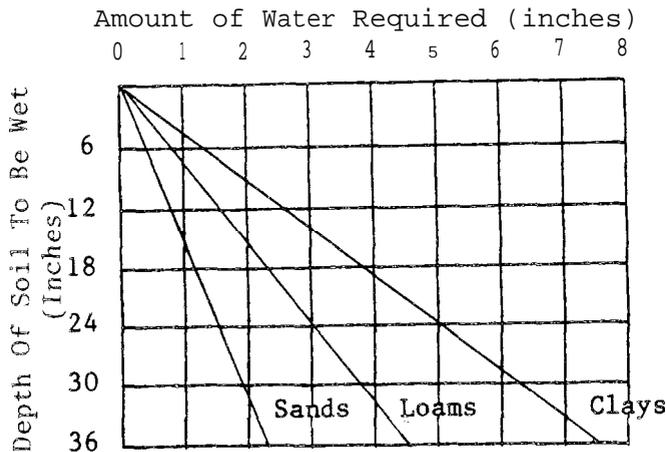


Figure 1

Relative inches of water required to wet soils to given depths (assuming no runoff).

Once a soil is wetted to the desired depth, the amount of water applied in subsequent irrigations depends upon the rate of plant water use. A proper application will return the soil to 100 percent of its waterholding capacity. Under certain conditions, a little extra water may be applied to leach salts. Obviously, if more water is applied than the amount which can be stored by the soil, some water will be lost through deep percolation. Sandy soils are especially prone to deep percolation. Likewise, if water application rates exceed a given soil's absorption and percolation rates, water is lost through runoff. Heavy and/or compacted soils are especially prone to runoff.

## ROOT DEPTH

Turfgrass species differ in their rooting abilities. Some species have deep root systems, other shallow ones. Approximate rooting depths of common turfgrasses are given on Table 2. As the table shows, warm season turfgrasses generally produce deep root systems, while almost all cool season turfgrasses have shallow root systems. (Tall fescue, with an intermediate root system, is an exception.) Since it is the objective of an efficient irrigation program to supply water throughout the root zone, rooting depth as well as soil texture should be considered when determining the rate and amount of water applied.

Although the rooting depth of each turfgrass species is genetically controlled, environmental factors also affect it considerably. Roots, for example, can penetrate deeper in sandy than in clay soils, are generally deeper in fall and spring than in summer and winter, and are deeper when the grass is mowed higher. Other environmental factors affecting turfgrass root depth are irrigation, fertilization, soil compaction, and shade.

The best way to determine turfgrass rooting depth in a specific location is physical inspection. A soil probe or a shovel can be used.

Table 2. Relative Turfgrasses Root Depth Under Normal Use Conditions

Grass Species	Root Depth
Annual bluegrass	Shallow
Creeping bentgrass	
Colonial bentgrass	
Perennial ryegrass	
Creeping red fescue	
Kentucky bluegrass	Intermediate
Tall fescue	
St. Augustmegrass	Deep
Zoyslagrass	
Bermudagrass	

## DROUGHT TOLERANCE

Turfgrass species vary greatly in their tolerances of drought stress. Commonly grown turfgrasses are ranked according to their drought tolerance in Table 3. Use of the more drought-tolerance turfgrasses should be considered when it is known before turf establishment that an area either will not be irrigated at all or only on a limited basis. It should be noted that although drought tolerance depends in large part on a turf species' genetic characteristics, several environmental factors also contribute to such tolerance. Generally, deep-rooted grasses growing in a deep soil with good subsoil moisture remain green for extended periods despite lack of irrigation. Once soil moisture in the root zone is depleted, however, the turfgrass cannot survive for long. Deep-rooted turfgrasses, such as the tall and hard fescues, growing in dry areas where rain or irrigation may wet only the top few inches of soil, may not exhibit as much drought tolerance as the same grasses grown in a soil with adequate subsoil moisture but infrequent rain and/or irrigation.

It is important to note that a "drought-tolerant" turfgrass does not necessarily provide a lush green turf under limited irrigation. Most drought-tolerant turfgrasses go dormant, lose color and stop growth under droughty situations. They do, however, have the capability to resume growth when moisture becomes available. Nondrought-tolerant turfgrasses have a much shorter drought-induced dormancy period before they die than do drought-tolerant species.

