

Journal Of ENVIRONMENTAL TURFGRASS

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

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**A SCIENTIFIC
VIEWPOINT:
DR. J.B. BEARD**

The Immediate Environmental Benefits From Turf Establishment by Sodding

The protection and enhancement of our environment is one of the mandates of the people in the United States for the 1990's. Historically turfgrasses have been a major contributor to the protection of our environment and the enhancement of our quality of life, particularly in urban areas. This is certainly not a new concept for those in the turfgrass industry.

During the establishment phase of turfgrasses there is a period of time when potential adverse affects on the environment could occur, if proper cultural practices are not followed. During construction of buildings, facilities, and allied landscapes typically there is extensive excavation, fill, and movement of soil. Hopefully, the contractor has removed and stockpiled all quality topsoil before the initiation of this construction. Furthermore, that the construction plan minimizes the amount of soil on the site that is exposed without a turf cover at any one time, therefore minimizing soil loss by erosion.

Once the construction is completed, the next phase is site development including tillage and soil preparation for turf establishment. The options in turf establishment include sodding, seeding, sprigging and plugging.

As one assesses the sodding option from the standpoint of immediate beneficial effects on the environment, there are a number of dimensions of a short term nature—still highly significant—that should be taken into consideration.

Erosion Control

Sodding offers immediate stabilization of the construction site; thereby avoiding significant loss of soil by wind or water erosion. In addition, the eroded soil typically fills ditch bottoms, waterways, and drainage culverts to the extent that subsequent costly clean-out is required once turf establishment on a site is achieved. Obviously this immediate erosion control is a major benefit in terms of environmental protection. There is no question when choosing from among the four turf establishment options that sodding offers a major benefit in protecting a vital natural resource.

Water Conservation

Sodded turf sites will require irrigation for a shorter period of time after planting than sites which are seeded, sprigged or plugged. This reduces the time frame and amount of irrigation water needed, contributing to water conservation. Equally important, the immediate installation of the sod will serve as an excellent means of water harvesting due to the superior capability of mature sods to (1) trap and hold rainwater in place for ground water recharge; and (2) enhance the moisture content of the root zone, further reducing the need for irrigation.

Reduced Herbicide Use Considerations

When establishing a turf with quality sod, there should be no need to apply herbicides for weed control for 1 to 4 years,



depending on whether the home owner or turf user follows proper turfgrass cultural practices subsequent to sodding. In contrast, establishment by seeds, sprigs or plugs generally necessitates the use of pre and/or postemergent herbicides for weed control, as the open areas between individual plants or turf plugs are exposed to full sunlight which stimulates seed germination of weedy annual grasses in particular. The result will be the need to control these weeds with the appropriate herbicide. It is important for the homeowner to understand the need for proper rate and timing of these herbicide applications, otherwise failure likely leads to additional unneeded treatment.

In contrast, sod grown in a production field typically will have a lower soil weed

Editor's Note: Dr. James B. Beard is a Professor of Turfgrass Physiology and Ecology in the Department of Soil & Crop Sciences at Texas A&M University, College Station. His research and teaching in Turfgrass Sciences include a broad array of topics including many mentioned in this article. Recognized as a leader by his peers, he has served as President of the Crop Science Society of America and the International Turfgrass Society, as well as being a recipient of numerous honorary positions and awards. Dr. Beard also is the author of six books on turfgrass and their cultures.

content. Most sod operations practice following operations to control most of the weed population prior to the original planting of the sod. Those weeds that do require chemical control will be treated by a trained, certified applicator knowledgeable in the proper rate, timing, and material selection for the particular weed or weeds identified as being a problem.

Earlier Environmental Benefits

Sodding offers almost instantaneous implementation of a significant range of benefits that turfgrasses provide to our quality of life in urban areas. These include temperature moderation, heat dissipation by transpirational cooling, glare reduction, noise abatement, atmospheric pollutant entrapment and degradation, water harvesting and soil water recharge, and an enhanced aesthetic environment immediately following sodding. It also translates to immediate access and use of the property whether it is from an aesthetic standpoint or a recreational need.

Reduced Probability of Failure

Quite frequently turfs are established on very adverse sites such as impermeable clays, stony sites, poorly drained areas, and steep slopes. Proper sodding offers a higher potential for initial successful stabilization of the area via turf. Such adverse sites may have a much greater potential for failure via seeding, sprigging, or plugging, resulting in one or more repeat plantings before successful turf coverage is achieved. This only increases the cost to the user, but also increases the likelihood of adverse impacts on the environment such as greater wind and water soil erosion.

While the immediate benefits to the environment and our quality of life outlined herein as achieved through sodding may be of a short duration of from 1 to 4 months, depending on the turfgrass species, this is a very important time frame that must be considered in terms of protecting our environment. □

Tough Times Need Tough Turf!

By Dr. Henry M. Cathey, National Chair for Florist and Nursery Crops Review, National Program Staff, USDA.

A new environmental awakening is going on with the more than 100 million private residences in North America. Homeowners are seeking how to make their yards into areas that are compatible in the "new garden ethic."

THE NEW AMERICAN YARD

This approach to yard design and use, called The New American Yard, includes:

- **All-Season Displays:** The garden is attractive year round. The typical yard can display easily over 100 species of plants.
- **All plants contribute to the display of every season:** Dull, never changing, ever-pruning-plants are eliminated from the planting design. All plants exhibit dramatic seasonal changes of leaf, flower, and seed head.
- **All plants are tough:** Plants are selected that will thrive with limited or reduced uses of pesticides, supplemental watering, or easy-to-leach nutrients.
- **All plants require little yearly care:** The shoots, flowers, and seed heads are allowed to develop over the entire growing season without pruning, staking, or deadheading.
- **Spring Care:** All plants are given a yearly check as the season's growth begins in early spring to correct form, to remove dried vegetation from the previous year, and to expose the soil surface.
- **Design:** All plants are planted in

natural groupings just like they are found in nature and are mulched with a 2-3 inch layer to conserve moisture and to block the emergence of weeds.

STEWARDSHIP OF OUR YARDS

The design of the New American Garden proposes a totally new thrust for the stewardship of our yards:

- **Broad all-weather walks** are installed so that you can move your garden furniture anywhere to enjoy what happens to be in flower or fruit.
- **Drainage is controlled** to insure that water and soil particles do not move out of your areas.
- **Soil is amended** with both limestone (dolomitic limestone) and gypsum to increase the pH and to improve the structure of the soil while supplying adequate amounts of calcium. The soils are dug to 8-12-16 inches deep. All competing root systems from weed trees are eliminated.
- **Natural soil is diluted** with organic matter (peat moss, compost, composted sewage sludge, shredded garden refuse) to increase the penetration and the retention of water in the root zone.

FUNCTIONAL YARDS

The role of the lawn in the New American Garden style has been realigned from its traditional ceremonial treatment. We do not have a lawn anymore that has no functional purposes—just ceremony is not enough. In the new garden ethic the

lawn becomes a very vital element in the design and the full performance of the garden. The lawn becomes:

- **Play:** In the many occasions of a family (or extended family) a place is needed to enjoy the active life of motions/competition/exercise. A lawn is the only place to have play area with soft impact on the players.
- **Events:** There becomes a time when one's residence is just not big enough to host all of your guests. Space must be provided for this spill over. A lawn is the only environmentally acceptable solution to having an extra outdoor room for events. It is also the only spot to place a tent for weddings and receptions.
- **Design:** Being the only ground cover that you can walk on—and yet be a living mantle—the design of your lawn can become very creative. We have two zig-zag ribbons of lawn in our New American Friendship Garden that put a great deal of energy into the feeling of the "backyard." These green ribbons also allow visitors to move through and beyond the garden, thus the visitor can see the strong design from all sides. The green lawn ribbons also give the garden a 3-D effect.
- **Business:** The lawns give us spaces to locate benches, place outdoor dining facilities, and even spots to get closer to the plants in a green setting. All gardeners prefer green spaces over hard landscapes because changes can be made in the design with disrupting the entire site. Sod and paving blocks set in tamped sand also increases the penetration of water into the area. Hard landscapes always define spaces permanently,

can create pockets of poor drainage, and can act as barriers for balanced/symmetrical root development.

FUNCTIONAL BENEFITS

The lawn in the New American Garden also performs all of its very established benefits of heat absorption, recycling water, refreshing the aroma in the garden, and insulating our homes during periods of stress. The new uses and appreciation for what lawns do will help change the tough times of the 90's into a new acceptance of tough turf.

