UNIVERSITY OF CALIFORNIA, RIVERSIDE TURFGRASS RESEARCH PROGRAM

Better Turf Thru Agronomics

UCRTRAC Newsletter, April 2002

NTEP Published UCRTRAC's Final Results in National On-Site Test of Overseed Grasses for Bermudagrass Fairways

Jointly sponsored, on-site turf performance evaluations have become a new strategy to address end-user needs.

The National Turfgrass Evaluation Program (NTEP) recently published UCRTRAC's final results from a two-year study to test the on-site performance of 42 overseed grasses for bermudagrass fairways in Southern California. Table 1 on page 3 presents a summary of key results.

The UCRTRAC study at Mountain Vista Golf Course in Palm Desert, overseen by **Robert Green**, UCR Turfgrass Research Agronomist, was one of 10 NTEP projects nationwide on in-use bermudagrass fairways in the southern tier of the U.S. where overseeding is a common practice.

"Millions of pounds of seed are bought and sown each autumn on golf courses in this region. Golf course owners, managers, and superintendents seek grasses that establish quickly, exhibit exceptional playability, are aesthetically pleasing and require less inputs," NTEP wrote in its final report. **Nancy Dickens**, UCRTRAC delegate, is the Superintendent at Mountain Vista Golf Course.

Information from this project is valuable to the golfing industry because it determined the adaptation of 42 grasses for golf course use. Grasses that have superior drought, cold, heat, disease, and insect resistance must be identified. The NTEP website (**www.ntep.org**) and NTEP Reports No. 00-13 and 01-20 provide results for 1999-2000 and 2000-2001, respectively, from the 10 trial sites nationwide. Table 1 on page 3 gives a summary of two-season average visual quality ratings for California, Arizona, and nationwide.

UCRTRAC's Green and other research cooperators collected and analyzed data on the following parameters:

- **Establishment Rate** (4-6 wk after seeding)
- **Turfgrass Quality** (monthly in winter; 2-4x/mo during spring and fall transition)
- **Genetic Color** (2x: late fall/early winter and spring)
- **Rate (Speed) of Transition** -- from bermudagrass to the overseeded grass in the fall and back again to bermudagrass in spring (2-4x/mo in spring and fall)
- Environmental Stress, Disease/Insect Damage, etc.

Trials received real-world golf course conditions and stresses, NTEP said. They were maintained by each golf course superintendent, in consultation with the research cooperator, using management procedures common to that golf course and the geographical region.

Please see **FAIRWAY OVERSEEDING**, *page 2*

The Overseed Year

Because overseeded grasses are cool-season grasses that provide a temporary playing surface mainly in the fall and winter and are reseeded every year, the 42 cultivars tested in the two-year study (Table 1) were seeded twice from the same seed lot. Evaluation guidelines divided the year as follows:

Early Establishment Period
Begins 4-6 wk after seeding the overseed grass. Percent establishment is measured.

Fall Transition Period
Begins when bermuda starts to go dormant and ends when bermuda is fully dormant. Turf transitions from a dominant bermuda stand to a dominant overseed grass stand.

Winter Period
Begins when bermuda is fully dormant and ends before bermuda breaks dormancy in spring.

Spring/Summer Transition Period
Begins when bermuda starts spring growth and ends when overseed grass is gone. Turf transitions from a dominant overseed grass stand to a dominant bermudagrass stand.

NTEP says the challenge facing superintendents who overseed is having a smooth fall transition from the bermuda entering dormancy and the overseed grass 'taking over', then having bermuda become dominant again in late spring and summer.

"Proper management, including choosing the best overseed grass, is very important; however, a review of the published scientific literature indicates that the weather probably has the greatest impact on spring transition," Green said.

Please see Table 1.

