TURFAX™
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TURFAX™ — The International Newsletter about Current Developments in Turfgrass

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The goal of this 6 issue per year newsletter is to provide international turf specialists with a network for current information about turf. It is FAXed to all Institute Affiliates that use the ISTI technical assistance services on an annual basis. FAXing is more costly, but ensures quick delivery to those outside the United States.

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WHERE WE'VE COME FROM!

"Horses and cattle can be kept off putting greens if a few shovelfuls of finely sifted coal-fire cinders are scattered over the greens every now and again after mowing." by Reginald Beale in The Practical Greenkeeper of 1913.

UNDERSTANDING HEAT STRESS

Heat stress is most commonly a problem with C_3 cool-season turfgrasses, especially when attempts are made to extend them into the transitional and warm climatic regions. Creeping bentgrass (*Agrostis stolonifera* var. *stolonifera*) is being extended to its limits.

When you assess research reports of heat stress resistance of turfgrass cultivars, it is important to understand there are two types of resistance: (a) heat avoidance and (b) heat tolerance. **Heat avoidance** is the ability to sustain tissue temperatures below lethal heat stress levels via transpirational cooling. The higher the evapotranspiration rate of a cultivar, the greater the heat avoidance, assuming adequate rooting can be sustained for moisture uptake. In contrast, **heat tolerance** is the internal physiological ability of the plant to survive high internal tissue temperatures.

Turfgrass cultivars that exhibit improved heat resistance in low humidity environments such as Arizona, California, or Kansas, may fail to exhibit comparable heat resistance in humid areas such as Mississippi, Georgia and New Jersey, if the resistance is of a heat avoidance type. In contrast, turfgrass cultivars with good internal heat tolerance will exhibit this trait in both humid and arid climatic regions. This is an important distinction to understand in interpreting heat resistance data of cultivars.

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THE AMAZING TURFGRASS PLANT

Turfgrasses have been used by humans to enhance their environment for more than 10 centuries. The complexity and extent of these environmental benefits that improve our quality-of-life are just now being quantitatively documented.

The functional benefits include:

- Excellent soil erosion control and dust stabilization, thereby protecting a vital soil resource.
- Improved quality protection and recharge of groundwater; plus flood control.
- Enhanced entrapment and biodegradation of synthetic organic compounds.
- Soil improvement via organic matter-carbon additions.
- Accelerated restoration of disturbed lands.
- Substantial urban heat dissipation and temperature moderation.
- Reduced noise, visual glare, and visual pollution problems.
- Decreased noxious pest problems and allergy-related pollens.
- Safety in vehicle operation on roadsides and engine longevity on airfields.
- Lowered fire hazard via open, green turfed firebreaks.
- Improved security of sensitive installations provided by high visibility zones.

The recreational benefits include:

- A low-cost surface for outdoor sport and leisure activities.
- Enhanced physical health of participants.
- A unique low-cost cushion against personal impact injuries.

The aesthetic benefits include:

- Enhanced beauty and attractiveness.
- Complimentary relationship with the ecosystem of flowers, shrubs and trees.
- Improved mental health, with a positive therapeutic impact and social harmony.
- Improved work productivity.
- An overall better quality-of-life, especially in densely populated urban areas.

PUBLICATIONS AVAILABLE:

Turfgrass Research Report 1993.
The Ohio State University. Ohio Agricultural Experiment Station. 126 pages (1993).

Contains 38 reports of research conducted at the Turfgrass Research Facilities at Ohio State University and Agricultural Experiment Station in Wooster. Included are 5 papers on turfgrass weed control, encompassing broadleaves, tall fescue, moss and crabgrass; 5 papers on turfgrass disease, encompassing red thread, rust, brown patch, leaf spot, and summer patch; 12 papers on turfgrass insects, encompassing black cutworm, sod webworm, billbug, black turfgrass attenius, white grub and Japanese beetle; 3 papers on turfgrass fertility and fertilization, encompassing natural organic and polymer-coated urea fertilizer sources; 7 papers on evaluation of cool-season turfgrass cultivars, encompassing perennial ryegrasses, fine-leafed fescues, bentgrasses, and Kentucky bluegrasses; 3 papers on turfgrass culture and plant growth regulators, and 3 papers on the turfgrass biotechnology.

Contact: Jill Taylor, Research Associate and Research Field Manager, Department of Agronomy, Ohio State University, 2021 Coffey Road, Columbus, Ohio 43210-1085, USA. Phone: (614) 889-1842.

Conference Proceedings of 65th International Golf Course Conference and Show.
Golf Course Superintendents Association of America. 150 pages. (1994).