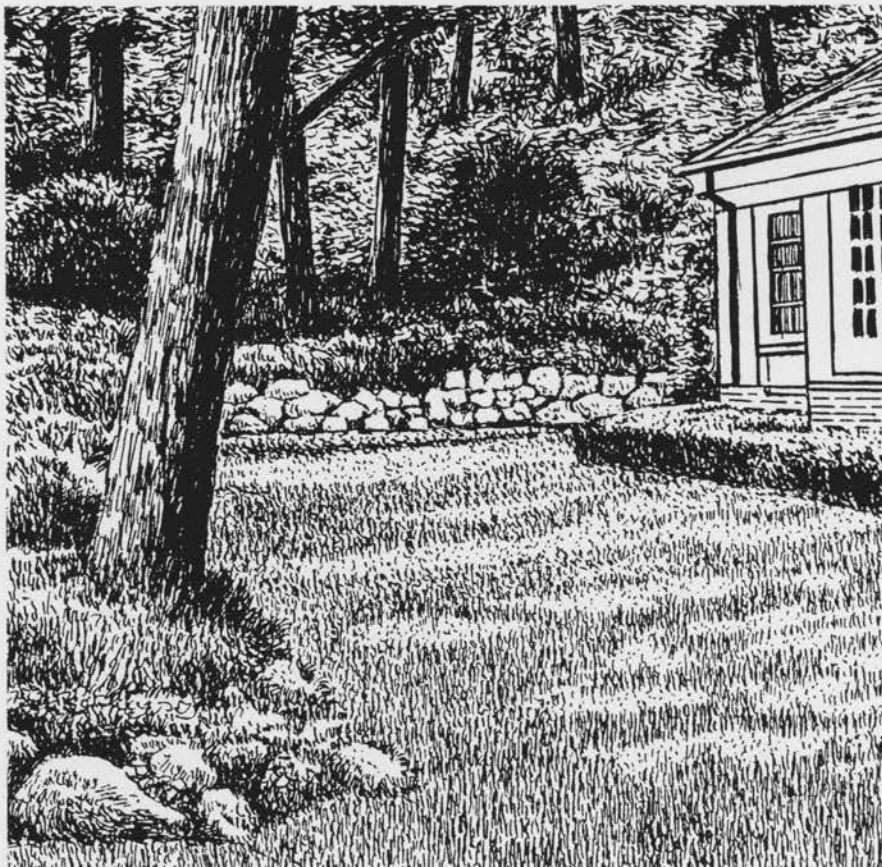
Where to see the photo type garden described in this article? The New American Friendship Garden is located to the right side of the "R" and 24th Street Entrance to the U.S. National Arboretum, Washington, D.C. The 2½ acre garden was designed by Wolfgang Oehme and James van Sweden, Landscape Architects of Washington, D.C. The Garden was dedicated on April 24, 1991, as the gift of the almost 300,000 members of the National Council of State Garden Clubs, Inc., (Mrs. C. Manning Smith, President). The Garden is open to the public 10 a.m. to 5 p.m. every day year round other than December 25. (See photograph below)

Dr. H. Marc Cathey is National Chair for Florist and Nursery Crops Review. He is stationed in the National Program Staff, Agricultural Research Service, U.S. Department of Agriculture, Beltsville Agricultural Research Center, West, Beltsville, MD 20705. He was the Chief of the Florist and Nursery Crops Laboratory from 1960 to 1980; Professor of the D. C. Kiplinger Chair at Ohio State University for the academic year 1981; and, Director of the U.S. National Arboretum, Washington, D.C., from 1981 to 1991. In his current position he is cooperating with the Federal and State experiment stations, and 40 professional and trade associations to put together a national research, marketing, and export plan for florist and nursery agriculture.



Turfgrass Pesticides: Their Positive Role in Our Environment

By Douglas Fender, Executive Director, The American Sod Producers Association, Rolling Meadows, IL



Each spring, just as millions of Americans are looking forward to a return to their outdoor lives after spending the winter as virtual shut-ins, a whole host of voices rise up in a chorus proclaiming that turfgrass pesticides are dangerous to our health. They cite wide-ranging, yet impressive statistics on the amount of these chemicals used each year:

"Americans spent \$6.4 billion last year on lawn-care products, up 13% from 1989."

Time magazine, June 3, 1991

"With spring in full bloom, millions of Americans are applying millions of pounds of chemicals to their lawns to kill weeds and bugs and make the grass grow thicker and greener. An estimated 51 million homeowners do the work themselves. More than 8 million will hire professional lawn care companies to do the job. The sale of lawn care products and services has developed into a multi-billion-dollar business."

Senator Joseph I. Lieberman, May 9, 1991

While some non-scientific commenta-

tors would lead us to believe that all of this turfgrass pesticide is killing us, the truth is that the life-threatening potential of pesticides is no greater than food coloring and preservatives, prescription antibiotics and spray cans! Less than 10 people a year are killed by any of these causes!

Although even a single death is one tragedy too many, the hype and hysteria being whipped up about turfgrass pesticides by the media, self-appointed watchdog groups and even legislators grossly overstate and misrepresent the facts. These chemical critics fail to report that since 1956, there has been a steady decline in the number of lethal pesticide-related accidents each year (from all causes, not just turfgrass chemicals). In 1956, there were 152 such deaths; however, by 1984, there were only 27 and the number continues to decline. In fact, far more children have died from accidental overdoses of aspirin than from pesticides, by a sizable margin.

Bicycle accidents, by comparison, kill 100 times more people each year and swimming accidents kill nearly 400 times more people.

As the volume of pesticide used annually has expanded and the number of pesticide-related deaths has declined, the overall lifespan of Americans has increased. Just since 1920, before the wide-spread use of any pesticides, lifespans in the U.S. have increased from 54 to 75 years. While many factors in addition to pesticide use have contributed to this increase, it should be obvious that if increased pesticide use was highly fatal, both the number of directly related deaths and the overall lifespan would not have made such significant changes to the good.

Turfgrass is a way of life to most people. If we don't have a lawn of our own, we cherish even more the public parks and playgrounds with their large grassy areas that provide us a relaxing, enjoyable and

refreshing part of our lives. The Lawn Institute estimates that there are some 25 to 30 million acres of turfgrass in the U.S., with over 20-million of those acres being home lawns.

In addition to providing people with an outdoor area to enjoy life, an aesthetic benefit, grasses also provide a vast array of functional environmental benefits, many of which are not immediately considered by the public. These include:

1. Water purification
2. Pollution absorption
3. Particulate entrapment
4. Oxygen generation
5. Temperature modification
6. Erosion control
7. Noise abatement
8. Glare reduction
9. Allergy control
10. Fire retardation
11. Groundwater replenishment
12. Safe play/sport areas

While people enjoy the mere presence of a lawn, turfgrasses are better able to provide their environmental benefits when they are made stronger through the proper use of chemicals. Without the use of pesticides lawns can quickly weaken, becoming thin and unable to perform their environmental role.

Fortunately, turfgrasses and pesticide usage can be very successfully combined, to achieve a highly functional environmental advantage, while naturally providing spaces of beauty and places to play and relax.

Practicing these common sense guidelines will help assure that everyone benefits from turfgrass pesticide use, and no one is harmed:

1 Accurately determine the "target" pest. In lawns, fungi can create symptoms almost identical to damage caused by insects. Know what the real problem is before you treat an area and use only the proper chemical.

2 Know the size of the area to be treated. Step-off or carefully measure large areas to know how many square-feet of space require treatment. This will help you calculate the amount of chemical to purchase, mix and use.

3 Carefully read all label directions. The label will instruct you on the specific use of the chemical, including the proportions to use to control a particular pest. It will also provide cautionary advice regarding the chemical's use around non-target items such as other plants, animals

and people. While the print is often-times very small and seemingly involved, its careful reading is worth the extra minute or two it may take.

4 Be familiar with the operation of your sprayer or other application device. Test the unit with plain water to determine how much volume is used in normal applications. If you're treating a lawn with a hose-connected sprayer, fill the unit with water and by trial and error determine how fast you need to walk and wave the sprayer to apply the proper quantities.

5 Mix and use only the amount of chemical required to treat the smallest area needed. Combining the knowledge you have of the size of the area to be treated, the amount of chemical required by the label and the capacity of your application unit, prepare only the minimum amounts of chemical. "More is better" does not apply to chemical use.

You should also consider whether a "spot treatment" will suffice to control the problem you've identified. Question whether you really need to apply chemicals to a large area when the problem itself is rather limited.

6 Thoroughly wash all items used in the chemical application procedure. If you've used a sprayer, partially fill it with water and spray the area you just treated, or other nearby similar area. Repeat this two or three times. Do not just dump any extra chemicals into the sewer or onto the street. Although it may not be highly toxic, it could have a negative impact on the environment or a non-target.

7 Use common sense whenever you're using chemicals. Window washing solutions and anti-freeze are more toxic than yard chemicals a homeowner will use, so all chemicals should be treated with care and respect. Eating or smoking should be totally avoided until you have thoroughly washed with soap and water. If any chemicals are sprayed or splashed on you during their use, remove the garments and wash them separately from other clothing. When using chemicals outside, be sure that any toys (used by children or animals) are removed from the area to be treated so they won't be hit by the spray or drift.

8 Be a good neighbor by knowing special sensitivities of people, plants and pets. Paracelsus, the Swiss physician and alchemist who lived during 1493-1541

noted, "What is there that is not a poison? Only the dose makes a substance not a poison." Chlorine can kill or it can clean. Aspirin can relieve pain or cause death. For a very, very few people, sunlight can cause an allergic reaction that results in death. It's not the substance, but the dose that can harm.

Turfgrass pesticides are effective because they have been developed for use against a specific target. Herbicides kill weeds, fungicides control diseases and insecticides eliminate insects. A herbicide will have no real effect on an insect simply because the chemicals used in herbicides aren't poisonous to bugs.

People, plants and pets may have particular sensitivities to any number of products, including pesticides. Being aware of these sensitivities when using turfgrass chemicals is being a good neighbor. This would include letting your ultra-sensitive neighbor know you'll be spraying a particular product on your property, avoid using herbicides around sensitive plants that could be stunted or killed by accident, or suggesting that your neighbor keep their pets off of your yard to avoid any potential problems.