UCRTRAC Developed BMPs for Tall Fescue Irrigation and Nitrogen Fertilization

UCRTRAC delegates **Robert Green**, UCR Turfgrass Research Agronomist, and **Vic Gibeault**, UCR Cooperative Extension Environmental Horticulturist, have developed best management practices (BMPs) for irrigation and nitrogen (N) fertilization of tall fescue, currently the most widely-planted turfgrass species in California.

Their findings will facilitate landscape water conservation and N fertilizer use efficiency. A final report for the three-year project was issued in December 2001.

BMPs for Tall Fescue Irrigation and N Fertilization

1. Provide adequate irrigation for the maintenance of growth activity (shoot growth and N uptake) and visual appearance. This is the first priority in the maintenance of tall fescue.

1.1. Match the area of tall fescue maintianed to the area the water budget can support for all 12 months of the year.

1.2 As often as possible, adjust irrigation amount to actual tall fescue water needs.

1.3 Maintain the most efficient irrigation system as possible.

1.4 Practice water banking.

1.5 Promote good growth activity, especially N uptake, for a good defense against NO_3-N leaching below the root zone. NO_3-N leaching is a contributing factor to groundwater contamination.

1.6 Comments 1.1 to 1.4 are important practices leading to water conservation.

2. Provide adequate N for the maintenance of growth activity (shoot growth and N uptake) and visual appearance.

2.1. Nitrogen has a dramatic effect on growth activity (shoot growth and N uptake) and visual appearance, especially when adequate water is provided.

2.2 Growth activity is helpful during times of plant stress and recovery. However, this growth activity should not be minimal nor excessive.

2.3 Use larger amounts of slow-release N fertilizers to improve visual appearance and growth activity of tall fescue subjected to drought stress.

2.4 In California, it is optimal to fertilize in the fall, followed by the spring, and then in the summer. Fetilization during the winter is not recommended. These comments are based on the air and soil temperatures required to support growth activity. As the season becomes less desirable for N fertilization, use smaller amounts of N and/or use N fertilizers with a higher percentage of slow-release N.

The Fertilizer Research and Education Program (FREP) of the California Department of Food and Agriculture (CDFA) supported UCR's research. FREP's goals are to improve crop-water management and fertilizer-use efficiency, minimizing N losses to the environment. Funding for FREP is generated from a mill tax on the sale of commercial fertilizers in California, which generates close to $1 million annually for project funding and program activities.

Please see **TALL FESCUE BMPs**, *page 4*

FAIRWAY OVERSEEDING

continued from page 1

Superintendents have long asked for information that bridged the gap between small-plot university trials and their end-use needs, Green said. Although on-site cultivar testing is not a new concept, joint sponsorship of on-site tests on fairways is new. The two-year study was sponsored jointly by NTEP, the Golf Course Superintendents Association of America (GCSAA) and the U.S. Golf Association (USGA) Green Section, the first coordinated effort to evaluate turfgrass varieties, blends, and mixtures under actual golf course conditions in the United States.

During the fall transition, winter period, and spring/summer transition, percent bermuda and overseed cover, overall plot quality, and color (genetic color) were measured. At the 10 trial sites nationwide, there were 3 replicate plots of each of the 42 overseed treatments. Each plot was 5.0 ft x 20.0 ft. See Table 1, the NTEP website, and Reports No. 00-13 and 01-20.

Information gleaned from the two years of on-site testing nationwide will be valuable to plant breeders, researchers, extension educators, USGA agronomists, golf course architects, and superintendents who need to select the best adapted turfgrasses for overseeding bermudagrass fairways for a particular regional climate, Green said.

Overseed trials on bermudagrass fairways were located on "active play sites where golfers hit fairway golf shots and/or drive golf carts" at golf courses near land grant universities with an active turfgrass research program or in metropolitan areas readily accessible to a university turfgrass scientist.

