Journal Of ENVIRONMENTAL TURFGRASS

Scientifically based and objective information to help educate the public to the environmental benefits of turfgrass

Vol. III, No. 1 **Spring, 1991**

Additional information, technical background details, resources and expert interviews will be provided media representatives upon request.

The American Sod Producers Association is located at 1855-A Hicks Road, Rolling Meadows, Illinois 60008. Phone 708/705-9898, Fax 708/705-8347.

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'TURF NEWS' MAGAZINE

'JOURNAL OF ENVIRONMENTAL TURFGRASS'

MIDWINTER CONFERENCE AND SUMMER CONVENTION

Trees and Turf Should Complement— Not Compete

Donald L. Ham and James R. Clark

Introduction

Has the grass under the big shade tree in the front yard been slowly thinning for several years? Does the tree's large surface roots present mowing obstacles? Are the young trees planted at the neighborhood park not growing? Are their trunks badly damaged by lawn mowers? These situations are all too familar when trees and turf are grown too closely together. Since trees and turf compete for water and nutrients in the soil, we must manage them both to enhance their overall vigor.

Effects of Turf on Tree Growth

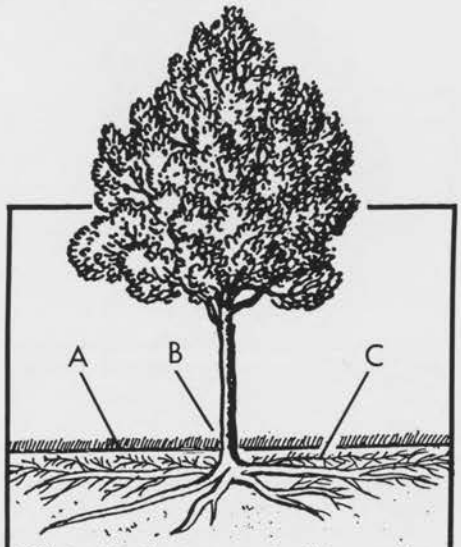
Most trees used in urban and other landscaped areas originated in forests with rich, fertile soils and surface layers covered with decomposed leaves and other organic matter. Competition did come not from grass, but from other woody plants and scattered herbaceous plants. Yet in a managed landscape, these same tree species are grown in compacted, disturbed soils with aggressive turfgrass competition over the entire root zone.

With the competition of grass and the absence of a litter or humus layer on the soil surface in the root zone of a tree, development of its absorbing or fine roots is restricted. Trees with a poorly developed fine root system will be smaller and less vigorous. As a result, they will be more sensitive to environmental stresses such as drought and nutrient deficiencies. These effects may occur on any-sized tree but are most evident on young trees. Supplemental watering and fertilization may help overcome some of the reduced tree growth, but not all of it.

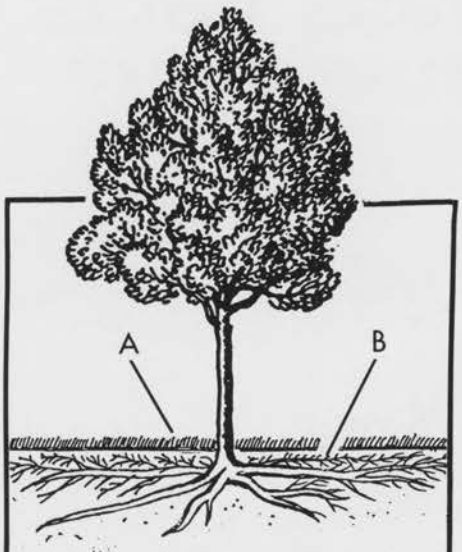
In fact the summer irrigation that is required to maintain turf may be detrimental trees. This may be especially true in the Pacific Northwest and California when water strikes the trunk and collects at the base. Root and stem rots of mature trees can develop in these situations.

Mowing and weed management in turf can also lead to tree problems. Mechanical bark damage, especially on the trunks of young trees, from lawn mowers and string "weed eaters" can be very extensive. Such injury can lead to wood rot problems or actually kill trees if the bark around most of the circumference of the trunk has been damaged.

Similarly, many herbicides or weed killers that are used in turf can kill or cause severe damage to trees whose roots are within the treated area. Herbicides that can cause tree damage have statements on their labels warning against using the product "near trees." The problem with such herbicides usually lies with the applicators not realizing how far-reaching the root system of a tree can be. Roots extending two to three times farther than the branch spread of a tree, or even more, is very common. Consequently, herbicides are often unknowingly applied "near" tree roots.



Effects of turf on tree growth: (A) competition from turfgrass restricts the development of a tree's absorbing or fine root systems; (B) bark damage due to mowers and string "weed eaters;" and, (C) damage due to herbicides and weed killers used in turf care.



Effects of trees on turf: (A) the lack of light caused by the tree's shade; (B) competition of the majority of fine, absorbing roots that are in the top six inches of soil.

Effects of Trees on Turf

Trees also cause problems for grass. Reduced radiation, or *shade*, is the most easily recognized problem. All green plants require a minimum amount of light to survive, and a somewhat larger amount to grow well. Most commonly used turfgrass species perform well in full sun, tolerate partially reduced light, and barely survive or die in heavy shade because of insufficient sunlight to photosynthesize and produce carbohydrates or "food" to keep the grass alive. Heavy shade conditions under trees can also create temperature and moisture conditions that are favorable to turf disease organisms.

While shade may be the greatest negative, tree-related influence on turf growth, tree roots also create problems. Contrary to general thinking, most tree roots are in the top three feet of soil. More importantly, the majority of fine, absorbing roots are in the top six inches of soil. While grass roots ordinarily occupy a much greater percentage of the soil volume than tree roots and out-compete them for water and nutrients, especially around young tree, grass root density is often much lower in areas where trees were established first. In these situations, tree roots compete much better for water and nutrients and prevent or reduce the success of establishing new turf.

While all tree roots grow much more shallow than most people realize, some tree species, such as red maple, form some roots that are so close to the soil surface that they become partially exposed. These roots are of no greater problem to turf growth, but they do create visual and mowing problems.

Managing to Optimize Turf And Tree Development

Since turf and trees do compete when growing closely together and one or both suffer in some manner, a landscape management goal should be to develop strategies that will eliminate or reduce the competition and allow the two to complement each other. Perhaps the best approach is to maintain large, mulched areas without turf around trees. The areas can be circular or irregularly shaped to conform to other landscape features. On large trees, an area extending 12 to 15 feet beyond the trunk on all sides or as far out as the branch spread (the larger, the better) is ideal. The area should extend as far out as the branch spread or dripline on smaller trees. In fact, the height growth of young, slow-growing

trees may triple if a 2x2 foot turf-free area around the base is left. If the turf-free area is approximately 10x20 feet, the height growth may increase by as much as six times the height of the same trees with turf growing up to the base of the tree.

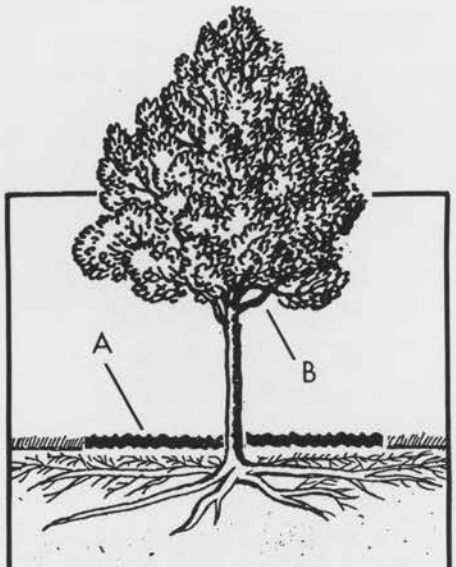
Mulching the area with two to four inches of organic matter, such as wood chips or bark, creates a soil surface condition much like the tree would have in its native forest habitat. Numerous studies have shown that trees and their roots grow considerably better in large mulched areas, because the mulch improves the aeration in the upper portion of the soil, improves soil water retention, and moderates the soil temperatures. Further, as the mulch decomposes, nutrients become available to the tree.

Tree roots will also proliferate in the large, mulched areas which will tend to limit, at least on trees becoming established, the extent of the root spread beyond the mulched area into turf. Consequently, potential competition to the adjacent turf is reduced. Also, any surface roots that might develop would remain in the mulched area and would not affect mowing. Large mulched areas also remove the need to mow near tree trunks; therefore, eliminating possible mower injury to the bark.

Keeping turf outside of the branch spread of a tree also eliminates tree and turf fertilization conflicts. Typically, fertilizer applied at rates recommended for turf is rapidly utilized by the grass, and trees in the same area receive little benefit. Similarly, fertilization rates recommended for trees can damage turf or create non-uniform growth area. With large mulched areas the appropriate types and rates of fertilizers can be applied to both the trees and the turf without problems.

As mentioned earlier, herbicides that may be safe to use in turf may cause tree damage. Whether herbicides are being applied to turf that may also contain tree roots or in mulched areas, extreme care should be used to select products that are labeled as safe to use near trees.

Finally, some types of turf are more shade tolerant than others and will perform better beneath trees. In addition, some types of trees produce heavier shade than others. For instance, southern magnolia and Norway maple cast very heavy shade while trees like honey locust and bald cypress produce filtered shade. Trees can also be pruned to allow more light to reach to the grass below. However, trying to match relative shade conditions and tolerance to shade does not address the real conflict of root competition for water and nutrients. Most landscape soils have poor aeration and drainage which prevents good root development by both trees and turf. If the weak tree and turf root systems that develop in our poor urban and suburban soils are forced to grow together and compete for rooting space and soil resources, then both plants suffer to a greater or lesser degree. Utilizing large, mulched areas around trees creates conditions that allow both trees and turf to grow in close, but not conflicting, proximity and reach their maximum potential for the site.