In answer to those who criticize or question the use of pesticides on lawns, it should be noted that the environmental and aesthetic benefits of lawns are dramatically increased when the grasses are healthy and growing vigorously. While pseudo-scientists and scare mongers are able to sensationalize an issue through the manipulation of information, practicing scientists have shown that the benefits of turfgrasses can be substantially increased through the proper use of pesticides and fertilizers, without a significant risk to man or his environment.

Know what the real problem is before you treat an area, use only the proper chemical and only treat when the occurrence warrants its use (utilizing IPM practices). Also consider alternative pest control methods.

Doug Fender is Executive Director of the American Sod Producers Association, Rolling Meadows, IL. Prior to becoming director, he served five years as director of public relations for the Million Dollar Round Table, an independent, international life insurance sales achievement association. Before joining the Round Table staff, Doug was director of communications for the Golf Course Superintendents Association of America.

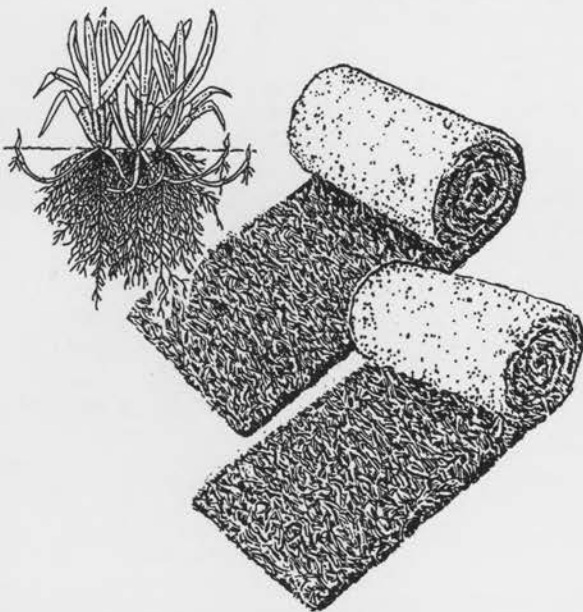


Turfgrass Sod Tips... *toward a greener, cleaner world*

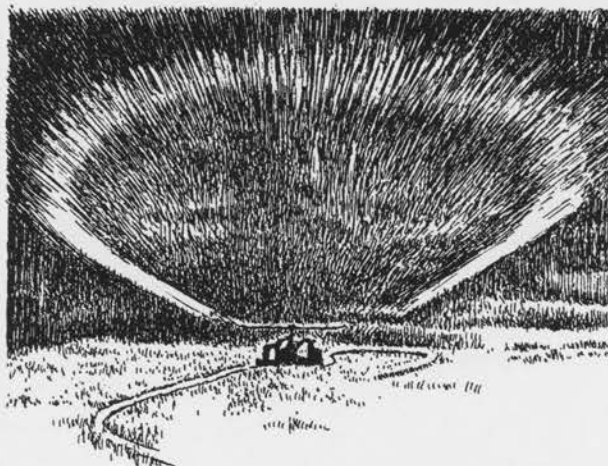
8 million turfgrass plants make up a dense home lawn.

An average yard has about 10,000 square feet. In a thick lawn, there are 6 turfgrass plants in each square inch, 850 per square foot, 8 million per home lawn.

A single square yard of mature turfgrass sod will immediately transplant over 7,750 grass plants. That's a major reason sod can almost immediately establish a new lawn. This plant density is also why turfgrass is a soft cushion for sports and why it's such a great air and water filter.



Turfgrass Sod Tips... *toward a greener, cleaner world*



Water your way to a better lawn, with these simple suggestions: don't over-water your lawn, apply water only when the grass needs it; water infrequently, but deeply; discontinue watering when run-off occurs and restart watering after it's soaked in.

Grasses need water when you can see footprints after walking across the lawn because the leaves don't spring back, or when you have difficulty pushing a soil probe (screwdriver) into the ground.

Turfgrass Sod Tips... *toward a greener, cleaner world*

"Let your lawn be your home's velvet robe, and your flowers not too promiscuous decorations."

The Art of Beautifying Suburban Home Grounds
Frank J. Scott, 1870

Turfgrass Sod Tips... *toward a greener, cleaner world*

Leave grass clippings on the lawn because they're too valuable to throw away.

Grass clippings are about 90 percent water, by weight. When left on the lawn, they dehydrate quickly and reduce the amount of material that remains.

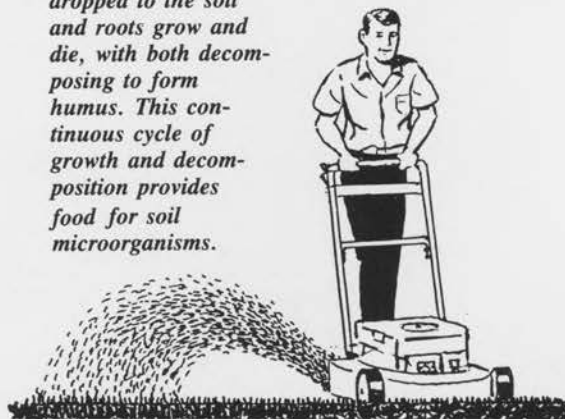
Grass clippings are very high in protein and are therefore rapidly attacked by bacteria and fungi which causes fast decomposition.

Grass clippings usually contain 4% nitrogen, around 2% potassium and ½% phosphorus... all essential nutrients for healthy lawns. When left on the lawn, the equivalent of 3 applications of fertilizer is made... without any additional cost or work.

The average lawn produces clippings at a rate of about 200 pounds per 1,000 square feet a year. That's

a ton of clippings coming from the average home lawn of 10,000 square feet that should never leave the lawn... it's too valuable to throw away.

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.



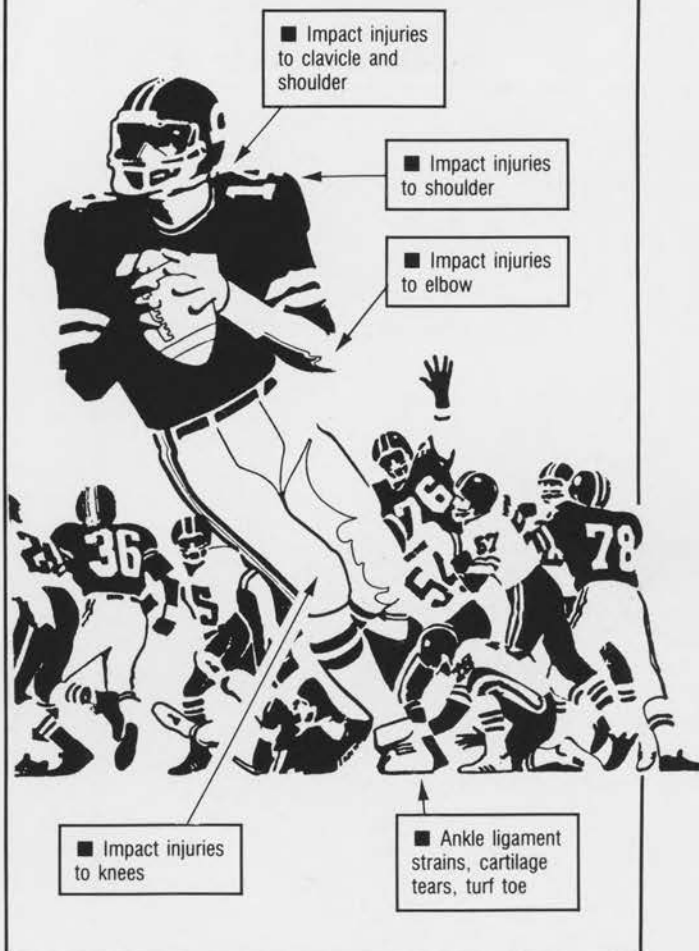
Stadium Surfaces: Grass Sod vs. Artificial Turf

Improved maintenance procedures and concerns for player safety has caused many stadiums with artificial turf surfaces to switch back to grass systems. Grass cushions a player's fall better than the artificial surface.

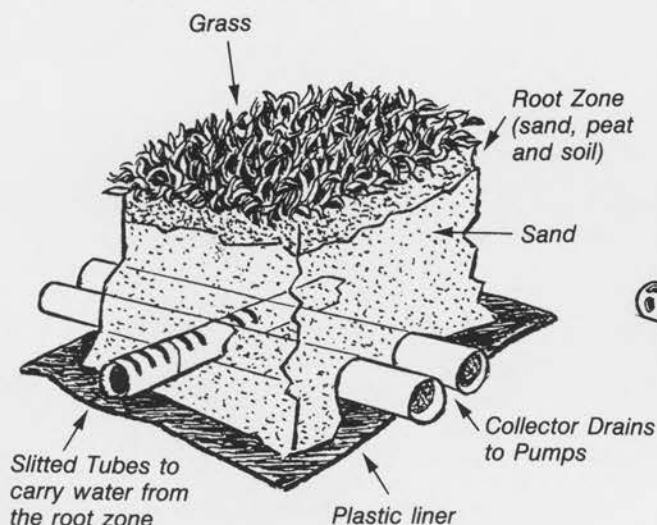
Another disadvantage of the artificial surface is its short lifespan. It usually requires replacement every 8-10 years. As the artificial surface ages, there are certain injuries related to each stage of the surface's wear and tear, but "turf burns" occur at all stages.

