UNIVERSITY OF CALIFORNIA, RIVERSIDE TURFGRASS RESEARCH PROGRAM

Better Turf Thru Agronomics

UCRTRAC Newsletter, June 2000

Fall Renovation Treatments Do Not Increase PM_{10} Emissions in the Coachella Valley

UCRTRAC responded to urgent industry needs.

Sweeping debris following scalping of common bermudagrass fairways in preparation for overseeding does generate dust but does not increase PM_{10} emissions in the Coachella Valley, if debris is wetted before sweeping, say UCR scientists who recently completed a one-year study at The Springs Club in Rancho Mirage.

About 49 tons of fine particulate matter of aerodynamic diameter of 10 microns or less (PM_{10}) are emitted on an average day in the Coachella Valley, primarily from fugitive dust, according to the Coachella Valley PM_{10} Attainment Redesignation Request and Maintenance Plan submitted by the South Coast Air Quality Management District (SCAQMD) to the U. S. Environmental Protection Agency (USEPA).

Turf has the *perception* of contributing to PM_{10} pollution because the dust plume associated with sweeping debris is visible to the naked eye, but the vast majority of particles are much larger than 10 microns and do not contribute to problematic PM_{10} emissions in the region.

"The results from our study, which are reported in Table 1 (page 4), show that the worst-case golf course activities associated with fall renovation -- the dry treatment -- released 99 g PM_{10}/mile, which equates to a total of 12.4 lb of PM_{10} dust particles on the 35 acres that are swept at The Springs Club, compared to 49 tons/day of PM_{10} emissions from other sources in the region," said UCR Turf Research Agronomist **Robert Green.**

The dry-wet treatment had significantly lower PM_{10} emissions than the dry treatment, Green said. The results show wetting (syringing) scalped debris with a minimal amount of water (0.02 inch) followed immediately by sweeping is an effective best management practice (BMP) for reducing PM_{10} emission and dust, he said. See Table 1.

"The Hi-Lo Desert Golf Course Superintendents Association (GCSA) is concerned about air quality. Syringing debris before sweeping is a BMP we can promote to our colleagues because it reduced PM_{10} emissions by 99% in the UCR study, although it must be emphasized that the worst emissions were negligible to begin with -- 12.4 lb compared to a regional problem of 49 tons daily," said **Mike Kocour**, Hi-Lo Desert GCSA Research and Scholarship Liaison, UCRTRAC delegate, and golf course superintendent at The Springs Club.

The evidence from the UCR study does not support the belief that the golf industry contributes to elevated PM_{10} emissions in the Coachella Valley, Kocour said.

Please see **COACHELLA VALLEY PM_{10}**, *page 4*

Golf Growth: California Led the Nation in 1999; Southern Counties Led the State

California led the nation, opening 32 18-hole equivalent golf courses in 1999, said National Golf Foundation (NGF) spokeswoman Judy Thompson. Southern California led the state, opening 18.5 18-hole equivalent courses, according to the NGF (Table 1).

"Last year was unique. We had a greater distribution spread in new course openings throughout the region than I have seen in the past decade," said **Kevin Heaney**, UCRTRAC delegate, and Director of Course Ratings at the Southern California Golf Association (SCGA). See Table 1.

The overwhelming majority of new starts were higher end daily fee and resort-type public facilities, Heaney said. Only 5 of the new facilities were private, he said.

Coachella Valley desert openings in Riverside County led the region, which was not unexpected (Table 1).

Nationwide, Florida was second to California, opening 27 18-hole equivalent courses last year. According to NGF data, one-third of Florida's openings were expansions of existing facilities; whereas, new facilities predominated in California. Expansions accounted for 1/10 of golf course openings in California last year.

Table 1. Golf Course Openings in Southern California in 1999

County	Number of 18-Hole Equivalent Courses
Riverside	8
San Diego	3
Orange	2.5
Ventura	2
Kern	1
Los Angeles	1
San Luis Obispo	1
Total	18.5

Soil Type Affects NO_3-N Leaching on Overseeded Bermudagrass Fairways

Loam leached a higher percentage of NO_3-N than sand, which was unexpected. Leaching from both soil types was below the EPA threshold level.

The overseeded bermudagrass fairways produced by Southern California golf course superintendents for the resort season are some of the best in the nation, but for turf scientists, they represent a situation in which nitrogen fertilization practices may need to be modified to ensure a reduced potential of environmental contamination.