Developing strategies to eliminate or reduce competition between trees and turf: (A) large, mulched areas without turf around trees; (B) pruned branches allowing more light to penetrate grass areas below tree.

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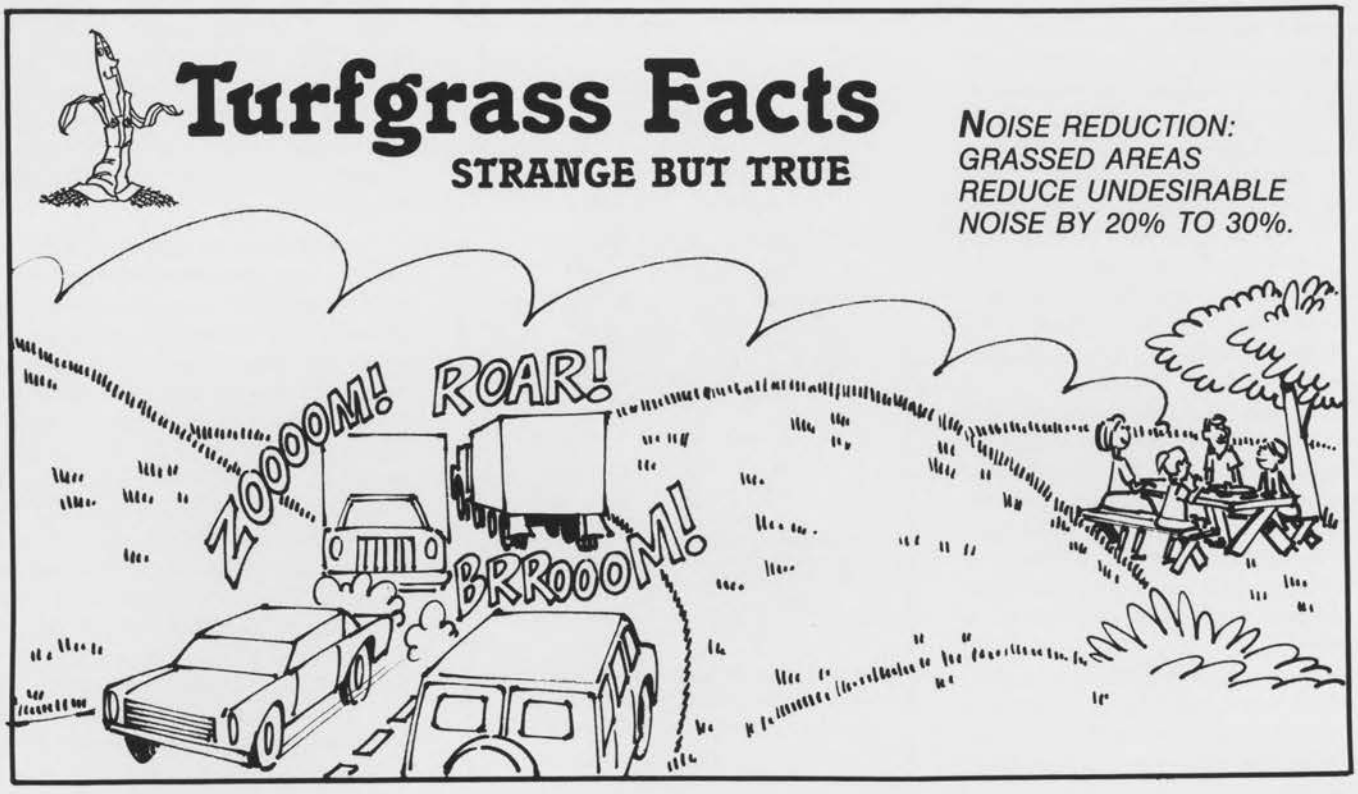


An Architect's Viewpoint: Walt Rogers, ASLA

Turf's Role in Today's Multi-use Landscape Designs

Deficit irrigation. Drought-resistant. Low-water use. Solid-state computerization. Drip irrigation. ET (evapotranspiration).

Few, if any, of these words were in the landscape architect's lexicon just a few short years ago, yet, today, they are common to the professional, if sometimes still confusing and complex to many others.

While these words can apply to many areas, they are an important new facet of turfgrass design and management. We no longer think in the simple terms of planting, mowing, fertilizing and watering, as we once did... and some still do. In the area of landscape architecture, the days of designing landscapes purely for aesthetics are over. As our world becomes more environmentally conscious, greater and greater insistence is being heard for multipurpose, multi-use landscapes that conserve water as much as possible and rely on minimal resource inputs. Some feel that turfgrass has only a very limited role in such plans. Others feel grass has absolutely no role.

While we've all read or heard comments such as: "Grass has no meaningful place in today's landscape;" or "Turfgrasses are water wasters. They require too much time and energy to maintain;" or "The best landscape is one without grass;" technological advancements and understandings have proven that turfgrass can (and often must) have a very significant role in an environmentally sound landscape design. The "grass-bashers" too often conveniently ignore the many positive benefits of turfgrass in our landscapes in their over-zealous efforts to convince others of their position.

Turfgrasses, when properly planned and efficiently managed in a multi-use landscape, provide a very real asset to the environment. While eye-pleasing and inviting, the grasses exchange carbon dioxide for oxygen in the atmosphere, they entrap particulate matter, cool surrounding areas, control erosion and even provide access for turf-filtered groundwater recharge.

While a hardscape (concrete, specialty rock or paving) and semi-hardscapes (crushed stone, scattered boulders, etc.) can be aesthetically pleasing, they can also be environmentally damaging. Such designs further seal sections of the earth and can become heat-sinks, absorbing large amounts of energy and then radiating that heat energy into the surrounding areas for very long periods thus contributing to the so-called "head island effect" we suffer in many metropolitan areas. When it rains, run-off waters from these hard-surfaced areas may create storm sewer overflows by their very design. While this form of landscaping requires minimal, if any, resource inputs such as water or fuel, its inert state also fails to provide positive environmental benefits.

To capitalize on the many benefits of turfgrass, today's landscape architects can develop unique plans for practically any situation. Factors that will be considered by an environmentally sensitive landscape architect would include:

1. Basic topography of the design area to avoid steep slopes that encourage wasteful runoff and positive incorporation of basins that can become "water harvest" storage facilities;

"Turfgrasses, when properly planned and efficiently managed in a multi-use landscape, provide a very real asset to the environment."

2. Identify and incorporate water harvesting source points such as run-off from roofs, yards, driveways, parking lots and even streets.
3. Utilization of turfgrass species and cultivars that offer the best combination of drought tolerance and low-water use rates;
4. Grouped placement of plants with similar water-use rates to better control irrigation requirements and allow the use of drip-type irrigation for trees, shrubs and groundcovers.
5. Incorporation of state-of-the-art irrigation systems that include use of computerized controllers, selection of proper spray heads, valves and sensors to detect rainfall, excess wind and soil moisture; and,
6. Utilization of the "oasis" design concept, locating areas of higher water using plants and turfgrasses in the center of a site or yard, putting the desirable turfgrass in the highest use area.

A study conducted for the Arizona Department of Water Resources by The Acacia Group, a Tucson & Phoenix based landscape architecture firm, to evaluate the water use practices and water conservation potential of turf facilities, unexpectedly found that management practices, rather than the application of technologically sophisticated equipment, showed the greatest practical potential for water conservation. Documenting once again that plants don't waste water, people do, this study found that improved education, daily visual inspection of the turf; night irrigation, control of soil compaction, and reduction of fertilizers all presented water conservation potentials at a high level.

Specific water conserving practices for turf facilities of any size that were also documented in the study include:

1. Use of computerized automatic irrigation controls.
2. Use of drip irrigation on selected non-turf areas.
3. Use of ET rate to schedule irrigation: The evapotranspiration (ET) rate of turfgrass is the rate at which water is evaporated from the soil surface and transpired from the turf. Atmospheric conditions dictate the ET rate. Once the ET rate is known, irrigation can be scheduled to replace only the moisture lost, reducing or eliminating excessive application of irrigation water.
4. Deficit irrigation which reduces the amount of applied water to a rate below the ET rate, thus requiring the turf to adjust to less water. This is particularly successful in low traffic areas.
5. Night irrigation to take fullest advantage of less wind distortion and less evaporation (when the ET rate is at the lowest point of the day).

Envisioning a world without turfgrass is practically impossible... Picnicking on pavement. Teaching children to walk in a rock garden. Playing ball in a dust bowl. It staggers the imagination.

On the otherhand, improved management and technology make it very practical to have the turfgrass areas we seem to want in our landscapes, and to gain the environmental benefits of turfgrass, while we fully enjoy the areas and still feel real pride in how we're wisely using and restoring the natural resources all about us.

