TURFGRASS RESEARCH CONFERENCE AND FIELD DAY

September 12, 1995

AND

LANDSCAPE MANAGEMENT RESEARCH CONFERENCE

September 13, 1995

University of California
Riverside

TURFGRASS RESEARCH CONFERENCE AND FIELD DAY
Tuesday, September 12, 1995

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LANDSCAPE MANAGEMENT RESEARCH CONFERENCE
Wednesday, September 13, 1995

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TURFGRASS RESEARCH
CONFERENCE AND FIELD DAY

TUESDAY, SEPTEMBER 12, 1995

UC RIVERSIDE TURFGRASS RESEARCH FACILITY

MISSION

The UCR Turfgrass Research Facility and program is involved with problem-solving applied and fundamental research and educational activities that are directed toward the functional, recreational and aesthetic uses of turfgrasses in man's planned landscape. The activities are primarily structured to assist members of the Environmental Horticulture industry that work with the design, establishment, maintenance and sale of turfgrass and turfgrass related products that ultimately benefit the general California population and the state's urban/suburban/rural environments. In support of this, the program focuses on current problems and issues facing the turfgrass industry such as:

#Resource efficiency in the areas of water, nutrition, pest management, energy and labor input in such areas as lawns, golf courses, parks and grounds, and etc.;

#Environmental enhancement for our urban and suburban areas; and

#Turfgrass persistence and performance with increased traffic and use on such areas as sports fields.

Personnel: Academic positions involved in turfgrass science are members of the University of California Agricultural Experiment Station and/or Cooperative Extension. The individuals are located in the following campus departments: Agricultural Operations, Botany and Plant Sciences, Soils and Environmental Sciences, Plant Pathology, Nematology and Entomology. Also, academic Cooperative Extension individuals are located in the following southern region counties: San Diego; Riverside-Orange; San Bernardino-Los Angeles; and Ventura.

Research: The central theme of the activities at Riverside encompasses plant material evaluation and development, turfgrass management and fundamental turfgrass physiology. Specific project areas include cultivar performance characterization, including the development and screening of new grasses for California; the determination of water requirements and irrigation strategies of the important California turf species and cultivars; the study of grasses and cultural practices under simulated traffic, such as occurs on sports fields; the evaluation of nutrient requirement and fertilizer performance and other primary management practices such as mowing, thatch control and aerification when appropriate; the management of pests, including weeds, insects, diseases and nematodes of turfgrasses; and environmental impact studies of turfgrasses and their culture. Specific project activities are strongly influenced by support funding from agencies, public non-profit organizations and for-profit organizations and individuals. Specific projects are also undertaken that are for the benefit of the general public. Research undertaken on turfgrass by the University of California and at the UCR Turfgrass Research Facility is unique in California because of the scope of controlled culture that can be practiced on both cool- and warm-season turfgrasses, and the breadth of non-biased researcher expertise and available support personnel on campus and in the region. Facilities include several acres of small-plot field maintained cool- and warm-season turfgrasses, field and campus laboratories, dedicated greenhouses and all necessary specialized equipment.

Education: Academics associated with turfgrass are involved with public and professional educational activities that include organizing and participating in the annual UCR Turfgrass Research Conference and Field Day; giving presentations locally, statewide, nationally and internationally to clientele and organizations or academic peers; providing requested tours of the Research Facility; and acting as resource support for class lectures and providing graduate student direction in the turf area, for conferences, for turfgrass needs associated with the UC Master Gardener Program, for open house at UC Riverside and on-site visitations by Cooperative Extension Advisors. Academics also publish widely, including release to technical, semi-technical and popular publications and articles in research journals, research reports, trade journals and UC publications such as California Agriculture, California Turfgrass Culture and various newsletters. At times, academics proactively or reactively participate in mass media releases including the media of newspapers, radio and television.

Specific Clientele: The number of individuals involved in the California turfgrass industry is high as is the economic activity associated with this industry. In 1982 it was estimated that there were 1,400,000 acres of turfgrass in the state and the economic activity of the industry exceeded 1 billion dollars. Because the turfgrass industry location and size is population based, and since 60 percent of Californians reside in Southern California, a large portion of the turfgrass acres, economic activity and personnel are in southern counties making this one of the largest turfgrass industries in the world.

IN APPRECIATION

From the establishment of the UCR Turfgrass Research Facility, in 1984, industry participation and contribution have been most important. In particular, manufacturers and their dealers have generously provided equipment for plot maintenance.

The faculty and staff of the Turfgrass Research Project at the University of California, Riverside, wish to specially recognize the companies that have been such a vital part of our success.

1984

Toro Irrigation

Rainbird Irrigation

Pacific Equipment and Irrigation
Ryan
Cushman
Toro

1986

Western Turf and Commercial Equipment
Jacobsen
EZ Go

1987

Hunter Industries
Hunter Irrigation

1993

AA Equipment
John Deere

1995

California Turf
Toro

The Development of the UC Riverside Turf Plots is Largely due to the Generosity of the Firms and Organizations Shown Here.

WEST COAST TURF

WESTERN TURF & COMMERCIAL
Jacobsen Division of Textron Inc.
JACOBSEN TEXTRON

JOHN DEERE

WATER DISTRICT

TORO

CALIFORNIA TURF

DIAMOND

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BEST.

UNITED STATES GOLF ASSOCIATION 1894

VIGORO INDUSTRIES INC.

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FARMERS MARKETING CORPORATION

SOUTHERN CALIFORNIA TURFGRASS COUNCIL

SOUTHERN CALIFORNIA GOLF ASSOCIATION

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SOUTHLAND SOD FARMS

OMC Lincoln
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SPECIALTY PRODUCTS
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SOUTHWEST CONSORTIUM ON PLANT GENETICS AND WATER RESOURCES

Hunter

RHÔNE-POULENC

CIC Canola Industries Canada Inc

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CIBA

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METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

CEDAR CHEMICAL CORPORATION

STOVER SEED COMPANY

Greener Pastures Inc.

KIKUYUGRASS MANAGEMENT STUDIES

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[2]*Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521*

Management studies were conducted on kikuyugrass (*Pennisetum clandestinum* Hochst. ex Chiov.) with and without sports traffic. Traffic was applied with a Brinkman Traffic Simulator (BTS). In 1994, traffic consisted of three football game equivalents per week during Spring, four in Summer, and two in the Fall. In both studies, turf receiving traffic developed less thatch than the non-trafficked plots.

Verticutting Study. Verticutting and thatch control were evaluated on kikuyugrass with visual ratings (turf scores) used to evaluate traffic tolerance and recovery from vertical mowing. All verticut management plots were fertilized every 4 weeks at 1.0 kg. N/are. All vertical mowing treatments were effective in thatch reduction. The May vertical mowing treatments with traffic decreased turf quality. Monthly vertical mowing decreased turf quality compared to less frequent treatments. Turf receiving vertical mowing grew more uniformly after treatment although growth was delayed the first week after each treatment.

Nitrogen Fertilizer Study. Field studies were initiated to evaluate nitrogen (N) fertilizer applications and traffic on turf quality of kikuyugrass. Ammonium sulfate was applied at 24, 48, and 96 kg N/ha/mo (0.5, 1.0, and 2.0 lbs N/1000 sq ft). Plots were vertical mowed in May and October. Visual color ratings and turf scores were used to evaluate traffic and recovery. Improved color ratings were observed with increased N rates and were not adversely affected by traffic. Turf quality did decrease with the increase in traffic.

TALL FESCUE GROWTH CHARACTERISTICS AND WATER-USE RATES

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There are substantial differences in evapotranspiration (ET) rates (often referred to as water-use rates) among turfgrass species, and even cultivars within a species. Correlating various growth characteristics of turfgrasses with their water-use rates may be a useful tool in the development, selection, and use of species and cultivars that require less water.

Due to the proliferation of dozens of new tall fescue (*Festuca arundinacea*) cultivars released over the last ten years that exhibit finer leaf texture, darker green color and increased density than earlier tall fescues, the authors were interested in assessing growth characteristics and evapotranspiration (ET) rates of some of these new introductions.

Tall fescue is native to Europe, and was introduced into the United States by early settlers for pasture use and soil stabilization purposes. Tall fescue is very useful in turfgrass transitional climatic zones, located between temperate and subtropical climate zones across the United States because of its high tolerance to warm temperatures and ability to grow in cool winter temperatures without going dormant. It is well adapted to the environmental conditions of Southern California.

In this study, ET rates, clipping yields, leaf density, vertical leaf-extension rates, leaf length, and leaf width of seven cultivars of tall fescue grown under field conditions at UC Riverside were recorded over a five-week period in July and August 1994, and again in June to August 1995. The above-ground morphological diversity within this group was fairly representative of the morphological diversity observed among turf-type tall fescue cultivars. Turfs were established from seed in plastic pots (9-inch diameter x 12-inch deep) filled with fritted clay for 7.5 months prior to 1994 measurements.

In 1994, correlation coefficients between clipping yield vs. leaf density, vertical leaf-extension rate, leaf length, and leaf width were -0.56**, 0.87***, 0.60***, and 0.39*, respectively. Note that there were positive (+) and negative (-) correlation coefficients. A (+) correlation means as one variable increases, so does the second variable, while a (-) correlation means as one variable increases, the second variable decreases. Whether a correlation is (+) or (-) should not be confused with its level of significance: NS; *; **; ***; not significant, significant at the 0.05 level, significant at the 0.01 level, and significant at the 0.001 level, respectively. The 0.001 level is the most significant level.

In 1994, correlation coefficients between ET rate and all morphological traits measured were not significant. This means that there is no association between the ET rate and all morphological traits, including clipping yield.

These preliminary data suggest that cultivars with a high leaf density and slow leaf extension rate produce the lowest amount of clippings. Dwarf-type tall fescue cultivars offer these characteristics. These data also suggest that morphological traits do not influence water-use rates of tall fescue when assessed under well-watered conditions.

In addition to the results reported above, another interesting finding in this study relates to the 46% range in clipping yield produced among the seven cultivars. Cultivar selection could be an important method for facilitating grasscycling and reducing the amount of grass clippings being deposited in California landfills.

Thanks are given to the Metropolitan Water District of Southern California, Southland Sod Farms, the Toro Company, and the Council For A Green Environment for partially funding this project.

TALL FESCUE QUALITY AS INFLUENCED BY IRRIGATION FREQUENCY

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Southern California's Mediterranean climate is characterized by long, hot, dry summers where rainfall is insufficient to meet landscape water requirements. Irrigation is essential to maintain the functional, recreational, and aesthetic benefits of the urban landscape, which includes turfgrasses. The amount of water applied to landscapes in southern California is significant, accounting for approximately 25% of all water delivered by the Metropolitan Water district of Southern California. This figure becomes more significant when urbanization continues to grow, yet water supplies remain constant. It is especially critical during multiple years of drought where recharge of water supplies is reduced and landscape irrigation needs increase. While there is justification for maintaining the functional benefits of turf in Southern California, there is a need to become more efficient with landscape irrigation. Methods and practices for utilizing lower amounts of irrigation water while maintaining landscape benefits are needed.

Water conservation research at UCR began in 1979 when a facility was installed at Irvine, CA to measure turfgrass response to different irrigation levels. Turf was irrigated once per week at 80, 64, and 48% ET_o for cool-season turfgrasses and approximately 60, 48, and 36% ET_o for warm-season turfgrasses. ET_o, or reference evapotranspiration, is an estimation of the combined value of a reference pasture grass water-use rate and soil evaporation. It is calculated from the modified Penman equation and can be obtained from CIMIS (California Irrigation Management and Information Service). The high ET_o irrigation treatments represented optimal irrigation conditions, while the lower ET_o treatments represented deficit irrigation conditions. Results indicated that 30 to 40% of irrigation water could be saved while maintaining acceptable turf quality. These early results also led to the assignment of crop coefficients (K_c) of .6 and .8 for warm and cool-season grasses, respectively. K_c is calculated as a ratio of ET_c (actual evapotranspiration or water-use of the turf canopy) to ET_o. ET_c is less than ET_o, so K_c values are less than one. If a K_c value is known, it can be multiplied by ET_o to yield an estimate of actual plant water-use. Irrigation can then be scheduled to accurately meet plant needs.

The current research thrust at the UCR turfgrass facility is designed to determine optimum irrigation schedules for turfgrass in terms of plant quality and irrigation water savings. The tall fescue irrigation frequency study seeks to provide this information.

The objective of this study is to determine if tall fescue performance can be improved by changing irrigation frequency, cultivar, and mowing height. Six-month old tall fescue turfgrass was irrigated at 80% crop ET (64% ET_o) during selected months of 1994 and 1995. Note that the 1995 study is in progress. In the 1994 study the amount of irrigation water applied from July 27 to December 9 was 24% less than CIMIS reference water-use rate or 16.6 inches compared to 21.9 inches, respectively.

1994 Data: Both Jaguar III (a standard turf-type cultivar) and Shortstop (a dwarf-type cultivar) exhibited acceptable visual quality during the course of irrigation treatments. Irrigation frequency (2, 3, or 4 times per week) generally did not significantly affect visual turfgrass quality nor color. However, Jaguar III had significantly higher quality and color than shortstop. Quality and color differences were not evident prior to initiation of irrigation treatments, suggesting that the turf-type cultivars may possess a higher tolerance to reduced amounts of irrigation than the dwarf-type cultivars. More work is needed to test this hypothesis. Both cultivars had significantly higher visual turfgrass quality at the 1.5-inch mowing height than at the 2.5-inch mowing height. A statistically nonsignificant trend toward higher soil moisture levels was evident in the plots mowed at 1.5 inches. Leaf density was significantly higher and leaf area was significantly lower in these plots and may have contributed to this trend. A higher leaf density has been associated with a greater canopy resistance to water loss (lower water-use rates), and also, a lower leaf area has been associated with a lower water-use rate.

1995 Data: The 80% crop ET irrigation treatments were initiated May 31 and will continue until October. Preliminary results show an overall lower visual quality and color from irrigating at 80% crop ET. Results also show that irrigating twice per week and mowing at 1.5 inches produce the best turf quality and soil moisture content.

A new study has been initiated to determine if the performance of bermudagrass and zoysiagrass, when irrigated at 60% crop ET, can be improved by changing irrigation frequency and mowing height. The facility is currently being established and data collection will begin in summer 1996.

The UCR Turfgrass Research Project would like to acknowledge the Metropolitan Water District of Southern California, The Toro Company, and The Council For A Green Environment for their generous contributions to the Tall Fescue Irrigation Frequency study.

USE OF TOPDRESSINGS FOR DISEASE CONTROL ON TURF

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Concerns regarding pesticide efficacy and regulation are prompting the development and use of various kinds of organic amendments to replace or reduce the use of inorganic fertilizer and synthetic pesticides. Cultural disease controls such as application of organic topdressings may suppress diseases such as dollar spot (caused by *Sclerotinia homoeocarpa)* as effectively as conventional fungicides. Other benefits gained by use of organic topdressings can include cost reduction and decreased health and environmental hazards, when paired with reduction of chemical use.

Two important factors in efficacy of biological (non-chemical) control of disease appear to be (1) introducing and maintaining adequately high biocontrol agent populations, and (2) determining and establishing environmental and nutritional conditions favoring efficacy of the biocontrol agents. Other concerns include practical considerations such as aesthetics and convenience of application and labor and materials costs of treatments on turf. Compost-based topdressings can serve as an effective carrier system for beneficial organisms as well as and improve the nutritional and physical environment for beneficial organisms.

Two examples of research on topdressing applications for disease control on turf include: Nelson and Craft (1991) applied cornmeal-sand topdressings fortified with strains of *Enterobacter cloacae* on golf course turf for biological control of dollar spot. They found significant control as compared to untreated plots. Disease suppression was evident for up to 2 months after application. It is notable that when they applied compost treatments without biocontrol agents, disease suppressive effects were of only l-month duration (Nelson and Craft, 1992); this effect suggests that perhaps microorganisms can be used to extend the effective disease suppressive period of topdressing treatments.

Grebus (1995) applied various compost topdressings (composted yard wastes, leaf humus, and municipal biosolids) to creeping bentgrass and found that during a two-year study, application of a composted municipal biosolids topdressing provided significant control of *Sclerotinia homoeocarpa* when compared with an untreated check.

The beneficial effects of composted organic amendments have been well-documented in the container media industry (see Grebus et al., 1994). This technology has not been as thoroughly researched in the turf industry, but according to current reports, compost topdressings hold promise for facilitating the reduction of chemical use as well as improve overall growth and plant quality.

References:

Grebus, M. E. 1995. Development of plant disease suppressive compost-amended bio-control agent-fortified potting mixes and turf topdressings and use of random amplified polymorphic DNA markers for identification of *Trichoderma hamatum* 382. Dissertation. Dept. of Plant Pathology, The Ohio State University, Columbus, OH.

Grebus, M. E., Watson, M. E. and Hoitink, H. A. J. 1994. Biological, chemical and physical properties of composted yard trimmings as indicators of maturity and plant disease suppression. Compost Sci. & Util. 1:57-71.

Nelson, E. B. 1991. Introduction and establishment of strains of *Enterobacter cloacae* in golf course turf for the biological control of dollar spot. Plant Dis. 75:510-514.

Nelson, E. B. and Craft, C. M. 1992. Suppression of dollar spot on creeping bentgrass/annual bluegrass turf with top dressings amended with composts and organic fertilizers. Plant Dis. 76:954-958.

USING SOIL MEASUREMENTS TO QUANTIFY COMPACTION ON SPORTS TURF

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Soil Compaction is one of the most difficult to identify effects of sports traffic on turfgrass soils. Not only is the soil itself obscured from view, it is difficult to evaluate in terms of changes in its structure or condition to support root and ultimately plant growth. A compacted soil has reduced soil pore spaces, thus accepts water more slowly and drains slowly. Ring Infiltrometers have been used by sports turf managers and agronomists as an indicator of the porosity of soils and an indirect measure of the degree of soil compaction. Water enters the soil in direct relation to the amount of pore space and the size of the pores at or near the soil surface. A more crude instrument that measures the hardness of soils is the Penetrometer. A probe is pushed into the soil by a uniform weight dropped from a set height. The harder the soil the less penetration by the probe. A scientific version of the Penetrometer is being used to evaluate simulated football traffic applied to soils in experiments at UC Riverside.

EFFECTS OF RECLAIMED WATER ON TURFGRASS AND SOILS

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An agronomic study was performed by the UC Cooperative Extension in San Diego County to compare the use of reclaimed waters with potable waters, assessing the impact on turfgrass performance, soil chemistry, and potential for groundwater contamination. The studies were performed under a contract with the City of San Diego. Data were collected on water quality, turf performance, and soil chemistry responses with general focus on tracking consistency and potential trends.

The experiments were located at the Torrey Pines Golf Course in La Jolla, the Eastlake Development in Chula Vista, and the Whispering Palms Water Pollution Control Facility at Fairbanks Ranch. Turfgrasses studied were tall fescue, bluegrass/ryegrass mix, common bermudagrass, and kikuyugrass. Water treatments consisted of potable and reclaimed water applied through sprinkler systems to plots located side by side in each replicated experiment.

Water analyses show that the reclaimed waters generally had higher values for all constituents than potable waters (Table 1). In addition, reclaimed waters were much more variable in quality between site and sample date.

Table 1. Average quality values for potable and reclaimed waters used in the studies.