Results from a 3-year study recently completed by UCR turf scientists have shown that the flow-weighted concentrations of nitrate-nitrogen (NO_3-N) leaching from overseeded bermudagrass fairways on loam and sand soils were well below the EPA threshold level of 10 ppm NO_3-N for the last 2.5 years of the study.

"The water in the leachate from the overseeded bermudagrass fairway planted on sand was actually cleaner than the irrigation water being applied."

-Dr. Robert Green
UCR Turfgrass Research Agronomist

"The water in the leachate from the overseeded bermudagrass fairway planted on sand was actually cleaner than the irrigation water being applied. The seasonal flow-weighted concentration of NO_3-N in the leachate was 0.1 to 0.2 ppm NO_3-N during the last two and a half years of our 3-year study versus 3.9 to 5.1 ppm NO_3-N for the irrigation water," said **Robert Green**, UCR Turfgrass Research Agronomist.

The loam results were also well below the EPA threshold in the last 2.5 years of the study, with leachate having a seasonal flow-weighted concentration ranging from 3.1 to 6.3 ppm NO_3-N, Green said.

The flow-weighted NO_3-N concentration is computed as follows: The total NO_3-N mass (milligrams) in the total leachate volume is divided by the total leachate volume (liters). Typically, flow-weighted concentrations are defined for a period of time.

The experimental, annual N fertility program was based on a survey of golf course superintendents' fertility programs. It was 6.0 lb and 3.0 lb N/1000 ft^2 or 5.0 lb N/1000 ft^2 for both the 24- to 27-week cool season and 22- to 23-week warm season, respectively. The irrigation rate was 100% or 130% of ET_{crop} divided by distribution uniformity.

The sand was expected to leach more NO_3-N than the loam, Green said. However, the rooting analysis he completed in 1999 revealed that the bermudagrass had more and deeper roots in the sand than in the loam.

"We believe that the increased rooting in the sand resulted in increased nitrogen uptake, which would explain the minimal NO_3-N leaching from the sand, relative to the loam," Green said.

Please see **OVERSEEDING,** *page 3*

Tall Fescue: BMPs Being Developed at UCR for Irrigation and Nitrogen

UCR turf scientists are conducting a research and education program to develop best management practices (BMPs) for irrigation and nitrogen (N) fertility efficiency on tall fescue, the most widely planted turf species in California.

According to the California Urban Water Conservation Council, future annual landscape water use budgets (a defined allotment of water) may not exceed 100% of reference evapotranspiration (ET_o) per square foot of landscape area. Local water agencies may use an adjustment factor that reduces the water budget to an amount less than 100% ET_o.

The UCR project involves new strategies for conserving irrigation water for turf not reported in the scientific literature to date.

Previous UCR research on tall fescue showed that an irrigation amount of not less than 85% ET_o was required to maintain ***minimally acceptable*** visual turfgrass quality during the warm season in southern inland valleys.

However, more irrigation water would be required by typical inland tall fescue landscapes because of higher visual quality requirements and lower irrigation system distribution uniformities (DU). The DU of the irrigation system at the UCR research plots is probably 20% higher than that of most landscape irrigation systems.

Irrigation water requirements are inversely proportional to the DU. As DU decreases, more irrigation water will be required, although the actual water used by the turf is unchanged, said **Vic Gibeault**, Environmental Horticulturist.

Please see **TALL FESCUE**, *page 3*

OVERSEEDING, *continued from page 2*

Soil type significantly affected the mass of NO_3-N leached and the NO_3-N concentration in the leachate, while soil type and irrigation rate (plus rain) significantly affected the leachate volume.

Best Management Practices for Special Situations

Under typical weather conditions, routine turf fertilization presents negligible potential for nutrient elements, such as N, to pass through the root zone and leach into groundwater or to be transported by runoff water into surface waters if established cultural strategies are used. However, the overseed season may present special challenges for which BMPs may need to be developed and implemented, Green said.

The special challenges during the overseed season that increase the potential for N leaching include the negative impact of fall renovation on the bermudagrass root system; an overseed turfgrass root system that is immature for several months; colder temperatures that reduce N root absorption; more rain during the overseed season, which increases the potential for N leaching; and the predominant use of fast-realease N fertilizer sources during the overseed season, Green said.