***Walt Rogers,** ASLA is a principal in The Acacia Group, a professional landscape architecture firm with offices in Tucson and Phoenix, Arizona. Mr. Rogers, a former professor at the University of Arizona, served as the principle in charge of the water conservation study carried out for the Arizona Department of Water Resources. The ultimate objective of the study was to determine the acceptable water application rates for turf facilities such as golf courses that would be required under the second implementation phase of the state's 1981 Groundwater Management Act.*

Environmental Guide for Cool Season Turfgrasses

By Mike Robinson, President, The Lawn Institute, Pleasant Hill, Tennessee; and, President, Seed Research of Oregon, Inc., Corvallis, Oregon

The choice of turfgrass species for landscape sites has traditionally involved the desired appearance and usage more than any other concern. Increasingly the effect the turf will have on the environment has become an important issue. There are many ways turf can modify the environment and a wide variety of environmental concerns, which can influence the choice of turf species.

The Guide shows the general characteristics of the different cool-season turf species that may be important in relation to the environmental concerns of a specific site. The importance of certain characteristics in species choice may be self-explanatory but a short explanation below shows why other characteristics are important. For most characteristics you will also find variation between varieties or cultivars of a species which could have the effect of significantly changing the generalized characteristic noted.

1. **Growth Habit**—This is often important in soil stabilization since stoloniferous and rhizomatous grasses may fill in and repair areas more easily. This is also related to recuperative ability after drought or other stresses.

2. **Establishment Rate**—Species that establish rapidly from seed will stabilize soil more quickly and often require less water for the establishment phase. All varieties shown in the accompanying table are produced as turfgrass sod, offering almost immediate establishment.

3. **Nitrogen Requirement**—Two primary concerns are utilization of fossil fuels to produce many nitrogen fertilizers and the potential of nitrogen leaching. Nitrogen leaching is dependent on grass species (and/or cultivar), amount and form of nitrogen applied, time of year, and amount of water applied. If sewage wastewater is utilized, species that can use high levels of nitrogen may be desired. Nitrogen use efficiency is still being defined for many species.

4. **Mowing Frequency**—More frequent mowing requirements can contribute to increased fuel usage, added pollutants to the atmosphere, and added burdens on landfills, if clippings are removed.

5. **Close Mowing Tolerance**—Grass that is mown more closely has reduced water use compared to the same species at a higher height of cut. Different varieties of a species may vary significantly in their tolerance. However, close mowing may reduce rooting depth.

6. **Water Use Rates, Drought Tolerance, Rooting Depth**—Interrelated characteristics that are of varying importance depending on site. In some situtions where irrigation water is limited, a species that utilizes high amounts of water, even if drought tolerant, may be unacceptable. The rooting depth helps determine available water and can relate to short duration drought tolerance in some species. Other species are drought tolerant due to low usage. Another consideration is how well a species will recover after a period of drought.

7. **Competitiveness**—A more competitive species, if properly managed, can reduce weed encroachment and thus herbicide usage.

8. **Evaporative Cooling Potential**—This is primarily related to water use rate and growth rate. Species that are growing faster and utilizing more water will do a better job of cooling the surrounding area. Landscaping can do a very effective job of reducing mechanical cooling needs and thus total energy expenditures.

9. **Insect Resistance**—Reduction of pesticide use is an important consideration in many sites. In most species, varieties vary in their genetic resistance but in those species where varieties with the Acremonium endophyte are available, this can provide insect resistance and other growth benefits.

10. **Salinity Tolerance**—This is an important consideration if sewage wastewater is being utilized for irrigation or for marginal well water in many areas of the country.

Environmental Guide for Improved Turfgrasses

	Kentucky bluegrass	Perennial ryegrass	Perennial ryegrass [overseeding]	Hard fescue	Chewings fescue	Creeping fescue	Blue or Sheep fescue	Turf-Type tall fescue	Creeping bentgrass
GROWTH HABIT	spreads by rhizomes	bunch type	bunch type	bunch type	bunch type	spreads by rhizomes	bunch type	bunch type	spreads by stolons
ESTABLISHMENT RATE	slow	very fast	very fast	slow to medium	medium	medium	slow to medium	medium	medium to fast
NITROGEN REQUIREMENT	medium	medium to high	medium to high	low	low to medium	low to medium	very low	medium	low to medium
MOWING FREQUENCY	low to medium	high	high	low	low to medium	low to medium	very low	medium	low to medium
CLOSE MOWING TOLERANCE [1.2"]	fair	very good	excellent	poor	good	poor	poor	poor	excellent
WATER USE [ET* RATES]	high	medium	medium	low	low	low	low	high	high
DROUGHT TOLERANCE	good	very good	good	excellent	very good	good	excellent	excellent	poor to good
COMPETITIVENESS	medium	high	high	medium	high	medium	medium	medium	high
EVAPORATIVE COOLING POTENTIAL	high	medium	medium	low	low	low	low	high	high
ROOTING DEPTH [NORMAL USE]	6''-2.0'	6''-1.5'	4''-1.0'	6''-1.5'	6''-1.5'	6''-1.5'	6''-1.5'	1.5'-4'	4''-1.5'
INSECT RESISTANCE	varies	high with endophyte	high with endophyte	high with endophyte	high with endophyte	varies	high with endophyte	high with endophyte	varies
SALINITY TOLERANCE	low to medium	medium	medium	low to medium	low	low	low to medium	high	high

*ET: The evapotranspiration rate of turfgrass is the rate at which water is evaporated from the soil surface and transpired from the turf.

Grasscycling: A Solution for Lawn and Environment

It is no secret that grasscycling is good for our lawns. Turf scientists and lawn care companies have advocated it for years, and thousands of lawn service customers have followed their advice with excellent results. The nutrients returned to the soil by grasscycling create greener, healthier lawns, which contribute significantly to the quality of the world's environment.

But as we enter this new decade, there is an additional case for spreading the word about grasscycling. It gives local governments another option for dealing with the current trash disposal crisis.

Today, at least ten states have less than five years of landfill capacity, and 14 others have less than 10 years of usable landfill space. Contributing to the problem is the large volume of grass clippings being dumped into our landfills each year. In fact, recent studies suggest grass clippings may account for almost 20 percent of the total volume of the municipal waste stream.

Grasscycling is one solution. It is a simple, effective way to conserve more than 10 percent of the total municipal landfill space and at the same time improve lawn and environmental quality.

If you are not already grasscycling, read the following ten reasons to find out why you should, and learn how by following the steps outlined in the grasscycling guide.

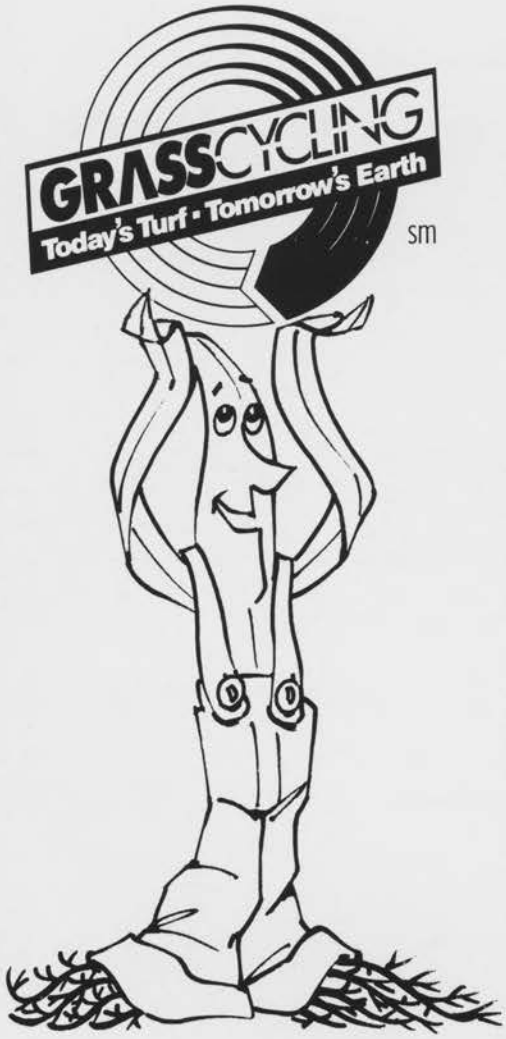
1. **Grasscycling Improves Lawn Quality.** When grass clippings are allowed to decay naturally on the lawn, they release valuable nutrients which improve the soil. Homeowners who grasscycle enjoy greener healthier lawns.

2. **Grasscycling Saves Time and Work.** A recent study conducted in Fort Worth, Texas, found that 147 homeowners who quit bagging their clippings mowed 5.4 times per month versus 4.1 when they bagged clippings, but saved an average of 35 minutes per mowing by not bagging clippings. After six months of returning clippings, these homeowners saved an average of seven hours of yard work.

3. **Clippings Do Not Cause Thatch.** In the 1960s, it was commonly believed that grass clippings were a major component of thatch and that removing clippings would dramatically slow thatch development. In 1969, researchers at the University of Rhode Island completed and published a detailed study of thatch which showed that thatch was composed of grass roots. Their findings have been confirmed in numerous other studies. An 11-year study at the USDA research station in Beltsville, Maryland, found that returning clippings contributes only .03 inch to the thatch layer each year.

4. **Grass Clippings Won't Damage Lawns.** When you mow regularly and at the proper height, your lawn is improved by grasscycling. If you allow the grass to grow too long between mowings, excessive clippings can damage your lawn. This problem can be minimized by gradually reducing your lawn to its proper height over a period of two or three mowings, rather than scalping it back to its normal height in one mowing.

5. **Doesn't Spread Lawn Diseases.** Diseases of turfgrass occur when disease causing spores contact susceptible grasses under ideal environmental conditions. Disease spores are present whether clippings are collected or returned. Watering, fertilization, and sharpness of the mower blade have a much greater influence on the occurrence of disease than grasscycling.