Water Type	pH	EC (dS/m)	SAR	Chloride (meq/l)	Nitrogen (ppm)
Potable	7.8	1.0	3.0	4.0	0.25
WP Reclaimed	7.3	1.4	5.3	5.7	11.80
EL Reclaimed	8.1	1.7	5.8	9.9	3.90

The results of these experiments indicate:

1. Water type did not consistently affect turfgrass quality. Turfgrass quality was acceptable. Reclaimed water did sporadically increase some turf quality scores in five of the six experiments, probably due to the additional nitrogen applied.

2. Approximately 50 to 70 percent more salts were applied to reclaimed water treatments due to the higher salinity of these waters.

3. Soil salinity and concentrations of sodium, chloride, and boron tended to be cyclic in nature, lowest in the spring and highest at the end of the irrigation season.

4. The greatest effects of irrigation treatments were seen as a function of EC, SAR, and chloride levels in soil extracts from samples taken in the fall. Peak values observed in reclaimed water treatments were: ECe = 5.1 dS/m; SAR = 10.0; and chloride = 25.2 meq/l.

5. Consistent significant differences between water treatments occurred at the Eastlake site.

6. Frequent irrigation resulted in the highest ECe values for both reclaimed and potable waters.

7. No reduction in infiltration or soil permeability in the reclaimed water plots was observed.

8. Reclaimed water did not result in significant nitrate-nitrogen leaching, even though, increased levels of salt were leached.

9. Screens in sprinklers delivering reclaimed water at the Eastlake site had consistently higher amounts of algae and contaminants.

MANAGING FOR BENTGRASS SUMMER STRESS IN SOUTHERN CALIFORNIA

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I. CURRENT RESEARCH

The major objective of this paper and presentation is to provide data concerning the application of various materials on a bentgrass putting green for the purpose of decreasing plant damage due to summer stress. Data also will be presented concerning the development of a summer cultivation program on bentgrass putting greens using the Toro HydroJect. Again, the purpose of summer cultivation is to reduce plant damage due to summer stress via the manipulation of soil physical properties.

Findings from Current Research

We have collected data for 2 years concerning the application of soil-applied, slow-release Fe, foliar applied Fe, and several biostimulants. Foliar applications of Fe, along with several of the soil-applied formulation, show promise in increasing bentgrass visual quality during the summer.

Data from the first year show that no treatment significantly increased rooting during the summer. We will collect data during the second year to either confirm or dispute these rooting data.

Very preliminary data concerning summer cultivation with the Toro HydroJect show that visual turfgrass quality is not affected by cultivations either once every 2, 3, or 4 weeks. We also will collect data concerning possible beneficial changes in plant growth, including rooting, and soil physical properties related to infiltration, porosity, and water retention.

Thanks are given to Vigoro, Toro, and Hi-Lo GCSA for partially funding this research.

II. BACK GROUND CONCERNING BENTGRASS/ANNUAL BLUEGRASS PUTTING GREEN SUMMER STRESS

This report would not be complete without some background information concerning summer stress of bentgrass/annual bluegrass putting greens in Southern California. It should be pointed out that generalizations are difficult due to the wide range of environmental conditions found in Southern California. The purpose of this abstract is to only briefly highlight several major issues. The reader should obtain more detailed references and also keep in mind that more research is needed.

Observations concerning bentgrass/annual bluegrass putting green summer stress in Southern California are listed below.

1. The major limiting factor of plant growth is long-term exposure to air and soil temperatures above the optimum range. The upper range for optimum bentgrass shoot and root growth is approximately 80F and 65F, respectively. Root efficiency and growth are affected more severely than shoot growth at supra-optimal temperatures. It should be pointed out that bentgrass putting greens are maintained under desert conditions where the average maximum air and soil temperatures can be in the range of 100 and 85F, respectively. It also should be pointed out that annual bluegrass is significantly less tolerant to heat stress than bentgrass.

2. The second most limiting factor is related to the putting green soil and how much the superintendent can control the soil air-water relationship. A green that has been constructed well and has good drainage is key to this control along with adjustments to the cultural program during the summer. A putting green with good drainage also will allow the superintendent to manage salt accumulations.

3. The third class of limiting factors to bentgrass/annual bluegrass summer stress tolerance may be more situational: diseases and insects that attack weakened, stressed-out greens; salt accumulations in and above the root zone due to poor drainage and possibly poor irrigating and leaching practices; nematodes that attack weakened stressed-out greens; and cultural practices that are not helpful to the plants ability to tolerate summer stress.

Listed below are several suggestions in light of the limiting factors to bentgrass/annual bluegrass summer stress tolerance. It should be noted that several of these issues need more research in Southern California and again they are only in outline from. Remember, these suggestions pertain to summer stress.

1. As practical as possible, manage for the highest amount of bentgrass vs. annual bluegrass. This is logical because bentgrass has a higher tolerance to heat, salt, drought, and disease. This may involve annual seeding of bentgrass, pre- and postemergent

control of annual bluegrass on as much as of the golf course as possible, reestablishing putting greens to bentgrasses every 7 years or so, possibly seed head suppression of annual bluegrass, and other approaches. Keep in mind that it may take several years and diligence to reach your goal.

2. Manage soil for the best possible drainage. May involve greens reconstruction, but will definitely involve a good cultivation/top dressing program. These activities should not be accomplished in the summer.

3. Provide as much air movement over the green as possible. Air movement is much more effective than syringing in dealing with heat. May involve vegetation considerations and fans.

4. Syring when necessary. Remember this is heat control not irrigation. Keep in mind University research does and does not support this activity. Air movement and low humidity are key to syringing.

5. Spike and HydroJect during the summer to prevent crusting and maintain aeration in the root zone. Manage hydrophobic spots with wetting agents, spiking, etc.

6. Verticutting and slicing are normally not recommended in the summer. Control thatch when the grass is actively growing. Light topdressing can be accomplished in some situations in the summer with care. The same can be said about grooming.

7. Fertilization in the hot summer is tricky. Always use care! In extreme heat (95F and above) root uptake of nutrients may be a problem. Consider foliar spray applications of low-salt materials at 0.1 lb N/1000 ft^2 per application. Slow-release granular fertilizers may be applied with care at low rates (0.3 lb N/1000 ft^2). Heat and salt kills in the summer.

8. Raise mowing height to 3/16, possibly higher on problem greens and high heat. Can mowing one less day be possible? Can walk-behind mowers be used in the summer?

9. Foliar applications of Fe during the summer are beneficial. During the extreme summer heat, root uptake of Fe is a problem.

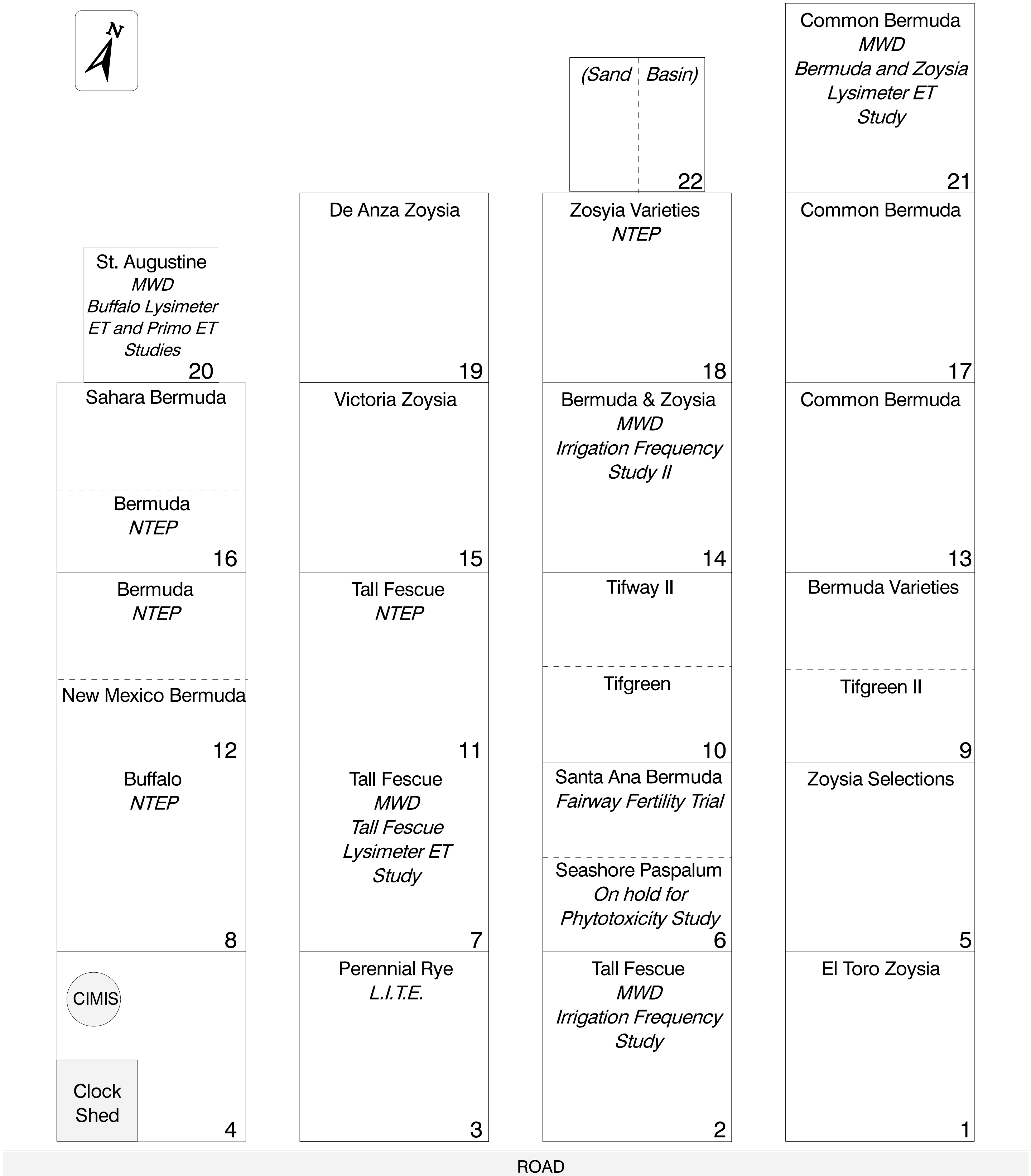
10. The jury is still out concerning the benefits of biostimulants applied on putting greens.

11. Irrigate to replenish root zone moisture. The trend is to over irrigate to maintain the annual bluegrass. It is a vicious cycle! Determine if leaching is or is not necessary; make no assumptions.

12. Control pest when needed; diseases, insects and nematodes. Chemical weed control in the heat of summer should be done with care, or why not consider hand weeding?

UCR TURFGRASS RESEARCH PROJECT FIELD PLOT MAP

As of April 1995



WATER-USE RATES AND ASSOCIATED GROWTH CHARACTERISTICS AMONG TALL FESCUE CULTIVARS

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[2]University of California Cooperative Extension, San Bernardino and Los Angeles Counties, 777 E. Rialto Ave., San Bernardino, CA 92415

Objective: To determine if significant differences exist among tall fescue cultivars for water-use rates when evaluated under well-watered field conditions. Utilization of cultivars possessing a lower water-use rate may result in irrigation water savings.

Status: During 1994, 22 cultivars of tall fescue were established in lysimeters for 7 months, and then evaluated for water-use rates during the summer season. Considerable effort was made to insure that we evaluated commercially-available cultivars, and that our turfgrass management program was representative of typical practices. Water-use measurements were also evaluated during the summer of 1995.

Procedures: 5-gallon 'egg can' pots were filled with a fine-textured fritted clay. The clay was packed and settled, and thoroughly rinsed prior to seeding. Minilysimeters were then seeded at a rate of 8 lb seed per 1000 ft^2 . Each of the 22 cultivars was replicated five times and placed in the field in a randomized block design. Pots were fertilized weekly with a nutrient solution (20-20-20) at a rate of 0.5 lb N per 1000 ft^2 per month, and mowed weekly at 2 inches. Water-use rates were determined by watering pots to field capacity (Tuesday), recording an initial weight, then recording weights at the same time on subsequent days of the week (through Friday). Daily weight losses were then used to calculate an accumulative water-use rate for each cultivar. A subset of seven cultivars were further evaluated for morphological and growth characteristics, including leaf extension rate (growth rate), clipping yields, and leaf density, length, and width (see Hartin et al., page 2).

Results: Significant differences in water-use rates among the tall fescue cultivars were observed in 1994. The range between cultivars for 3-day accumulative ET rates varied between 16 and 10% -- a range similar to those previously reported. Water-use rates were highly influenced by environmental conditions. These date may suggest that tall fescue cultivar selection is a valid approach towards irrigation water conservation. Water savings may be even greater when cultivars are evaluated under less than well-watered conditions. Significant differences were found between cultivars for morphological and growth measurements, however, no correlations with water-use rates existed (when evaluated under well-watered conditions.

TALL FESCUE CULTIVARS USED IN THE WATER-USE RATE STUDY.

	Cultivar	Seed Company
1.	Amigo	Medalist America
2.	Apache	Turf-Seed and Pure Seed Testing
3.	Arid	Jacklin Seed Co.
4.	ATF007	Advanta Seeds West, Inc.
5.	ATF136	Advanta Seeds West, Inc.
6.	ATF141	Advanta Seeds West, Inc..
7.	Bonsai	Turf Merchants
8.	Crewcut	Lesco, Inc.
9.	Emperor II	Zajac Performance Seeds
10.	Encore	Southland Sod Farm, Inc.
11.	Falcon	E.F. Burlingham
12.	JC12	Southland Sod Farm
13.	KY-31	Advanta Seeds West, Inc.
14.	Mojave	Mid-Valley Ag. Products
15.	Monarch	Turf-Seed & Pure Seed Testing
16.	Murietta	Turf-Seed & Pure Seed Testing
17.	Pixie	Jacklin Seed Co.
18.	RF1	Southland Sod Farm
19.	Rebel Jr.	Loft's Seed, Inc.
20.	Tomahawk	Turf-Seed & Pure Seed Testing
21.	Trailblazer II	Lesco, Inc.
22.	Wilight	Turf Merchants

Thanks are given to the Metropolitan Water District of Southern California, The Toro Company, The Council For A Green Environment, Southland Sod Farms, and Advanta Seeds West, Inc., for partially funding this study.

SENSITIVITY OF *PASPALUM* TO COMMON FOLIAR APPLIED HERBICIDES

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Paspalum vaginatum is a comparatively new turf to California. Since its introduction to California in the 1970's, information about its culture and management has been developed. However, little is known about its response to the commonly used foliar herbicides.

Very few herbicides are completely selective. When we use 2,4-D or MSMA or nearly any of our foliar herbicides in crops such as turf we seldom notice the symptoms that they can produce in the crop. These symptoms range from a temporary slowing of growth to a temporary change in color. Most often these symptoms persist only a few hours. The negative effect of the slight symptoms that are sometimes produced is far outweighed by the benefits of weed control. Yet occasionally the response of a species to an herbicide is severe enough that we cannot utilize that herbicide selectively in that species to control weeds. An example of such a response can be found in the reaction of St. Augustine to MSMA application, where severe injury can occur. For this reason label precautions warn against the use of MSMA in St. Augustine turf. In order to assess the effects of the commonly used foliar herbicides in P*aspalum* the following trial was established in late August of 1995:

Herbicides: 2,4-D, MCCP, dicamba, MSMA,triclopyr, fenoxaprop, ethofumesate, and combinations of 2,4-D, MCCP, and dicamba.

Application: All treatments were applied with a $C0_2$ plot sprayer at a spray volume of 50 gallons per acre and were replicated four times.

Evaluations will include: phytotoxicity, turf growth, and turf quality. Evaluations will commence 2 days after application and continue through the month of September.

EVALUATION OF CUTTING HEIGHT AND VERTICAL MOWING ON ZOYSIAGRASS

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Zoysiagrass (*Zoysia japonica*) is a warm-season turfgrass and is well adapted to southern and central California. It is considered a minimum maintenance turfgrass and has been established in playgrounds, parks, home lawns and golf courses. It is planted by sprigging, i.e. spreading stolons on the prepared soil surface.

Zoysiagrass is tolerant to heat, drought and salinity and can withstand moderate to heavy traffic. It forms a uniform, dense, low growing, high quality turf that has a slow rate of growth. However, because of its slow rate of establishment, long dormant period and tendency to produce thatch, it is not as popular as other warm season grasses.

The two zoysiagrass selections used in this study - De Anza and Victoria, have been developed at University of California, Riverside, by Drs. V. B. Youngner, V. A. Gibeault and M. Leonard.

A field experiment is now in progress to ascertain minimum - maximum mowing heights and vertical mowing intervals which may be advantageous in effective thatch control as well as acceptable visual turf quality. Field plots are mowed twice weekly at four heights, with leaf clippings collected once per week during mowing. At the end of the study, we hope that the data will further assist us in establishing effective thatch control with minimum stress to zoysiagrass.

1995-1996 EVALUATION OF SLOW-RELEASE AND FAST-RELEASE NITROGEN FERTILIZERS APPLIED ON TALL FESCUE DURING ONE ENTIRE YEAR

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Objectives:
To evaluate the performance of nitrogen fertilizers when applied on tall fescue for one entire year (March to March).

Cultivar:
Bonsai tall fescue.

Experimental Site:
A mature plot established at the UCR Turfgrass Field Research Center, Riverside, CA on September 28, 1993. The root zone is a native soil which is classified as a Hanford fine sandy loam; pH = 7.4; P = 17ppm; X-K = 75ppm. This site is maintained similar to general turfgrass conditions.

Experimental Design:
Randomized Complete Block design with four replications. Plot size 4.5 x 6.0 ft.

Mowing:
Twice per week with a walk-behind rotary mower set at 2.0 inches. Clippings removed.

Irrigation:
Plots irrigated to prevent visual drought symptoms. Irrigation rates calculated in accordance with an on-site CIMIS station.

Fertilizer Treatments *(see Treatment Table)*:

Annual N rate set at 6 lb/1000 ft^2.
Test runs March to March.

Measurements:

Visual turfgrass ratings are taken biweekly beginning 2 weeks after initial treatment applications, using a 1 to 9 scale with 1=poorest, 5=acceptable, 9=best tall fescue. Ratings are taken at approximately 10:30AM.

Clipping yields are taken biweekly beginning 3 weeks after initial treatment applications. Yields, are from 4 days of growth, and are collected with the same mower used for routine mowing. Clippings are dried for 48 hours in a forced-air oven maintained at 60C. Clippings collected represent a 27% subsample of the 27.0 ft^2 plot.