Green recommends some modified N fertilization practices to reduce the potential for NO_3-N leaching during the overseed season:

- Try not to fertilize if rain is forecasted.
- Apply smaller amounts of N more frequently.
- Irrigate only as needed. Try to keep a soil water content as low as possible.
- Use fertilizers with a higher percentage of slow-release N. These products produced good season-long visual color ratings in a UCR study reported previously in ***Better Turf Thru Agronomics*** (Nov. 97).
- Use perennial ryegrass cultivars with greater amounts of genetic color, which should reduce the N requirement.
- Make foliar iron applications. They have been reported to increase visual color of perennial ryegrass, which should result in a lower N requirement to maintain the same good visual turf color. High traffic areas may require more growth and recuperative ability and thus more N.

Other situations requiring special attention to N fertilization practices are periods during establishment when the soil is disturbed and the root system is immature and during periods of dormancy and stress when root absorption of nutrients is low.

UCR's 3-year study was funded by the Coachella Valley Water District and the Hi-Lo Desert GCSA. **Marylynn Yates**, Extension Groundwater Quality Specialist and Environmental Microbiologist at UCR, collaborated on the project.

TALL FESCUE,

continued from page 2

Many urban turfgrass sites have an irrigation system DU ranging from 60 to 70% with more water savings being realized as the DU increases.

The UCR project is testing irrigating tall fescue at a defined annual amount -- 80% historical ET_o + rain -- but the actual irrigation water applied fluctuates throughout the year. Irrigation increases during the warm season to improve grass performance (usage exceeds the annual average) and then a reduced irrigation amount, adjusted proportionally downward during the cool season, makes up for the additional usage during the warm season.

The efficacy of such seasonal carryover, known as "water banking" -- allocating water on an annualized basis but accounting for reduced physiological demand in the winter and increased demand in the summer -- is being assessed by the UCR study.

The seasonally adjusted 80% historical ET_o + rain treatments described above is being compared to two other treatments: constant rates of 80% historical ET_o + rain and 80% real time ET_o + rain.

In conjunction with the irrigation treatments, the influence of annual N fertility rates on tall fescue performance is being tested and quantified.

Seasonal timing and rate of N fertilizer applications can significantly influence the degree of a turf's drought stress tolerance. Generally, slow to moderate growth 4 to 6 weeks before drought conditions is helpful to develop improved drought stress tolerance.

Irrigation and N BMPs will help to provide desired tall fescue performance in terms of visual quality, drought stress tolerance, growth (clipping yields) and N uptake.

COACHELLA VALLEY PM_{10}, *continued from page 1*

UCRTRAC's Green collaborated with **Dennis Fitz** of UCR's Center for Environmental Research and Technology to respond to the golf industry's need for unbiased data.

The Coachella Valley Association of Governments (CVAG), the Hi-Lo Desert GCSA, and the SCAQMD have collaborated on a scalping brochure, "***Promoting Healthier Grass Re-seeding Options for the Coachella Valley***," which was distributed recently to homeowner associations and country clubs in the Coachella Valley, said **Aurora Kerr**, Director, Human and Community Resources, CVAG.

CVAG is designated by the SCAQMD to handle PM_{10} issues in the region. The brochure, which was mailed in preparation for grass reseeding that occurs traditionally in the fall, is a guideline to maintaining green-belts and lawns, while eliminating annoying and unhealthful dust, Kerr said.

Results from the Four Experimental Treatments

The UCR research was conducted on mature, in-use common bermudagrass fairways located at The Springs Club in Rancho Mirage using standard scalping and dry-down procedures practiced there and on other Coachella Valley golf courses.

The entire 125 acres of fairways and roughs at The Springs Club are scalped, but, to reduce dust creation, only the 35 acres of fairways are swept, Kocour said.

The PM_{10} emission rate results from the four experimental treatments in the UCR study -- dry, dry-wet, Primo and Reward -- during sweeping of scalped debris using a Toro-Rake-o-Vac traveling at 6 miles/hr are shown in Table 1.

This research project was funded by the County of Riverside and supported by CVAG and the Hi-Lo Desert GCSA.

Please see ***COACHELLA VALLEY PM_{10}****, page 5*

Table 1. The Effect of Four Fall Renovation Treatments in 1999 on PM_{10} Emissions

Treatment	PM_{10} emission rate g/mile	PM_{10} emission rate g/minute	Interval between irrigation off and scalp/rake (day)
Dry	99.0 a[z]	9.9 a	21
Primo	65.4 a	6.5 a	10
Dry-wet	1.2 b	0.1 b	22
Reward[y]	2.2 b	0.2 b	3
LSD, P=0.05	50.7	5.1	–
CV (%)[x]	78.5	78.5	–

[z] Means followed by the same letter are not significantly different, Fisher's protected least-significant-difference (LSD) test. LSD is the least significant difference between two treatment means before they are significantly different at the P=0.05 level.