Please see **FAIRWAY OVERSEEDING**, *page 5*

Table 1. Average Visual Turfgrass Quality Ratings on an Overseeded Bermudagrass Fairway, 1999-2001

Overseed Treatment	Species[y]	Turfgrass Quality[z] 2-Season Average			Company Sponsor
		Palm Desert Calif.[x]	Tucson/ Green Valley Ariz.[w]	National (Ten Locations)[v]	
Paragon	PR	7.4	6.4	5.9	Turf Merchants, Inc.
Barlennium	PR	7.4	5.6	6.0	Barenbrug USA
Marvelgreen Supreme	PRb	7.4	5.7	5.9	Budd Seed
Tourstar	PRb	7.3	6.4	6.1	Budd Seed
Seville II	PR	7.3	6.2	5.9	ProSeeds Marketing
Elfkin	PR	7.3	6.2	5.9	Jenks Seed Connection
Brightstar II	PR	7.3	6.3	5.9	Turf-Seed, Inc.
Charger II	PR	7.2	5.8	6.0	Turf-Seed, Inc.
First Cut	PR/*Pt*	7.2	5.5	5.9	Turf Merchants, Inc.
Leaderboard	PRb	7.2	6.2	6.0	Independent Seeds
Pirouette	PR	7.2	6.0	5.8	Barenbrug USA
Phantom	PR	7.2	5.3	5.8	ProSeeds Marketing
Fiesta 3	PR	7.1	6.0	6.0	Pickseed West, Inc.
Mt. View Blend 2	PRb	7.1	6.4	6.0	Mountain View Seed Co.
Professional's Select	PRb	7.1	5.8	6.0	Pennington Seed, Inc.
MED-007	PRb	7.1	5.8	5.9	Simplot Turf & Hort.
Cebeco Blend 1	PRb	7.1	5.9	5.9	Cebeco Int'l. Seeds
Charger	PR	7.1	5.8	5.8	Standard Entry
Mt. View Blend 1	PRb	7.1	5.7	5.8	Mountain View Seed Co.
LS-DE1	PRb	7.1	5.9	5.7	LESCO, Inc.
Citation III	PR	7.1	6.0	5.7	Turf-Seed, Inc.
Mt. View Blend 3	PRb	7.1	5.7	5.8	Mountain View Seed Co.
Prime	PRb	7.1	6.3	5.7	Jenks Seed Connection
Essence	PR	7.0	6.0	5.9	Cebeco Int'l. Seeds
Marvelgreen + Laser	PRb/*Pt*	6.9	5.2	5.8	Budd Seed
Allsport	PR	6.9	6.1	5.8	LESCO, Inc.
Top Hat	PR	6.9	6.0	5.8	Standard Entry
Brightstar II + Winterplay	PR/*Pt*	6.9	5.1	5.7	Turf-Seed, Inc.
MP58	PR	6.9	5.7	5.6	Jenks Seed Connection
PST-3BK-99 (Quick Trans.)	PR	6.9	5.6	5.5	Pure-Seed Testing, Inc.
MP111	PR	6.8	5.5	5.5	Cascade Int'l. Seed Co.
Citation III + Winterstar	PR/*Pt*	6.8	5.6	5.8	Turf-Seed, Inc.
Futura 2500	PRb/IR	6.7	5.1	5.6	Pickseed West, Inc.
Capri	PR	6.7	5.0	5.5	DLF Trifolium
Pick HR A-97	IR	6.3	5.2	5.5	Pickseed West, Inc.
Transist	IR	6.0	5.0	5.4	Pickseed West, Inc.
Proam	*Pt*	5.4	3.5	5.3	LESCO, Inc.
Snowbird	*Pt*	5.3	3.5	5.3	ProSeeds Marketing
Sabre	*Pt*	5.3	3.5	5.2	Standard Entry
Bariviera	*Pt*	5.1	3.6	5.1	Barenbrug USA
Winterplay	*Pt*	5.0	3.3	5.1	Standard Entry
ABT-99-3.268 (Axcella)	AR	4.3	5.3	5.0	Cebeco Int'l. Seeds
Mean		6.7	5.5	5.7	