One-Year Fertilizer Programs for Tall Fescue in Riverside, CA: March 9, 1995 - March 7, 1996

TRT	Company	Fertilizer Program: Product (lb N / 1000 ft^2)						Tot. lb N / 1000ft^2 / 12 months
Application Dates --->		March 9	May 9	July 10	September 8	November 9	N/A	
1	Scotts	27-3-4 (1.5)	27-3-4 (1.0)	27-3-4 (1.0)	27-3-4 (1.0)	27-3-4 (1.5)	--	6.0
2	Sea Source	16-4-8 (1.5)	16-4-8 (1.0)	16-4-8 (1.0)	16-4-8 (1.0)	16-4-8 (1.5)	--	6.0
Application Dates --->		March 9	May 18	August 10	October 19	N/A	N/A	
3	Pursell	Polyon 43-0-0 (2.0)	Polyon 42-0-0 (1.0)	Polyon 42-0-0 (1.0)	Polyon 43-0-0 (2.0)	--	--	6.0
Application Dates --->		March 9	June 15	September 15	December 7	N/A	N/A	
4	Vigoro	Excote 44-0-0 (2.0)	Excote 43-0-0 (1.0)	Excote 43-0-0 (1.0)	Excote 44-0-0 (2.0)	--	--	6.0
5	Vigoro	Excote 43-0-0 (2.0)	Excote 43-0-0 (1.0)	C. IBDU 31-0-0 (1.0)	C. IBDU 31-0-0 (2.0)	--	--	6.0
6	Vigoro	Excote 43-0-0 (2.0)	Excote 43-0-0 (1.0)	Excote 44-0-0 (1.0)	Excote 44-0-0 (2.0)	--	--	6.0
7	Vigoro	N Humate / IBDU 16-0-0 (2.0)	N Humate / IBDU 16-0-0 (1.0)	N Humate / IBDU 16-0-0 (1.0)	N Humate / IBDU 16-0-0 (2.0)	--	--	6.0
Application Dates --->		Once every month, every second month, or every third month as indicated.						
8	ITRONICS	20-1-8 (W/V): Sprayed at 0.5 each month						6.0
9	ITRONICS	20-1-8 (W/V): Sprayed at 0.5 every second month						3.0
10	ITRONICS	20-1-8 (W/V): Sprayed at 0.5 every third month						2.0
Application Dates --->		March 9	May 18	August 10	October 19	January 25	N/A	
11	CIC Canola	Canola 6-2-1 (2.0)	Poly Supreme 23-5-10 (1.0)	Canola 6-2-1 (1.0)	Poly Supreme 23-5-10 (0.5)	Poly Supreme 23-5-10 (0.5)	--	5.0
Application Dates --->		March 16	May 9	July 10	September 8	November 9	N/A	
12	Greener Pastures	Greener Pastures 15-1-15 (1.5)	Greener Pastures 15-1-15 (1.0)	Greener Pastures 15-1-15 (1.0)	Greener Pastures 15-1-15 (1.0)	Greener Pastures 15-1-15 (1.5)	--	6.0
Application Dates --->		March 16	July 15	October 19	N/A	N/A	N/A	
13	United Hort. Supply	Turfgo 25-5-16 (2.0)	Turfgo 25-5-16 (2.0)	Turfgo 25-5-16 (2.0)	--	--	--	6.0
Application Dates --->		March 16	May 9	July 10	September 8	November 28	N/A	
14	United Hort. Supply	Turfgo 24-4-16 (1.0)	Turfgo 24-4-16 (1.0)	Turfgo 24-4-16 (1.0)	Turfgo 24-4-16 (2.0)	Turfgo 24-4-16 (1.0)	--	6.0
Application Dates --->		March 9	May 9	July 10	September 8	November 9	January 25	
15	UCR	Turf Supreme 16-6-8 (1.0)	Turf Gold 21-3-5 (1.0)	Poly Supreme 23-5-10 (1.0)	Turf Supreme 16-6-8 (1.0)	Nitra King 22-3-9 (1.0)	Nitra King 22-3-9 (1.0)	6.0
16	Check	N/A						0.0

SHADE, TRAFFIC, SAND MEDIA AND TURFGRASS VIGOR

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There has been increasing interest by the turfgrass industry to understand the ability of different grasses to withstand shade. A better understanding would allow use of capable turfgrasses in indoor situations such as domed stadiums. This study demonstrates the comparative abilities of turfgrasses to survive in periodic sun periods followed by shade when subjected to traffic on sand media. Four turfgrasses (bermudagrass, perennial rye-grass, and 2 different varieties of zoysiagrass) were subjected to four shade situations: a) no shade; b) shade applied every second day; c) shade applied every fourth day; and d) shade applied every eighth day. All sun periods were limited to 5.5 to 6 hours per period.

The plot was excavated, graded, and filled with river sand of specified particle size in mid-March of 1995 and turfgrass replicates were sodded a week later. Shade was applied after a 10 week establishment period. Light levels and canopy temperature and humidity were monitored using radio-telemetry and down-loaded each month. Traffic equivalent to 1 to 2 pro football games per week was applied using the Brinkman Traffic Simulator. All replicates were mowed at 5/8" twice a week using a triplex reel mower and fertilized at 1.5 lbs N every 4 weeks and periodically supplemented with other nutrients (P, K, Fe, Mn, Zn). Irrigation was applied at 1.5 inches per week with handwatering as needed in the no shade reps and along the perimeter.

Tifton 419 bermudagrass had the best quality and traffic recovery under full sun, but lost much quality with any light limitation. Manhattan II perennial ryegrass did not survive in any shade treatment, but was acceptable under no-shade conditions. The zoysiagrasses appeared best able to withstand the applied shade periods. Dallas 8502 zoysiagrass maintained good color and uniformity in non-traffic areas, but suffered from lack of establishment. DeAnza zoysiagrass maintained the best color and density in all shade treatments, even in non-traffic areas in the heaviest shade treatment. No turfgrass maintained acceptable quality in shaded, with-traffic replicates. Follow-up studies include maximizing zoysiagrass management factors (i.e. nutrient input, irrigation and mow height) when grown under limiting light and utilizing solar reflection or augmented light to overcome light restrictions.

A STUDY OF LEAF FIRING RESISTANCE AMONG BERMUDAGRASSES

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Water is one of the most precious natural resources in the arid and semi-arid Southwest U.S. The amount of water utilized for turfgrass and landscape irrigation can be substantial, and will increase as urbanization continues. Approximately 25% of all the water delivered by the Metropolitan Water District in Southern California is applied on turfgrass and landscapes and as much as 35% is utilized for the same purposes in southern Nevada. Thus, it is vital to investigate water management strategies that will enable the wise and efficient use of available water resources.

The development, selection, and utilization of turfgrass species and cultivars that require less irrigation has been studied by turfgrass scientists over the past 15 years. Most of this work has involved evaluating turfgrass species and cultivars for evapotranspiration (ET) rate when plants are maintained under well-watered conditions, and for percent green cover and/or leaf firing, wilting, and rolling when plants are subjected to drought. Results have shown that there are substantial differences among turfgrasses for ET rate and for the ability to remain green and functional during drought conditions, termed leaf firing resistance (LFR).

The LFR trait, like drought resistance, is complex and it seems probable that there is no single unique trait that unequivocally conveys LFR. Though there may be several significant molecular, physiological, and whole-plant traits that help confer LFR, we plan to determine which traits could be utilized in a rapid screening procedure to select for LFR. Root development is closely associated with LFR among bermudagrass genotypes and has potential to be the basis for screening procedures. We also plan to investigate whether traits associated with increased tolerance to tissue moisture deficits that are important in conferring LFR can be defined at the level of changes in gene expression. This would be desirable because biochemical assays, based on changes in gene expression, lend themselves well to rapid screening procedures.

The primary objectives of this research are to identify molecular, cellular, physiological, and whole-plant markers that are closely associated with LFR, and to begin investigation of possible mechanisms for LFR. We will assess known LFR and non LFR bermudagrass genotypes grown in both container and field environments for biochemical traits associated with changes in gene expression; physiological traits associated with the maintenance of leaf water content, positive turgor, and the reduction of transpiration; and whole-plant traits associated with growth and water absorption. The same set of measurements will be taken in the container experiments as in the field experiment, so we can test the reliability of screening in containers against actual field performance.

This research links molecular biology with whole-plant biology and provides the technical expertise necessary for studying LFR. In the short term, it will lead to an understanding of a valuable plant trait associated with tolerance and avoidance of drought. Over the long term, this work should lead to improved turfgrass germplasm consistent with the goal of reducing water use in arid and semi-arid regions.

Thanks are given to the Southwest Consortium on Plant Genetics and Water Resources for partially funding this project.

AN OVERVIEW OF CULTIVAR PERFORMANCE

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Turfgrass cultivar evaluations are an important component of the University of California Turfgrass Research Facility activities. We cooperate with the National Turfgrass Evaluation Program (NTEP), which is designed to developed and coordinate uniform evaluation trials of turfgrass cultivars and selections in the United States and Canada. Test results are used by seed companies and plant breeders to determine the adaptation of a grass. Also, local turf facilities can benefit from cultivar performance characteristics in a local climate and soil.

Currently, we have 96 tall fescues, 28 zoysiagrasses, 27 bermudagrasses, and 22 buffalograsses under maintenance at UCR. The grasses are mowed weekly during the growing season, fertilized on a regular, moderate program and irrigated to replace water used as calculated from the CIMIS station. There are no secondary management practices used during the study. Turfgrass quality is rated on a monthly schedule and annually the results are analyzed and reported by NTEP.

Following are the plot plans, cultivar and selection information about source of material, and results on a national level. In each report, the UCR location is referred to as CA3.

1992 NATIONAL BERMUDAGRASS TEST

Entries and Sponsors

Seeded Entries

Entry #	Name	Sponsor
1	J-27	Jacklin Seed Company
2	Jackpot (J-912)	Jacklin Seed Company
3	Sonesta	O.M. Scott & Son
4	Cheyenne	Pennington Seed Company
5	Primavera (FMC 1-90)	Seed Research of OR/Farmers Mkt. Corp.
6	FMC 2-90	Farmers Marketing Corp.
7	FMC 3-91	Farmers Marketing Corp.
8	FMC 5-91	Farmers Marketing Corp.
9	FMC 6-91	Farmers Marketing Corp.
10	Sundevil	Medalist America
11	Arizona Common	Standard Entry
12	Mirage (90173)	International Seeds, Inc./ Arizona Grain, Inc.-Valley Seed Co.
13	OKS 91-1	Oklahoma State University
14	OKS 91-11	Oklahoma State University
15	Numex-Sahara	Farmers Marketing Corp. (Standard Entry)
16	Guymon	Oklahoma State University (Standard Entry)

Vegetative Entries

Entry #	Name	Sponsor
17	Floradwarf (FHB-135)	Univ. of Florida-Gainesville
18	Arizona Common	Standard Entry
19	Midiron	Standard Entry
20	Tifgreen	Standard Entry
21	Tifway	Standard Entry
22	Texturf 10	Standard Entry
23	STF-1	Sunnyvale Turf Farm
24	Midlawn	KSU Research Foundation & Oklahoma State University
25	Midfield	Kansas State University & Oklahoma State University
26	TDS-BM1	Turfgrass Development Systems

Bermudagrass NTEP Variety Trial

I	7	10	13	1	5	9	4
I	2	8	11	3	6	14	16
I	15	12	22	19	26	20	18
I		21	25	23	17	24	27
II	5	9	15	6	2	16	13
II	10	1	12	11	3	4	7
II	8	14	26	25	20	21	17
II		22	19	24	23	18	27
III	16	1	13	11	12	15	7
III	9	8	14	3	5	4	6
III	10	2	23	20	24	22	25
III		21	19	17	26	18	27

Varieties:

1. J-27
2. J-912
3. Sonesta
4. Cheyenne
5. FMC 1-90
6. FMC 2-90
7. FMC 3-91
8. FMC 5-91
9. FMC 6-91
10. Sundevil
11. Arizona Common
12. 90173
13. OKS 91-1
14. OKS 91-11
15. Sahara
16. Guymon
17. FHB-135
18. Arizona Common
19. Midiron
20. Tifgreen
21. Tifway
22. Texturf 10
23. STF-1
24. Midlawn
25. Midfield
26. TDS-BMI
27. CT 2

1-16: Seeded varieties
17-27: Vegetative vars.

Established: June 1992 **Mowing:** 5/8 inch **Fertility:** 4 lbs N / 1000 ft^2 / year

MEAN TURFGRASS QUALITY RATINGS OF BERMUDAGRASS (SEEDED) CULTIVARS
GROWN AT TWENTY-THREE LOCATIONS IN THE U.S.
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 1/

NAME	AL1	AR1	AZ1	CA2	CA3	FL1	GA1	GA2	IL2	KS2	KY1	LA2	MD1	MO2	MO3	MS1	OK1	OK2	TX1	TX2	UB1	VA1	VA4	MEAN
MIRAGE (90173)	5.8	5.8	5.9	5.0	5.0	5.5	4.4	3.8	3.7	7.3	8.8	5.7	6.3	5.2	4.0	4.9	5.9	6.2	6.3	1.2	5.1	4.3	5.7	5.3
OKS 91-11	5.9	6.5	6.7	5.5	5.2	5.4	4.0	3.6	4.4	8.0	8.0	5.3	7.0	4.4	3.4	4.7	5.9	5.8	6.1	1.0	5.6	3.5	5.4	5.3
J-27	5.6	5.7	6.0	5.2	4.8	5.1	4.3	3.3	3.5	7.8	8.2	4.9	6.0	5.0	4.0	4.8	5.2	5.5	6.1	1.3	5.5	3.9	5.5	5.1
GUYMON	5.7	5.9	5.9	5.2	4.9	5.1	4.4	3.2	3.3	7.6	8.0	5.3	6.0	4.9	3.2	4.9	6.0	5.8	6.1	1.1	4.9	3.9	5.2	5.1
JACKPOT (J-912)	5.6	5.9	5.4	5.0	4.7	5.5	4.3	3.3	5.2	7.3	7.8	5.4	2.7	3.4	2.8	5.1	5.0	6.0	5.7	1.1	4.5	3.6	5.9	4.8
SUNDEVIL	5.8	5.4	5.3	4.6	4.7	4.6	4.2	3.3	3.6	7.1	7.8	5.2	4.7	3.8	3.3	4.8	4.4	5.3	5.9	1.0	4.1	2.5	5.7	4.7
FMC 5-91	5.6	5.8	4.9	4.7	4.7	5.4	4.5	3.5	4.5	7.5	6.6	5.5	3.0	2.1	1.6	4.9	5.3	6.2	5.9	1.1	5.1	2.0	5.5	4.6
FMC 6-91	5.8	6.2	5.5	4.8	4.6	5.1	4.5	3.8	4.1	7.7	6.7	5.4	2.3	1.6	1.6	5.3	5.5	6.3	6.1	1.1	2.9	1.7	6.1	4.5
OKS 91-1	5.7	5.3	4.7	4.3	4.5	4.7	4.3	3.5	3.4	7.0	7.1	5.3	3.3	2.8	2.9	4.9	5.1	5.7	6.0	1.1	2.1	2.1	5.7	4.4
FMC 2-90	5.6	5.5	4.8	4.9	4.5	5.0	4.4	3.8	3.1	7.3	6.6	5.3	2.0	1.4	1.0	4.9	4.9	5.8	6.0	1.0	3.4	2.5	5.7	4.3
FMC 3-91	5.7	5.3	5.3	4.7	4.7	5.3	4.1	3.7	3.9	6.6	6.3	5.5	2.3	1.1	1.6	5.0	5.1	6.2	6.0	1.0	2.8	1.1	5.8	4.3
SAHARA	5.8	5.7	5.3	4.7	4.8	4.9	4.2	3.6	4.0	6.5	6.3	5.5	2.0	1.3	1.4	4.8	4.3	5.7	6.0	1.0	3.5	2.2	5.7	4.3
CHEYENNE	5.7	5.3	4.5	4.4	4.5	4.7	4.6	3.3	3.9	6.8	6.2	4.8	1.7	1.8	1.9	4.8	4.5	5.2	5.7	1.0	5.3	1.2	5.1	4.2
SONESTA	5.8	5.3	5.1	4.5	4.5	4.8	4.3	3.3	3.3	6.9	6.4	5.3	1.7	1.3	1.4	4.8	3.9	4.5	6.0	1.0	3.2	1.2	5.2	4.1
PRIMAVERA (FMC 1-90)	5.8	5.5	4.5	4.3	4.5	4.7	4.3	3.4	3.6	6.8	6.1	5.1	1.7	1.3	1.2	4.7	3.3	4.3	5.8	1.0	2.3	1.3	5.2	3.9
ARIZONA COMMON-SEED	5.6	5.3	4.9	4.3	4.5	4.6	4.1	3.5	3.3	6.9	5.8	5.3	2.0	1.1	1.1	4.9	3.4	4.3	5.8	1.1	1.7	1.2	5.1	3.9
LSD VALUE	0.2	0.4	0.8	0.3	0.3	0.6	0.7	0.8	1.2	0.7	0.7	0.5	1.7	1.2	1.2	0.3	1.4	1.5	0.5	0.3	1.4	1.3	0.5	0.2

TABLE 1C. MEAN TURFGRASS QUALITY RATINGS OF BERMUDAGRASS (VEGETATIVE) CULTIVARS
GROWN AT TWENTY-THREE LOCATIONS IN THE U.S.
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 1/

NAME	AL1	AR1	AZ1	CA2	CA3	FL1	GA1	GA2	IL2	KS2	KY1	LA2	MD1	MO2	MO3	MS1	OK1	OK2	TX1	TX2	UB1	VA1	VA4	MEAN
TDS-BM1	5.8	8.0	7.3	5.7	5.9	7.5	4.6	4.4	7.9	7.9	7.9	6.0	1.7	6.4	5.3	7.1	7.4	8.3	6.4	1.9	4.3	3.7	7.6	6.0
MIDLAWN	5.7	7.3	6.1	5.2	5.5	5.3	4.4	2.7	6.5	8.5	8.2	5.9	7.7	5.4	4.9	5.7	7.0	7.0	6.5	1.6	6.3	5.8	6.0	5.9
MIDFIELD	5.7	6.9	6.1	5.4	5.5	5.8	3.8	2.9	6.5	8.4	8.1	5.0	7.3	5.9	5.3	5.9	6.9	6.7	6.7	1.4	6.1	5.9	6.1	5.8
MIDIRON	5.7	7.2	5.9	5.4	5.6	6.8	4.1	3.0	6.7	8.0	8.1	5.4	7.0	5.6	4.4	5.9	6.5	6.8	6.6	1.6	5.2	5.2	6.8	5.8
TIFGREEN	5.8	8.3	7.2	5.5	5.7	6.8	4.4	4.2	7.9	7.7	7.3	6.5	1.7	5.8	5.2	7.0	7.0	8.3	6.6	1.4	2.7	2.5	7.5	5.8
TIFWAY	5.8	7.6	7.1	5.4	6.0	7.7	5.5	3.4	8.0	8.8	7.3	6.2	1.3	2.7	2.9	7.6	7.0	8.0	6.9	2.3	4.9	2.3	7.3	5.7
TEXTURF 10	5.8	7.3	5.3	5.7	5.2	7.1	4.3	2.8	6.3	6.8	7.9	5.6	1.0	5.8	4.1	5.6	6.3	7.0	6.4	1.4	4.1	3.7	6.4	5.3
STF-1	5.9	6.8	5.5	5.4	4.8	5.4	4.2	2.9	6.2	8.2	7.5	5.4	3.0	5.5	5.3	5.3	6.1	6.7	6.2	1.8	4.4	2.9	5.8	5.3
FLORADWARF (FHB-135)	5.8	6.7	5.5	4.9	5.6	6.6	4.3	3.4	9.0	6.8	3.8	4.7	1.0	1.0	1.1	5.8	3.9	5.8	4.9	1.1	1.0	1.3	5.8	4.3
ARIZONA COMMON-VEG.	5.7	5.2	3.6	4.1	4.0	3.3	3.9	3.0	4.0	6.2	5.1	4.1	1.3	1.1	1.1	4.5	5.2	5.5	5.8	1.1	3.8	1.0	4.6	3.8
LSD VALUE	0.2	0.5	1.2	0.2	0.5	0.8	0.7	0.6	0.6	0.6	0.6	1.1	1.3	1.1	1.1	0.4	1.2	1.6	0.3	0.8	2.5	1.3	0.6	0.2

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT ONE ENTRY'S MEAN FROM ANOTHER ENTRY'S MEAN. STATISTICAL DIFFERENCES OCCUR WHEN THIS VALUE IS LARGER THAN THE CORRESPONDING LSD VALUE (LSD 0.05).