[y] Note: unplanned 5-minute irrigation (0.06 inch water) on the day of scalping and sweeping.

[x] CV is the coefficient of variation, a unitless calculation for the amount of variation in the population of measurements.

Did you wonder how to convert the PM_{10} emission rate results in Table 1 from g/mile to lb/acre? First, you need to know that the width of the reel or brush on a Toro Rake-o-Vac is 61 inches or 5.08 ft. Then, you need to plug in the following conversion factors: 1 mile = 5,280 ft. 1 acre = 43,560 sq ft and 1 lb = 454 g. To calculate the dry treatment results and the dry-wet treatment results of 12.39 lb and 0.15 lb PM_{10} emitted, respectively, for the 35 acres of swept fairways at The Springs Club, you multiply the following:

Dry Treatment Results.

99g PM_{10}/mile = 99g PM_{10}/5,280 ft x 5.08 ft [one sweeper pass] = 99g PM_{10}/26,822 sq. ft = 99g PM_{10}/0.6157 acre = 160.8g PM_{10}/acre = 5,628g PM_{10}/35 acre = 12.39 lb PM_{10}/35 acres.

Dry-Wet Treatment Results.

1.2g PM_{10}/0.6157 acre = 1.9g PM_{10}/acre = 66.5 g PM_{10}/35 acre = 0.15 lb PM_{10}/35 acres.

Sports Turf Management Overview

Part II. Secondary Maintenance Practices

Editor's Note: ***Part I. Primary Maintenance Practices*** *was printed in the December 1999 issue. Sports turf managers must focus on cultural practices in 10 categories to ensure a safe, playable, durable and aesthetically pleasing turf surface for sporting events, in which wear tolerance and recuperative ability are nurtured. The six primary maintenance practices discussed in the previous issue are (1) mowing, (2) irrigating, (3) fertilizing, (4) aerating, (5) rolling, and (6) repairing or replacing turf. This article, Part II, begins with the four secondary maintenance practices.*

(7) Topdressing

"The soil on sports fields can be changed or amended by topdressing after hollow tine aerification," said **Steve Cockerham**, Superintendent, UCR Agricultural Operations. Topdressings help control thatch, provide a firm, uniform profile, and fine-tune the smoothing of the playing surface. Topdressing is usually performed twice a year, in the spring and late summer, and is most useful on fields that are in reasonable playing condition where the surface drainage could be improved. Topdressing an aerated surface and using a drag to work the chosen material into the holes gradually modifies an existing soil medium. Mineral amendments, such as sand and calcined clay, increase porosity.

(8) Overseeding

Water management is the key to successful overseeding. Seed for overseeding is usually broadcast over the surface and is very susceptible to drying out and dying. Irrigation should be scheduled so that the surface will not dry out for the first week. Grooves for over-seeding can be made with a tine harrow or disc harrow (closed) followed by a broadcast seeder and topdressing. Overseeding and colorants are used for winter color of dormant warm-season grasses, such as bermudagrass or zoysiagrass. The overseeding is applied near the time the warm-season turf enters dormancy, and the overseeded cool-season grass provides the winter color. Perennial ryegrass is the most durable species for overseeding bermudagrass athletic fields. However, when the overseeded bermuda is subjected to traffic, spring transition is poor. Overseeding can be speeded up by presoaking or pregerminating the ryegrass seed.

(9) Applying Surfactants

Surfactants reduce the surface tension of water, allowing water movement through soil when it might otherwise be retained. Surfactants applied to wet spots in a sports field can help to increase drainage temporarily, which improves traction and reduces the effects of field softness. Dry, hard spots can sometimes be relieved with surfactants because they may allow water to penetrate the soil, softening the area. Sod rooting is sometimes faster when laid over an application of surfactant due to the increase in soil permeability.

(10) Managing Pests

A strong cultural management program will usually prevent serious outbreaks of weed, insect, and disease pests because they cannot compete successfully with a dense, healthy turfgrass stand on a sports field. When pest problems do occur, have the pest identified before taking action because secondary problems can mask the original offender. Turf pest information is available through the UC website *http://www.ipm.ucdavis.edu*.