In a healthy, thick turfgrass playing surface, there are 6 turfgrass plants in each square inch, 850 per square foot, and over 40 million per football field. A single grass plant can have 387 miles of roots, which means that beneath the playing surface is a tangled mass of billions of miles of roots. This plant density is why turfgrass is a soft cushion for sports.

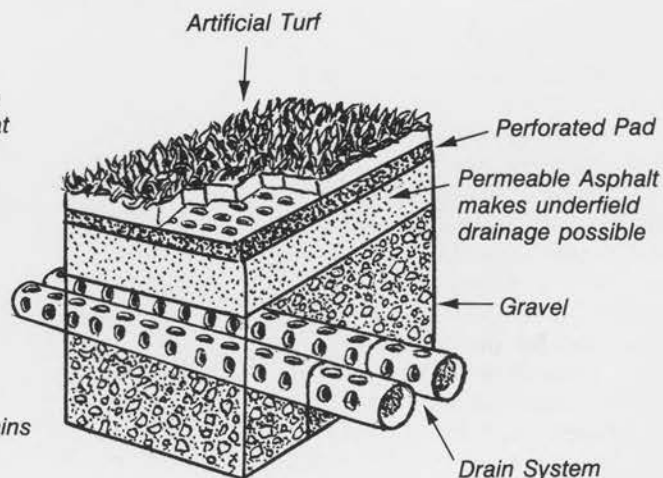
Common Injuries On Artificial Turf



Grass Sod Surface



Artificial Surface



America The Beautiful National Tree Program and the Role of Turfgrass

Rapidly gaining momentum, interest and enthusiasts, a new land-use concept is sweeping across the country. Rather than moving people to the countryside so they can enjoy the benefits of its related open and wooded areas, people are establishing open and wooded areas in their existing communities—Urban and Community Forests. No, this isn't the latest Washingtonian non-sequitur, double-speak, but a plan with a promise to return livability to urban areas through the careful use of trees, turf and groundcovers. It is receiving backing and bucks from the U.S. Congress and the Bush Administration, with direction, coordination and leadership coming from the U.S. Department of Agriculture Forest Service.

To gain new insights and an expanded understanding of Urban and Community Forests, we spoke with a number of Forest Service (FS) personnel directly involved in the program's implementation.

Q: What is the "America The Beautiful National Tree Program" and what is the role of turfgrass sod?

FS: In 1990, President Bush proposed a major new initiative to provide an environmental legacy for future generations, enhance existing natural and recreational resources, and address mounting public concerns about the buildup of atmospheric carbon dioxide. That initiative—called America the Beautiful—began in fiscal year 1991. A major component of the initiative was the National Tree Program, a nationwide multiyear program of "tree plantings and ground covers such as low growing dense perennial turfgrass sod." This program calls for a public and private sector cooperative approach with a goal of planting, improving, and maintaining nearly 1 billion additional trees per year in communities and rural areas nationwide. Virtually every State, community, and individual in the Nation can contribute to this program through individual and collective planting and care efforts, and forest improvement.

Q: As simply as possible, will you define or describe the "The National Tree Program?"

FS: As a part of the Forestry Title of the 1990 Farm Bill, Congress enacted America The Beautiful legislation and provided \$20 million for the National Tree Trust to create awareness and citizen involvement and to raise funds to support local tree planting and care work.

The legislation contains both rural and community components. To help address the Rural Tree component of America The Beautiful, Congress enacted the Forest Stewardship and Stewardship Incentive Programs. To help address the Community Tree component, Congress enacted the Urban and Community Forestry Assistance Program.

The rural component is designed to address tree, shrub and turfgrass planting and forest improvement needs on private lands in the United States through a combination of technical assistance and cost shares for private land-owners.

The community component, designed to address tree, shrub and turfgrass planting and care, and retention of these covers in the nation's cities, towns, and communities, will expand technical assistance by the Forest Service and State forestry agencies to municipal governments and volunteer groups.

Q: What benefits do trees, shrubs and turfgrass provide?

FS: Trees provide environmental, social, and economic benefits. They enhance air and water quality, biodiversity, and wildlife habitat and reduce soil erosion. Trees remove carbon dioxide and certain impurities from the atmosphere, store the carbon in their tissues as part of the photosynthesis process, and release oxygen as a by-product. Thus they are a natural air cleaner. Trees provide shade and shelter from wind and improve landscape esthetics. They are an investment

we can make for future generations of Americans. Trees increase property values, conserve energy, provide valuable wood products for human needs, and provide jobs that can strengthen local economies. In addition, increased health and safety, as well as reduced crime are often cited as environmental benefits of urban landscaped areas.

Turfgrasses, like trees, serve the environment through the absorption of carbon dioxide and the release of oxygen. These plants, through evapotranspiration, also provide a cooling effect to surrounding areas. Through their natural growth processes, turf and trees achieve what man can accomplish only mechanically, primarily by burning fossil fuels and discharging still more carbon dioxide and other pollutants.

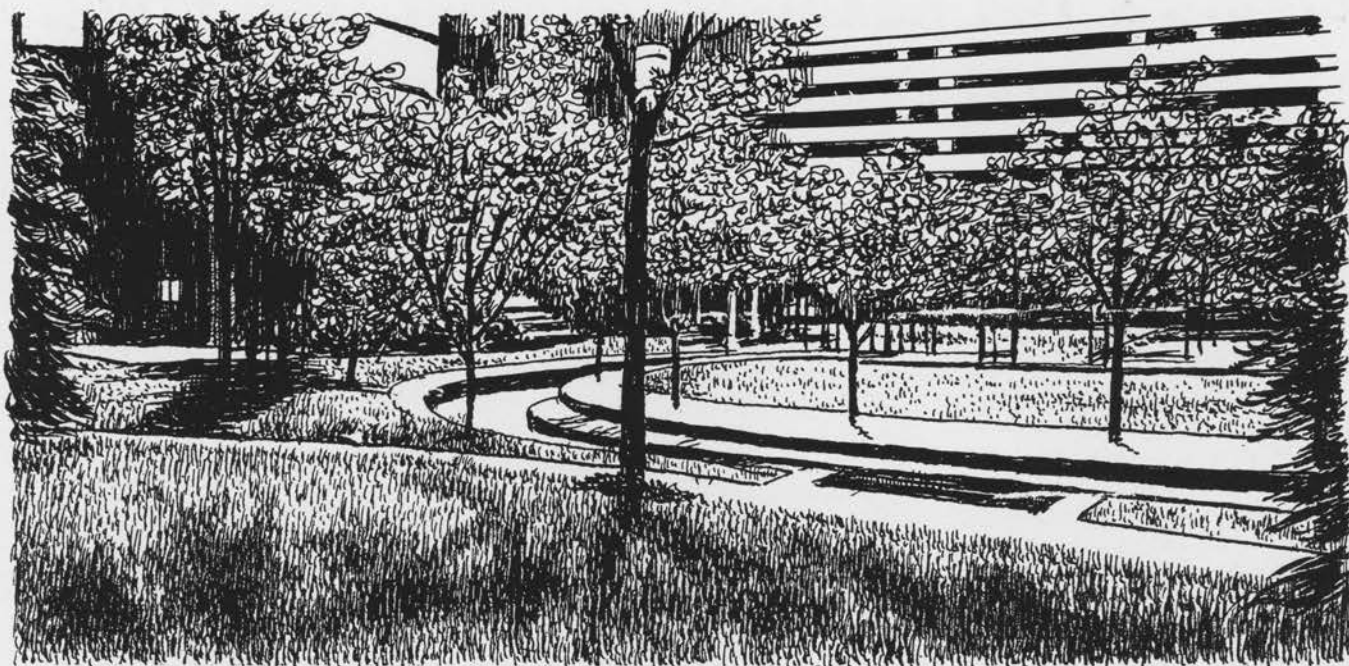
Turfgrasses, with their extensive ground-level leaf and root systems also entrap particulate pollution from the air and water, while the associated microbial ecosystem converts these pollutants into energy for themselves and ultimately into harmless, soil-building by products.

Q: Why emphasize such planting and care in cities and towns?

FS: Trees and turfgrass are especially effective in cleaning the air and conserving energy in communities. Cities, with vast expanses of concrete and asphalt, create "heat islands" and often have temperatures as much as 5 to 9 degrees Fahrenheit hotter than surrounding areas. With increased temperatures, smog and ozone formation rates increase as does the demand for energy for air conditioning.

Trees in cities are particularly valuable and help break up "heat islands" by shading homes, buildings, streets, and parking lots. Research has shown that trees can lower peak energy demands in urban areas by 20 to 40 percent. Three well-placed trees around a home can reduce home air conditioning needs by 10 to 50 percent.

Turfgrass lawns of just eight average



houses have the cooling effect of about 70 tons of air conditioning; the average home-size central air unit has only a 3 to 4 ton capacity.

By offsetting energy needs that would be supplied by fossil fuels, a tree that provides shade and cooling indirectly causes reductions in carbon dioxide emissions up to 15 times more than the amount directly absorbed by the tree. Well-placed trees can also help buffer against winter winds, reducing heat loss and the demand for energy to maintain warmth in buildings.

Q: Where will the trees, shrubs and turfgrass come from?