Contains one to two page abstracts of 62 invited papers presented at the 65th conference held in Dallas, Texas. Topic headings include golf course management, bentgrasses in the north, bentgrasses in the south, public golf, developing people skills, innovative superintendent activities, history of the GCSAA, computers, landscaping, water resources, regulatory compliance, employee training, and equipment managers forum.

Contact: Education Department, Golf Course Superintendents Association of America, 1421 Research Park Drive, Lawrence, Kansas 66049-3859, USA. Fax: (913) 882-4433.

JB COMMENTS:

There are three fundamental dimensions to successful turfgrass culture. They include the following:

1. Select properly adapted turfgrass species and cultivar(s) for the particular use, environmental and soil conditions.
2. Implement the proper mowing height and frequency.
3. Maintain the turfgrass nutritional levels in relation to the turf quality desired and the intensity of use and resultant turf injury.

A key diagnostic indicator in implementing the nutritional strategy is chemical soil testing. I am continually amazed at how many major, high visibility, intensely used turfgrass facilities fail to follow the fully proven practice of sustaining a continuing chemical soil testing program. In the last year alone I have been called into major golf course, sports field, and horse race track facilities with turf problems where either (a) the proper chemical soil testing has not been practiced or (b) periodic chemical soil tests are obtained, but proper follow-up assessment and interpretation have not been accomplished.

As a result of the failure to sustain a proper chemical soil testing program, I continually encounter the following problems:

- Continuous potassium (K) deficiencies and resultant lack of rooting and tolerance to environmental stresses including heat, cold, drought, and traffic.
- Progressive development of a phosphorus (P) deficiency over time, especially on high-sand root zones where a complete analysis fertilizer is not being used.
- Development of turfgrass toxicities from zinc (Zn), and to the lesser extent copper (Cu), and sometimes manganese (Mn) or boron (B).

It can not be emphasized enough that many serious problems develop on turfgrass facilities because of a failure to obtain chemical soil tests. A chemical soil test is very inexpensive and an important insurance policy to ensure proper decision making in selection of the specific nutrients to be applied and associated application rates required. A number of turfgrass companies that market fertilizers will provide free chemical soil tests as a service program in marketing their products. Why then is it not used? In some cases it is not done even at the time of turfgrass establishment which is a most critical phase.

Long-term, comprehensive chemical soil testing is further justified in addressing the contemporary issue of protecting the quality of our surface and ground waters. Turfgrass facilities and their managers are prone to criticisms by environmentalists of using fertilizers in an unjustified way. Documentation of actual soil nutrient levels through chemical soil tests on an annual basis is important as a long term record to show that sound science-based diagnostic procedures have been used in the decision-making process concerning when, what, and how much fertilizer to apply.

The chemical soil tests should be made on an annual basis, with the samples scheduled to be collected at the same time each year. Chemical soil tests should be made in two to four locations in the case of sports fields of 1 to 2 acres (0.4 to 0.8 hectare) and on each individual green, tee, and fairway area in the case of golf courses. On fairways or larger turf facilities, soil tests should be taken on each individual area that varies in soil texture, irrigation regime, or use intensity.

In relation to soil chemical testing, it is important to select a reputable lab. I have encountered problems where the turf facility management has (a) conducted regular soil testing but at a unsatisfactory lab or (b) selects a lab that uses only a tissue testing approach rather than a combination with chemical soil testing as the basic reference.

JB VISITATIONS:

St. Andrews, Scotland - July.

Presented an invited keynote lecture before the 2nd World Scientific Congress of Golf at the University of St. Andrews. 92 papers were presented in three major topic groupings. They were Part I, The Golfer; Part II, The Equipment; and Part II, The Golf Course and the Game. 33 papers were presented in the third section, with 8 of the papers by United States turfgrass researchers. The 3rd Congress is scheduled to be held again in four years (1998) at St. Andrews University. Also was privileged to spend a half day with the St. Andrews Links Supervisor, Walter Woods.

Edinburgh, Scotland - July

Visited the Murrayfield Stadium facility with Tim Oliver. They have rebuilt and established two turfed sports fields to a high-sand mesh element system. These areas adjacent to the stadium have a dual challenge of functioning as practice fields as well as emergency-over-spill parking during major events.

Turnberry, Scotland - July

Attended the British Open at Turnberry Golf Course on the coast south of Glasglow. Superintendent George Brown had the course in excellent condition. The roughs of fine fescue (*Festuca rubra*) were very impressive, especially in terms of the extensive underlying mat of living stems that had been built up since the course was rebuilt following World War II.

Glasgow, Scotland - July

Visited Professor McGown at Strathclyde University where he is conducting some interesting studies simulating the multiple stress forces involved in the action of horses hooves on turfed surfaces.