6. Clippings Are Too Wet To Incinerate. Grass clippings are 90 percent water by weight. It takes more energy to burn them than can be recovered for power generation. It also takes truck space and fuel to haul them to the incinerator. Many states are recognizing this problem and outlawing the incineration of grass clippings.

7. **Lawn Care Services Recommend Grasscycling.** Lawn care companies have advocated grasscycling for years. Thousands of lawn service customers have been grasscycling with excellent results.

8. **All Lawn Mowers Can Grasscycle.** No special equipment is necessary to grasscycle. Many manufacturers have attachments that improve your mower's grasscycling performance. Check with your dealer for advice. For the best results keep your mower sharp and mow when the grass is dry. Mowing more frequently will also help minimize equipment problems. Remember, each year the average Texas grasscycler saved seven hours of mowing time even though he mowed more often.

9. **Collecting Clippings Is Becoming More Expensive.** Today, clipping disposal is affordable, but most states will ban landfill disposal of landscape waste, including clippings, in the next two to five years. Grasscycling eliminates the need to pay any fees associated with disposal of clippings.

10. **Grasscycling Is a Responsible Environmental Practice.** Turfgrasses are environmentally important. They cool and clean our environment, protect soils and groundwaters, and absorb noise and carbon dioxide while providing beautiful and superior recreational surfaces. Currently, landscape wastes, including grass clippings, account for almost 20 percent of all curbside waste. Grasscycling provides an environmentally important opportunity for citizens to participate in curbside waste reduction.

Sandy Hensel Marting is Director of Public Relations for the Professional Lawn Care Association of America (PLCAA). Based in Marietta, Georgia, the association represents approximately 1,000 lawn care companies in the United States and Canada.

Guide to Grasscycling

Grasscycling is the natural recycling of grass clippings by leaving them on the lawn when mowing. It is a simple and effective way to help conserve landfill capacity, while saving time, work, and money. And the benefit is a greener, healthier lawn. Here's how to do it.

Mowing Tips

Proper mowing is essential to grasscycling and can increase lawn quality by 30 percent or more. Cut when the grass is dry. Keep your mower sharp. Set your mower to cut at the proper height. Mow often enough so you never remove more than one-third of the lawn height each cut. You may have to mow every 5 days when your lawn is growing fast, but once every 10 days may be sufficient when turf is growing slowly.

All mowers can grasscycle. Simply remove your mower's collection bag. Many manufacturers have attachments or special designs that improve a mower's grasscycling performance. Check with your local retailer for more information.

Mowing Heights

Mowing heights depend upon the type of grass in your lawn:

Kentucky Bluegrass . . . . . 3.0''
Fescues & Ryegrass . . . . . 3.0''
Bentgrass . . . . . 1.0''
Bermudagrass . . . . . 1.0''-1.5''
Zoysia . . . . . 1.0''-1.5''
St. Augustine . . . . . 3.0''
Bahiagrass . . . . . 3.0''
Centipedegrass . . . . . 1.5''

Watering Plan

Established lawns need irrigation to supplement natural rainfall. They require more water in hot weather, but may require water in dry cool periods as well. In hot dry weather, lawns may need as much as one inch of water every 5-7 days. That's equal to three hours of watering time with the typical lawn sprinkler. Avoid daily watering and watering in evenings as these practices encourage disease. The best time to water is early morning.

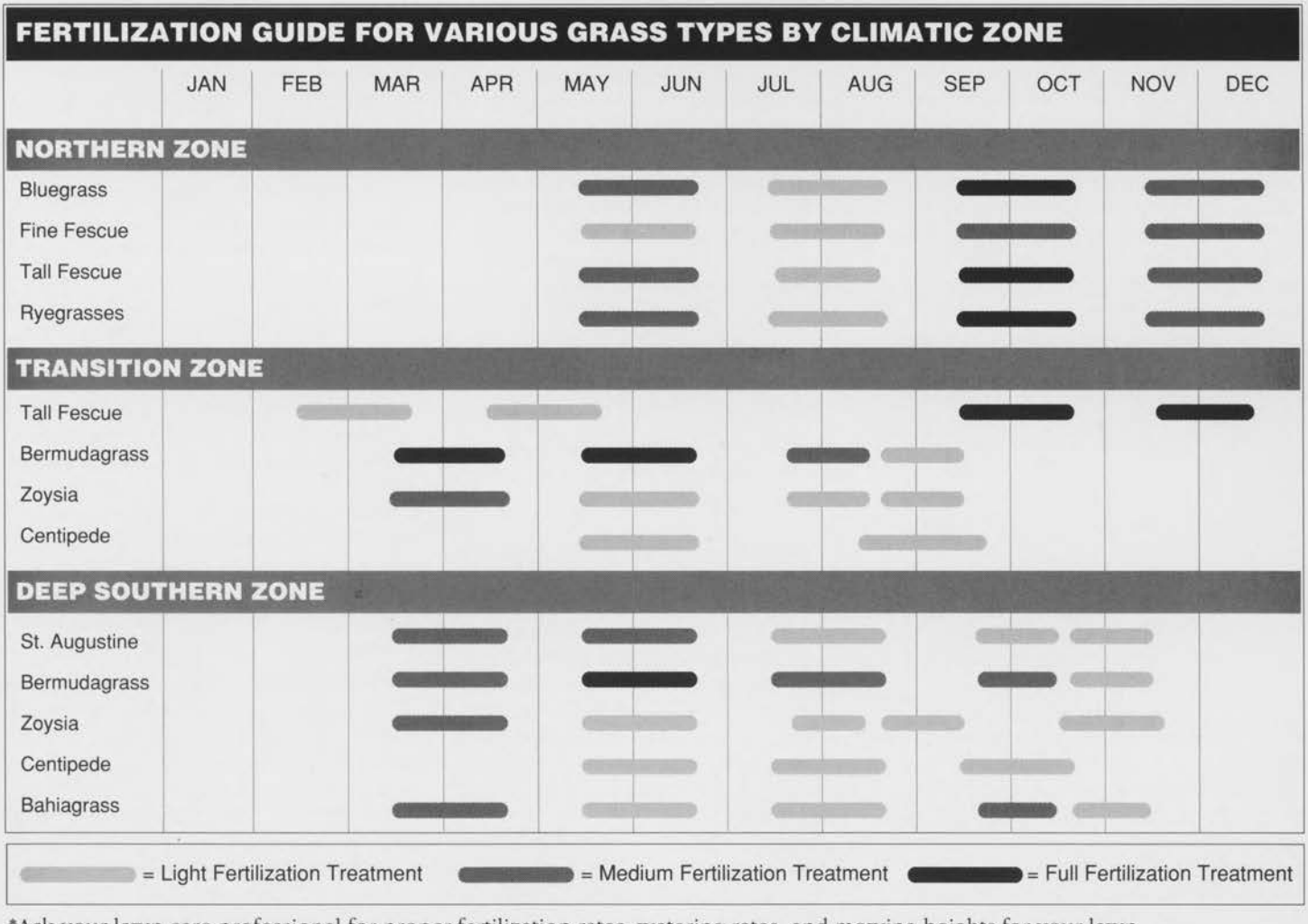
Fertilize Properly

Lawns need properly timed fertilizer applications to become dense and green. Over fertilization weakens your lawn and causes excess top growth. Grasscycling, in conjunction with proper fertilization, enhances the health of your lawn.

Rates: Fertilizer lbs. per 1,000 sq. ft.

Analysis	Light	Medium	Full
12-4-8	6	8	10
15-5-10	5	7	9
21-7-14	4	5	6
16-4-8	5	6	7
20-5-10	4	5	6
24-6-12	3	4	5

For more even growth when using medium to full rates, use fertilizers containing methylene urea, ureaformaldehyde, sulfur coated urea, IBDU, or other slowly available organic forms of nitrogen.



*Ask your lawn care professional for proper fertilization rates, watering rates, and mowing heights for your lawn.

One of the original (early 1980s) guidelines of the Xeriscape concept recommended the "limited use of turfgrass." The American Sod Producers Association (ASPA) and other turfgrass oriented organizations took strong exception to this guideline, based on a broad array of scientific fact that clearly demonstrated the many environmental benefits of turfgrass. In time, the original guideline was modified by the National Xeriscape Council from "limited turf" to "practical turf areas."

The current National Xeriscape Council, Inc., position paper has been reviewed and commented upon by ASPA and others; however, it is and will remain a statement of the National Xeriscape Council's position. While the American Sod Producers Association finds position paper a positive modification that recognizes at least some of the values of turfgrass in today's environment, there are components of the Council's statement that ASPA maintains deserve still further consideration.

ASPA has and will continue to be supportive of a working relationship with the National Xeriscape Council, Inc., for the mutual benefit of both organizations, their memberships and the population at large. Ultimately, however, both organizations will rightfully maintain their autonomous and independent positions.

American Sod Producers Association

Practical Turf Areas: The Controversial Xeriscape Guideline

A Position Paper from the National Xeriscape Council, Inc.

By Douglas F. Welsh, Ph.D., President, National Xeriscape Council, Inc., Extension Horticulturist, Texas A&M University

Recently, much attention and controversy has surrounded the Xeriscape guideline regarding turfgrass in the landscape. Misinformation has been touted as fact by "experts" in Xeriscape and turf culture. After much investigation, the National Xeriscape Council, Inc. has taken the following position concerning the use of turfgrass in a Xeriscape.