FS: Locally grown trees are available from both public and private sector nurseries. Turfgrass sod is available from sod farms in the local area. Both trees and turfgrass must be environmentally adapted and suitable for the setting in which they are to be planted.

Because the environmental stresses for plants are much greater in community settings, selections must be given careful attention. Privately owned nurseries and sod farms will be able to provide quality plant materials that are well adapted to thriving in the harsher community environment.

Q: How does the technical assistance and cost-sharing program work?

FS: Such a program would build upon existing activities. Professional foresters would assist rural landowners in determining what portion of their lands would be suitable for tree planting. The foresters would also assist these landowners with existing forest cover in improving growth and productivity through appropriate forest management practices.

The availability of technical assistance for tree planting in communities is also being strengthened. The program provides assistance to State and local governments to expand the capability to provide technical assistance to municipalities and volunteer groups interested in planting and caring for trees.

Q: Who will be involved from the public and private sectors?

FS: The USDA's Forest Service will work closely to coordinate an effective approach to a sustained planting program with cooperators and partners. The initiative provides the opportunity for the public and private sectors to build a working partnership. It provides the opportunity for in-

dividuals, groups, businesses, and organizations to volunteer their assistance in accomplishing the goals of the initiative.

Examples of cooperators include organizations such as the American Forestry Association, the National Arbor Day Foundation, business and trade associations and industrial groups (such as the American Sod Producers Association, the American Association of Nurserymen, American Forest Council, and Association of Consulting Foresters), and professional societies such as the Society of American Foresters, the International Society of Arboriculture, and the American Society of Landscape Architects, among many others.

Important public sector partners in tree planting and care programs include the USDA's Agricultural Stabilization and Conservation Service, Extension Service, and Soil Conservation Service, as well as State forestry agencies, soil and water conservation districts, National Arborist Association, Society of Municipal Arborists, Municipal Arborists and the Urban Forestry Society.

Information for this article provided by Dr. Rita Schoeneman, Cooperative Forestry USDA Forest Service, Washington, D.C.

Integrated Pest Management For Home Lawns

By Anne R. Leslie, U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC

The use of pesticides for home lawn care has become an important environmental issue. To achieve picture perfect green lawns, some homeowners are applying chemicals, and a growing number of people are claiming adverse health effects associated with chemical applications. These critics are raising serious questions: (1) Are these lawn chemicals necessary? (2) Do lawn chemicals cause detrimental effects to people and/or the environment? (3) How much value do these chemicals add to the lawn? (4) Can we grow healthy lawns without chemicals?

Until such questions are answered, these critics suggest restricting the use of lawn chemicals. Currently some labels on chemical products are being re-examined by the United States Environmental Protection Agency (EPA).

The Benefits of a Healthy Lawn

Turfgrass is the term used to describe grassy plants which—rather than being raised as forage for livestock—are used as a relatively inexpensive, low maintenance surface covering for property. There are many functional benefits derived from turfgrass. Turfgrass acts as a very efficient filter for pollutants in air and water. Grass blades take in carbon dioxide and the worst atmospheric pollutants and give back pure oxygen. The surface area of grass leaves, where this exchange takes place, is greater than that of many ornamental plants occupying the same amount of ground, and its activity may be more extensive because of the length of its growing season. Turfgrass modifies temperature; scientists have estimated that front lawns of just 8 average houses have the cooling effect of about 70 tons of air conditioning. Turfgrass is the safest playing surface for athletic activities. Turfgrass stands up well to foot traffic and protects the underlying soil from wind and water erosion. And finally, turfgrass relates to community beautification and the enhancement of real estate values.

The EPA Integrated Pest Management Program

Once the scientific evidence is examined, few people deny the functional benefits derived from turfgrasses. The basic question centers on whether or not these benefits can be obtained without heavy chemical applications.

EPA has developed a program of minimal chemical input for a healthy lawn.

Quality lawns can be achieved with common sense, maintenance rules; proper site preparation; and, the selection of the best grass variety for that site. Extensive scientific testing and breeding programs provides the public a large selection of grass varieties adapted to a wide range of conditions and sites. In addition, scientists have developed a number of promising biological control agents from some of the worst pest problems related to turfgrasses.

The Integrated Pest Management (IPM) program is an important part of that development.¹ The goal of IPM is to manage pests and the environment, balancing costs, benefits, public health, and environmental quality. IPM systems use all available technical information on the pest and its interaction with the environment. The programs apply a holistic approach to pest management, taking advantage of all appropriate pest management options, including—but not limited to—pesticides. In summary, IPM is:

- A system utilizing multiple methods
- A decision-making process
- A risk reduction system
- Information intensive
- Cost effective
- Site specific

Deciding on the Use of a Pest Management Program

The decisions on what is a pesticide problem and how to solve that problem is affected greatly by a community. It is important to know who is included in the IPM problem-solving program. IPM suggests three categories: occupant, pest manager, and decision-maker. Understanding and communication between them is important.

The homeowner is the *decision-maker* for his or her home lawn. The *pest manager*, who carries out pesticidal action or any alternative that is appropriate, may be the homeowner or a professional lawn care service. *Occupants* include the homeowner and all members of the family that use the lawn or are affected by decisions about its management. Occupants can also include any neighbors that are affected—children that come to play on the lawn, visitors, and any whose property can be affected by a pesticide application. Non-human occupants include pets, wild animals, birds and plants.

The basic guideline in planning a pest management program is thoughtfulness toward others.

Basic Decisions Before Implementing the IPM Program

You should decide on your management objectives for your lawn as a basis for planning modifications in its re-design or management. Knowing what you are trying to achieve will help decide the best possible control methods for any pest problem that arises. This can be as simple as determining the primary purpose for the lawn. As a play area, its design and management will be quite different from the lawn that serves as a resource for wildlife or a lawn designed to satisfy the owner's aesthetic sense. Another type of landscape design emphasizes minimal maintenance through limited grass areas and the selection of a less aggressive growing grass with a short growing season and minimal water and nutrient requirements.

Implementation of IPM for the Home Lawn

There are four interrelated components to an IPM program. Omission of portions of the system, in EPA's experience, has led to greater, unnecessary dependence on repeated pesticidal treatments. These components are: (1) monitoring; (2) determining injury levels; (3) applying strategies and tactics; and (4) evaluating and re-designing the program.

Monitor the Site Environment and Pest Populations: This step involves an active "down on the knees" examination of the site on a regular basis, looking particularly at any trouble spots identified in previous years for signs of pest problems. Your extension office will have informative publications that will help you identify the common insect and plant pests. Monitoring is also done after a management action is performed to establish whether the action was effective.

Weeds are indicators of poor soil conditions or improper management practices. It is helpful to identify the weed species in your lawn, because this will also help identify the underlying problem.

An area of bare soil will be inhabited by a succession of plants in a natural setting, and we re-create the natural event by our activities. Bare soil in lawn areas compacted by traffic favors weed invasion, as weeds are often the only plants that will grow in this environment. Soil that is poor in nutrients will favor growth of clover, which can give nutrients back to the soil.

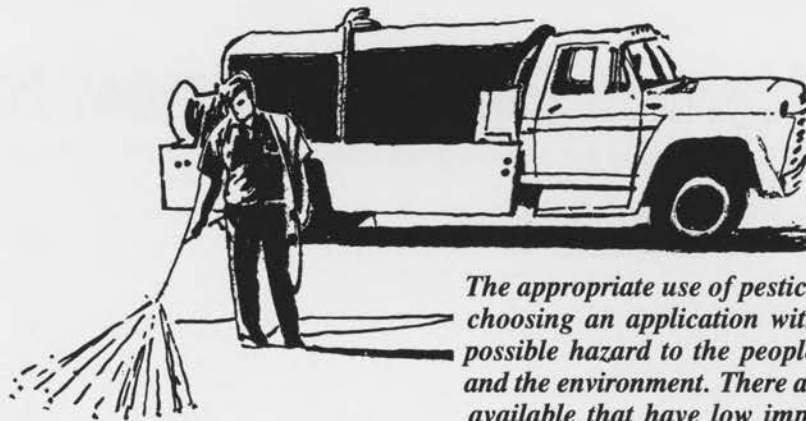
Certain weeds prefer acid soils, and their population can be reduced by adjusting the pH or acid content of the soil. Grass grows better at a neutral to slightly acid pH. A soil test should be performed once a year for acidity, and additions or "amendments" made to the soil based on the results.

There are many causes of dead spots in a lawn. In addition to damage from insects and fungus diseases, excess nitrogen, dog urine, and vandalism should be considered in the monitoring process. If a disease is suspected, collect a sample of the damaged grass and take or mail it to your local county cooperative extension office, where plant pathologists can diagnose the pathogen. There are sampling strategies for insect pests, such as sticky traps, traps baited with attractants, and applying irritants such as soapy water to a sample to bring insects to the surface.

Set Action Thresholds: IPM for agricultural crops uses economic injury levels to establish action thresholds. This means that a threshold is set at a population below the level that has been found to cause enough injury to the crop to reduce the yield and quality, and thereby profit. This type of action level is more difficult to define for the home lawn. It is based on the consequences of allowing pest damage to the lawn. For instance, Japanese beetle larvae can injure the roots of grass sufficient to cause death, but a healthy lawn can tolerate a certain number of grub larvae per square foot without showing signs of damage. The number will depend on the traffic on the lawn, the health and density of the lawn, and other factors, so the threshold might be quite different for the above scenarios.