[z]Scale is 1-9 with 1=worst and 9=best quality. [y]PR=perennial ryegrass, PRb=perennial ryegrass blend, IR=intermediate ryegrass, AR=annual ryegrass, Pt = Poa trivialis. [x]Study was seeded 1 Oct 1999 and 6 Oct 2000 at Mountain Vista Golf Course. [w]The Arizona study was conducted at the Tucson Country Club in 1999-2000 and at the Green Valley Country Club in Green Valley, AZ in 2000-2001. [v]All 10 research sites nationwide, including California and Arizona. Note: In CA and AZ, the PR, PRb, IR, and AR were seeded at 600 lb/acre, other locations nationwide at 300, or 450, or 600 lb/acre. In CA and AZ, ryegrass/Pt mixtures were seeded at 400 lb/acre, other locations nationwide at 250 or 400 lb/acre. Pt was seeded in CA at 200 lb/acre, in AZ at 100 lb/acre, and other locations nationwide at 100 or 200 lb/acre.

Final Results from Annual Bluegrass Putting Green Management Study: Apply Fertilizers in Ratio of 3:1:2-3

Final results from the first GCSAA Chapter Cooperative Research Program in California on management of annual bluegrass putting greens have affirmed that fertilizer applications of nitrogen (N) phosphorus (P), and potassium (K) in a ratio of 3 N:1 P_20_5:2-3 K_20 provide good annual bluegrass performance. N was applied at a rate of 6.0 lb N/1000 ft^2/yr.

Robert Green, UCR Turfgrass Research Agronomist, issued his final report in December 2001. The three-year study was conducted on an in-use annual bluegrass practice putting green constructed to USGA specifications on a modified sand root zone at Industry Hills Golf Courses, City of Industry. **Bert Spivey**, Superintendent, is a UCRTRAC delegate.

Most golf course superintendents in California are managing annual bluegrass (*Poa annua*) as their putting green turfgrass, Green said. At Industry Hills, the putting green was approximately 80% annual bluegrass and 20% creeping bentgrass. The region's relatively mild Mediterranean climate results in newly established creeping bentgrass putting greeens converting to annual bluegrass putting greens in about 5 to 7 years, Green said.

An exception to this rule-of-thumb occurs in the more inland, hotter locations, such as Palm Springs, where bermudagrass and, less frequently, creeping bentgrass putting greens are maintained, Green said.

Eight liquid fertility treatments, applied once/3 wk, were tested at Industry Hills: high and low levels of N and K_2O and +/- iron (Fe). Preliminary results were reported in the April 2001 issue of ***Better Turf Thru Agronomics***. Final results are reported here.

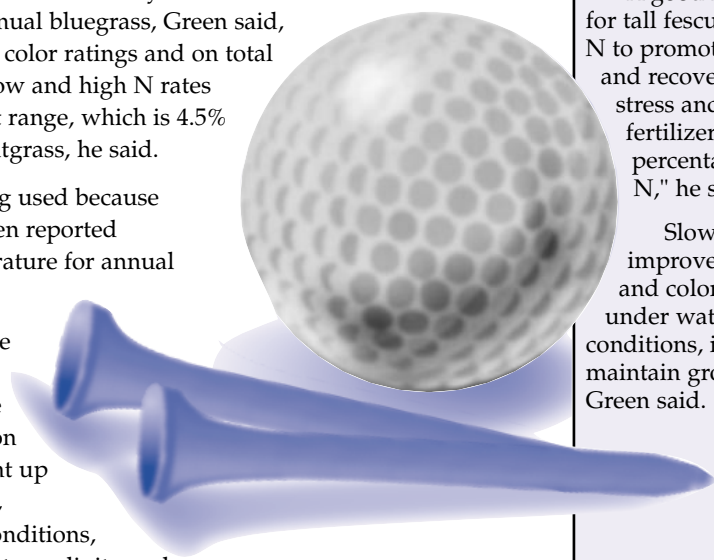
Nitrogen (N). The high and low N fertilizer applications were 10.0 and 5.0 lb N/1000 ft^2/yr, respectively, as reported in ***Better Turf Thru Agronomics*** (April 2001), but additional tests on the effluent irrigation water determined that it contributed about 1.0 lb N/1000 ft^2/yr, not 1.5 lb N as reported previously. Thus, N fertility treatments -- the sum of N supplied by the effluent irrigation water added to the applied rates -- were a total of 11.0 and 6.0 lb N/1000 ft^2/yr.