1991 NATIONAL BUFFALOGRASS TEST

Entries and Sponsors

Entry No.	Name	Sponsor
1	609 (NE 84-609)	Crenshaw/Douget Turfgrass Austin, Texas
2	315 (NE 84-315)	Crenshaw/Doguet Turfgrass
3	NE 85-378	T. Riordan University of Nebraska
4	NE 84-45-3	University of Nebraska
5	NE 84-436	University of Nebraska
6	Buffalawn	Quality Turfgrass Houston, Texas
7	AZ 143	C. Mancino, University of Arizona
8	Highlight 4	River City Turf Farm Sacramento, CA
9	Highlight 15	The Grass Farm Morgan Hill, CA
10	Highlight 25	L. Wu, University of California
11	Prairie	M. Engelke, Texas A&M University
12	Rutger's	D. Huff, Rutger's University
13	Sharp's Improved	Sharp's Brothers Seed Co.
14	Tatanka (NTG-1)	Native Turf Group
15	NTG-2	Native Turf Group
16	NTG-3	Native Turf Group
17	NTG-4	Native Turf Group
18	NTG-5	Native Turf Group
19	Bison	Native Turf Group
20	Top Gun (BAM101)	Bamert Seed Co.
21	Plains (BAM202)	Bamert Seed Co.
22	Texoka	-

Seeded Entries: 12-22

Buffalograss NTEP Variety Trial

	19	18	4	1	7	16	8
I	2	11	20	14	21	13	3
	15	10	9	22	12	17	5
	6	5	12	3	7	19	6
	11	22	10	17	1	14	4
II	13	21	15	18	16	9	2
	8	20	4	10	11	3	16
III	17	21	7	1	8	14	2
	9	19	18	5	6	13	22
					12	15	20

OPEN

Varieties:

1. NE 84-609
2. NE 84-315
3. NE 85-378
4. NE 84-45-3
5. NE 84-436
6. Buffalawn
7. AZ143
8. Highlight 4
9. Highlight 15
10. Highlight 25
11. Prairie
12. Rutgers
13. Sharp's Improved
14. NTDG-1
15. NTDG-2
16. NTDG-3
17. NTDG-4
18. NTDG-5
19. Bison
20. BAM 101 (Topgun)
21. BAM 202 (Plains)
22. Texoka

Established: October 1991 **Mowing:** 2 inches **Fertility:** 3 lbs N / 1000 ft^2 / year

MEAN TURFGRASS QUALITY RATINGS OF BUFFALOGRASS (SEEDED) CULTIVARS
GROWN AT NINETEEN LOCATIONS IN THE U.S.
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 1/

NAME	AR1	AZ1	CA1	CA3	IL1	IL2	KS1	KS2	KS3	MO1	MO2	MS1	NE1	OK1	TX1	TX4	UB1	VA6	WA4	MEAN
NTG-4	5.2	6.2	4.8	4.6	4.0	6.8	6.3	7.3	7.0	5.8	6.6	4.7	5.8	6.1	6.2	3.5	6.0	3.3	5.8	5.6
NTG-5	5.3	6.4	4.5	4.3	3.9	6.6	6.0	6.8	7.0	7.1	6.3	3.3	6.2	6.1	6.4	3.3	6.0	3.6	5.9	5.5
NTG-2	6.1	6.3	4.7	4.3	3.8	7.2	5.4	6.8	7.0	6.8	6.0	2.8	6.0	6.4	6.3	2.8	5.8	4.1	5.6	5.5
NTG-3	3.2	6.7	4.4	4.6	4.4	7.3	6.2	6.8	7.2	7.1	7.0	3.7	5.8	6.1	6.4	2.2	6.0	4.6	3.6	5.4
TATANKA (NTG-1)	4.4	6.3	4.7	4.6	3.8	6.3	5.7	7.0	7.4	6.3	5.8	3.3	5.5	5.9	6.3	2.8	5.9	3.5	4.7	5.3
TEXOKA	5.1	6.0	4.9	4.3	3.3	6.1	6.4	7.0	7.7	6.3	5.5	3.6	5.0	5.9	6.3	3.7	5.8	2.3	3.6	5.2
BISON	4.2	6.4	5.1	4.4	3.2	5.2	5.9	7.6	7.6	6.0	5.5	2.8	5.2	5.8	6.4	2.3	5.5	3.1	5.1	5.1
SHARPS IMPROVED	3.8	6.3	4.8	4.5	3.7	6.1	5.9	7.3	7.3	6.6	5.2	3.4	5.3	5.8	6.5	2.2	5.9	2.4	3.6	5.1
TOP GUN (BAM 101)	4.1	6.2	4.9	4.5	3.3	5.3	5.3	7.1	7.2	5.7	6.1	3.6	5.3	6.0	6.2	2.4	5.7	2.1	4.9	5.0
PLAINS (BAM 202)	4.9	6.3	5.1	4.2	3.8	4.9	4.9	7.4	7.8	5.3	5.9	2.9	4.7	5.8	6.4	3.4	5.1	2.2	4.5	5.0
RUTGERS	4.6	5.7	4.9	5.0	1.7	3.3	4.9	6.6	7.1	3.9	6.7	3.7	1.0	6.1	6.5	2.0	4.1	1.3	2.3	4.3
LSD VALUE	1.7	0.5	0.5	0.4	1.0	1.2	1.4	0.8	0.8	0.9	0.8	0.9	0.6	0.6	0.4	1.0	0.6	1.0	1.9	0.2

TABLE 1C.

MEAN TURFGRASS QUALITY RATINGS OF BUFFALOGRASS (VEGETATIVE) CULTIVARS
GROWN AT NINETEEN LOCATIONS IN THE U.S.
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 1/

NAME	AR1	AZ1	CA1	CA3	IL1	IL2	KS1	KS2	KS3	MO1	MO2	MS1	NE1	OK1	TX1	TX4	UB1	VA6	WA4	MEAN
NE 85-378	6.0	6.5	4.5	5.0	3.9	5.8	6.6	6.9	7.3	7.1	7.0	3.7	6.0	7.4	6.2	4.1	6.5	4.2	4.7	5.8
609 (NE 84-609)	5.8	6.8	5.6	5.0	4.4	5.2	6.1	8.1	8.4	5.5	7.7	4.2	4.3	7.2	6.9	4.8	5.7	1.8	3.4	5.6
315 (NE 84-315)	5.8	6.1	4.9	4.8	4.2	6.2	5.6	6.6	6.4	7.2	7.0	2.9	6.4	7.3	6.0	2.3	6.8	3.9	4.1	5.5
NE 84-436	4.7	6.4	3.7	4.7	4.1	7.3	6.7	6.6	7.4	6.9	6.2	3.7	5.8	7.1	6.5	3.0	6.5	2.6	3.3	5.4
AZ 143	4.8	6.0	4.4	4.5	3.5	7.5	6.2	6.0	6.8	6.3	6.6	3.8	6.3	7.1	6.3	3.3	6.4	2.3	3.6	5.4
PRAIRIE	2.6	6.4	5.5	5.1	3.8	6.9	5.3	6.7	7.0	5.3	7.6	2.7	3.0	6.8	6.7	3.6	5.4	1.5	3.5	5.0
BUFFALAWN	5.3	6.2	5.5	5.2	2.1	6.9	6.7	6.8	7.1	3.7	6.8	4.8	1.0	7.1	6.9	2.8	5.3	1.6	1.4	4.9
NE 84-45-3	3.7	5.8	3.6	4.4	2.7	5.7	4.4	6.1	6.3	5.1	6.1	3.5	5.5	5.8	5.5	1.6	5.3	2.1	3.7	4.6
HIGHLIGHT 25	5.0	6.1	5.3	5.1	1.9	5.7	5.6	5.3	5.2	4.7	7.3	4.3	1.0	6.4	6.8	2.4	4.5	1.3	2.4	4.5
HIGHLIGHT 4	4.7	6.1	5.2	5.0	2.0	5.1	3.9	6.2	6.1	3.7	8.0	3.4	1.1	6.8	6.6	2.8	4.8	1.6	1.9	4.5
HIGHLIGHT 15	3.6	6.1	5.5	5.1	1.7	5.1	5.4	6.0	6.4	4.2	6.7	3.3	1.3	6.1	6.4	3.1	3.7	1.4	2.3	4.4
LSD VALUE	1.7	0.5	0.6	0.4	0.9	1.5	1.0	0.9	0.8	1.1	1.0	1.4	0.5	0.3	0.5	1.0	0.4	0.9	1.7	0.2

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT ONE ENTRY'S MEAN FROM ANOTHER ENTRY'S MEAN. STATISTICAL DIFFERENCES OCCUR WHEN THIS VALUE IS LARGER THAN THE CORRESPONDING LSD VALUE (LSD 0.05).

1991 NATIONAL ZOYSIAGRASS TEST

Entries and Sponsors

Entry No.	Name	Sponsor
1	TC 2033	Turfgrass Germplasm Services Bradenton, FL
2	QT 2047	Quality Turfgrass Houston, TX
3	CD 2013	Crenshaw/Douget Turfgrass Austin, TX
4	TC 5018	Turfgrass Germplasm Services
5	QT 2004	Quality Turfgrass
6	CD 259-13	Crenshaw/Douget Turfgrass
7	Korean Common	-
8	JZ-1	Jacklin Seed Company
9	Meyer	-
10	Emerald	-
11	Belair	-
12	Sunburst	Grasslyn, Inc.
13	El Toro	University of California
14	DALZ 8514	Texas A&M University
15	DALZ 8512	Texas A&M University
16	DALZ 8516	Texas A&M University
17	DALZ 8507	Texas A&M University
18	DALZ 8508	Texas A&M University
19	DALZ 9006	Texas A&M University
20	DALZ 8502	Texas A&M University
21	DALZ 8701	Texas A&M University
22	TGS-B10	Turfgrass Germplasm Services
23	TGS-W10	Turfgrass Germplasm Services
24	DALZ 8501	Texas A&M University

Seeded Entries: 7, 8, 22, 23

Zoysia NTEP Variety Trial

N

I	19	18	4	1	26	7	16
	8	28	2	25	11	20	14
	21	13	3	15	10	23	9
	22	12	17	5	24	6	27
II	6	23	27	28	5	12	3
	7	19	11	22	10	17	25
	24	1	26	14	4	13	21
	15	18	16	9	2	8	20
III	28	4	10	11	2	24	9
	19	18	5	6	13	22	25
	20	15	27	12	23	3	16
	17	21	7	1	8	14	26

Varieties:

1. TC2033
2. GT2047
3. CD2013
4. TC5018
5. GT2004
6. CD259-13
7. Korean Common*
8. JZ-1
9. Meyer
10. Emerald
11. Belair
12. Sunburst
13. El Toro
14. DALZ8514
15. DALZ8512
16. DALZ8516
17. DALZ8507
18. DALZ8508
19. DALZ9006
20. DALZ8502
21. DALZ8701
22. TGS-B10*
23. TGS-W10*
24. DALZ8501
25. DeAnza
26. Z88-11
27. Victoria
28. Z88-3

* Seeded variety.

Established: June 1991 **Mowing:** 5/8 inch **Fertility:** 3 lbs N / 1000 ft^2 / year

MEAN TURFGRASS QUALITY RATINGS OF ZOYSIAGRASS (VEGETATIVE) CULTIVARS
GROWN AT TWENTY-THREE LOCATIONS IN THE U.S.
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 1/

NAME	AL1	AR1	AZ1	CA1	CA2	CA3	FL1	GA1	GA2	IL1	IL2	KS2	KY1	MD1	MO1	MS1	NE1	OK1	TX1	TX2	UB1	UB2	VA1	MEAN
TC 2033	6.2	7.6	6.3	6.8	5.8	5.1	6.7	5.9	4.3	2.9	8.4	8.0	8.7	7.7	5.3	7.0	2.7	7.4	6.7	5.3	6.9	5.6	3.3	6.1
CD 2013	6.3	7.9	6.4	6.3	5.5	4.6	6.0	5.7	3.9	4.1	8.2	7.7	7.9	8.0	5.5	6.3	4.8	6.9	6.6	4.1	6.6	5.2	4.9	6.1
EMERALD	6.2	8.0	6.6	6.7	5.8	5.0	6.7	5.7	4.0	3.0	9.0	8.0	7.9	8.0	5.2	6.6	2.6	6.5	6.3	5.2	7.1	5.3	3.7	6.0
TC 5018	6.2	5.7	6.1	5.9	5.4	5.0	6.3	5.6	4.3	5.1	5.3	7.7	8.3	7.7	5.1	6.3	5.6	6.1	6.4	4.7	5.8	5.5	6.1	5.9
DALZ 8507	6.2	7.7	6.6	6.8	5.8	4.6	6.5	6.0	4.7	2.7	8.6	7.4	7.5	8.0	5.6	6.9	1.0	6.1	6.7	4.8	6.6	5.3	3.2	5.9
QT 2004	6.3	7.6	6.1	6.7	5.6	4.4	5.5	5.6	4.3	3.3	8.1	7.4	6.9	8.0	5.8	5.1	4.8	6.9	6.7	3.1	6.9	5.4	4.4	5.9
SUNBURST	6.1	6.2	6.3	5.8	5.7	5.0	6.3	5.5	4.7	3.8	5.6	7.5	8.5	7.0	5.6	5.5	5.8	5.9	6.1	4.2	6.1	5.3	5.4	5.8
MEYER	6.3	6.8	6.1	6.0	5.5	4.1	5.5	5.8	3.7	3.3	6.9	8.2	8.1	7.7	5.4	6.0	6.1	6.4	6.1	3.0	5.0	6.5	4.1	5.8
DALZ 8508	6.3	8.2	6.0	6.2	5.7	5.3	6.2	5.6	3.9	2.3	8.7	7.6	7.1	7.0	4.7	6.7	2.4	7.1	5.9	5.0	6.6	5.1	2.3	5.7
CD 259-13	6.3	6.4	5.3	5.8	5.5	4.6	6.7	5.5	3.3	5.2	6.5	7.4	8.3	6.3	5.2	5.4	5.6	5.7	5.6	2.8	6.4	5.5	6.9	5.7
BELAIR	6.1	6.7	5.0	5.9	4.7	4.0	7.0	5.4	3.9	5.0	4.7	8.1	8.1	7.3	5.9	4.8	5.8	6.0	6.1	3.9	4.7	5.4	4.4	5.6
DALZ 9006	6.4	8.2	6.4	6.7	5.7	4.8	6.5	6.0	3.7	2.1	8.6	7.1	7.3	5.0	5.1	6.2	1.5	6.3	6.4	5.1	6.0	5.5	2.1	5.6
DALZ 8512	6.4	5.1	6.7	5.9	6.3	5.3	6.5	5.5	4.5	4.0	4.0	7.7	7.3	6.3	5.1	6.4	1.4	5.9	6.8	5.2	4.2	4.0	6.1	5.5
DALZ 8514	6.4	5.6	6.6	5.5	5.6	4.8	6.2	5.7	4.5	3.1	4.9	7.3	7.1	7.0	5.1	6.1	1.5	6.3	6.5	4.8	5.7	4.3	5.2	5.5
EL TORO	6.3	5.1	6.6	4.9	6.1	4.9	6.3	5.5	4.2	3.8	4.5	7.2	7.4	7.3	4.9	6.2	1.0	5.5	6.6	4.7	4.5	4.2	5.2	5.3
QT 2047	6.0	5.9	5.8	5.3	4.0	4.4	5.7	5.2	3.5	4.9	5.1	6.7	7.9	6.3	4.4	5.8	4.6	5.4	5.7	3.3	5.3	4.2	5.6	5.3
DALZ 8516	6.4	7.7	6.1	6.7	4.8	4.7	5.8	6.7	4.9	1.7	5.0	7.5	4.3	4.3	5.2	3.6	1.0	6.9	5.3	5.4	3.7	5.3	1.0	5.0
DALZ 8502	6.3	6.8	6.3	5.5	5.5	5.0	5.8	5.4	3.7	1.7	7.3	7.3	4.1	1.0	2.3	5.9	2.0	5.5	6.4	5.6	2.7	2.1	1.0	4.6
DALZ 8501	6.4	5.9	5.8	4.1	4.3	4.2	5.5	4.8	2.6	2.4	8.7	6.1	2.1	1.0	1.2	5.0	1.0	5.0	6.1	3.7	2.4	2.5	1.0	4.0
DALZ 8701	6.2	5.6	6.3	1.8	5.3	4.9	5.8	4.9	3.2	1.9	.	5.2	2.9	1.0	1.0	5.4	1.0	5.3	6.1	4.2	1.3	1.0	1.0	3.7
LSD VALUE	0.3	0.9	0.7	0.8	0.4	0.7	0.8	0.6	1.4	1.0	1.3	1.0	1.8	1.0	0.7	1.1	1.4	1.3	1.1	1.3	1.2	0.7	1.4	0.2

TABLE 1C. MEAN TURFGRASS QUALITY RATINGS OF ZOYSIAGRASS (SEEDED) CULTIVARS
GROWN AT TWENTY-THREE LOCATIONS IN THE U.S.
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 1/

NAME	AL1	AR1	AZ1	CA1	CA2	CA3	FL1	GA1	GA2	IL1	IL2	KS2	KY1	MD1	MO1	MS1	NE1	OK1	TX1	TX2	UB1	UB2	VA1	MEAN
TGS-W10	6.2	5.6	5.8	4.1	4.9	4.8	7.0	5.8	3.8	4.7	2.7	6.8	8.3	6.7	5.6	5.3	5.5	5.6	5.2	4.4	5.5	5.2	5.1	5.4
TGS-B10	6.2	5.3	5.7	5.1	5.4	4.5	6.3	5.5	3.2	5.1	2.8	7.3	8.4	6.3	5.1	4.5	5.2	5.6	5.7	3.9	5.8	4.9	5.0	5.3
KOREAN COMMON	6.1	4.5	5.1	4.5	4.8	4.4	5.5	5.2	3.7	4.8	2.3	5.5	7.4	6.3	5.3	5.0	4.3	5.8	5.7	3.7	5.1	4.2	4.8	5.0
JZ-1	6.3	4.9	5.5	5.2	5.1	4.3	5.2	5.4	3.5	4.7	2.6	5.3	7.7	6.3	5.2	4.7	4.3	5.4	5.6	2.9	5.0	4.1	5.1	5.0
LSD VALUE	0.2	0.6	0.7	1.5	0.3	0.5	1.0	0.4	1.3	0.6	1.2	1.0	0.7	0.9	0.5	1.3	0.5	0.6	0.5	0.9	1.0	0.4	0.6	0.2

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT ONE ENTRY'S MEAN FROM ANOTHER ENTRY'S MEAN.
STATISTICAL DIFFERENCES OCCUR WHEN THIS VALUE IS LARGER THAN THE CORRESPONDING LSD VALUE (LSD 0.05).