Apply Indirect Suppression Strategies and Tactics: The actions in this step can be performed at a pest population below the action threshold, as a part of good general management practices. If the population has reached the action threshold, these actions can be taken in conjunction with direct suppression tactics to effect a long-term reduction in pest numbers. A site that is made incompatible with the pest's survival needs will interfere with population buildup. For example, removal of diseased plant material is an important action that should be regularly performed to avoid further pest invasion.

Weeds are the most common pest problem on home lawns, followed by insects. Most properly cared for home lawns will not be prone to disease problems, except in limited areas of the country.



The appropriate use of pesticides means choosing an application with the least possible hazard to the people, property and the environment. There are products available that have low impact on the environment.

1. Weed Management practices: Regular aeration, which involves using a machine that lifts out plugs of soil, grass and thatch (the interlayer of dead plant material between the growing grass and the soil), and vigorous raking or verticutting to reduce thatch, will allow air and water to penetrate into the root zone of the grass. A cross-section of a lawn so treated shows a dramatic increase in the grass roots in the areas where the plug was removed. The material in the plugs is broken up and distributed on the lawn and is a good source of nutrients.

Even as simple a practice as raising the mowing height on the lawn mower can effectively prevent invasion of broad-leaved weeds such as dandelions, because they need light to germinate and grow. Although different grasses have different optimal heights, the general tendency is to cut the grass too short and to mow too infrequently. If more than one third of the grass blade is removed at one time, the plant will be stressed.

If the clippings are bagged and removed, not only is a valuable source of nutrient lost, but also a source of microorganisms that help protect the grass plant from disease damage. Mulching lawn mowers will efficiently return the clippings to the lawn.

2. Insect management examples: Three major species account for most lawn insect problems: caterpillars (larvae of sod webworms, armyworms, and cutworms), white grubs (larvae of Japanese beetles, June beetles, black turfgrass ataenius and masked chafers), and chinch bugs ("true bugs"). Management practices for lawns that diminish one pest population may favor another. For instance, chinch bugs and sod webworms prefer lawns with a heavy buildup of thatch and insufficient irrigation often due to soil compaction. Damage may first be noticed in areas close to paving. These conditions also are

favorable for white grubs, but if the soil is kept constantly moist, it will attract the Japanese beetles to lay eggs.

Reseeding the lawn to a certified endophytic grass (one of the rye or fescue varieties) is one of the most effective controls for sod webworms and chinch bugs, both of which feed on the grass leaves. White grubs feed on the grass roots at varying levels beneath the surface. Biological control by nematodes that infect the grubs is a promising development, but an effective commercial product is not yet on the market. There are many naturally occurring predators of all these pests, which will maintain effective control in a well managed lawn. Some pesticide applications may diminish their effectiveness.

3. Fungus disease management: As indicated above, most home lawns are not prone to show symptoms of fungus disease. Disease symptoms are usually the result of a lawn ecosystem being thrown out of balance by various stresses, such as high temperature combined with excessive irrigation and fertilization. The time of day that water is applied (preferably early morning in hot weather) and the frequency and amount of water applied (watering deeply when the grass reaches the "wilt point") are the most important management practices to minimize disease expression. Correcting drainage problems and installing irrigation systems can also be helpful.

When a disease problem is identified, treatment with a fungicide is not the only action that can be taken. With some diseases the lawn will recover without help; with others, e.g. pythium blight, the grass is dead and total renovation or replacement is necessary. Inappropriate application of a fungicide can kill the grass and even correct application may eliminate a population of beneficial fungi and other beneficial organisms.

The most promising biological control

is the use of biologically active composted material. Both homemade compost and commercial preparations seem effective, even as preventive treatments. Breeding programs have developed new cultivars of Kentucky bluegrass and other common lawn grasses that are resistant to disease, and these can be introduced to eliminate a recurring problem.

Apply Direct Suppression Strategies and Tactics: Pesticides are only one of many solutions to pest problems. They are a valuable tool, but just as antibiotics are not prescribed by the doctor for every health problem, pesticides are not needed for every lawn care problem. In this section specific recommendations will not be given: ample information is available on the pesticides labeled for use on turf: reference books are maintained at garden centers, and plant clinics run by the Extension Service can offer advice on the right pesticide to use.

The word "appropriate" in the title is the key: If the pest is detected at a stage in its life cycle when it is not vulnerable to the pesticide, there is no point in wasting the chemical. Pre-emergent weed control applied after the weeds have sprouted and have leaves is of no value, and a broadcast application of a post-emergent herbicide in a lawn containing only 10-15% weeds may cause damage to the grass. If the management plan calls for minimizing

pesticide exposure, pesticides will only be used as a last resort.

"Appropriate" also means choosing the pesticide with the least possible hazard to the people, property and the environment. There are products available that have low impact on the environment.

IPM does not call for eliminating pesticide use, but in a home lawn there are many alternatives to the use of pesticide. In the face of a severe problem the situation may call for more pesticide to be applied than would be used in a routine calendar type application plan. However, appropriate use of pesticide in this example means making a one-time treatment, to be followed by other measures to prevent recurrence of the problem. For more information on use of pesticides in an IPM framework, see reference 4 below.

Evaluate and redesign program: This is a secondary round of monitoring, and is very important to obtain optimum control. Only by careful attention to the results or habitat modification and pesticide treatment can the homeowner choose appropriate treatment in the future.

IPM is sometimes redefined and renamed Integrated Turf Management or Plant Health Care, but the principles are the same: Management is directed at the crop (grass) rather than an individual pest problem.)

The U.S. Environmental Protection Agency (USEPA) defines IPM as follows: "Integrated Pest

Management is the coordinated use of pest and environmental information with available pest control methods to prevent unacceptable levels of pest damage by the most economical means, and with the least possible hazard to people, property and the environment." Another definition is given by the Bio-Integral Resource Center: "IPM is an approach to pest control that utilizes regular monitoring to determine if and when treatments are needed and employs physical, mechanical, cultural, biological and education tactics to keep pest numbers low enough to prevent intolerable damage or annoyance. Least-toxic chemical controls are used as a last resort." (Common-Sense Pest Control, 1991.)

Anne R. Leslie is a chemist in the Office of Pesticide Programs of the U.S. Environmental Protection Agency (USEPA).

She has been a member of the Environmental Division for eight years, is now serving as Social Chairman and member-at-large on the Executive Committee, and has served as Chairman of the Agrochemical Subcommittee of the Council Committee on Environmental Improvement (CEI). She is currently a member of the Meetings and Expositions Committee of ACS. Anne is a chemist in the Integrated Pest Management (IPM) Section of the Field Operations Division in EPA's Office of Pesticide Programs. In conjunction with her work at EPA, she has developed three Environmental Division symposia on IPM at ACS meetings and was Co-Chair of a symposium on residue sampling in groundwater, co-sponsored by Agrochemicals and Environmental Chemistry. Anne is a past chairman of the Chemical Society of Washington and a Councilor for the Section.



Sources of information on IPM techniques, biological control and appropriate use of pesticides.

1. The most available source of accurate information to the home owner on IPM techniques and good management practices is the County Extension Office. The Cooperative Extension Service offers training in several States for extension agents, and often localities will offer courses for the general public. Unfortunately some States do not provide as much information on home lawns as they do for agricultural crops.

2. The U.S. Environmental Protection Agency has an Integrated Pest Management program within the Office of Pesticide Programs. The primary thrust of this program is to promote transfer of new technologies, to develop informational materials about IPM techniques, and to catalyze their implementation wherever there are pest problems. The USEPA also supports a Pesticide Hotline which can provide information on the proper use and toxicity of pesticides and give referrals on poisoning problems. The National Pesticide Telecommunications Network (NPTN) is located at Texas Tech University Health Sciences Center, School of Medicine, Dept. of Preventive Medicine, Lubbock, TX 79430. The 24 hour hotline number is (800) 858-7378.

3. The Bio-Integral Resource Center

(Address: BIRC, P.O. Box 7414, Berkeley, CA 94707), headed by William and Helga Olkowski and Sheila Daar, has published much useful information on home lawn IPM in their newsletter, The IPM Practitioner, their journal, the Common Sense Pest Control Quarterly, and an excellent new book, *Common Sense Pest Control* (1991). This private foundation began as a cooperative contract with the National Park Service, funded by the USEPA, to develop alternative ways of managing pest problems in our national parks, particularly in areas where vulnerable populations (children, pregnant women and the elderly) would be exposed to any pesticide used.

4. A book cited by the Olkowskis in the above reference as being the best basic discussion of pesticide composition, behavior, toxicity and appropriate methods of use currently in print, is *The safe and effective use of pesticides* by P. J. Marer, published in 1988 in Davis, CA by the University of California Statewide Integrated Pest Management Project, Division of Agriculture and Natural Resources (Publication 3324, 387 pp.) It is written for professionals but is accessible to the layperson, and it contains practical advice for the use of pesticides in an integrated pest management framework.

5. Research on new biological controls as well as safer pesticides is generally carried out by the U.S. Department of Agriculture and at land-grant universities.