The lower N fertilization rate of 6.0 lb may be close to the optimal N fertilizer rate for annual bluegrass, Green said, based on turfgrass quality and color ratings and on total N content of clippings. Both low and high N rates had clippings within the target range, which is 4.5% to 6.0% total N in creeping bentgrass, he said.

"Creeping bentgrass is being used because sufficiency ranges have not been reported previously in the scientific literature for annual bluegrass," Green said.

In this study, the high N rate had negative consequences for turf performance, he said. The 6.0 lb N/1000 ft^2/yr fertilization rate may need some adjustment up or down for other golf courses, depending on putting green conditions, such as soil type, infiltration rates, salinity and leaching requirements, amount of rainfall,

Please see **PUTTING GREEN MANAGEMENT**, *page 5*



TALL FESCUE BMPs

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"A good plan for a tall fescue irrigation water budget includes not planting 100% of the landscape area in tall fescue, maintaining the best possible irrigation system, and irrigation water banking," Green said.

The efficacy of seasonal carryover -- **"water banking"** -- was assessed by allocating water on an annualized basis but irrigating with seasonal adjustments that accounted for reduced physiological demand in the winter and increased demand in the summer.

Tall fescue was irrigated at a defined annual amount -- 80% historical ET_o + rain -- but actual irrigation water applied fluctuated throughout the year. Irrigation increased during the warm season to improve grass performance (usage exceeds the annual average) and a reduced irrigation amount, adjusted proportionally downward during the cool season, made up for the additional usage in the warm season.

Water banking is part of the BMPs, Green said. It proved efficacious, better than the two constant rates tested: 80% historical ET_o + rain and 80% real-time ET_o + rain.

"There were no significant irrigation x N treatment interactions," Green said.

"A good N fertility program for tall fescue includes enough N to promote growth to endure and recover from drought stress and the use of fertilizers with a higher percentage of slow-release N," he said.

Slow-release N fertilizer improved visual turf quality and color, indicating that under water-limiting conditions, it may help to maintain growth activity, Green said.

(***Editor's note***: See June 2000 issue of ***Better Turf Thru Agronomics*** for background and the website **www.cdfa.ca.gov/is/frep**).

PUTTING GREEN MANAGEMENT, *continued from page 4*

rounds of golf, N application schedule, N source, and iron (Fe) applications, Green said.

"Additional research is needed to define the minimum annual N fertilization rate that will provide adequate annual bluegrass performance during the warm and cool season," Green said.

Please see the text and Figs. 1-4 in the April 2001 issue of ***Better Turf*** for details about the detrimental effects of the higher N fertilization rate (11.0 lb N), which was excessive, stressed the grass, and had negative consequences on performance: Visual quality and root mass density were reduced; percent coverage of seedheads, patchiness/mottling, and leaf wilting and rolling significantly increased, Green said. The grass was expended and unhealthy, induced to grow its shoots out to the detriment of its overall health.

Potassium (K). The high and low K fertilizer applications were 12.0 and 4.0 lb K_2O/1000 ft^2/yr, respectively, as reported previously, but more testing of the effluent water used to irrigate the putting green at Industry Hills determined that it contributed an additional 3.4 lb K_2O/1000 ft^2/yr, which was not reported previously, Green said. Therefore, final results support a ratio of 3N:2 to 3 K_2O/1000 ft^2/yr for fertilizing a sand-based annual bluegrass putting green. Higher amounts of K above this ratio do not appear to enhance the stress resistance of annual bluegrass, Green said.