COACHELLA VALLEY PM_{10}

continued from page 4

Coachella Valley's PM_{10} Problem

The region was classified until recently as a "serious" nonattainment area for PM_{10} by the USEPA, but local cities, the County of Riverside, local growers, and the building industry have reduced dust emissions by almost 50%, which has placed the region in attainment of PM_{10} standards, except on the most severe, windy days, said Emily Nelson, Health and Environmental Risk Consultant with CVAG.

"The Coachella Valley has taken an aggressive, collaborative approach to maintaining its attainment status and is used as a model by the South Coast Air Quality Management District for other struggling areas across the country," Kerr said.

PM_{10} exceedances are due primarily to locally generated sources of fugitive dust, not gaseous emissions from vehicle and industrial exhaust. About 96% of the 49 tons of PM_{10} emitted on an average day in the Coachella Valley is from fugitive dust emissions from wind erosion of disturbed sources, entrained road dust, construction and demolition activity, and farming operations. The breakdown is as follows:

Coachella Valley PM_{10} Sources

16 tons/day	Windblown dust on agricultural lands
11 tons/day	Windblown dust on disturbed desert soils
7 tons/day	Mobile sources -- traveling on paved roads
5 tons/day	Mobile sources -- traveling on unpaved roads
1.4 tons/day	Mobile sources -- (Heavy-duty diesel trucks account for more than 50%)

Elevated ambient PM_{10} levels are correlated with mortality rate increases, respiratory infections, number and severity of asthma attacks, and number of hospital admissions.

UCRTRAC 1999 Annual Research Summary

The UCRTRAC Annual Research Summary Report for 1999 is now available. The projects included are summarized in Table 1. **Robert Green**, UCR Turfgrass Research Agronomist, is a principal investigator on all 15 UCRTRAC research projects listed.

UCRTRAC member organizations support turf research to improve the playing surface for golf, baseball, and other sports; preserve the environment; increase the efficient use of inputs; develop unbiased information on cultivars and products (fertilizers, pesticides, equipment); decrease operating costs; and stay abreast of innovation. UCRTRAC 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 industry clientele, government agencies, UC researchers, extension specialists, and farm advisors," said **Vic Gibeault**, UCR Extension Environmental Horticulturist and UCRTRAC delegate.

In addition to UCR, other UCRTRAC member organizations include the Southern California Golf Association, Southern California Turfgrass Council, California Sod Producers Association, Southern California Turfgrass Foundation, California Golf Course Superintendents Association (GCSA), GCSA of Southern California, Hi-Lo Desert GCSA, San Diego GCSA, Southern California Section Professional Golfers Association, and the United States Golf Association.

"The objectives of my research team are to conduct unbiased cultivar evaluations and management studies that can improve the playability and visual quality of the playing surface; to undertake unbiased product testing that will result in savings in fertilizer or plant protectant costs; and to oversee studies on drought tolerant cultivars that can maintain quality standards and result in significant savings in irrigation expenses," said Green.

"When we accomplish these objectives and disseminate the results, then we have performed important research and outreach services for our UCRTRAC industry clientele," Green said. A printed copy of the report can be obtained by calling Robert Green at (909) 787-2107.

Table 1. Research Projects in the 1999 UCRTRAC Annual Research Summary Report

I. Three UCRTRAC Research Projects Completed and Final Report or Technical Article Prepared in 1999
Maintaining Putting Green Soil Aeration and Leaching Capability During the Summer with a Toro HydroJect ●
Evaluation of Water Conservation Surfactants on Two Warm-Season Grasses in Southern California ■ ●
Influence of Primo on Total Nonstructural Carbohydrate Partitioning of Tall Fescue ■ ●

II Four UCRTRAC Research Projects Completed in 1999 and Technical Article Planned
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 ■ ●
Nitrogen Leaching and Best Management Practices for Overseeded Bermudagrass Fairways ● ■
Characterization of Markers for Leaf Firing Resistance Among Turf-Type Bermudagrasses ■ ●

III. Six UCRTRAC Research Projects In Progress in 1999
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 ●
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 ● ■
UCR Bentgrass Variety Trials ●
Measurement and Model Prediction of Pesticide Partitioning in Field-Scale Turfgrass Plots ● ■

IV. Two New UCRTRAC Research Projects on the Books
Further Evaluation and Modeling of Pesticide Partitioning Data from the UCR Putting Green Lysimeters ● ■
Breeding and Genetics of Intergeneric Hybrids of Ryegrasses with Fescues as Cool-Season Turfgrasses ■ ●

● 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 and Dr. Robert Green and designed by Jack Van Hise, UCR Printing and Reprographics.