6. The largest library collection of research work on turfgrass is at the Turfgrass Information Center, Library W-212, Michigan State University, East Lansing, MI 48824-1048. As a project supported by funds from the U.S. Golf Association, this library has developed a computer-accessible Turfgrass Information File (TGIF), but literature searches can also be requested by phone or mail from Peter O. Cockingham, the Project Manager, at (517) 353-7209.

7. An interesting book published by Wiley Interscience presents and early review of the British research on "amenity grassland," which is defined in a report published by the Natural Environmental Research Council in 1977 as "all grass with recreational, functional or aesthetic value and of which agricultural productivity is not the primary aim." The book is: Rorison, I. H. and Roderick Hunt. *Amenity Grassland: An Ecological Perspective*. 1980. John Wiley & Sons, Ltd., U.K.



7 Environmental Benefits of Turfgrass Sod

Without getting into scientific jargon, researchers at Texas A&M University have quantified the cooling effects of turfgrass, noting that turf will reduce surface temperatures by 30-40 degrees-F in comparison to bare soil.

Many activities in our lives create poisonous gases such as carbon dioxide, ozone or methane. Grass, on the other hand, requires carbon dioxide to survive and as it takes this gas out of the atmosphere, it replaces it with oxygen. Grass is such an efficient carbon dioxide oxygen converter that an area just 50 feet by 50 feet generates enough oxygen to meet the needs of a family of four.

LEAF

Within a thick lawn, there are six turfgrass plants in each square inch, 850 plants in a square foot and about 8 million plants in an average lawn of 10,000 square feet.



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.

THATCH

Thatch is composed of grass roots that help to trap atmospheric pollutants.



With such an extensive and intertwined system of leaves and roots, it's no wonder that grass is estimated to trap some 12 million tons of dust and dirt from the air annually. Just one acre of grass will absorb hundreds of pounds of fossil fuel created sulfur dioxide in a single year.

ROOT

A single grass plant can have 387 miles of roots, which means that beneath that average lawn are a tangle of some 3 billion miles of roots!



As rains fall or we water our lawns, trapped pollutants are not washed into our drinking water systems, but rather moved into the thatch and surface soil levels where they are almost immediately acted upon by millions and millions of microbes who call this area home.

Studies at Penn State University, concerned about the water quality effects of man-applied fertilizers and pesticides, found that the runoff and lechate (run-through) water collected just two days after chemicals had been applied, were usually cleaner than what the government requires for drinking water.

With up to 90% of the weight of a grass plant in its roots, it makes a very efficient erosion prevention device, also removing soil particles from silty water.

Turfgrass Sod Tips

toward a greener, cleaner world

Today's lawn mowers owe their origin, at least in part, to a spiral cutting mechanism used in English textile mills to cut off extra fibers from cloth. In 1830, Edwin Budding, after observing this machine, devised a similar device to cut grass uniformly in place of the then popular scythe.



Leaving grass clippings on the lawn will improve the lawn because of the fertilizer and water contained in these leaves. Allowing the clippings to naturally decay on the lawn also reduces the amount of material going into landfills.

Turfgrass Sod Tips...

toward a greener, cleaner world

Mow your way to a better lawn, with these simple suggestions: Never remove more than one third of the leaf blade in one mowing. Mow in early mornings or evenings when it's cooler. Use a sharp mower blade. Allow the clippings to stay on the lawn.

Grasses grow at different rates throughout the year. Time your mowing schedule to match the needs of the lawn, not the calendar. Early spring usually means more frequent mowing, while summer means less.

Turfgrass Sod Tips...

toward a greener, cleaner world

Weeds in a lawn are not the problem. The problem really is that the grass isn't dense enough to crowd out and keep out the weeds. Proper mowing, watering and fertilization will thicken the grass to a point where herbicides are rarely required for a weed-free lawn.

Turfgrass Sod Tips...

toward a greener, cleaner world

The green, green grass of home is not a 20th century American phenomenon.

Anthropologists believe that the large savanna grassland areas in East Africa provided Early Man with a sense of comfort and security, thus, establishing a link to grass that continues today.

Evidence suggests there were lawns in China 5,000 years ago and that the Mayans and Aztecs had lawns in the New World. Many experts conclude that the designs of early Persian carpets mimic elaborate gardens with areas of manicured grasses.

Throughout medieval Europe, grassy fields around castles gave defenders a clearer view of approaching enemies. Later, the upper classes cultivated grassy areas around their mansions and soon lawns became established symbols of prestige.

Home lawns are not a new idea. Closely trimmed grass has served mankind for centuries and it continues today as it helps improve the environment in countless ways.

Turfgrass Sod Tips

toward a greener, cleaner world

Can grass help cool the environment? Just ask the residents of Palm Springs, California.

While surrounding areas are experiencing rising temperatures, the average temperatures in Palm Springs have dropped two to three degrees over the last 15 years. Arizona State's Laboratory of Climatology Director Robert Balling says the temperature reversal coincides with a surge of golf course construction!

Solar energy, which otherwise would have been absorbed by concrete, asphalt and houses, is used by the golf courses grass plants and they in turn set a cooling trend into motion.



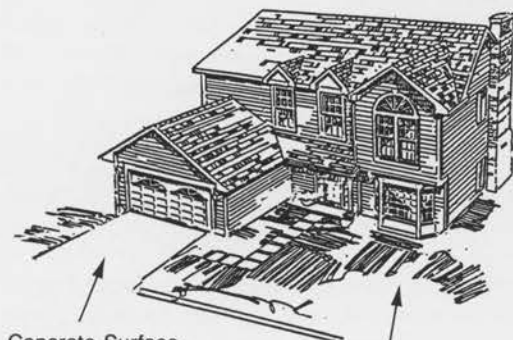
Turfgrass Sod Tips...

toward a greener, cleaner world

Grasses, unlike trees, shrubs and flowering plants, do not grow from the tip. Instead, they grow from an abbreviated stem located near the soil surface. That's why grass can be mowed without harming new leaf formation.

Because grass blades grow closely together, they are an excellent filter to trap particulate-type pollutants and filter silty water. In addition, grass blades require carbon dioxide to grow and exchange clean oxygen in return.

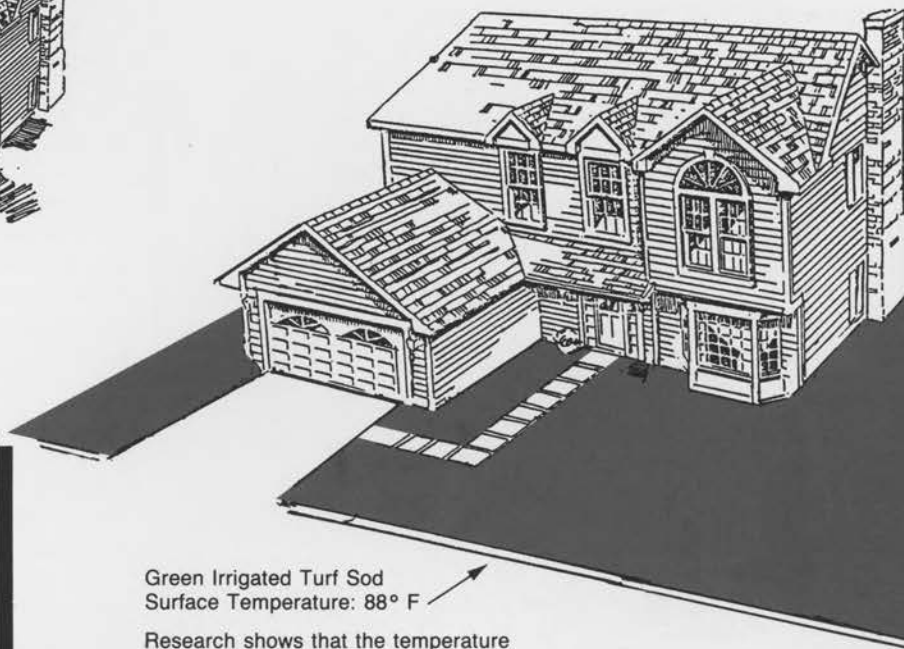
Temperature Comparisons Before and After Turf Sod



Concrete Surface
Temperature: 115° F

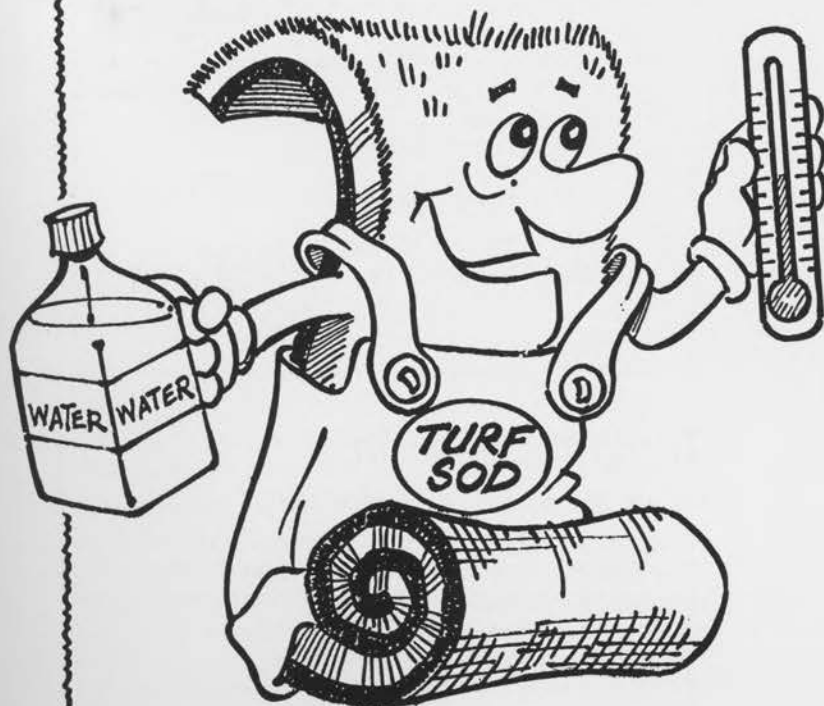
Bare Soil Surface
Temperature: 102° F

FRONT LAWNS OF JUST 8 AVERAGE HOUSES HAVE THE COOLING EFFECT OF ABOUT 70 TONS OF AIR CONDITIONING—THE AVERAGE HOUSE-SIZE CENTRAL AIR UNIT HAS A 3 TO 4 TON CAPACITY.