The Xeriscape movement recognizes turfgrass as an integral component of the landscape. Turfgrass is certainly the best recreational surface for children and athletes. Turfgrass in the landscape has a tremendous mitigating effect on the environment, reducing heat loads and noise, water and air pollution. A turfgrass lawn is second only to a virgin forest in the ability to harvest water and recharge groundwater resources. And as a design component, turf provides unity and simplicity to the landscape while inviting participation in the landscape.

Xeriscape highlights the use of turfgrass in the landscape because of the tremendous opportunity for abusive use of irrigation water in the name of maintaining turfgrass. Within the traditional landscape, turfgrass has received the major portion of the total landscape irrigation. Through the guidelines of Xeriscape, turf irrigation can be reduced, while the property owner continues to derive the many benefits of turfgrass.

"Practical Turf Areas" is only one of the Xeriscape guidelines which addresses appropriate turfgrass use and management. The Xeriscape remaining guidelines which directly relate to turfgrass use and management in the landscape include:

- ☐ Planning and design
- ☐ Appropriate plant selection
- ☐ Efficient irrigation
- ☐ Appropriate maintenance

Specifically, Xeriscape guidelines promote the following strategies to reduce turfgrass irrigation:

- ☐ Placement of turf species into landscape zones based on water requirements
- ☐ Selection of adapted, lower-water demand turf species and varieties
- ☐ Use of irrigated turf in areas which provide function (i.e., recreational, aesthetic, foot traffic, dust and noise abatement, glare reduction, temperature mitigation)
- ☐ Use of non-irrigated turf areas where appropriate
- ☐ Proper irrigation of the turf based on true water needs
- ☐ Increased mowing heights to decrease evaporation
- ☐ Decreased fertilizer rates and proper scheduling of fertilization

The original turf guideline established by the Denver forefathers of Xeriscape was: "limited turf use." For Denver and much of the arid West, the seemingly logical approach to reducing landscape water consumption was simply to reduce the incidence of water intensive turf. However, as the Xeriscape concept has matured and spread across the nation, the guideline of "limited turf use" has been under increased scrutiny by horticulturists and turf experts. The Xeriscape movement has taken a more holistic approach to reducing turf irrigation, fully recognizing that the type of plant materials or irrigation system in the landscape has much less effect on water consumption than the human factor of good landscape water management.

However, the fact remains that turfgrass is the highest user of irrigation water in the traditional landscape. Notice the statement is not that turfgrass is the highest water using plant in the landscape. This is the most common misconception and misrepresentation in Xeriscape, and is therefore the foundation for controversy and unproductive efforts. To shed light on this controversy, presented through the follow-

ing Xeriscape guidelines are some scientific and practical fundamentals with regard to turfgrasses.

Planning and Design

The current trend in quality landscape design calls for a "balanced landscape;" a landscape which has balance between the lawn area, shrub and flower plantings and the hardscape. This trend is seen in both residential and commercial landscape design, and even in golf course design. With this shift in landscape design to more balance, landscapes have more interest, variety, color, texture and increased opportunity for landscape water savings.

Good landscape water management begins with planning and design. By designing the landscape into zones based on plant water needs, turf can be appropriately placed for function, benefit and water efficiency. However, on any property, the client and the landscape professional are challenged to find an acceptable balance between the benefits of turfgrass in the landscape versus the "costs" (i.e., water, fuel, manpower).

Practical Turf Areas

Through traditional landscape design, turfgrass has comprised the major portion of American landscapes. This love for expansive lawns in the United States is traced back to English influence. The tremendous square footage of turfgrass in a traditional landscape begins to explain why turfgrass irrigation, as a percentage of total landscape irrigation, is so high. The guideline, "practical turf areas," promotes the use of turf only in those areas of the landscape which provide function. In residential landscapes, a turf area for recreation and entertainment is usually a necessity. However, turf placed between the houses may provide little function yet still require considerable water, fertilizer and labor.

A turf area between houses also illustrates the inefficiency of long, narrow turf areas. John O. Nelson's study of landscape irrigation requirements in multi-family dwellings verified that the perimeter of the turf area is a better indicator of irrigation requirement than square footage of turf. To enhance irrigation efficiency, Xeriscape encourages designing turf areas into the landscape which are large enough to provide function, yet have the smallest perimeter possible, relative to the total contiguous turf area.

One other way to incorporate turf into the landscape with little effect on irrigation requirement is simply not to irrigate. Many turfgrass species are drought tolerant and can survive extreme drought conditions. The grass may turn brown for a while, but rainfall will green it up again. This approach may be unacceptable for many residential and commercial landscapes; but in the case of parklands, industrial sites and right-of-ways, stressed turf may be acceptable.

Appropriate Plant Selection

Wherever the landscape, the proper selection of turfgrass species and varieties is of utmost importance. Extensive research has shown that there are significant differences in water requirements among turf species and even among varieties within species. The response of turf species to drought through mechanisms of avoidance and resistance also varies significantly. Research has identified turf varieties which remain green even after four to five months of drought. Research has also identified many varieties which show poor response to prolonged drought. To help reduce landscape water requirements, Xeriscape recommends selecting turfgrass varieties, and woody plants, which are both adapted to the area and possess the lowest water requirements practical.

Turfgrass Irrigation Efficiency

As stated earlier, proper landscape water management provides the greatest opportunity for water conservation in the landscape. Throughout the Xeriscape movement, the truth is evident that plants do not waste water, people do. An additional truth is that irrigation systems do not waste or save water, people do. The mission of Xeriscape is clear: change the attitudes and irrigation habits of professional and amateur landscape managers.

Landscape managers must understand the complexities of landscape water requirements and strive to supplement natural rainfall with needed irrigation. The following discussion is an attempt to provide general guidelines to the landscape manager in an effort to maximize irrigation efficiency.

First, turfgrass irrigation makes up a large percentage of the total landscape irrigation simply due to the large portion of the landscape which is comprised of turf. In addition, turfgrass has genetic characteristics which help explain why turfgrass is the highest user of irrigation water in the landscape.

Total water use of landscape plant species varies tremendously, but total water use does not correlate directly with total use of irrigation water. For example, a mature pecan tree may use as much as 120 gallons of water a day, yet landscape managers do not apply 120 gallons every day to a pecan tree to keep it aesthetically pleasing. In the overall hydrological cycle, the pecan tree is a very high user of water in the landscape, but its demand on irrigation water may be minimal. It is recognized, however, that a pecan tree will take advantage of irrigation water by establishing roots among the turfgrass roots; but in the absence of irrigation, the pecan tree will draw moisture from deeper soil depths.

In general, most woody plant species (i.e., trees, shrubs) genetically have more extensive root systems than turfgrasses commonly used in the United States (however, great strides are being made by researchers to increase turfgrass root system size). Certainly there are exceptions to this rule of thumb in the plant kingdom; but for the manager, this guideline serves well. With a more extensive root system, woody plants have a bigger "bank account" of water to draw from than turfgrass. The smaller "bank account" of water utilized by the turfgrass must be replenished more often than the big account of the woody plants.

The landscape manager, therefore, irrigates the turfgrass more often; or perhaps only occasionally through better plant selection or in the milder summers of the Northeast. However for much of the nation, if the appropriate woody plants are used, supplemental irrigation of established trees and shrubs should occur rarely, if at all. This is why irrigation systems should be zoned to allow for irrigating of turfgrass on a more frequent schedule than shrubs. For established trees and shrubs, the irrigation strategy should utilize deep soil moisture and depend on natural rainfall to replenish soil moisture. When sufficient rainfall does not occur, irrigation of trees and shrubs may be required.

Being a herbaceous plant, many turfgrasses tend to show stress from lack of water more quickly in terms of visual color than most woody plants. Generally, most woody plants can endure much longer without rainfall or irrigation than a herbaceous turfgrass before showing visual signs of drought stress (i.e., leaf drop/rolling, yellowing). Again there are exceptions, which emphasizes the importance of appropriate turf and woody plant selection in terms of water stress tolerance for regions prone to drought.

Plant response to lack of water in turfgrasses varies significantly from leaf rolling to yellowing to no response. Landscape managers should be keenly aware of drought stress indicators shown by turfgrasses and other plants in the landscape and strive to meet the water needs of each group of plants. By striving to irrigate when the plants need water versus by the calendar, the manager can dramatically reduce landscape water use.

Appropriate Maintenance

Finally, through specific cultural practices, the water requirements of turfgrasses can be reduced. Such practices include mowing at higher mower heights during the summer. This allows the turf to mature and serve as a living mulch, shading the ground and reducing evaporation. Also, decreasing fertilizer application rates and using timely applications of slow-release fertilizers tend to reduce flushes of growth, which can increase water requirements. Some research is now investigating the use of growth retardants as a way to reduce turf water use.

The Xeriscape Challenge

Xeriscape is a challenge and an opportunity for the green plant industry. Even for the turfgrass producer, Xeriscape has tremendous potential. Turfgrass sod has, for all practical purposes, become a commodity. This situation has resulted from intense competition and narrow profit margins. Through Xeriscape, the sod producer is encouraged to investigate, grow and market new water-conserving turf species with an anticipated goal of product differentiation (i.e., water-thrifty turf). Through product differentiation, sod producers can establish new markets and increase profits for their product.

By embracing the Xeriscape concept, including the guideline of "practical turf areas," the green industry can continue to be recognized as good stewards of the environment. Ultimately, Xeriscape promotes water conservation through high-quality, beautiful landscaping. Xeriscape is truly a win-win program for everyone!