**Table 3. Relative Turfgrasses Drought Tolerance**

High	Hybrid bermudagrass
↑	Zoysiagrass
	Common bermudagrass
	Seashore paspalum
	St. Augustinegrass
	Ktkuyugrass
	Tall fescue
	Red fescue
	Kentucky bluegrass
	Perenmal ryegrass
	Highland bentgrass
	Creeping bentgrass
	Colonial bentgrass
	Weeping alkaligrass
↓	Dichondra
Low	

**Table 4. Relative Turfgrasses Salinity Tolerance**

High	Seashore paspalum
↑	Weeping alkaligrass
	Hybrid bermudagrass
	Zoysiagrass
	St. Augustinegrass
	Common bermudagrass
	Kikuyugrass
	Creeping bentgrass
	Tall fescue
	Perennial ryegrass
	Kentucky bluegrass
	Red fescue
	Highland bentgrass
	Colonial bentgrass
↓	Dichondra
Low	

### SOIL SALT CONTENT

Soil salt content can influence irrigation practices. Where soil salinity is a problem, over-irrigation can be helpful for leaching. As a general rule, if the amount of water applied to the soil (irrigation + natural precipitation) exceeds evapotranspiration, salt movement in the soil is downward. Conversely, salt movement is upward if evapotranspiration exceeds the amount of water applied. In the later case, salt drawn to the soil surface gradually accumulates to levels toxic to turfgrasses. A salinity problem is best prevented by applying water in amounts greater than ET. Accumulated salt is thereby constantly leached downward through the soil profile to below the root zone. This is especially important if reclaimed effluent water which contains already soluble salts is used for irrigation. In severe cases of salinity, planting a salt-tolerant turfgrass (Table 4) also should be considered.

### SUMMARY

Irrigation efficiency is affected by many factors. The turfgrass manager interested in adopting efficient and effective irrigation techniques must acquire a thorough understanding of soil-water-turf relationships. This understanding should extend to the role of water in turfgrass growth and development, the influence of climate and soil factors on water utilization by turf, and to the genetic characteristics of turfgrass species grown.

### REFERENCES

Buckman, H.O., N.C. Brady. 1960. *The Nature and Property of Soils*. MacMillan Co. New York. 567 Pages.

Butler, J.D., C.M. Feldhake. 1981. Drought Tolerant Grasses for Golf Courses. *Proc. California Golf Course Superintendents Institute*. Pages 98-101.

Gibeault, V.A., 1977. Preparing Turf to Survive a Drought. *California Turfgrass Culture*. Vol. 27. No. 2.

Gibeault, V.A., J.L. Meyer, V.B. Youngner, M. Mahady, and R. Strohmman. 1982. *Irrigation of Turfgrasses for Water Conservation*. A report by University of California and the Metropolitan Water District

Hariivandi M.A 1981. Factors in Turfgrass Irrigation California *Turfgrass Culture*. Vol. 31. No. 2.

Hariivandi, M.A. 1981. The Use of Effluent Water for Turfgrass Irrigation. *California Turfgrass Culture*. Vol. 37. No. 3,4.

### WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in their original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Recommendations are based on the best information currently available, and treatments based on them should not leave residues exceeding the tolerance established for any particular chemical. Confine chemicals to the area being treated. THE GROWER IS LEGALLY RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

Consult your County Agricultural Commissioner for correct methods of disposing of leftover spray material and empty containers. Never burn pesticide containers.

**PHYTOTOXICITY:** Certain chemicals may cause plant injury if used at the wrong stage of plant development or when temperatures are too high. Injury may also result from excessive amounts or the wrong formulation or from mixing incompatible materials. Inert ingredients, such as wetters, spreaders, emulsifiers, diluents, and solvents, can cause plant injury. Since formulations are often changed by manufacturers, it is possible that plant injury may occur, even though no injury was noted in previous seasons.

**NOTE:** Progress reports give experimental data that should not be considered as recommendations for use. Until the products and the uses given appear on a registered pesticide label or other legal, supplementary direction for use, it is illegal to use the chemicals as described.

### CALIFORNIA TURFGRASS CULTURE EDITORIAL COMMITTEE

William B. Davis, Extension Environmental Horticulturist  
University of California, Davis

Forrest Cress, Extension Communications Specialist  
University of California, Riverside

Victor A. Gibeault, Extension Environmental Horticulturist  
University of California, Riverside

Correspondence concerning *California Turfgrass Culture* should be sent to:

Victor A. Gibeault  
Batchelor Hall Extension  
University of California  
Riverside, CA 92521

The University of California, in compliance with the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and the Rehabilitation Act of 1973 does not discriminate on the basis of race, creed, religion, color, national origin, sex, or mental or physical handicap in any of its programs or activities or with respect to any of its employment policies, practices or procedures. The University of California does not discriminate on the basis of age, ancestry, sexual orientation, marital status, citizenship, nor because individuals are disabled or Vietnam Era veterans. Inquiries regarding this policy may be directed to the Affirmative Action Officer, Division of Agriculture and Natural Resources, 2120 University Ave., University of California, Berkeley, California 94720 (415) 644-4270.