"Other than total K in clippings, no difference in turf performance was observed between the high and low K treatments," Green said. Visual turf quality and color did not improve. Both high and low K treatments were within or higher than the target range of 2.2% to 2.6% total K in clippings of creeping bentgrass, he said.

Iron (Fe). Foliar applications of 2 oz $FeSO_4$/1000 ft^2/3 wk increased visual turfgrass color. Applying $FeSO_4$ every 2 weeks should provide even more color improvement because the turf's color response to $FeSO_4$ lasted about 2 weeks, Green said. Not irrigating after an iron application maximized foliar Fe absorption, he said. When Fe fertilization is used to improve visual turfgrass color, N fertilization rates may be reduced.

The Toro Company provided laboratory analyses of clipping tissues, and Western Farm Service provided all liquid fertilizers. Green's cooperators were **Bert Spivey**, Superintendent, Industry Hills Golf Courses; **Grant Klein** and **Bill Richie**, UCR Staff Research Associates; **Janet Hartin**, UC Cooperative Extension Environmental Horticulture Advisor, Los Angeles and San Bernardino Counties; **Van Cline**, The Toro Company; and **Vic Gibeault**, UCR Extension Environmental Horticulturist.

The Golf Course Superintendents Association of America (GCSAA) Foundation matched resources with the California Golf Course Superintendents Association (CGCSA) to underwrite the three-year UCRTRAC study. The CGCSA is composed of six chapters (Hi-Lo Desert; Southern, Northern, and Central California; San Diego; and Sierra Nevada), which all contributed to this study.

FAIRWAY OVERSEEDING, *continued from page 2*

In addition to the UCRTRAC research site at Mountain Vista Golf Course in Palm Desert, the other 9 on-site fairway overseeding research trials were located at the following golf courses nationwide:

- **Green Valley Country Club Green Valley, AZ (2000-2001)**
- **Tucson Country Club Tucson, AZ (1999-2000)**
- **Grand Cypress Golf Course Orlando, FL**
- **Atlanta Athletic Club Duluth (Atlanta), GA**
- **Glenmore Country Club, Charlottesville, VA**
- **Mississippi State University Golf Course Starkville, MS**
- **Blackmoor Golf Course Myrtle Beach, SC**
- **Fire Wheel Golf Park Garland (Dallas), TX**
- **The Woodlands Golf Course Houston, TX**
- **Players Club at St. Louis Crescent (St. Louis), MO**

UCRTRAC's Robert Green cooperated with Nancy Dickens, Superintendent, Mountain Vista Golf Course, Palm Desert, and UCRTRAC delegate representing the Hi-Lo Desert Golf Course Superintendents Association; Mike Henry, Environmental Horticulture Advisor, UC Cooperative Extension, Riverside and Orange Counties; Jeff Place, Associate Professor of Turfgrass and Ornamental Horticulture, College of the Desert, Palm Desert; and UCR Staff Research Associates Grant Klein and Bill Richie.

Summary of Annual UCRTRAC Research Activity for 2001

A summary of UCRTRAC's annual research activity for 2001 is provided in Table 1. **Robert Green**, UCR Turfgrass Research Agronomist, is a principal investigator on all 16 UCRTRAC research projects listed.

Some research projects are completed when a final report is prepared; others are completed when a technical article is submitted to a scientific journal, Green said. Popular and semitechnical articles are prepared for trade journals when results are newsworthy, he said. UCRTRAC publishes a newsletter, ***Better Turf Thru Agronomics***, to communicate research results and periodically disseminates special reports on issues of interest to the green industries.