1992 NATIONAL TALL FESCUE TEST
Entries and Sponsors

Entry	Name	Sponsor
1	Avanti	Davenport Seed Co.
2	Lexus	Barenbrug/USA
3	Vegas	Barenbrug/USA
4	Austin	Barenbrug/USA
5	BAR Fa 214	Barenbrug/Holding
6	BAR Fa 2AB	Barenbrug/Holding
7	BAR Fa 0855	Barenbrug/Holding
8	GEN-91	Genesis Group
9	Ninja (ATF 006)	Ampac Seed Co.
10	ATF-007	Advanta Seeds West
11	FA-19	Advanta Seeds West
12	FA-22	Advanta Seeds West
13	Rebel-3D	Lofts Seed Co.
14	Rebel, Jr.	Lofts Seed Co.
15	Bonsai	Turf Merchants, Inc. (Standard Entry)
16	Bonsai Plus	Turf Merchants, Inc.
17	Twilight	Turf Merchants, Inc.
18	Mirage (KWS-DSL)	Turf Merchants, Inc.
19	Micro DD	Turf Merchants, Inc.
20	Finelawn 88	Finelawn Research Corp.
21	Finelawn Petite	Finelawn Research Corp.
22	Kittyhawk	Smith Seed Service
23	Aztec	O.M. Scott & Sons Co.
24	Bonanza II	Proprietary Seed
25	Adobe (SFL)	O.M. Scott & Sons Co.
26	Empress (ZPS-E2)	Zajac Performance Seeds
27	Crossfile II (Pick 90-12)	Pickseed West
28	Shortstop II (Pick 90-6)	Pickseed West
29	Eldorado	Turf-Seed, Inc.
30	PST-5LX	Pure-Seed Testing, Inc.
31	PST-5STB	Pure-Seed Testing, Inc.
32	PST-5PM	Pure-Seed Testing, Inc.
33	Safari	Turf-Seed, Inc.
34	Olympic II	Turf-Seed, Inc.
35	Coronado (PST-RDG)	Pure Seed Testing, Inc.
36	PST-5VC	Pure Seed Testing, Inc.
37	Silverado	Turf-Seed, Inc.
38	PST-5DX w/endophyte	Turf-Seed, Inc.
39	Tomahawk	Turf-Seed, Inc.
40	Monarch	Turf-Seed, Inc.
41	Cochise	Ampac Seed Co.
42	M-2	Mid-Valley Ag Products
43	403	Mid-Valley Ag Products
44	Anthem	Green Seed Co.
45	Astro 2000	Green Seed Co.
46	Apache II (PST-59D)	Pure-Seed Test., Inc.
47	Jaguar 3 (ZPS-J3)	Zajac Performance Seeds
48	Coyote (ZPS-ML)	Zajac Performance Seeds
49	Gazelle (ZPS-VL)	Zajac Performance Seeds
50	Duster (ITR-90-2)	Pennington Seed Co.
51	Virtue	Pennington Seed Co.
52	Palisades (OFI-TF-601)	Olsen-Fennel Seeds
53	Chieftain II (Pick CII)	Roberts Seed Co.
54	Pick 90-10	Pickseed West
55	Phoenix	Barenbrug/Normarc Group
56	Cafa101	Cala Farms, Inc.
57	Ky-31 no endo.	Standard entry
58	Ky-31 w/endo.	Standard entry
59	Houndog V (ISI-AFE)	International Seeds, Inc.
60	ISI-AFA	International Seeds, Inc.
61	ISI-CRC	International Seeds, Inc.
62	OFI-ATK (ISI-ATK)	Olsen-Fennel Seed Co.
63	Duke	Cascade International
64	Montauk	Cascade International
65	Pixie	Jacklin Seed Co.
66	Alamo (J-1048)	Medalist America
67	Lancer	LESCO, Inc.
68	Trailblazer II	LESCO, Inc.
69	SR 8200	Seed Research, Inc.
70	SR 8300	Seed Research, Inc.
71	Grande (SR 8400)	Seed Research, Inc.
72	Titan 2 (SR 8010)	Smith Seed Services
73	SR 8210	Seed Research, Inc.
74	Arid	Jacklin Seed Company (Standard entry)
75	PSTF-LF	Pro-Seeds Marketing
76	PSTF-200	Pro-Seeds Marketing
77	PSTF-401	Pro-Seeds Marketing
78	Guardian	Roberts Seed Company
79	Leprechaun	Roberts Seed Company
80	Falcon	E.F. Burlingham (Standard entry)
81	Falcon II (MB-21-92)	E.F. Burlingham
82	MB-22-92	E.F. Burlingham
83	Marksman (MB-23-92)	E.F. Burlingham
84	Starlet (MB-24-92)	E.F. Burlingham
85	Southern Choice (MB-25-92)	E.F. Burlingham
86	PRO-9178	Seed Research, Inc.
87	CAS-LA20	Cascade Int'l Seed Co.
88	CAS-MA21	Cascade Int'l Seed Co.
89	Debutante (WXI-208-2)	Willamette Seed Co.
90	Shenandoah	Willamette Seed Co.
91	Bonanza	Standard entry
92	Pyramid (SIU-1)	Olsen-Fennel Seed Co.

Tall Fescue NTEP Variety Trial

I	74	85	22	31	13	4	17	40	20	7	71	44	75	72	29	1
	69	24	11	52	42	89	78	3	87	14	46	83	61	21	50	54
	81	2	59	86	55	90	82	35	26	70	15	45	30	27	33	84
	10	18	73	64	9	41	53	6	60	8	68	12	91	36	25	51
	66	76	39	62	63	28	43	32	92	34	80	19	65	5	79	48
	38	47	88	23	77	56	49	58	37	16	57	67	95	96	94	93
II	63	5	73	8	17	40	10	1	80	39	51	82	71	76	38	91
	70	26	42	20	41	83	22	84	61	18	9	29	56	75	45	33
	31	57	79	88	2	58	60	3	54	65	77	21	23	64	32	35
	74	43	66	50	6	4	81	16	90	59	92	49	36	55	12	87
	52	37	47	34	89	68	85	14	24	28	62	78	27	44	46	13
	25	53	11	30	15	69	72	19	7	67	86	48	93	95	96	94
III	65	41	80	79	31	66	81	8	87	6	74	75	84	7	44	11
	85	18	58	56	39	27	72	62	71	46	45	50	88	9	55	21
	12	77	76	1	43	30	68	5	23	25	2	60	82	40	61	14
	28	53	17	38	34	64	69	24	91	78	37	84	70	67	22	57
	83	73	35	29	13	4	33	3	26	89	16	51	20	52	59	49
	10	42	19	48	15	90	92	36	63	47	32	86	95	94	93	96

KEY:
1 = Avanti
2 = Lexus
3 = Vegas
4 = Austin
5 = BAR Fa 214
6 = BAR Fa 2AB
7 = BAR Fa 0855
8 = GEN-91
9 = ATF-006
10 = ATF-007
11 = FA-19
12 = FA-22
13 = Rebel-3D
14 = Rebel, Jr.
15 = Bonsai
16 = Bonsai Plus
17 = Twilight
18 = KWS-DSL
19 = Micro DD
20 = Finelawn 88
21 = Finelawn Petite
22 = Kittyhawk
23 = Aztec
24 = Bonanza II
25 = SFL
26 = ZPS-E2
27 = Pick 90-12
28 = Pick 90-6
29 = Eldorado
30 = PST-5LX
31 = PST-5STB
32 = PST-5PM
33 = Safari
34 = Olympic II
35 = PST-RDG
36 = PST-5VC
37 = Silverado
38 = PST5DX/endophyte
39 = Tomahawk
40 = Monarch
41 = Cochise
42 = M-2
43 = 403
44 = Anthem
45 = Astro 2000
46 = PST-59D
47 = ZPS-J3
48 = ZPS-ML
49 = ZPS-VL
50 = ITR-90-2
51 = Virtue
52 = OFI-TF-601
53 = Pick CII
54 = Pick 90-10
55 = Phoenix
56 = Cafa101
57 = Ky-31
58 = Ky-31/endophyte
59 = ISI-AFE
60 = ISA-AFA
61 = ISI-CRC
62 = ISI-ATK
63 = Duke
64 = Montank
65 = Pixie
66 = J-1048
67 = Lancer
68 = Trailblazer II
69 = SR 8200
70 = SR 8300
71 = SR 8400
72 = SR 8010
73 = SR 8210
74 = Arid
75 = PSTF-LF
76 = PSTF-200
77 = PSTF-401
78 = Guardian
79 = Leprechaun
80 = Falcon
81 = MB-21-92
82 = MB-22-92
83 = MB-23-92
84 = MB-24-92
85 = MB-25-92
86 = PRO-9178
87 = CAS-LA20
88 = CAS-MA21
89 = WXI-208-2
90 = Shenandoah
91 = Bonanza
92 = SIU-1
93 = MED 2-11-24
94 = MED 2-18-18
95 = MED 2-12-10
96 = MED 10-8-5

Established: October 1992 **Mowing:** 2 inches **Fertility:** 4 lbs N / 1000 ft^2 / year

MEAN TURFGRASS QUALITY RATINGS OF TALL FESCUE CULTIVARS
GROWN AT FORTY-FIVE LOCATIONS IN THE U.S. AND CANADA
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 1/

NAME	AL1	AR1	AR2	AZ1	BC1	CA1	CA3	DC1	GA1	GA2	IL1	IL2	IN1	KS1	KS2	KY1	MA1	MD1	MI1	MO1	MO2	MO3	MO4
* JAGUAR 3 (ZPS-J3)	5.4	6.7	6.6	6.6	5.6	7.4	5.9	4.1	4.7	2.9	7.7	7.7	6.3	6.3	8.1	7.9	6.0	6.9	7.2	7.5	7.8	5.6	7.4
* HOUNDOG V (ISI-AFE)	5.4	7.4	5.1	6.6	5.7	7.1	5.9	2.6	4.7	2.9	7.9	7.2	5.6	6.5	7.8	8.0	6.2	6.6	6.8	6.0	7.9	6.2	7.2
ISI-AFA	5.4	7.1	6.4	6.7	5.8	7.2	6.0	2.4	5.2	3.5	7.3	6.9	6.3	6.8	8.3	7.8	6.3	6.6	6.7	7.5	7.9	5.5	7.2
* FALCON II (MB-21-92)	5.3	6.5	5.7	6.5	5.6	7.2	6.0	2.7	4.8	3.1	6.9	7.6	6.4	6.9	7.9	7.4	6.1	7.0	6.3	7.1	7.8	6.4	7.2
* SOUTHERN CHOICE (MB-25-92)	5.4	7.0	5.5	6.6	5.8	7.4	6.0	2.4	4.8	3.2	7.1	7.9	6.5	6.3	8.2	7.7	6.6	6.5	6.3	7.3	7.7	6.1	6.7
* GEN-91	5.3	7.3	6.4	6.3	5.4	7.0	6.0	2.3	4.6	2.6	7.3	7.2	6.2	7.0	8.0	7.4	7.0	6.6	6.9	7.5	7.9	6.2	7.4
* CROSSFIRE II (PICK 90-12)	5.4	7.6	6.3	6.7	5.9	7.3	6.0	2.1	4.9	3.4	7.7	7.1	6.6	6.8	8.2	7.9	6.6	6.3	6.7	7.4	8.1	6.5	6.8
* COYOTE (ZPS-ML)	5.3	8.5	5.0	6.9	5.9	7.3	6.0	2.6	4.9	3.0	7.5	7.1	6.1	6.5	8.0	7.4	7.0	6.3	6.1	7.3	7.7	5.6	7.5
PST-5DX W/ENDOPHYTE	5.4	7.0	5.6	6.8	5.6	7.3	6.0	2.8	5.0	3.1	7.3	7.2	6.3	6.3	7.5	7.6	5.8	6.1	6.9	6.8	7.8	6.3	7.1
ATF-007	5.3	7.9	5.1	6.6	6.3	7.4	6.1	2.1	5.0	3.2	6.8	6.9	6.3	6.4	8.1	7.5	5.9	6.3	6.8	7.0	7.7	6.6	7.3
* FINELAWN PETITE	5.4	7.3	5.4	6.6	5.5	7.1	6.0	2.7	4.9	3.5	6.5	6.7	6.5	6.3	7.9	7.5	6.2	6.3	7.2	7.0	7.7	5.7	7.4
* PIXIE	5.5	7.2	4.8	6.5	5.8	7.3	6.0	3.3	4.9	3.2	7.1	7.3	5.1	6.1	8.0	7.5	6.4	6.5	6.8	7.4	7.8	6.2	7.7
* MB-22-92	5.4	6.4	6.8	6.5	5.8	7.3	5.9	2.4	5.0	2.7	7.0	7.1	5.7	6.8	7.3	7.7	5.9	6.8	6.8	7.2	7.7	6.0	7.3
* LANCER	5.4	7.9	4.3	6.6	5.9	7.4	5.9	2.5	4.4	3.1	7.4	7.0	6.6	6.4	7.9	7.7	6.1	6.5	6.6	7.3	7.7	5.9	7.0
* REBEL,JR.	5.4	7.3	5.7	6.7	5.7	7.2	5.9	2.5	4.8	3.2	6.7	6.8	6.7	6.4	7.9	7.2	6.0	6.5	6.6	7.7	7.9	5.8	7.5
* CORONADO (PST-RDG)	5.3	7.9	6.1	6.5	5.6	7.3	5.9	1.5	5.0	3.8	6.6	7.7	5.9	6.6	8.0	7.3	6.9	6.3	6.3	7.4	7.9	6.2	7.4
* LEXUS	5.2	7.9	5.8	6.8	6.0	7.1	6.1	2.8	4.8	1.7	7.2	7.6	4.7	6.9	8.0	8.0	6.9	6.2	6.5	7.6	7.7	6.1	7.3
* EMPRESS (ZPS-E2)	5.3	7.5	6.1	6.6	6.1	7.3	5.9	2.2	4.9	2.6	7.4	7.4	5.9	6.2	8.1	7.8	5.9	6.3	6.6	7.3	7.8	6.0	7.5
* MARKSMAN (MB-23-92)	5.4	7.0	6.0	6.7	5.9	6.9	6.0	1.8	4.6	2.2	6.9	7.4	6.3	6.1	8.0	7.4	6.1	6.5	6.2	7.2	7.8	6.1	7.0
* APACHE II (PST-59D)	5.4	7.5	4.6	6.6	5.9	7.2	5.9	2.3	5.0	3.2	6.5	7.5	5.5	6.8	7.7	7.8	6.6	6.1	6.5	7.5	7.8	6.4	7.1
PICK 90-10	5.3	7.9	5.0	6.3	6.1	7.3	5.9	2.2	4.5	3.4	6.9	7.1	5.8	6.8	7.8	7.3	6.6	6.3	6.2	7.5	7.8	5.7	7.2
PST-5PM	5.4	6.7	5.6	6.8	5.9	7.1	5.9	2.3	4.6	3.0	7.4	6.4	5.9	6.3	8.1	7.6	6.1	6.5	6.7	7.4	7.6	5.7	7.3
* TOMAHAWK	5.4	7.3	6.1	6.8	5.8	7.2	6.0	2.3	4.7	2.7	7.5	7.1	6.3	6.2	7.9	7.4	6.0	6.2	6.5	7.3	7.8	5.4	7.1
* GRANDE (SR 8400)	5.3	6.9	6.3	6.4	5.6	6.9	5.9	3.3	4.7	4.0	7.8	6.6	6.0	6.6	7.7	7.7	5.0	6.3	6.7	7.4	7.6	5.0	6.8
* DEBUTANTE (WXI-208-2)	5.4	7.1	5.2	6.5	5.5	7.2	6.0	3.1	4.8	3.4	7.1	7.7	6.4	6.3	7.8	7.5	5.6	6.3	6.2	7.4	7.7	5.6	6.9
* MICRO DD	5.4	7.3	4.9	6.7	5.6	7.4	5.9	3.1	4.8	2.7	7.0	6.7	6.5	6.5	7.5	7.4	6.2	6.7	6.7	7.4	7.7	5.9	7.2
* PYRAMID (SIU-1)	5.3	6.4	6.4	6.8	6.0	7.4	5.8	3.1	4.6	2.5	6.9	6.6	6.9	6.6	7.5	7.8	5.5	6.3	6.7	7.4	7.7	5.9	7.2
* DUSTER (ITR-90-2)	5.3	7.3	5.3	6.4	5.6	7.3	6.0	2.3	4.5	2.0	6.8	6.7	6.1	6.1	7.7	7.5	6.3	6.3	6.4	7.3	7.8	5.3	7.6
SR 8210	5.2	7.1	5.3	6.5	5.9	7.1	5.9	2.8	4.9	2.2	7.1	6.6	6.2	6.3	7.7	7.4	5.4	6.3	6.3	7.2	7.7	5.3	7.1
* GAZELLE (ZPS-VL)	5.6	7.7	5.3	6.5	5.2	7.4	5.9	2.1	4.7	1.1	5.9	7.2	6.0	6.5	7.9	7.2	7.0	6.3	6.7	7.4	7.8	6.4	7.4
* STARLET (MB-24-92)	5.3	6.9	5.1	6.6	5.7	7.3	5.9	2.3	4.8	3.2	7.1	7.0	5.4	5.8	8.0	7.2	6.0	6.5	6.6	7.3	7.8	5.9	7.6
* VIRTUE	5.1	6.9	5.8	6.6	5.6	7.1	5.7	3.4	4.5	1.0	7.1	7.2	5.8	6.5	7.5	7.3	6.3	6.3	6.3	7.4	7.7	5.9	7.5
* TITAN 2 (SR 8010)	5.3	6.2	5.7	6.4	5.9	7.0	5.6	3.7	4.4	3.0	6.4	6.6	5.9	6.5	6.6	7.3	4.7	6.5	6.9	7.1	7.7	5.8	6.8
FA-19	5.4	7.2	5.3	6.6	5.7	7.2	5.9	3.1	4.5	3.0	6.4	6.9	6.8	6.2	7.4	7.4	5.5	6.1	6.6	7.1	7.8	5.6	7.1
* SILVERADO	5.4	7.3	4.9	6.3	5.7	7.2	5.8	2.3	5.1	3.5	7.1	6.8	6.9	6.3	7.7	7.8	5.3	6.2	6.8	7.4	7.7	5.6	7.1
* MONTAUK	5.3	6.5	5.7	6.6	5.6	6.9	5.8	2.7	4.6	3.2	7.2	5.9	6.3	6.3	7.0	7.4	5.8	6.6	6.5	7.3	7.6	5.4	7.2
* PALISADES (OFI-TF-601)	5.3	6.9	6.0	6.5	5.3	7.0	5.9	3.2	4.4	2.4	6.7	6.2	6.4	6.3	7.5	7.5	5.6	6.5	6.3	7.2	7.5	5.3	6.9
PST-5LX	5.4	7.2	4.8	6.6	5.6	7.0	6.0	2.4	4.7	2.6	6.9	6.9	5.4	6.2	7.9	7.5	6.0	6.2	6.1	7.0	7.6	5.9	7.1
* REBEL 3D	5.3	7.1	5.3	6.7	5.7	7.1	5.9	2.4	4.8	2.9	6.7	6.2	6.5	6.7	7.9	7.1	6.0	6.2	6.8	7.0	7.8	5.8	7.1
NINJA (ATF-006)	5.2	7.5	4.9	6.6	5.8	7.3	6.1	2.1	4.6	3.4	6.4	6.6	6.6	6.3	7.5	7.4	6.6	6.3	6.7	7.1	7.8	5.4	6.9
PST-5VC	5.2	7.1	6.1	6.5	5.6	6.9	5.8	1.6	4.7	2.3	6.7	6.2	6.9	6.3	7.3	7.6	5.8	6.3	5.7	7.1	7.9	5.1	7.1
* DUKE	5.3	6.5	5.6	6.7	5.8	7.1	5.9	3.3	4.7	2.7	7.2	5.8	6.1	6.1	7.5	7.4	5.7	6.3	6.2	7.1	7.6	5.0	6.7
* ADOBE (SFL)	5.4	6.9	4.3	6.4	6.1	7.2	5.9	2.1	5.0	2.8	6.9	6.7	6.4	6.2	7.7	7.2	5.5	6.2	6.8	7.3	7.7	5.8	6.9
* GUARDIAN	5.3	6.4	5.3	6.6	5.7	7.0	5.8	3.5	4.7	2.8	7.4	6.1	6.2	6.2	7.5	7.5	5.5	6.4	6.7	7.1	7.5	5.7	7.0
CHIEFTAIN II (PICK CII)	5.4	6.9	5.2	6.5	5.9	7.1	5.8	3.3	4.2	2.6	7.1	6.1	6.0	6.6	7.8	7.0	6.1	6.3	6.8	7.4	7.4	5.4	7.3
* BONSAI PLUS	5.4	7.0	5.9	6.4	5.7	7.3	5.8	2.3	4.7	3.8	6.8	6.9	6.0	6.3	7.3	7.1	5.6	6.2	6.6	7.4	7.7	5.7	7.3
* SR 8200	5.4	6.7	4.8	6.6	5.5	7.2	5.9	3.1	4.9	4.1	7.3	6.3	5.9	6.5	6.9	7.4	5.4	6.3	6.7	7.1	7.3	5.5	7.3
BAR FA 0855	5.4	6.3	5.3	6.6	5.6	7.2	5.9	2.5	4.7	2.7	6.7	7.1	6.2	6.1	7.7	7.2	5.5	6.3	6.2	7.2	7.4	5.8	7.2
* TRAILBLAZER II	5.3	6.4	5.4	6.5	5.4	6.9	5.8	2.5	4.9	2.4	7.1	7.1	6.3	6.4	7.2	7.2	5.9	6.5	6.9	6.9	7.8	5.4	6.7