Acknowledgement

The author acknowledges the valued critical review provided by NXCI board members; Drs. James Beard and Richard Duble, turfgrass faculty Texas A&M University; Randall Ismay, California landscape consultant; Ed Davis, Florida sod producer; Dr. Tim Bowyer, Georgia sod producer; and select members of the American Sod Producers Association.

Turfgrass Facts

STRANGE BUT TRUE

PEST CONTROL: RODENTS, SNAKES, SKUNKS, AND OTHER SMALL ANIMALS ARE LESS LIKELY TO INHABIT A LOW-MOWED TURF AREA AND THEN INVADE HOMES.

A SCIENTIFIC VIEWPOINT:
DR. VICTOR A. GIBEAULT

Dealing With a Drought

A drought is defined as a period of abnormal moisture deficiency. This definition implies that normal moisture conditions will return to an area in time and that temporary changes in turfgrass culture may be sufficient to ride out the water shortage. Attention to the details of mowing, fertilization, thatch and compaction control, and especially irrigation practices, can maximize water efficiency on a turfed site during a short-term drought.

In contrast, some areas face the possibility of permanent drought conditions because of jurisdictional, political or economic considerations. Under such circumstances, attention to details of design, and the selection of low water using and drought resistant species, in addition to careful cultural practices, are needed.

Turf Needs Water

Turfgrass, and other landscape plant material, needs water for its growth and development. There is neither sufficient precipitation, nor is the precipitation adequately spaced throughout the year in many parts of the United States, to sustain turfgrasses or other landscape plants without supplemental water supplied as irrigation.

The amount of water used for landscape irrigation can vary from a very small amount of the total in a rural water agency or area to a significant amount of the total in the urban area.

In urban southern California, as an example, 10 percent of their water is used for agricultural production and 90 percent for the urban categories of residential, commercial, industrial, public and other. It is believed that in 1990, a dry year, 25.7 percent of the 3.6 million acre feet (MAF) of water for urban use went for urban irrigation purposes. Statewide, however, 78.8 percent of all water is used for agricultural purposes. The statewide urban category accounts for 16.3 percent of total water used in California but there are not estimates, published or stated, of the amount of water statewide used for landscape irrigation. Using projections, however, it would be expected that 4 percent of statewide water would be used for landscape irrigation. Under drought conditions, conservation of water is needed in all water use categories, including the landscape industry segment.

A popular misconception during drought conditions is that to conserve water, people should replace their current landscapes with gravel, other hardscapes and native plants. Actually, studies have consistently shown that irrigated landscapes are usually overwatered and that sufficient amounts of water can usually be saved by improving irrigation system water distribution and watering existing plants, including turfgrass, just enough to keep them alive and functional

Irrigating Turfgrasses

As an example, a study conducted in Irvine, California was designed to investigate the effects of applying optimum and reduced amounts of irrigation water calculated as a percentage of evapotranspiration of applied water on cool and warm season turfgrasses. It showed the irrigation requirement differences between these grass groupings. The grasses tested included Kentucky bluegrass, perennial ryegrass and tall fescue for the cool season species and hybrid bermudagrass, zoysiagrass and seashore paspalum for the warm season grasses. Irrigation regimes resupplied 100, 80 or 60 percent of calculated evapotranspiration for the grasses. Thirty-six percent less water was applied to the warm season species than to the cool season species for acceptable turf quality. Also, all cool season turfgrasses gave good performance when at 80 percent of optimum water requirement and warm season turfgrass gave good performance when irrigated at 60 percent of optimum.

Mowing

In addition to irrigation practices, mowing affects turfgrass growth, including root system development, and water use. The balance that is desired is to use mowing practices that enhance root system depth and density yet efficiently use water resources. Turf mowed at optimum heights for the individual species and at a frequency that allows no more then ⅓ to ½ the leaf blade removal, achieves that balance as much as possible given the overall uses of turfgrass.

Fertilization

Fertilization influences turfgrass growth and the greater the growth rate, the greater will be the water-use rates so turfgrass fertilization practices, especially nitrogen fertilization, directly influences water use.

Both root and shoot growth increase as nitrogen nutrition is raised from a deficiency level. The resulting deeper roots and more vigorous topgrowth are beneficial for the turfgrass sward. Additional nitrogen fertilization at high rates and/or at frequent intervals are less beneficial and, in fact, can be detrimental to the turfgrass because of root growth stoppage and excessive, lush topgrowth. Turf owners must monitor and adjust nitrogen fertilization programs to produce the least amount of topgrowth and the greatest rooting possible within the use parameters of the turfed facility. Otherwise, rapid growing grasses will have an unnecessarily high water use rate.

Other Considerations

Other points to consider to increase watering efficiency would include some short-term considerations including:

- Control thatch and soil compaction.
- Late night or early morning irrigation is most effective. At these times water loss by evaporation is minimal and distribution is usually good because of good water pressure and limited wind.
- Avoid runoff by matching water application rates to soil infiltration percolation rates. Cycle water application when necessary to ensure infiltration.
- Practice good weed control methods. If not controlled, the weeds, not the desired turf species, will use the water.
- Shaded areas will use much less water than turf in open sun. Therefore, shaded areas will require less irrigation. Soil moisture measuring devices can be used to determine water needs of shaded areas.
- Line water storage lakes to reduce water loss.
- If your facility is considering the installation of a new, more effective and efficient irrigation system, then this may be the time to act.
- Level mounds and redesign other hard to irrigate topographic features.
- Investigate the possibility of effluent water.
- Remove poor performing plants from the landscape.
- If establishing plant material, group plants with similar water requirements so all can be irrigated for optimum performance.
- Use mulches 1-2 inches thick to reduce evaporation water loss in plant beds.

In summary, turfgrass provides many benefits to our highly urbanized society and the way we live. It provides the medium for play on many recreational facilities; it modifies our environment to make life easier and more pleasant; it provides the opportunity for a pleasing and functional home landscape.

There are costs associated with turfgrasses, one of which is the use of water. During temporary or more long term drought conditions, the efficient utilization of this natural resource is essential.

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FIRE PREVENTION AND CONTROL: WELL MAINTAINED LAWNS SURROUNDING A HOME SERVE AS A FIRE-FIGHTING BUFFER AND WILL NOT SUSTAIN FIRES AS DENSE, WOODY VEGETATION MAY.

A World of Miniature, Yet Mighty Wonders...
The Environment Right Uunder Our Feet

By Eliot C. Roberts, Ph.D., Director, The Lawn Institute, Pleasant Hill, Tennessee

Interest and involvement in our environment is increasing. Getting back in touch with nature is appealing to more and more people, especially those of us living in modern, but densely populated cities. There seems to be an inherent longing to more closely study nature and its many marvelous wonders. But, few people realize that within a few steps of their homes, there exists a world of miniature, yet mighty wonders that has a daily effect on their lives.

While not as visually impressive, or as awe inspiring as some forest jungle areas or ocean reefs, the life-forces at work in a patch of simple and commonplace turfgrass can be every bit as interesting, perhaps even more intriguing.

In an average lawn of 10,000 square feet, an area just 100-feet by 100-feet, there will be some 35-million individual turfgrass plants. No other type of plant culture involves such crowding. Because grasses grow from a base "crown," the tops of the leaves can be mowed to a uniform, carpet-like appearance, without killing the plant as would happen with so many others. Those grass leaves we can see are responsible for photosynthesis that makes the grass plant grow and in the process they exchange carbon dioxide in the atmosphere for clean and pure oxygen people need for their growth. The closely growing nature of grasses also make them an ideal filter for removing tremendous amounts of particulate matter that cars, homes and factories dump into the air each year.

While the above-ground benefits of turfgrasses are significant to human life, the below-ground activities challenge the imagination. A single grass plant can have up to 375 miles of roots! There can be as many as 14-million individual roots, with a surface area of 2,500 square feet! The tremendous density of grass roots also provide benefits to humans because of its ability to slow-down runoff rain waters so it can be absorbed into the soil, thus reducing erosion and the very real problem of storm sewers becoming filled with silt and debris.

The extremely fine structure of grass roots fits ideally in the soils they're grown. Soils are composed of mineral particles that include sand, silt and clay. Each of these components exist in a variety of sizes, and percentages, helping scientists to classify soil types. Rather than talk in scientific terms of sand being 2 to 0.2 millimeters, or silt being .02 to 002 and clay particles smaller still, consider the following comparison.

Imagine that a medium sand particle is enlarged to the size of the White House in Washington, D.C. By comparison, a silt particle would be the size of a stretch-limousine parked at the entrance. A clay particle would be about the size of an apple.

The significance of the various sizes, especially to the grass plant, is that because of the very small particle sizes, there is an inversely large total surface area that can be highly active with unique physical, chemical and biological properties. The fine root structure of grasses allows them to grow between and among the soil particles, exchanging nutrients and absorbing water in processes that allow the grass to grow and actually improve the consistency of the original soil. Consider for a moment where the most productive agricultural soils of the world are located. Almost without exception, the best farms are where grasslands have had a tremendous influence on soil formation. Whether it's a farm, park or a home yard, grasses continually improve the soil as another benefit of their growing processes.

But the miniature world of grasses doesn't stop with roots and soil alone. Within the life-cycle of grasses (often with man's assistance), leaf clippings are dropped to the soil and roots grow and die, with both decomposing to form humus. This continuous cycle of growth and decomposition provides food for soil microorganisms that are very crucial in this living, dynamic system.