Green Irrigated Turf Sod
Surface Temperature: 88° F

Research shows that the temperature over a paved area at 4 PM on an August day to be 27° F higher than over a nearby grassed area.



The Cooling/Purifying Effects of Turf Sod

"Grass offers a unique cooling capability that greatly enhances the comfort of people in highly populated urban areas. It accomplishes this at no cost of outside energy or the burning of carbon dioxide creating fossil fuels.

Recent scientific studies consistently demonstrate that actively growing turfgrass will reduce surface temperatures by 30-40° F in comparison to bare soil and by 50 to 70° F in comparison to synthetic turf surfaces. Cement, asphalt and stone surfaces also act as heat sinks with surfaces much hotter than turf."

Dr. J.B. Beard

"Water running off or passing through a well managed lawn is not likely to be of significantly lower quality than the tap water available in many cities. Most chemicals applied to turfgrass are trapped within the thatch and rootzone areas of the plant and do not contaminate water supplies."

Dr. Thomas Watschke

Turfgrass Sod Tips...

toward a greener, cleaner world

3 billion miles of grass roots may lie under the average home lawn! That's equal to 15 round trips between the Sun and Earth!

A single grass plant can have over 380 miles of roots and there are some 8 million grass plants in a dense 10,000 square foot lawn. Up to 90% of the weight of a grass plant is contained in its roots.

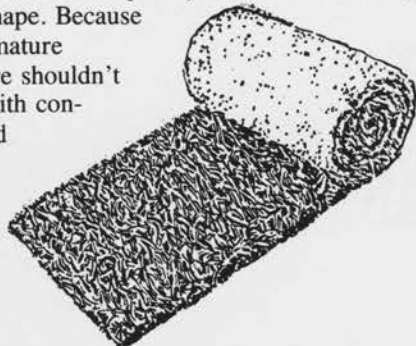
This massive root structure makes turfgrass an excellent way to eliminate erosion and control harmful runoff.



Turfgrass Sod Tips...

toward a greener, cleaner world

To quickly and easily repair an area of dead grass in your lawn, or a washout on a steeply sloped area, use strips of mature grass sold as turfgrass sod. Garden centers, nurseries and sod farms can supply your needs in grasses suited to your area's particular growing requirements. Pieces of sod range in size from 3 square feet to 1 square yard and can be easily cut to any size or shape. Because the grass in sod is mature when it's sold, there shouldn't be any problems with continual wash-outs and weeds that usually occur with seeding.



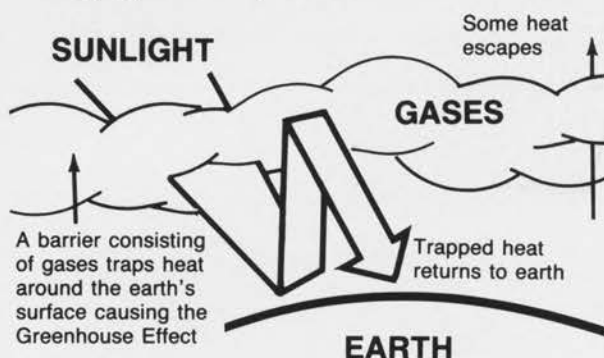
How Turfgrass Helps to Improve the Greenhouse Effect

Most climate-change scientists now believe that the average temperature of the Earth will increase two to five degrees C in the next 100 years, according to a recent survey by the *Global Environmental Change Report*, an Arlington, MA, newsletter.

The survey found that 76 percent of the 330 scientists who participated believe that global warming caused by human activities has already begun; 90 percent believe countries should take immediate steps to reduce carbon dioxide emissions.

The Greenhouse Effect Defined

The greenhouse effect is the name given to a theory that says temperatures will rise as carbon dioxide, methane and other gases build up in the atmosphere, much as a greenhouse traps solar heat. Among the projected effects are melting ice caps, rising seas, shifting of agricultural lands and changing weather patterns.

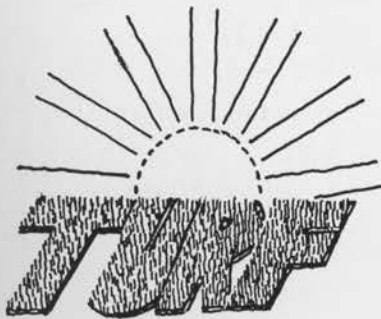
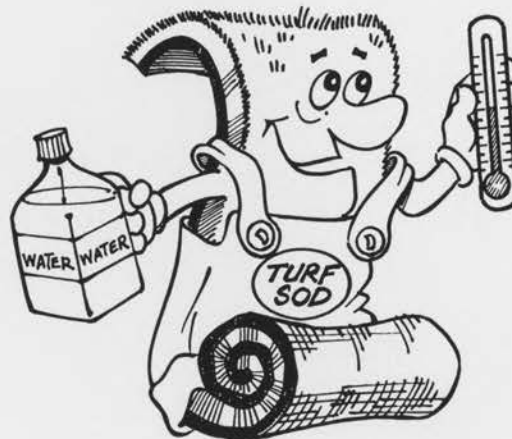
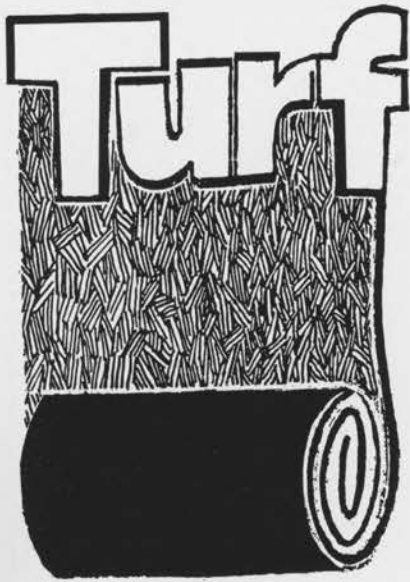
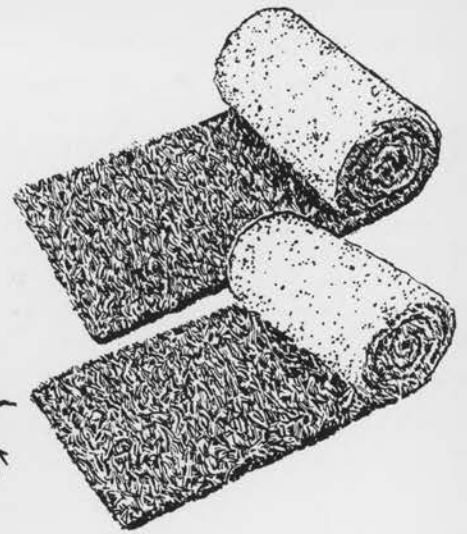
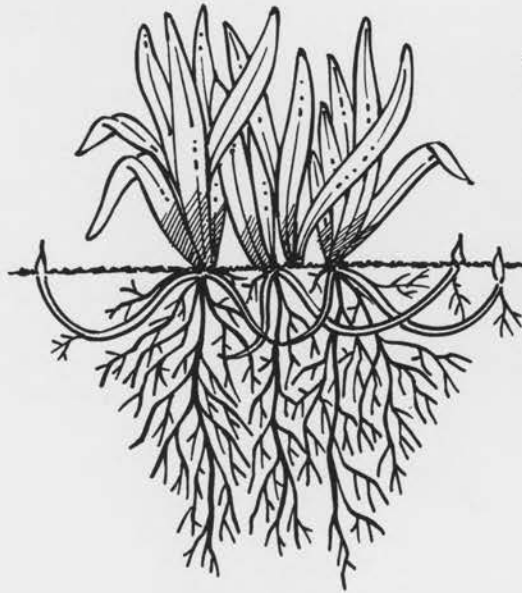


How Turfgrass Helps the Problem

Many activities in our lives create poisonous gases such as carbon dioxide, ozone or methane. Grass, on the other hand, requires carbon dioxide to survive and as it takes this gas out of the atmosphere, it replaces it with oxygen.

Grass is such an efficient carbon dioxide—oxygen converter that an area just 50 feet by 50 feet generates enough oxygen to meet the needs of a family of four. In addition to absorbing CO₂, grass is also taking in other gases poisonous to humans such as ozone, hydrogen fluoride and peroxyacetyl nitrate.

Article Illustrations and Clip Art



**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
Associated Landscape Contractors of America
National Xeriscape Council, Inc.**

American Sod Producers Association
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