MEAN TURFGRASS QUALITY RATINGS OF TALL FESCUE CULTIVARS
GROWN AT FORTY-FIVE LOCATIONS IN THE U.S. AND CANADA
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF

NAME	AL1	AR1	AR2	AZ1	BC1	CA1	CA3	DC1	GA1	GA2	IL1	IL2	IN1	KS1	KS2	KY1	MA1	MD1	MI1	MO1	MO2	MO3	MO4
* SHORTSTOP (PICK 90-06)	5.5	8.1	4.9	6.3	5.7	7.3	6.0	1.9	4.3	3.4	6.8	7.4	5.5	6.5	7.7	7.5	6.0	6.0	6.3	6.6	7.8	5.3	7.3
* VEGAS	5.2	7.1	5.1	6.6	5.7	7.2	5.8	2.7	4.6	1.8	6.9	6.5	6.0	6.9	7.5	6.9	6.1	6.1	6.6	7.3	7.7	5.8	6.7
* ELDORADO	5.4	6.7	4.9	6.6	5.7	7.2	6.0	2.6	4.7	3.5	6.7	6.7	5.0	6.5	7.1	7.5	5.5	6.2	6.5	7.5	7.6	5.6	7.3
* COCHISE	5.6	7.0	4.9	6.4	5.6	7.2	6.0	2.3	4.6	3.7	6.3	6.2	6.4	6.5	7.9	7.4	6.2	6.1	6.7	7.3	6.9	6.2	7.4
FA-22	5.2	7.6	5.3	6.1	5.9	7.3	5.7	2.2	4.7	2.2	6.5	6.9	6.2	6.3	6.7	7.2	4.8	6.3	6.1	7.5	7.7	5.1	7.1
* ALAMO (J-1048)	5.3	6.7	4.9	6.8	5.7	6.9	5.8	3.5	4.6	2.7	7.3	5.8	5.9	6.3	7.2	7.4	5.5	6.5	6.5	7.3	7.0	5.7	7.7
PSTF-401	5.3	6.3	5.4	6.7	5.7	7.0	5.6	3.1	4.4	3.6	7.1	5.8	6.2	6.7	6.8	7.3	5.3	6.4	6.5	7.2	7.4	5.7	6.9
* SAFARI	5.3	5.7	5.3	6.8	5.6	7.1	5.8	3.3	4.8	2.8	6.1	6.2	6.0	6.5	7.5	7.3	5.8	6.6	6.9	7.0	7.7	5.4	7.3
* LEPRECHAUN	5.5	7.5	5.3	6.5	5.6	7.1	5.9	2.5	4.4	3.0	7.2	6.7	6.0	6.4	7.2	7.4	5.3	6.3	6.8	7.5	7.6	5.2	7.1
* SR 8300	5.4	6.8	5.9	6.6	5.6	7.0	5.9	3.5	4.7	2.8	6.6	5.7	6.3	6.1	6.7	7.4	4.9	6.6	6.5	7.5	7.5	5.8	6.8
BAR FA 2AB	5.4	6.9	5.9	6.7	6.1	7.2	6.0	1.7	4.6	3.0	6.6	6.5	5.3	6.3	7.6	7.6	6.2	6.1	6.5	6.8	7.7	5.9	7.0
* OFI-ATK (ISI-ATK)	5.3	6.4	4.7	6.6	5.6	7.3	5.4	3.5	4.5	2.4	7.4	6.0	5.8	6.4	7.7	7.4	5.6	6.2	6.4	7.1	7.4	5.2	7.1
PRO-9178	5.4	7.1	4.7	6.6	5.7	7.3	5.9	2.8	4.5	2.7	6.6	7.2	6.0	6.3	7.7	7.0	5.5	6.2	6.5	7.3	7.8	5.5	7.1
* BONANZA II	5.4	6.0	5.9	6.6	5.6	7.1	5.9	2.9	4.8	3.1	7.4	5.4	6.0	6.2	7.3	7.0	5.2	6.3	6.8	7.1	7.6	5.7	7.4
ISI-CRC	5.3	6.3	5.2	6.6	5.3	7.0	5.7	3.3	4.5	2.6	7.7	6.1	5.4	6.5	7.1	7.0	5.5	6.4	6.7	7.2	7.6	5.5	7.0
* MIRAGE (KWS-DSL)	5.3	6.7	5.1	6.0	5.7	7.2	6.0	2.7	4.8	2.8	6.5	6.7	6.3	6.4	7.5	7.2	5.7	6.5	6.4	7.1	7.6	5.4	7.4
PSTF-200	5.5	5.7	5.7	6.4	5.5	7.1	5.6	3.9	4.9	2.7	7.5	6.1	5.8	6.3	6.5	7.7	5.0	6.2	6.6	7.3	7.3	5.1	7.1
M-2	5.4	6.5	5.1	6.6	5.4	7.2	5.8	3.7	4.8	2.2	6.6	6.9	6.6	6.1	6.7	7.0	5.5	6.2	6.9	7.2	7.6	5.5	6.8
* SHENANDOAH	5.5	5.9	4.9	6.6	5.6	6.7	5.6	2.9	4.5	3.7	6.8	6.4	6.2	6.3	6.9	7.0	5.2	6.6	7.0	7.3	7.5	5.3	7.1
403	5.3	6.1	5.5	6.3	5.8	7.0	5.6	2.6	4.7	3.1	7.3	6.4	5.8	6.5	7.7	7.3	5.9	6.4	6.5	7.2	7.6	5.4	7.3
CAFA101	5.4	5.7	5.1	6.4	5.9	6.9	5.8	3.2	4.4	2.9	6.7	5.7	5.9	6.0	7.1	7.2	5.1	6.7	6.6	7.2	7.0	5.4	7.1
PST-5STB	5.4	7.1	4.7	6.3	5.3	7.3	6.1	2.3	4.5	2.8	5.8	6.4	5.5	5.9	7.7	7.1	6.0	6.3	6.4	7.0	7.6	5.4	6.9
PSTF-LF	5.4	6.4	4.9	6.6	5.6	7.1	5.6	3.7	4.9	3.3	7.0	5.3	5.6	5.9	7.1	7.2	5.4	6.2	6.5	7.0	7.3	5.4	6.8
* AVANTI	5.3	6.0	5.3	6.6	5.9	7.1	6.0	2.5	4.9	2.0	6.2	6.3	6.5	6.4	7.1	7.4	5.5	6.0	6.5	7.0	7.6	5.3	7.1
* FINELAWN 88	5.3	6.5	5.1	6.5	5.4	7.1	5.8	2.8	4.5	3.2	6.8	5.9	5.8	6.3	7.0	7.0	5.4	6.3	6.6	7.4	7.4	5.7	7.3
* AUSTIN	5.3	6.1	5.5	6.9	5.4	7.1	5.5	3.1	4.6	2.6	6.9	5.3	5.7	6.3	7.0	6.8	5.3	6.5	6.5	7.4	7.3	5.4	6.9
* KITTYHAWK	5.7	6.6	5.1	6.6	5.9	7.2	5.7	2.9	4.4	2.5	6.5	6.3	6.0	6.5	7.0	7.3	5.3	5.9	6.5	7.4	7.4	5.4	7.2
CAS-MA21	5.4	6.3	5.6	6.6	5.4	6.9	5.9	2.7	4.5	2.3	7.3	5.9	6.3	6.4	7.5	7.1	5.4	6.3	6.7	7.1	7.6	5.3	6.9
* BONSAI	5.4	7.4	4.8	6.4	6.1	7.3	6.0	1.9	4.2	2.6	6.2	6.7	6.5	6.0	7.4	6.7	6.3	6.3	5.8	6.8	7.8	5.2	7.0
* MONARCH	5.3	6.2	6.1	6.6	5.6	7.0	5.8	2.9	4.4	2.5	6.5	6.2	6.4	5.9	7.3	7.3	5.0	6.2	6.4	7.2	7.6	5.3	7.3
* OLYMPIC II	5.3	5.5	5.2	6.8	5.3	6.9	5.6	3.4	4.4	3.3	6.1	6.1	6.2	6.2	6.5	7.0	4.9	6.3	6.8	7.0	7.0	4.9	7.1
CAS-LA20	5.4	6.6	5.7	6.3	5.4	7.0	5.9	2.7	4.4	3.0	6.7	6.2	5.3	6.0	7.7	7.0	5.3	6.1	6.4	7.1	7.7	5.3	6.9
* AZTEC	5.3	6.3	5.8	6.7	5.6	7.0	5.9	2.3	4.7	2.6	7.1	1.8	6.1	6.0	6.9	7.1	5.3	6.2	6.3	6.9	7.5	6.0	7.1
BAR FA 214	5.3	6.9	5.6	6.5	5.7	7.5	5.6	2.1	4.7	1.9	6.5	5.9	6.5	6.1	7.0	6.8	4.9	6.2	5.9	7.1	7.2	5.3	7.5
* ASTRO 2000	5.1	6.2	5.4	6.4	5.2	7.0	5.3	3.0	4.5	3.4	6.3	5.4	5.6	6.0	6.3	7.4	4.9	6.2	6.5	7.2	7.1	5.3	6.8
* PHOENIX	5.3	5.7	5.5	6.5	5.6	6.4	5.4	3.5	4.6	3.4	6.5	5.1	6.1	6.0	6.4	7.1	4.8	6.3	7.1	7.5	7.0	4.8	6.9
* BONANZA	5.5	5.5	4.8	6.4	5.4	6.2	5.7	3.2	4.5	2.9	6.4	5.2	6.0	6.0	7.1	6.9	5.2	6.3	6.4	6.9	7.2	5.2	7.5
* ARID	5.4	5.1	5.4	6.5	5.1	5.9	5.4	4.4	4.3	2.7	5.8	4.2	5.9	5.9	6.1	7.0	4.3	6.1	6.4	7.0	6.5	4.7	7.1
* TWILIGHT	5.4	7.3	4.3	6.0	5.0	7.0	5.8	2.1	5.0	2.5	5.7	6.4	4.8	6.3	7.7	6.2	6.7	5.9	6.3	7.0	7.5	5.9	6.1
* FALCON	5.4	5.0	5.0	6.3	5.2	6.0	4.9	4.1	4.3	2.9	6.1	4.2	5.5	5.9	5.9	6.8	4.3	6.3	6.2	7.0	5.8	4.2	6.7
* ANTHEM	5.3	4.7	5.2	6.3	5.0	5.8	5.1	3.9	4.2	2.9	5.7	3.9	6.3	5.7	5.2	6.8	4.1	5.9	6.4	7.2	6.6	4.2	5.7
* KY-31 NO ENDO.	5.3	3.8	3.9	6.1	4.8	4.5	4.2	3.2	4.1	2.0	4.7	2.7	3.8	5.0	4.8	6.1	3.6	5.7	5.5	6.8	5.2	3.3	7.0
* KY-31 W/ENDO.	5.1	3.4	4.2	6.2	4.6	4.3	4.2	2.9	3.9	2.3	4.7	2.8	4.0	4.9	4.5	6.1	3.7	5.5	5.2	6.1	5.1	3.1	6.0
LSD VALUE	0.2	0.8	1.5	0.5	0.5	0.4	0.3	1.0	0.4	1.9	1.2	1.0	1.0	0.5	0.8	0.5	0.6	0.7	0.6	0.5	0.5	0.9	0.9

* COMMERCIALLY AVAILABLE IN THE USA IN 1995.

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT ONE ENTRY'S MEAN FROM ANOTHER ENTRY'S MEAN. STATISTICAL DIFFERENCES OCCUR WHEN THIS VALUE IS LARGER THAN THE CORRESPONDING LSD VALUE (LSD 0.05).

MEAN TURFGRASS QUALITY RATINGS OF TALL FESCUE CULTIVARS
GROWN AT FORTY-FIVE LOCATIONS IN THE U.S. AND CANADA
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 1/