UPCOMING JB VISITATIONS:

Provided for Institute Affiliates who might wish to request a visitation when I'm nearby.

- September 14 to 21 - Toledo, Springfield and Columbus, Ohio, USA.
- Sept. 29 to October 4 - Halifax, Nova Scotia, Canada.
- October 15 to 20 - Rome and Milan, Italy.
- Oct. 22 to November 2 - Tokyo, Japan.
- Nov. 12 to 16 - Seattle, Washington, USA.
- Nov. 17 to 30 - Reims and Paris, France.

UPCOMING INTERNATIONAL EVENTS:

November 13 to 18, 1994. Annual Meeting of the C-5 Turfgrass Division of the Crop Science Society and the American Society of Agronomy. Seattle, Washington, USA. Approximately 100 scientific papers on research conducted with turfgrasses will be presented at 15-minute intervals. Also, a symposium on a selected topic will be presented along with the annual meeting of the Turfgrass Division and a field tour of local turf facilities.
Contact: David Kral, American Society of Agronomy, 677 South Segoe Road, Madison, WI 53711, USA. FAX: 608-273-2021.

TERMINOLOGY:

- **Evapotranspiration (ET)** - is the total amount of water transpired from plants and evaporated from the associated soil surfaces.
- **Drought resistance** - encompasses a range of mechanisms whereby plants withstand periods of dry weather. There are 3 components: dehydration avoidance, dehydration tolerance, and escape.
- **Dehydration avoidance** - is the ability of a plant to avoid tissue damaging water deficits even while growing in a drought environment favoring the development of water stress. In this case the plant remains green longer.
- **Dehydration tolerance** - is the ability of a plant to endure low tissue water deficits caused by drought. In this case the plant turns brown, but survives.

TURFGRASSES AND WATER CONSERVATION ISSUES

In recent national headlines, there have been allegations that turfgrass culture has a major role in adversely increasing water use. It is important to address these allegations and to identify those that can be supported by sound scientific data in order to make the adjustments needed to eliminate or minimize any potential problems. At the same time it is necessary to nullify those unfounded allegations that are based on speculative pseudo-scientific information.

Conservation of water has become an issue, not only in the arid regions of the world, but also in many densely populated urban areas that do not have adequate reservoir supplies as a contingency when extended droughts occur. Considering all uses for water in the USA, the average person directly or indirectly uses between 1,800 and 2,000 gallons per day (6813 and 7570 L d^{-1}) (Rossillion, 1985). To put this in perspective, this is more than applying 1-inch (25 mm) of water across a 1000 sq. ft. (92.9 m^{-2}) lawn each day for a year. Industry accounts for 43% of the water use, agricultural irrigation for 47%, and domestic use in cooking, bathing, sanitation, drinking, and landscape irrigation for the remaining 10%. Decisions concerning the most effective programs to reduce water use should consider these data. A primary concern that is seldom mentioned is the actual water leakage loss rate of municipal water distribution systems.

Zeriscape Concept Validity?

The original xeriscape group and others have actively promoted the reduction of turfgrass areas and their replacement with trees and shrubs as an urban water conservation measure (Beard, 1993). Statements have been made in widely distributed nonscientific publications such as all turfgrasses are higher water users than trees and shrubs. There are no published scientific data available to support this allegation. In fact, the limited experimental data available suggest the opposite position. What then is known?

Comparative Evapotranspiration Rates

Very few of the many hundreds of tree and shrub species-cultivars have actually been quantitatively assessed for their evapotranspiration (ET) rates. In contrast, a major portion of the turfgrass species-cultivars have been assessed for their evapotranspiration rates. There are bermudagrass (*Cynodon* spp.) cultivars with evapotranspiration rates of < 0.1 inch per day (3 mm d^{-1}), whose evapotranspiration rates are 50% lower during dry-down periods between irrigations or rain (Beard, 1990). If one compares the few evapotranspiration studies that are available, typically trees and shrubs are found to be higher water users than turfgrasses on a per unit land area basis (D. Devitt, 1993), personal communication). This is based on the sound premise that the evapotranspiration rate increases with leaf area when under a positive water balance (Johns, Beard and van Bavel, 1983; Kim and Beard, 1987). Note that the major grasslands of the world are located in the semiarid regions, whereas the major forests of the world are located in high rainfall areas.

Much confusion has arisen from the "low water use landscape plant lists" from the xeriscape groups that have been widely distributed. The lists are based on the incorrect assumption that those plants capable of surviving in arid regions are low water users, when these plants typically are only drought resistant. When these species are placed in an urban landscape with drip or other forms of irrigation, many become high water users. This occurs because the physiological mechanisms controlling evapotranspiration and drought resistance are distinctly different and can not be directly correlated within a plant species or cultivar (Beard, 1989).