"Support from the UCRTRAC member organizations continues to provide new growth opportunities for the Turfgrass Research Program at UCR. ***Better Turf Thru Agronomics***, the UCRTRAC newsletter, has broadened communication about turf research projects and issues of interest with clientele, government agencies, UC researchers, Extension Specialists, and Farm Advisors," said **Vic Gibeault**, Extension Environmental Horticulturist and UCRTRAC delegate.

UCRTRAC member organizations (see the blue box at the bottom of this page) support research to improve turf performance; preserve the environment; increase the efficient use of inputs; develop unbiased information on cultivars and products; decrease operating costs; and stay abreast of innovation.

For more details about the 16 studies listed in Table 1, please see recent issues of ***Better Turf Thru Agronomics*** or contact **Robert Green** at (909) 787-2107.

Table 1. Status of 16 UCRTRAC Research Projects as of December 2001

I. Five UCRTRAC Research Projects Completed and Final Report or Technical Article Prepared in 2001

- Improvement of the Spring Transition of Overseeded Bermudagrass Putting Greens in the Coachella Valley ●
- Influence of Primo on the Water Stress Relations of Tall Fescue during the Warm Season ■ ●
- GCSAA, USGA, and NTEP On-Site Testing Program for Bentgrass and Bermudagrass Cultivars on USGA Specification Golf Course Putting Greens ●
- GCSAA, USGA, and NTEP On-Site Testing of Grasses for Overseeding of Bermudagrass Fairways ● ■
- Further Evaluation and Modeling of Pesticide Partitioning Data from the UCR Putting Green Lysimeters ● ■

II. Four UCRTRAC Research Projects Completed and Preparation of Technical Article Planned

- Nitrogen Leaching and Best Management Practices for Overseeded Bermudagrass Fairways ● ■
- Characterization of Markers for Leaf Firing Resistance among Turf-Type Bermudagrasses ■ ●
- The Development of Irrigation and N Fertilization Programs on Tall Fescue To Facilitate Irrigation-Water Savings and Fertilizer-Use Efficiency ■
- Management of Annual Bluegrass Putting Greens in California ●

III. Two UCRTRAC Research Projects In Progress in 2001

- The Effect of endoROOTS and ROOTS 2 on Creeping Bentgrass Establishment and Maintenance on a Newly Constructed Sand Rootzone ● ■
- Test of NutriSmart on Established Tall Fescue ■ ●

IV. Five New UCRTRAC Research Projects on the Books

- Further Evaluation of On-Site Testing of Bermudagrass Cultivars on USGA Specification Golf Putting Greens ●
- Development of BMPs for Fertilizing Lawns To Optimize Plant Performance and Nitrogen Uptake While Reducing the Potential for Nitrate Leaching ■
- Tall Fescue Irrigation Studies in Riverside, an Inland Valley Climate ■
- Texas Bluegrass, Kentucky Bluegrass, and Tall Fescue Performance and Quality as Affected by Irrigation Frequency and Variety at Different Locations in the Transition Region ■
- Defining Optimal and Deficient Nitrogen Fertilizer Rates for Annual Bluegrass Putting Greens in California ●

● Golf Course Turfgrass ■ General Turfgrass and Sod Production

Better Turf Thru Agronomics is prepared for the delegates and membership of the University of California, Riverside Turfgrass Research Advisory Committee (UCRTRAC). Member organizations are the Southern California Golf Association; California Golf Course Superintendents Association (GCSA); GCSA of Southern California; San Diego GCSA; Hi-Lo Desert GCSA; California Sod Producers Association; Southern California Section, Professional Golfers Association; Southern California Turfgrass Council; Southern California Turfgrass Foundation; United States Golf Association; and UCR. The intent is to present summaries of turfgrass research results and topical information of interest to the Southern California turfgrass industries. The newsletter is written by Deborah Silva and edited by Dr. Vic Gibeault, Extension Environmental Horticulturist, and Dr. Robert Green,UCR Turfgrass Research Agronomist, and designed by Jack Van Hise, UCR Printing and Reprographics.