Another challenge for the imagination is the multitude of life forms that are active in the soil, fitting into and around the smallest of soil particles and grass roots. Microorganisms, including bacteria, fungi, actinomyces and protozoa make the grass rootzone their home. In a single pound of root zone soil there will be more than 930-billion of these tiny organisms. One thousand square feet of lawn root zone contains some 45-quadrillion (45 and 15 zeros!), microorganisms that will have a live weight of some 70 pounds. These soil building oganisms require carbon as a source of energy. The carbon dioxide removed from the atmosphere by the grass plant becomes food for the microorganisms when the plant decomposes. The result is improved soils with increasing amounts of humus and a reduction of carbon dioxide from the atmosphere.

As a return benefit to the grass, 100 pounds of dead microorganisms will contain close to 10 pounds of nitrogen, 5 pounds of phosphorus and 2 pounds of potassium. This equates to a 10-5-2 fertilizer production plant within the root zone. Although this output is small in terms of turfgrass requirements, it is important because of its continuing contribution to soil fertility.

While it's impossible to imagine a big market for turfgrass safaris using microscopes to enjoy the sights, the miniature world of turfgrasses are indeed mighty... and mighty important to humans.

The grass root zone, with its unique soil system helps accomplish these tasks:

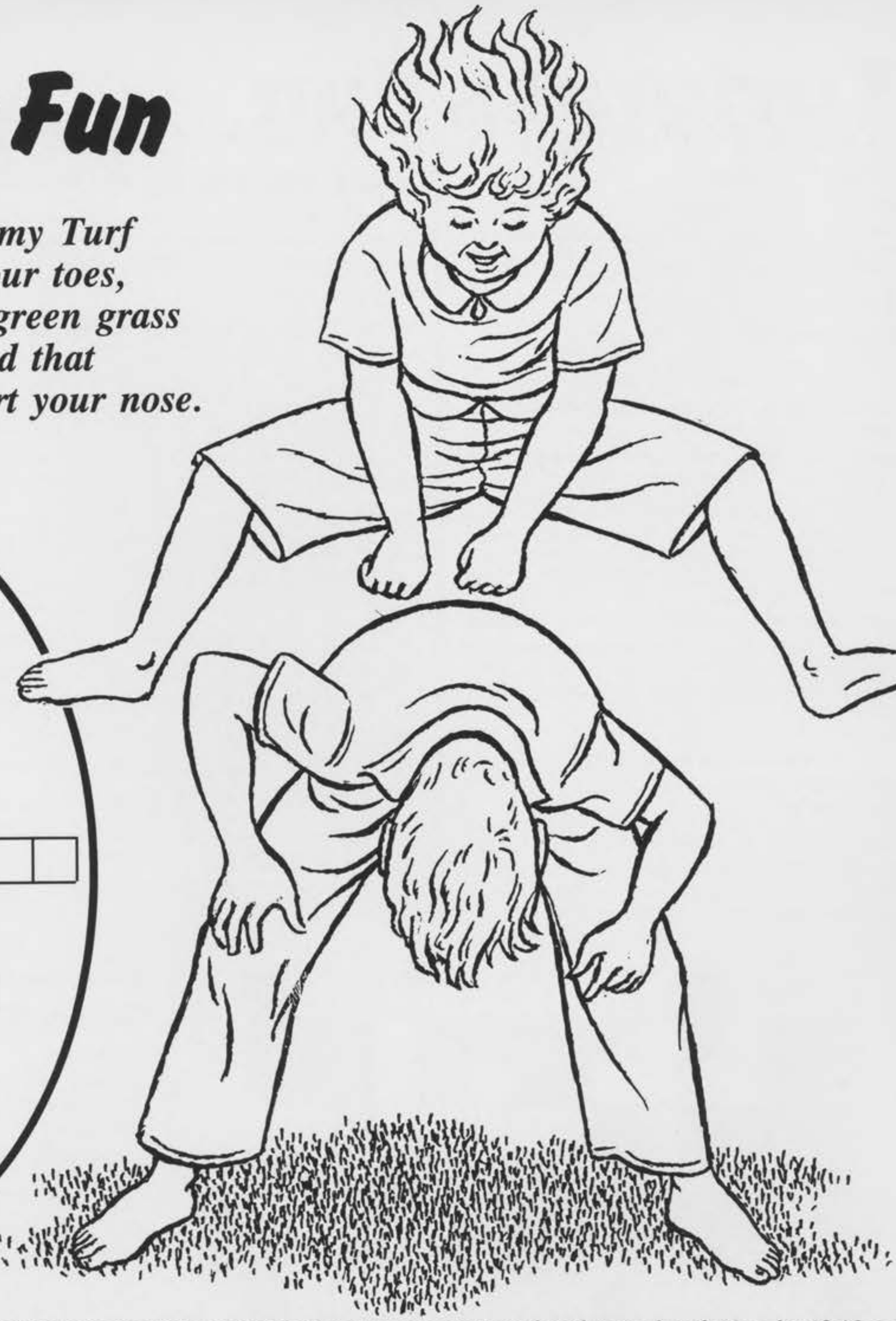
- Makes lawns easier to maintain with less weeds, insect and disease problems.
- Improves soil structure and reduces soil compaction so that infiltration of rain and irrigation water is enhanced.
- Improves processes that cause biodegradation of all sorts or organic pollutants and contamination from air and water.
- Promotes soil building processes through decomposition of organic matter and formation of humus.
- Promotes the development of the best in turfgrass ground cover that provides a wide variety of functional and aesthetic benefits for all of us, wherever we live.

Whenever you're out-of-doors, take a minute to look down and consider that right under your feet exists a whole other world, foreign and strange to most people, yet vital to our very existence.

A world of miniature, yet mighty wonders... the environment right under our feet.

Turfgrass Fun

Tiny Tommy Turf
Tickles your toes,
Growing green grass
On ground that
Won't hurt your nose.



Crossword Puzzle

The Grass In Our Yards

DOWN

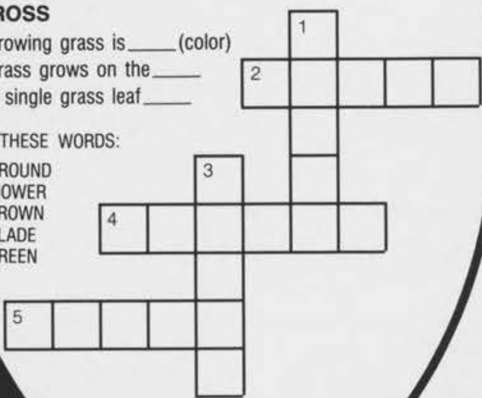
1. Dry grass turns_____(color)
3. Long grass is cut with a_____(thing)

ACROSS

2. Growing grass is_____(color)
4. Grass grows on the_____
5. A single grass leaf_____

USE THESE WORDS:

GROUND
MOWER
BROWN
BLADE
GREEN



Answers:
Down: (1) Brown; (3) Mower
Across: (2) Green; (4) Ground; (5) Blade

A Secret Code, just for YOU!

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

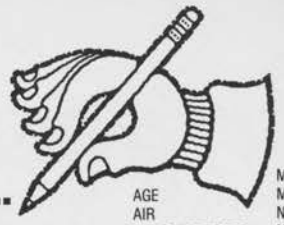
Q	R	S	T	U	V	W	X	Y	Z
17	18	19	20	21	22	23	24	25	26

Can YOU discover the secret message?

__ __ __ __ __ __ __   __ __ __ __ __   __ __   __ __ __ __.
7 18 15 23 9 14 7   7 18 1 19 19   9 19   3 15 15 12

Grass really is cool when it grows. On a hot summer day, lawns will be 30-degrees cooler than asphalt and 10 to 14 degrees cooler than bare soil.

Turfgrass Fun



Play It Safe

When you play, play it safe. Play on grass.

When you play on grass, you don't have to worry about cars, trucks or other vehicles. Games played on grass are safe because of the springy cushion when you're running, sliding or even falling.

EGG-DROP EXPERIMENT

Here's a fun experiment you can do to see how soft and safe grass is, compared to other areas you may sometimes play on.

Supplies Needed: (1) Three uncooked eggs; (2) Tape measure; (3) Paper towels; (4) Pencil and paper.

Step 1: On pavement, a sidewalk, or other man-made surface, hold the tape measure straight up in the air, with one end on the surface. Hold one fresh egg exactly 6-inches above the ground, against your tape measure, and let the egg drop to the surface. Did it crack? If not, continue to drop the egg from higher levels, always starting it against your tape measure, until the egg cracks or breaks. Record the highest distance. (After each of these experiments be sure to clean up the broken eggs.)

Step 2: On bare dirt, repeat the experiment. Record the distance.

Step 3: On a grassy area, continue the experiment by dropping the third fresh egg from higher and higher levels until it breaks. Record the highest distance. (One last thing, be sure to clean up the broken eggs.)

Findings:

Which surface let the egg fall the farthest? _____

Which surface would be the safest to play on? _____

Your body is not as fragile as a fresh egg, but skin gets cuts and bruises; bones can chip, crack or break if you don't play it safe.