It also should be noted that when turfed areas are irrigated, the adjacent trees and shrubs also are being irrigated as a result of the multitude of shallow tree and shrub roots that concentrate under the irrigated turf area. Thus, when a home owner is irrigating the lawn, most of the adjacent trees and shrubs also are being irrigated.

Comparative Dehydration Avoidance and Drought Resistance

For unirrigated landscape sites, detailed assessments have been conducted of drought resistance and dehydration avoidance for many turfgrass species and cultivars (Sifers, Beard and Hall, 1990). The results have shown that a number of turfgrass genotypes possess superior dehydration avoidance and can remain green for more than 158 days in a high-sand root zone without irrigation under the hot summer conditions in College Station, Texas. Comparable detailed studies of dehydration avoidance and drought resistance among tree and shrub species are lacking.

Numerous turfgrass species are capable of ceasing growth, entering dormancy, and turning brown during summer drought stress, but they readily recover once rainfall occurs (Sifers, Beard and Hall, 1990). Some people incorrectly assume that turfgrasses must be kept green throughout the summer period to survive, and thus will irrigate. Many trees drop their leaves during summer drought stress or during the winter period when only brown bark remains. What then is wrong with a tan to golden-brown, dormant turf during summer droughts, if one chooses not to irrigate? If water conservation is the goal, then a dormant turf uses little water.

Mulching Fallacies. Zeriscape advocates propose the replacement of turfgrasses with a mulch cover and then planting landscape shrubs within the mulched area as a water conservation measure. Some mulches do reduce evaporation of moisture from the soil. However, the presence of a mulch increases the radiant energy load on the under side of deciduous shrubs and trees, which have a majority of their stomata on the undersides of the leaves. This in turn substantially increases the evpotranspiration rate. For example, detailed studies revealed that crape myrtle (*Lagerstroemia indica* L.) grown on a mulched surface used 0.63 to 1.25 kg m^{-2} per day more water than those located in a bare soil, and 0.83 to 1.09 kg m^{-2} per day more water than crape myrtle located in a bermudagrass (*Cynodon* spp.) turf (Zajicek and Heilman, 1991). Further, crape myrtle located on bare soil used 0.2 kg m^{-2} per day more water than when growing in a bermudagrass turf. Sensible heat and long wave radiation from the mulched area increased plant temperatures and thus the leaf air vapor pressure deficit and associated transpiration rate. Thus, replacing turfs with a mulch-shrub landscape can actually increase water use.

In summary.

There is no valid scientific basis for water conservation strategies or legislation requiring extensive use of trees and shrubs in lieu of turfgrasses. Rather the proper strategy based on good science is (a) the use of appropriate low-water-use turfgrasses, trees, and shrubs for moderate-to-low irrigated landscapes and similarly (b) to select appropriate dehydration-avoidant and drought-resistant turfgrasses, trees, and shrubs for nonirrigated landscape areas.

The main cause for excessive landscape water use in most situations is the human factor. The waste of water results from improper irrigation practices and poor landscape designs, rather than any one major group of landscape plant materials.

What is the future?

Great natural genetic diversity exists among turfgrass genotypes in terms of both low evapotranspiration rates and superior dehydration avoidance/drought resistance (Beard, 1989). Applying appropriate breeding techniques should achieve even lower water use rates among the currently used turfgrass species and cultivars. Unfortunately, efforts by turfgrass breeders in addressing these water conservation issues have been very limited.

Avoid Single Issue Approach

There is one caution as we strive for low evapotranspiration rates. One must avoid a narrow, single-issue emphasis that ignores the potential effects of a lowered evapotranspiration rate on the total urban ecosystem. Urban areas already suffer from substantially higher temperatures of 10 to 12°F (6-7°C) when compared to adjacent rural areas. Lowering the evapotranspiration rate through plant material selection and judicious irrigation will reduce transpiration cooling, and increase the heat loads on residences and buildings, thereby increasing energy requirements for interior mechanical cooling. Depending on the relative costs and availability of water versus energy, it may be wise in certain urban areas not to strive for the lowest possible water-using landscapes. Here again, detailed scientific investigations will be required to develop appropriate definitive strategies that take into consideration the total effects on all components within the urban ecosystem.

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Note: This article was adapted from portion of the scientific paper entitled "The Role of Turfgrasses in Environmental Protection and The Benefits To Humans" from Journal of Environmental Quality, 23:452-460, by J.B Beard and R.L. Green.