NAME	MS1	NE1	NE2	NE3	NJ1	NJ2	NV1	NY1	PA1	PA2	RI1	SD1	SK1	TX1	UB1	UB2	VA1	VA4	VA6	VA8	WA1	WI1	MEAN
JAGUAR 3 (ZPS-J3)	6.3	6.2	6.7	5.2	5.9	7.3	5.7	4.2	7.6	4.2	6.1	6.4	5.5	6.7	7.7	6.5	5.5	5.7	4.0	4.9	5.8	7.7	6.2
HOUNDOG V (ISI-AFE)	6.4	6.5	6.5	5.7	6.1	7.0	6.0	4.6	7.8	4.3	5.8	5.5	5.1	6.9	7.8	6.6	5.7	5.7	3.7	5.2	5.7	7.5	6.1
ISI-AFA	6.3	6.9	6.1	4.4	5.8	6.9	5.6	3.3	7.9	4.2	5.9	6.1	5.5	6.5	7.8	6.7	5.7	5.6	3.4	4.9	5.6	7.3	6.1
FALCON II (MB-21-92)	6.3	6.7	6.3	5.6	5.5	6.0	6.2	4.3	6.9	4.2	6.3	6.0	5.7	6.8	7.8	6.4	5.7	5.6	4.0	5.2	5.4	7.6	6.1
SOUTHERN CHOICE (MB-25-92)	6.2	6.7	6.9	5.4	5.5	5.8	6.3	4.3	7.6	4.4	5.9	5.7	5.3	6.7	7.5	6.8	5.5	5.2	3.7	4.7	5.9	7.5	6.1
GEN-91	6.0	6.2	5.9	5.8	5.4	6.3	6.1	3.8	7.1	4.5	5.6	5.8	5.4	6.6	7.4	7.1	5.6	5.3	3.8	5.3	5.9	7.4	6.1
CROSSFIRE II (PICK 90-12)	6.3	5.6	6.1	4.6	6.2	6.0	5.9	3.6	7.0	4.1	6.0	6.0	5.4	6.7	7.8	6.5	5.8	5.3	3.3	4.5	5.6	7.5	6.1
COYOTE (ZPS-ML)	6.1	6.0	6.2	5.3	5.5	6.2	4.6	4.2	7.1	3.9	6.1	6.5	5.6	6.7	7.5	6.6	5.4	5.7	3.3	4.8	5.8	7.9	6.1
PST-5DX W/ENDOPHYTE	6.3	6.0	6.2	5.1	5.3	6.1	6.0	3.4	7.6	4.4	5.8	6.1	5.3	7.1	7.4	6.4	5.6	5.6	4.3	4.5	5.8	7.3	6.0
ATF-007	6.3	6.3	6.2	5.1	4.5	6.7	6.2	4.3	7.3	3.9	5.7	5.9	5.0	6.8	7.6	6.9	5.5	5.0	3.2	4.2	6.0	7.7	6.0
FINELAWN PETITE	6.1	6.6	7.2	5.4	4.6	5.6	5.5	3.3	7.1	4.4	6.0	5.5	5.4	7.0	7.2	7.0	5.1	5.4	3.6	5.4	6.0	7.8	6.0
PIXIE	6.2	5.5	6.1	5.3	5.5	6.0	5.9	4.6	7.6	4.2	5.9	5.1	5.0	7.0	7.6	6.3	5.4	4.9	3.6	4.5	5.8	7.6	6.0
MB-22-92	6.2	6.8	5.7	5.9	4.5	5.0	5.5	4.6	7.8	4.2	5.8	6.4	5.3	7.1	7.1	6.4	5.2	5.0	3.6	4.7	5.8	7.3	6.0
LANCER	6.3	6.6	6.8	5.0	5.1	6.0	6.4	2.7	6.9	4.1	6.0	5.9	5.2	6.7	7.3	6.5	5.2	5.6	3.5	4.6	6.0	7.3	6.0
REBEL,JR.	6.2	5.9	6.1	5.8	4.9	6.0	5.2	3.9	7.1	4.4	5.9	5.9	5.3	6.7	7.2	6.3	5.2	4.9	3.8	5.2	5.7	7.6	6.0
CORONADO (PST-RDG)	6.3	6.0	6.1	4.9	5.7	6.0	6.0	2.7	6.2	4.1	5.7	6.0	5.4	6.4	6.8	6.3	5.6	5.6	3.7	4.8	5.5	7.8	6.0
LEXUS	6.1	6.7	6.2	5.6	5.2	6.3	5.0	3.2	6.9	3.8	5.7	5.0	5.2	6.7	7.4	6.7	5.2	4.9	3.0	4.5	5.6	8.1	5.9
EMPRESS (ZPS-E2)	6.3	6.3	6.1	5.0	5.1	6.3	5.6	2.9	6.7	3.8	5.8	5.7	5.1	7.0	7.0	6.1	5.3	5.8	3.7	4.4	5.9	7.3	5.9
MARKSMAN (MB-23-92)	6.3	6.5	5.9	5.0	5.2	5.2	5.6	5.1	7.8	4.2	6.0	5.3	5.2	7.2	7.2	6.5	5.2	4.9	3.6	4.2	5.8	7.8	5.9
APACHE II (PST-59D)	6.3	5.7	6.0	4.4	4.7	5.9	6.0	3.7	7.3	4.2	5.8	5.1	5.8	6.7	7.2	6.3	5.7	5.4	3.6	4.7	5.6	7.5	5.9
PICK 90-10	6.4	6.1	6.3	4.6	4.8	5.5	5.5	3.2	7.5	4.2	6.0	5.9	5.4	6.5	7.5	6.6	5.3	5.6	2.9	4.6	5.6	7.5	5.9
PST-5PM	6.3	5.5	6.1	4.4	5.1	6.2	5.5	4.1	7.4	4.2	5.7	5.4	5.4	7.2	7.3	6.3	5.6	5.6	3.5	5.0	5.4	7.3	5.9
TOMAHAWK	5.7	5.3	5.8	5.0	4.2	5.7	5.5	4.3	7.4	4.2	5.7	6.1	5.7	6.7	7.4	6.3	5.4	4.8	4.3	4.7	5.5	7.8	5.9
GRANDE (SR 8400)	6.3	6.5	6.1	4.6	4.7	5.6	5.6	3.9	7.6	4.3	6.0	5.5	5.8	6.9	6.7	6.2	5.1	4.6	3.6	5.3	5.6	7.2	5.9
DEBUTANTE (WXI-208-2)	6.2	6.4	6.0	4.9	5.1	5.0	5.6	4.0	6.9	4.0	5.9	6.0	5.2	6.7	6.9	6.3	5.1	5.3	4.0	5.1	5.6	7.3	5.9
MICRO DD	6.3	6.0	5.8	4.7	5.0	5.6	5.7	4.2	6.9	4.2	6.0	6.0	5.1	6.9	7.2	6.4	5.0	5.0	3.8	4.4	5.3	7.0	5.9
PYRAMID (SIU-1)	6.1	6.0	6.0	4.9	4.0	5.1	5.7	4.0	7.2	4.3	6.0	6.2	5.1	6.8	7.3	6.3	5.0	4.5	4.2	4.9	5.4	7.7	5.9
DUSTER (ITR-90-2)	6.2	6.0	6.5	4.9	4.5	5.8	5.5	4.3	7.1	4.3	5.8	5.9	5.5	6.6	7.2	6.5	5.8	5.4	3.5	4.9	5.8	7.5	5.9
SR 8210	6.3	6.4	6.3	5.2	4.4	5.4	6.2	4.9	6.9	4.3	6.0	5.8	5.6	7.0	7.0	6.4	5.4	4.7	3.4	4.7	5.9	7.6	5.9
GAZELLE (ZPS-VL)	6.2	6.1	6.1	6.6	4.7	5.4	4.5	4.1	7.1	4.0	5.5	5.9	5.0	6.3	6.9	5.9	5.7	5.4	3.8	4.9	6.0	8.0	5.9
STARLET (MB-24-92)	6.3	6.1	6.7	5.4	4.4	4.6	5.4	3.3	7.3	4.1	6.0	5.9	5.4	6.7	7.0	6.4	5.3	5.3	3.8	4.3	5.6	7.3	5.9
VIRTUE	6.2	6.0	5.1	5.6	5.1	5.6	5.8	3.8	7.2	4.3	5.7	5.1	5.3	7.0	6.8	6.3	5.3	4.9	3.8	5.1	5.7	7.6	5.9
TITAN 2 (SR 8010)	6.3	6.1	6.3	5.1	4.5	5.9	5.7	4.8	7.2	4.6	5.9	6.4	5.0	6.9	6.8	6.1	5.1	5.1	4.2	5.0	5.0	7.0	5.8
FA-19	5.9	5.9	6.0	5.7	4.5	5.4	6.2	3.5	7.6	4.3	5.3	5.5	4.9	6.8	7.3	6.4	5.2	4.6	3.5	4.6	6.0	7.3	5.8
SILVERADO	6.0	6.3	6.5	5.0	4.7	5.3	5.0	4.0	6.9	4.2	5.3	6.1	5.3	6.7	6.9	6.2	5.5	4.8	3.0	4.6	5.4	7.2	5.8
MONTAUK	6.1	5.9	5.8	5.7	4.3	5.0	6.6	4.3	7.6	4.2	5.7	5.3	5.4	6.6	7.1	6.0	5.2	5.2	3.7	4.5	5.7	7.2	5.8
PALISADES (OFI-TF-601)	6.3	5.8	5.9	5.0	4.6	5.3	5.7	4.4	7.4	4.3	6.0	5.6	5.7	6.6	7.1	6.2	5.4	5.1	3.5	4.8	5.6	7.3	5.8
PST-5LX	6.0	5.9	6.1	4.7	4.7	5.8	5.9	3.7	7.2	4.2	5.8	6.1	6.0	6.0	7.0	6.4	5.4	4.7	3.5	5.0	5.7	7.8	5.8
REBEL 3D	6.0	6.2	6.1	5.3	4.4	5.6	5.7	3.2	6.6	4.4	6.3	5.5	5.6	6.5	7.1	6.5	4.8	4.8	3.7	4.6	5.3	7.2	5.8
NINJA (ATF-006)	5.6	6.4	6.1	4.6	4.4	5.3	5.2	3.4	7.2	4.1	5.8	5.9	5.3	6.3	7.5	6.7	5.1	4.4	3.5	4.2	6.1	7.7	5.8
PST-5VC	6.0	6.4	5.5	5.3	4.3	6.0	5.5	4.1	7.3	4.2	5.8	5.8	4.9	6.2	7.5	6.8	5.7	5.2	4.2	4.4	5.5	7.4	5.8
DUKE	6.3	6.0	6.2	4.8	4.8	5.1	5.6	3.8	7.4	4.2	6.0	5.8	5.9	6.4	7.1	6.1	5.4	4.8	3.9	4.6	5.7	7.6	5.8
ADOBE (SFL)	6.4	6.0	6.0	4.8	5.1	5.4	5.6	3.1	7.0	4.0	5.9	5.7	5.2	6.7	6.9	6.3	5.1	5.7	3.7	5.3	5.5	7.3	5.8
GUARDIAN	6.2	6.2	6.2	5.5	4.4	5.5	5.7	3.3	7.1	4.3	5.6	5.3	5.2	6.5	6.7	5.8	5.2	4.9	3.8	5.0	5.4	7.3	5.8
CHIEFTAIN II (PICK CII)	5.9	5.9	6.3	4.4	4.8	5.2	5.1	4.4	6.6	4.3	6.0	5.5	4.9	6.9	7.2	6.3	5.0	5.3	3.7	4.7	5.4	7.2	5.8
BONSAI PLUS	6.3	5.9	6.3	4.8	4.3	5.3	5.7	2.9	6.9	4.1	5.7	5.0	5.0	6.9	6.5	6.1	4.9	4.9	4.0	5.3	5.7	7.3	5.8
SR 8200	6.3	5.9	5.8	4.5	4.9	5.1	5.2	4.0	6.8	4.3	5.9	5.7	5.4	6.7	6.8	6.1	5.4	4.8	3.1	5.2	5.5	7.2	5.8
BAR FA 0855	5.9	5.5	6.0	5.6	4.6	4.9	6.0	4.5	7.6	4.4	6.0	6.2	4.5	6.9	6.8	6.2	4.8	4.2	3.7	4.9	5.6	7.0	5.8
TRAILBLAZER II	6.0	6.1	5.8	5.1	4.6	5.3	5.9	3.5	6.6	4.1	5.6	5.6	5.0	6.9	7.3	5.7	5.0	5.0	4.2	5.1	5.4	7.7	5.8

MEAN TURFGRASS QUALITY RATINGS OF TALL FESCUE CULTIVARS
GROWN AT FORTY-FIVE LOCATIONS IN THE U.S. AND CANADA
1994 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF

NAME	MS1	NE1	NE2	NE3	NJ1	NJ2	NV1	NY1	PA1	PA2	RI1	SD1	SK1	TX1	UB1	UB2	VA1	VA4	VA6	VA8	WA1	WI1	MEAN
SHORTSTOP (PICK 90-06)	6.2	5.6	6.5	5.4	4.8	5.0	5.7	2.9	6.5	3.9	5.7	5.8	5.2	6.9	7.3	6.3	5.4	4.8	3.0	4.4	5.6	7.2	5.8
VEGAS	5.9	5.8	6.2	4.9	5.1	5.9	5.6	4.8	7.0	3.8	5.7	5.5	5.6	6.7	6.9	5.9	5.1	4.8	3.7	4.3	5.7	6.8	5.8
ELDORADO	6.0	6.3	6.0	3.8	4.6	5.5	5.8	4.2	6.2	4.3	5.4	6.1	5.2	7.0	6.8	6.4	4.8	4.8	3.8	4.8	5.6	7.5	5.8
COCHISE	6.1	5.7	5.5	4.6	5.0	4.8	5.6	3.6	6.7	4.4	5.7	5.2	5.2	7.1	6.6	6.3	5.0	5.0	4.0	4.1	5.4	7.5	5.8
FA-22	6.3	5.9	6.0	5.6	3.8	5.4	5.9	4.4	7.9	4.3	6.1	5.0	5.4	7.1	7.0	6.2	5.0	5.1	3.9	4.3	5.2	7.2	5.8
ALAMO (J-1048)	6.2	5.7	6.1	4.8	4.5	5.5	6.1	3.3	6.5	3.7	6.1	5.7	5.6	6.3	6.9	6.1	5.2	5.0	4.0	5.0	5.1	7.3	5.8
PSTF-401	6.2	5.9	5.4	4.9	4.3	5.3	5.9	4.4	6.5	4.4	5.8	4.9	5.4	6.9	6.7	6.0	5.1	4.5	4.1	5.3	5.6	7.3	5.8
SAFARI	6.3	5.3	5.8	5.5	4.6	5.6	6.3	3.9	6.3	4.3	5.7	5.9	4.5	6.8	6.8	6.0	5.0	5.2	3.6	4.7	5.7	7.1	5.8
LEPRECHAUN	6.2	6.3	5.7	5.0	4.6	5.3	4.7	3.3	7.2	4.2	5.9	6.1	5.4	6.6	7.0	6.3	4.9	4.9	3.0	4.1	5.4	7.2	5.8
SR 8300	6.1	6.2	6.0	5.1	4.0	4.8	5.9	3.2	7.3	4.2	5.9	5.9	5.1	7.1	6.9	6.0	5.3	5.0	3.7	4.6	5.6	7.2	5.8
BAR FA 2AB	6.1	5.7	6.2	5.5	4.4	4.9	5.6	3.5	7.1	4.2	5.7	5.4	4.5	7.0	7.0	6.6	5.0	4.5	3.7	4.3	5.7	7.5	5.8
OFI-ATK (ISI-ATK)	6.4	6.2	6.1	4.2	4.9	5.1	5.8	4.1	7.2	4.3	5.7	6.0	4.7	7.1	6.9	5.8	4.9	4.9	4.2	4.5	5.4	7.4	5.8
PRO-9178	6.3	5.7	6.0	4.5	4.4	5.1	5.8	4.3	6.7	4.1	5.8	5.6	5.1	6.8	7.0	6.4	5.1	4.5	3.6	4.1	5.3	7.3	5.7
BONANZA II	6.3	5.1	6.0	4.7	3.8	5.1	6.3	4.3	6.9	4.0	5.8	4.9	5.4	6.9	7.0	6.1	5.0	5.0	3.9	4.6	5.4	7.1	5.7
ISI-CRC	6.3	6.0	6.0	4.6	4.3	4.5	5.4	4.7	6.9	4.4	5.6	5.7	4.9	7.2	6.9	5.8	4.8	5.1	3.5	5.4	5.1	7.8	5.7
MIRAGE (KWS-DSL)	6.1	5.7	5.7	5.0	4.6	5.3	6.0	3.4	6.7	4.2	5.9	6.0	5.5	6.4	7.0	6.0	5.1	4.3	3.5	4.2	5.3	7.2	5.7
PSTF-200	6.2	5.5	5.5	4.6	4.7	5.1	6.4	5.6	6.9	4.4	6.2	5.2	4.5	6.8	6.7	5.9	4.8	4.8	4.2	4.1	5.5	7.0	5.7
M-2	6.2	5.8	5.2	4.5	4.4	5.3	5.9	4.6	6.6	4.3	6.0	5.3	4.8	6.6	6.7	6.0	5.0	5.0	4.2	5.0	5.5	6.8	5.7
SHENANDOAH	6.2	6.4	5.3	5.3	4.8	4.6	6.0	4.3	6.5	4.3	5.3	5.5	5.0	6.9	6.8	6.0	5.1	5.0	4.0	4.9	5.4	7.0	5.7
403	6.3	5.5	5.3	4.6	4.9	5.1	5.0	4.1	6.6	4.2	5.9	4.8	5.2	6.9	6.8	6.1	4.9	4.9	4.0	4.6	5.2	7.0	5.7
CAFA101	6.3	5.8	5.9	5.1	4.3	5.0	5.5	4.4	6.9	4.4	6.1	5.9	5.1	7.1	6.5	5.7	5.3	5.0	4.3	4.8	5.3	6.8	5.7
PST-5STB	5.6	6.2	6.3	4.9	4.1	4.6	6.0	4.5	6.4	4.3	5.4	5.8	5.3	6.7	6.7	5.9	5.1	4.7	3.5	4.9	5.6	7.8	5.7
PSTF-LF	6.2	5.4	5.5	4.8	3.9	4.9	5.8	4.7	6.4	4.2	5.8	5.2	5.0	7.1	6.8	5.4	5.0	4.8	4.0	5.3	5.4	6.9	5.7
AVANTI	6.2	5.3	5.5	5.2	4.2	4.9	5.3	3.5	7.4	4.2	6.0	5.8	5.0	6.2	6.7	6.1	5.0	4.5	3.8	4.5	5.6	7.1	5.7
FINELAWN 88	6.0	5.7	5.9	4.4	4.0	4.8	6.0	3.0	6.7	4.2	6.1	6.1	4.8	6.4	6.5	6.0	4.7	5.0	4.0	4.6	5.1	7.0	5.7
AUSTIN	6.2	5.9	5.7	4.4	4.3	5.2	6.2	4.8	6.5	4.2	5.7	5.3	5.1	6.9	6.3	5.7	4.9	4.9	4.2	4.4	5.5	6.9	5.7
KITTYHAWK	6.2	5.3	5.5	4.2	3.8	4.6	6.1	4.3	6.6	4.2	5.9	5.6	4.5	6.9	6.7	5.7	5.0	4.9	4.1	4.4	5.6	7.0	5.7
CAS-MA21	6.1	5.1	5.7	4.8	3.6	4.8	6.1	2.4	7.2	3.9	6.2	5.6	5.0	6.8	6.8	5.7	4.9	4.6	3.8	5.0	5.4	7.3	5.6
BONSAI	6.1	6.7	6.5	5.1	4.4	4.5	4.9	2.6	6.7	3.9	5.6	6.0	4.5	7.0	6.8	6.3	4.6	5.0	3.3	4.0	5.7	6.7	5.6
MONARCH	6.3	5.7	5.5	4.3	3.8	4.6	5.9	3.8	6.9	4.3	5.0	5.7	4.7	6.7	6.8	5.9	5.0	4.8	3.9	4.3	5.5	7.1	5.6
OLYMPIC II	6.2	5.9	5.1	4.6	3.4	4.1	5.8	5.1	6.5	4.6	5.9	6.0	4.8	7.0	6.5	5.3	4.6	4.8	4.9	5.3	5.4	7.0	5.6
CAS-LA20	6.1	5.7	6.3	4.7	4.2	4.6	5.2	2.8	7.3	4.1	5.5	5.4	4.9	6.4	6.3	6.1	4.7	4.4	3.7	4.5	5.4	7.2	5.6
AZTEC	5.8	5.3	5.7	4.1	4.4	5.1	5.6	3.8	7.1	4.2	6.2	5.8	5.2	6.5	7.2	6.3	5.1	4.4	3.6	4.9	5.5	7.1	5.6
BAR FA 214	6.2	6.1	5.6	4.7	3.9	5.1	5.2	4.1	6.6	4.2	5.5	5.4	5.4	7.1	6.8	5.8	5.2	4.1	3.2	4.4	5.2	6.8	5.6
ASTRO 2000	6.2	6.3	5.2	5.1	4.3	4.1	5.4	5.4	6.7	4.3	6.0	5.8	4.7	6.5	6.3	5.6	4.5	4.8	4.3	4.6	5.0	6.7	5.6
PHOENIX	6.2	5.6	5.2	4.5	4.5	4.6	4.9	4.8	6.6	4.4	5.9	5.6	4.4	7.2	6.3	5.3	4.8	5.1	4.2	4.4	5.2	6.7	5.5
BONANZA	6.1	5.4	5.8	4.7	3.5	4.5	6.1	4.6	6.7	4.2	5.4	5.2	5.3	6.8	6.3	5.9	4.8	4.5	4.3	4.3	5.3	6.8	5.5
ARID	6.0	5.6	6.0	5.0	3.1	3.7	5.3	4.1	6.1	4.4	5.8	6.1	4.6	7.0	6.0	5.0	4.7	4.3	4.2	4.7	5.2	6.5	5.3
TWILIGHT	5.3	5.5	5.5	3.9	3.3	3.6	5.9	2.8	4.4	4.1	5.9	5.0	4.5	6.7	6.2	5.6	3.8	4.3	3.4	4.3	4.7	7.6	5.3
FALCON	5.9	5.1	5.4	4.2	3.2	3.1	5.9	3.7	6.1	4.3	5.1	5.3	5.0	6.7	5.6	5.0	4.2	4.3	3.4	5.1	5.0	6.4	5.2
ANTHEM	5.5	5.7	5.3	4.6	2.7	2.9	5.7	4.2	5.5	4.4	5.6	4.8	4.1	6.7	5.3	4.6	4.2	4.3	4.3	4.4	4.8	7.0	5.1
KY-31 NO ENDO.	5.2	4.1	4.5	3.2	2.2	1.9	5.2	3.4	4.5	4.4	3.5	5.5	4.4	6.6	4.3	4.0	3.6	3.7	4.5	4.5	4.4	5.6	4.4
KY-31 W/ENDO.	5.3	3.7	4.3	3.3	2.3	2.0	4.4	4.4	4.3	4.4	3.6	5.2	4.0	6.5	4.3	4.0	3.6	3.7	4.4	4.2	4.3	5.5	4.3
LSD VALUE	0.3	1.1	1.0	1.1	0.8	0.8	1.1	1.4	1.0	0.4	0.6	0.8	0.5	0.6	0.5	0.5	0.4	0.8	1.2	1.0	0.5	0.6	0.1

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT ONE ENTRY'S MEAN FROM ANOTHER ENTRY'S MEAN. STATISTICAL DIFFERENCES OCCUR WHEN THIS VALUE IS LARGER THAN THE CORRESPONDING LSD VALUE (LSD 0.05).

LANDSCAPE MANAGEMENT RESEARCH CONFERENCE

WEDNESDAY, SEPTEMBER 13, 1995

OVERVIEW AND PERSPECTIVE OF LANDSCAPE IRRIGATION RESEARCH

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Up until the early 1980s, landscape irrigation managers had little information available to them on the water needs of landscape plant materials. Irrigation scheduling was based on field experience and observations. Certainly, when plants were over-irrigated, plant pests flourished and when under-irrigated, growth was limited and appearance suffered. Athletic fields were irrigated to maintain turf health while avoiding waterlogged, muddy conditions.