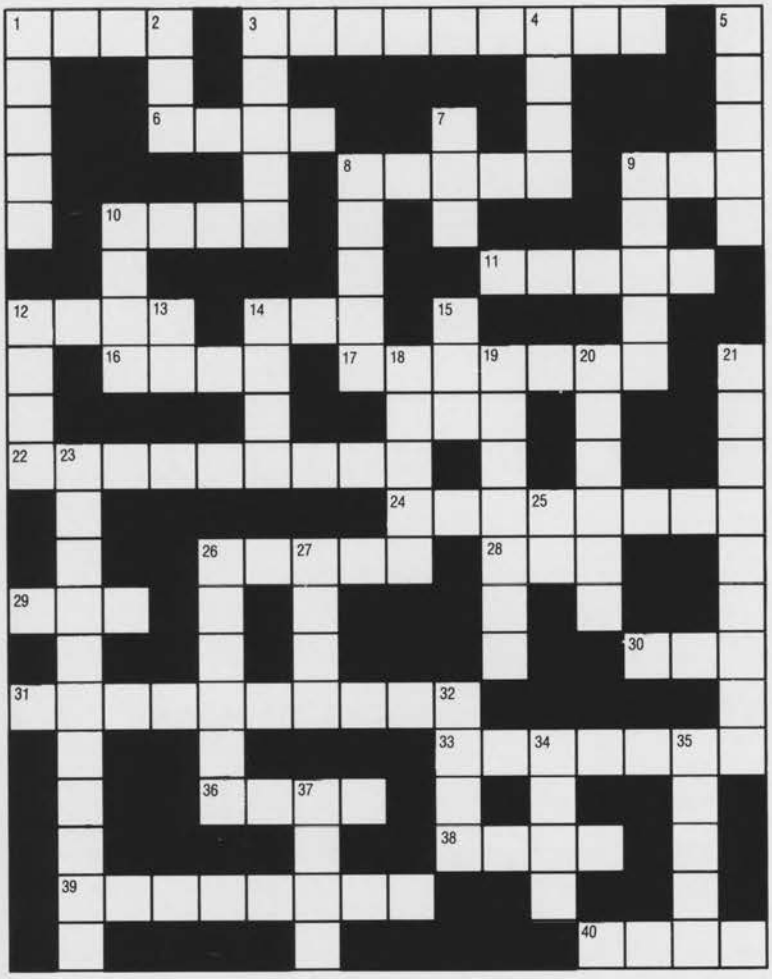
Enjoy the great outdoors and all that you can do safely with your family and friends, but be sure to watch out for unsafe areas and be especially careful if you're not playing on grass.

Word Search: All Things Grass...

Each of the words listed to the right will be found in the puzzle. Using a pen or pencil, circle each word (as an example, the word "GRASS" is circled). Words can run in any direction and diagonally. Some letters are used more than once.

B	B	B	L	A	D	E	U	L	B	K	R	A	P	O	I
O	L	O	P	N	A	R	F	O	O	T	B	A	L	L	R
Y	G	I	R	L	E	O	T	L	I	S	O	C	C	E	R
B	T	R	I	T	I	S	O	D	A	W	O	R	G	R	I
A	A	N	A	C	L	I	P	P	I	N	G	S	E	U	G
S	E	W	E	S	T	O	E	E	T	E	E	L	N	G	A
E	H	O	E	B	S	N	L	R	B	E	K	T	U	B	T
B	N	M	B	H	A	C	I	S	D	N	A	D	R	Y	I
A	I	R	C	O	N	D	I	T	I	O	N	E	R	L	O
L	T	E	E	S	I	R	M	R	S	P	F	S	O	L	N
L	R	E	Y	E	F	S	P	I	F	U	I	N	O	A	N
M	O	W	E	R	I	S	A	E	N	A	N	W	T	B	D
A	G	E	U	N	E	E	R	G	U	T	E	A	S	Y	R
N	E	T	N	G	U	T	U	R	F	W	O	L	S	E	A
W	N	E	N	P	I	L	C	U	E	I	O	N	G	L	Y
O	T	A	G	L	M	O	O	N	E	G	Y	X	O	L	A
R	G	M	I	R	T	G	R	O	U	N	D	R	L	O	W
B	A	Z	B	O	C	C	E	F	C	U	E	A	F	V	O
T	E	U	Q	O	R	C	A	F	M	H	W	S	O	I	L

AGE
AIR
AIR CONDITIONER
ALLY
BASEBALL
BENT
BIG
BLUE
BOCCE
BOY
BROWN
CLIP
CLIPPINGS
CORE
CROQUET
DEW
DIRT
EROSION
FERTILIZE
FINE
FOOTBALL
FRISBEE
FUN
GANG
GIRL
GOLF
✓GRASS
GREEN
GROUND
GROW
HEAT
HERO
HOE
HORT
HOSE
IRRIGATION
LAWNS
LEAF
LINE
LOW
MAT
MAN
MOON
MOW
MOWER
MUD
NEW
NEET
NICE
NITROGEN
OXYGEN
PAR
PARK
POLO
RAKE
RAN
RAP
RISE
ROOTS
ROW
RUGBY
RUN
RUNOFF
RYE
SAP
SEED
SILT
SIP
SIT
SLOW
SOCCER
SOD
SOIL
SPRINKLER
SUN
TAG
TEE
TEN
TENNIS
TOP
TRIM
TURF
TWIG
VOLLEYBALL
WAY
WATER
WET
WEST
YARD



Crossword Puzzle: Green, Green Grass

ACROSS

1. Grass, when it needs mowing
3. Irrigation ending
6. Catches
8. Dry grass (color)
9. Petrol
10. Shorten
11. To make wet
12. Shorten (not 10.)
13. Not all
14. Piece of grass
15. Horses game
17. Soil loss
22. To feed grass
24. Drawn out
26. Family of plants
28. Before two
29. What we breath
30. Cheer
31. Grass traps these
33. Not inside
36. Best time to water
38. _ _ _ _ grass
39. Basic grass food
40. Good, Better, _ _ _ _

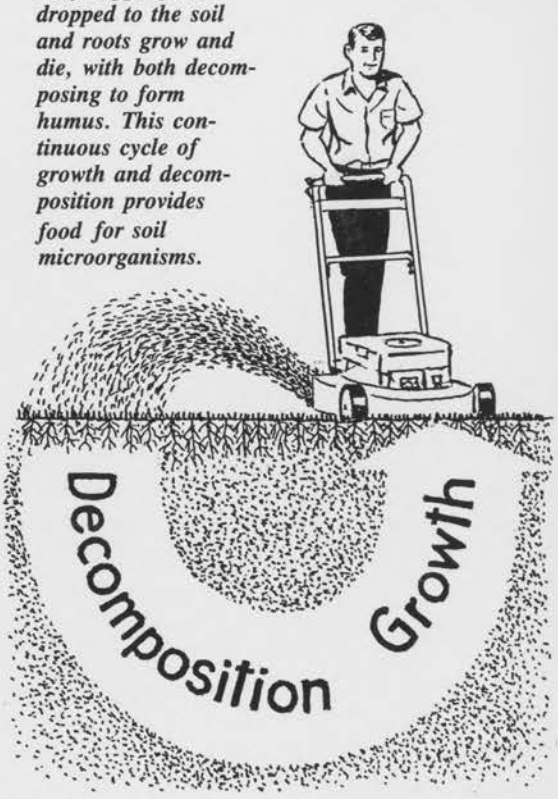
DOWN

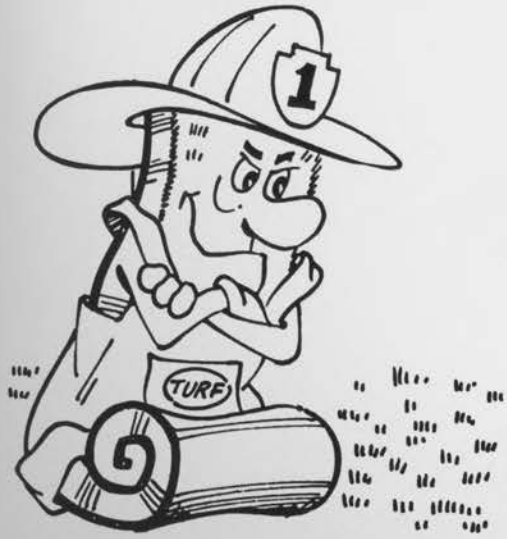
1. Connects to sprinklers
2. Opposite of cool
3. Mower blade needs
4. Yard grass
5. To grow
7. To cut
9. Growing grass color
10. Shorten
12. _ _ _ _ grass
14. Basic need of grass
15. Good feeling
18. One of grass family
19. Four each year
20. Grass makes from carbon dioxide
21. Yard design
23. All things around us
25. Opposite of out
26. Where grass grows
27. American Sod Producers Association (abbr.)
32. Type of landing on grass
34. _ _ _ _ grass (and again)
35. Results of leak
39. Earned mowing lawns

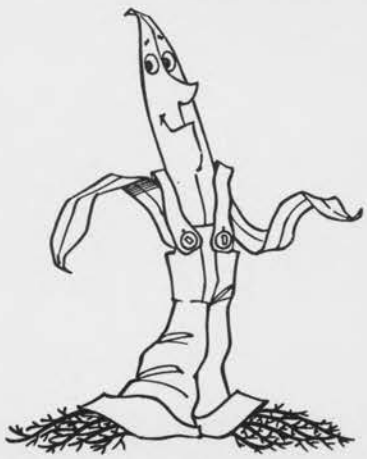
Article Illustrations and Clip Art

(Illustration for the article "A World of Miniature..." on page 14)

Leaf clippings are dropped to the soil and roots grow and die, with both decomposing to form humus. This continuous cycle of growth and decomposition provides food for soil microorganisms.







The following organizations endorse the environment educational efforts of the American Sod Producers Association,

American Society of Landscape Architects
International Society of Arboriculture
Irrigation Association
National Arborist Association
Professional Grounds Management Society
Professional Lawn Care Association of America
The Lawn Institute
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