Several factors changed the way we perceive and practice landscape irrigation scheduling. The drought conditions which occurred in California in the mid 1970s, early 1980s, and from 1989 to 1993 had tremendous impact on the landscape industry. Increased population has also raised the demand for our finite water supplies. Probably the biggest factor is the cost of water. Water prices have increased to the $600 to $800 range per acre foot. Political and social pressures have also been applied to the landscape water issue.

The landscape industry, universities, irrigation companies, and state and local agencies have responded with many research, educational, and legislative programs aimed at landscape water conservation. Irrigation manufacturers have made tremendous advancements in sprinkler, drip, and controller technology. Universities are performing research on water needs of landscape plants and providing educational programs on irrigation scheduling. Unfortunately, adoption of the information by irrigation managers has been a slow process.

In 1982, the California Irrigation Management Information System (CIMIS) was established by the University of California at Davis through a grant from the California Department of Water Resources. The CIMIS project incorporated of a network of weather stations which gathered real-time evapotranspiration (ET_o) data to estimate the water needs of agricultural crops. The field research aspects of the project concentrated on refining crop water use estimates, implementing the water budget technique, and extending the program to growers with the emphasis on crop yield and quality.

About this same time, turfgrass researchers developed crop coefficients (Kc values) for turfgrasses, and the Department of Water Resources adopted CIMIS as its landscape water conservation program. Even though information was limited with regard to the water use of landscape species, the ET_o model fit well into the water conservation agenda. Computer programs which are able to generate droves of ET estimates and irrigation schedules have been developed to use this model. In addition, complex relationships between landscape species, microclimate, and plant density were added and landscape water “experts” subjectively complied lists of the water needs of the multitude of plant materials. One must wonder whether these efforts have advanced the industry beyond where we were 20 years ago, especially since this methodology is so complex and adoption by irrigation managers is dubious.

The key to the success of the ET-based model is good data on plant water needs. Researchers have several methods for determining the water needs of landscape plant materials. However, the estimates are confounded because landscapes consist of multiple species and the concept of yield does not apply. Further, the water needs are variable depending on the irrigation frequency, rooting depth, soil texture and amount of water available from rainfall, and if the plant materials are under water stress.

Often researchers will use several methods and correlate them to achieve the best, most accurate answer. The water budget method involves measuring applied water and changes in soil moisture content to estimate the water used by the plant material. This method is often used in experiments where the amount of applied water is varied in several replicated treatments. Plant performance and aesthetic appearance are then assessed for each treatment.

The use of lysimeters has also been popular, although expensive and time consuming. Large weighing lysimeters have been used for agricultural crops. The crop is planted in essentially a large pot (as big as 30 foot diameter) which is set on a large capacity scale and water use is determined by change in the pot’s weight. In turfgrass experiments, small lysimeters (mini-lysimeters) have been utilized. The turf is planted in small pots which are sunk into a surrounding turfgrass sward to emulate actual field conditions. The pots are then weighed manually to determine the water loss.

In both the lysimeter and water balance methods, the resulting water use estimates and planted area are then related to reference evapotranspiration (ET_o) data to determine Kc values. Other methods of measuring actual water loss above the plant canopy using vapor pressure and rapid temperature measurements are currently under study.

Water needs and actual water use of trees has been estimated with the water balance method and through the use of stomatal flow measuring devices (porometers) and stem flow gauges. However, the information gained is best related to canopy size and/or leaf area. This complicates the relationship between the tree size, shape, and ground shading and ET_o. Currently, these methods are being refined to achieve a more accurate estimate of water use.

Results of water use studies of landscape plant materials indicate that ET_o information can be used with good confidence in the scheduling of turfgrass irrigation. However, due to the water stress that other plants can endure and the variability of landscapes, the accuracy of ET information for other landscape irrigation is questionable. Studies have shown that when water is available, some “drought tolerant” trees will use it at high rates. Conversely, trees and shrubs exposed to extreme solar radiation and hot, dry conditions may shut down their metabolism and use little water.

While ET information is useful, these two examples show that irrigation managers need to be instructed on the limitations involved and how to apply and adjust the data to meet their needs and the needs of their clientele.

SUMMARY OF IRRIGATION MANAGEMENT STUDIES ON GROUNDCOVERS

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Previous field research with six species of groundcovers showed that four species, representing a range of plant forms and origins, maintained aesthetically acceptable performance when irrigated at 30% ET_o while two species apparently have irrigation requirements greater than 50% ET_o. (ET_o, or reference evapotranspiration, is an estimation of the combined value of a reference pasture grass water-use and soil evaporation. Daily ET_o values can be obtained from CIMIS -- California Irrigation Management and Information Service -- via modem). In that study irrigations of 1.5 in. were scheduled when percentages of cumulative ET_o totaled 1.5 in. Treatments were 50%, 40%, 30%, and 20% ET_o. Thus, each irrigation applied the same amount of water and the soil was rewetted to the same depth at each irrigation, but seasonal total amounts of water varied because the number of irrigation events per treatment varied.

These schedules provided water very infrequently, even in the wettest treatment, and tested the drought resistance capabilities of the species involved. The question remained whether or not groundcover performance under a low total amount of irrigation (30% ET_o) could be improved by small amounts of water applied frequently rather than large amounts of water applied infrequently. Frequent irrigation of small amounts of water result in more shallow penetration of water into the soil and thus may rewet only a portion of the root system. However, shallow frequent irrigation may reduce heat and drought stress on plant material.

The primary objective of recent studies was to determine, under deficit irrigation, if frequent, shallow irrigation or infrequent, deep irrigation resulted in differences in groundcover quality when the total water applied is equal. Six species of groundcover (*Baccharis pilularis* 'Twin Peaks'; *Drosanthemum hispidum, Vinca major, Osteospermum fruticosum*, *Potentilla tabernaemontanii*, and *Hedera helix* 'Needle point') were grown in 12 ft x 15 ft plots. Plots were treated with four irrigation schedules: three times per week, once per week, once every two weeks, and once every four weeks. The amount of water applied at each treatment was 30% of CIMIS ET_o accumulated since the previous irrigation, minus any precipitation. Groundcover performance and density was measured monthly by a three-member panel using a 1 to 9 rating scale (9 being optimum). Soil moisture was measured monthly to five depths (9, 18, 24, 36, and 48 inches) using a neutron probe. Gypsum blocks located in selected plots at 12 and 24 inches enabled daily monitoring of soil moisture. Gravimetric soil sampling also provided moisture data on a periodic basis. Two years of data were collected, terminating in October 1994.

Results:

Potentilla tabernaemontani could not be sustained under any of the treatments. For the other species there were no season-long differences in a species' performance or density due to irrigation frequency, but there were significant differences among species across irrigation treatments. *Drosanthemum* and *Osteospermum* provided good overall appearance and density consistently through the season. *Baccharis* maintained acceptable performance most of the irrigation season, while *Vinca* and *Hedera* became unacceptable in appearance in mid-season. Density of groundcovers was slightly better in the once per week and once every two week treatments. Soil moisture content differed among species, but was not consistently different between irrigation treatments.

Conclusion:

Under deficit irrigation, irrigation frequency has no effect on the performance of many groundcovers. Intermediate irrigation frequency (once every 7 to 14 days) may enable groundcovers to maintain better density when they are deficit irrigated.

EFFECTS OF TURF AND MULCH SURFACES ON TREE WATER LOSS

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Shade trees are commonly planted in a variety of non-vegetated urban surfaces. Such surfaces are typically hotter than a vegetated surface. Conventional thinking is that heating from pavement increases tree water loss. How different non-vegetated surfaces, such as asphalt, concrete, and mulches affect quantitative tree water loss is not known. The objective of this study was to quantify heating from different non-vegetated urban surfaces and the resulting effect on tree water loss.

Initially we measured energy-balance properties, soil (T_o), top surface (T_s), and air temperature (T_a), of shredded-bark, lava-rock, and gravel mulch, concrete, asphalt, and turf surfaces. Different properties affected the energy balance of each surface. Turf transpiration moderated T_o and T_s compared to the non-turf surfaces. Mulch had higher T_s and consequently lower T_o than the other surfaces due to low thermal conductivity. Mulch T_s was up to 23C (73F) higher than turf and 10C (50F) higher than asphalt. Lava rock and shredded bark had higher T_s than gravel due to lower reflectance of solar radiation. Higher thermal conductivity of the asphalt and concrete resulted in higher T_o than other surfaces and T_s generally lower than the mulch surfaces. Differences in T_a among all the surfaces were minimal likely due to close proximity to one another that allowed substantial air mixing between surfaces. Higher T_s of mulches, asphalt, and concrete would result in increased long-wave radiation away from these surfaces.

We investigated how increased radiation from bark-mulch, and asphalt surfaces affected water loss of 2 m high (about 6 ft), container-grown Norway maple and crabapple. In each surface stomatal conductance, leaf temperature (T_l), and photosynthesis were measured dawn-to-dusk. Increased long-wave radiation flux due to higher T_s raised midday T_l of trees in the mulch and asphalt 3 to 8C (37 to 46F) higher than trees in the turf. Differences in tree T_l between the asphalt and mulch were minimal. Stomatal conductance declined with increasing leaf-to-air vapor pressure gradient in all trees, and was consistently lower for trees in the mulch and asphalt through the day due to larger gradients induced by higher T_l. Midday photosynthesis was highest for trees in the turf and lowest for those in the mulch. Foliar interception of higher energy fluxes from mulch and asphalt surfaces apparently limited gas exchange in both species due to over-optimal leaf temperatures as compared to trees in the turf.

ROOTING CHARACTERISTICS OF *QUERCUS ILEX* ASSOCIATED WITH MINIMUM IRRIGATION

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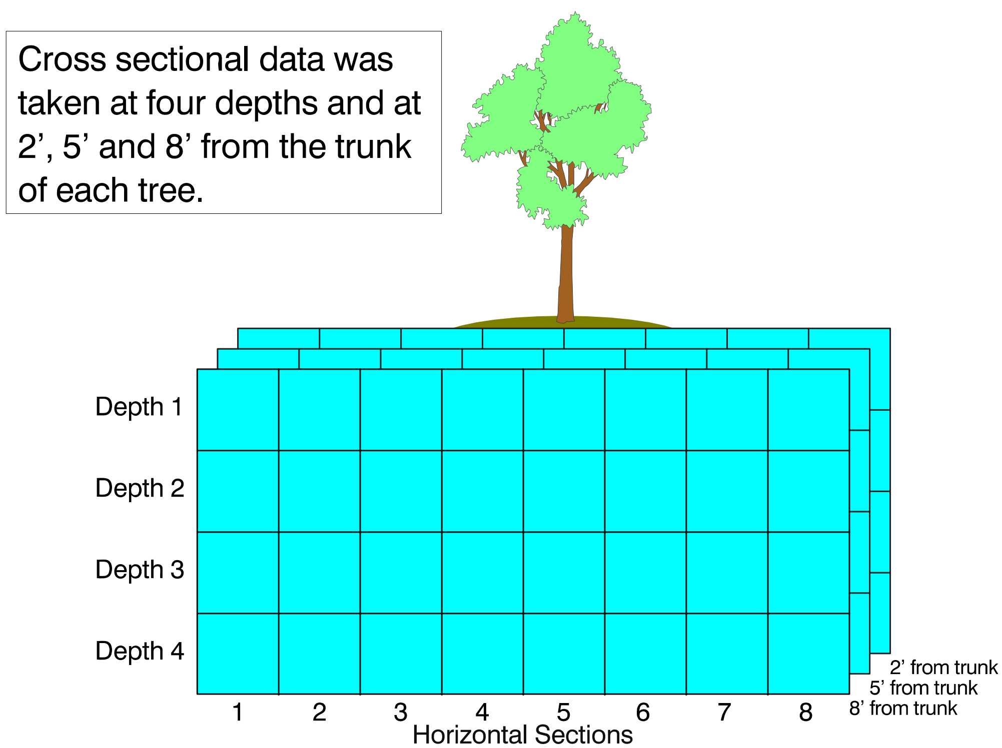
Four species of common landscape trees were transplanted from 15-gallon containers in 1987 into a field at South Coast Research and Extension Center in Irvine, CA. Trees were established on 100% reference evapotranspiration (ET_o), and henceforth received one of four irrigation treatments: 20, 40, 60, or 80% ET_o. In 1993 root systems of *Quercus ilex* (holly oak) trees from the study were investigated to determine the association between rooting characteristics and irrigation treatments. This was of interest since there were no significant differences among irrigation treatments and tree diameter at 6-inches above soil level during the previous 5 years of the study. Soil was trenched to a depth of four feet at three distances from tree trunks to facilitate root counts of three root diameter sizes (< 1 mm, 1-5 mm, and > 5 mm), measured over 32 one-foot-square areas per trench:



The most interesting finding of this study was that trees receiving the most water (80% ET_o) over a five-year period produced more small-diameter roots (< 1 mm) in shallow soil than in deeper soil. A significant interaction between irrigation treatment and soil depth was found for roots < 1 mm. At 1 foot depth, trees irrigated with 80% ET_o had the largest number of roots followed by 60%, 40%, and 20% ET_o irrigation treatments. At a depth of 4 feet, this relationship was reversed where the 20% ET_o treatment had the most fine roots and the 80% ET_o irrigation the least.

Quercus ilex is one of many species of suitable landscape trees for Southern California, and results of this study do not necessarily relate to the performance of other species. Because there are few similar studies reported in the literature, there is tremendous opportunity and need for further research in this area.

URBAN FORESTS: ENEMY, AMENITY, COMMODITY?

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How do you view the urban forest? Trees cost money, their roots destroy sidewalks and obstruct sewers, their leaves and trimmings clog our landfills, there are even killer trees. Why do we put up with trees in our cities? Many of us do because we like them, they make our cities more attractive, provide contact with nature, and reduce the stressfulness of everyday life . . . how could we get along without them?

Scientists at the Western Center think of the urban forest as a commodity. A commodity is a product of the land, an article of commerce with a value determined by market forces. What is the value of an urban forest, what goods and services does it produce, and do the benefits provided outweigh the costs? In times of shrinking public budgets accompanied by increased demand for services, a "bottom-line" oriented approach may be the key to the maintenance and survival of our urban forest resource.

At the Western Center, research, development and education focusing on the urban forest are underway. This presentation will cover recent and current work to quantify some of the many effects that urban tree canopies have on their environment. This includes effects on building space conditioning energy use found in Chicago, and currently being done in Sacramento. Work begun in Chicago to evaluate the impact of the urban forest on air quality is being extended and expanded to California cities. Information is also being gathered nationwide to provide better cost estimates for sidewalk and sewer repair, and other costs. Discussion of techniques used to obtain information on urban forest structure necessary for these analyses, based on aerial photo and ground surveys, will be included.

Results of these efforts are being incorporated into an economic model, Cost-Benefit Analysis for Trees (C-BAT) developed by Western Center Project Leader Greg McPherson to find the net benefits and costs over time as trees grow and mature. Results of this analysis for some recent studies will illustrate this approach. In summary, a strategy is being developed and implemented to evaluate the role of vegetation in the urban environment using an integrated approach that accounts for a wide range of costs and benefits. Work continues to widen the scope of C-BAT and associated models, improve estimates of the various costs and benefits, extend analyses to several cities in California, and transfer findings and new management tools to appropriate professionals and organizations.

MANAGING TREE INSECT PESTS THROUGH IRRIGATION AND EUCALYPTUS SNOUT BEETLE UPDATE

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Managing Tree Insect Pests Through Irrigation

Eucalyptus are ubiquitous trees in urban and rural landscapes of California where they serve a vital role as shade, wind row and ornamental trees. A severe pest of these Australian trees, the eucalyptus longhorned borer (*Phoracantha semipunctata* F.), was first identified in California in 1984. *P. semipunctata* is also native to Australia, and one of a suite of borer species whose larvae feed under the bark of eucalyptus. In Australia, this large beetle is uncommon and of only minor economic significance, its hosts being limited to downed or unhealthy trees. However, in nearly every region in the world where *Eucalyptus* has been introduced (e.g., Israel, Spain, Portugal, Italy, Tunisia, Egypt, and South Africa), the beetle kills apparently vigorous trees with serious economic consequences. *P. semipunctata* rapidly established and spread in California, and is killing trees by the thousands.

Eucalyptus species show great variability in their susceptibilities to attack by *P. semipunctata*. Low resistance to the borer is primarily due to eucalyptus trees being planted in environments to which they are poorly adapted. Those species that can maintain bark turgidity under drought conditions are better able to resist attack by *P. semipunctata;* turgid bark acts as a physical barrier, preventing larvae from penetrating to the cambium. In California, *Eucalyptus* species that are especially vulnerable to borer attack appear to be those that are intolerant of drought in Australia. However, even trees of resistant species may be rendered vulnerable to attack by poor soil quality or water deficit. Subtle slope and irrigation effects that determine soil moisture patterns also have an impact on the survivorship of eucalyptus trees.

Eucalyptus Snout Beetle Update

In March 1994, a new and serious pest of eucalyptus trees was discovered in Ventura County, California: the eucalyptus snout beetle (ESB), *Gonipterus scutellatus* Gyll. This defoliating weevil has a long history as a pest of eucalyptus in other regions where it has been accidentally introduced. Both ESB adults and larvae feed on the leaves, buds, and shoots, and this damage retards growth, causes malformations of the branches, and eventually kills branches and entire trees.

Fortunately, there is a very selective and effective biological control agent for ESB. The egg parasitoid, *Anaphes nitens* Siscaro, has been introduced in nearly every country where the weevil has appeared. There, this minute parasitoid (< 1mm in length) has brought weevil populations under control so rapidly and effectively that damage was reduced to insignificant levels within a few year's time. We imported this parasitoid and began releasing it in Ventura County in fall 1994.

Survey of the distribution of ESB has revealed that the weevil is already widely distributed throughout Ventura County. In many of the citrus growing areas, weevil populations have reached high densities and have inflicted severe defoliation. Parasitoids successfully overwintered at their release site and were parasitizing nearly 100% of the weevil eggs by spring 1995. As a result of this high parasitism rate, weevil larvae virtually disappeared during the summer. Parasites have already spread to neighboring eucalyptus windrows. It appears that *A. nitens* will quickly bring the spreading weevil population under control, nipping the ESB threat in the bud.

USE OF MULCHES TO IMPROVE GROWTH OF CITRUS AND AVOCADO

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(Abstract not available).

NOTES

STUDIES ON NUTRITIONAL NEEDS OF PALMS

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Palms require large amounts of nitrogen, potassium, and magnesium, and appear especially sensitive to some micronutrient deficiencies. Micronutrient deficiencies usually occur as a result of insufficient nutrients in the soil. Nitrogen deficiency appears as a general yellowing of all leaves. Potassium and magnesium deficiency appear on the older leaves. Potassium deficiency shows as translucent orange or yellow flecking or speckling, while magnesium deficiency appears as a distinct orangish band around the outside of a leaf. Micronutrient deficiencies are on the newest leaves and are usually the result of environmental factors such as damaged roots or improper soil pH that affect the palm's ability to extract the nutrient from the soil. Iron deficiency shows as chlorosis while that of manganese appears as chlorosis, stunting, and even frizzling. Deficiencies are more easily prevented than corrected by proper fertilization, good soil aeration, proper planting depth, root disease prevention, and proper soil pH. Palms respond best to a fertilizer with the N-P-K ratio of 3-1-3 or 3-1-2, all in slow-release form, and with magnesium and micronutrients.