Assessing Nitrogen Losses during Grow-in of a Golf Putting Green under Two Irrigation Treatments

By Martin Burger, John Baker, Rod Venterea, USDA-ARS, Soil & Water Management and Dr. Brian Horgan, Dept. of Horticultural Science, University of Minnesota

The effects of irrigation intensity on nitrate and phosphate leaching, and on the emission of environmentally harmful nitrogen (N) trace gases are important considerations when evaluating irrigation practices. We measured nitrate and phosphate leaching during the grow-in of a USGA putting green with the use of lysimeters installed underneath the sand/peat layer. One of the two irrigation treatments followed general local irrigation practices for grow-ins, i.e. irrigation at a fixed daily rate of about 8mm (3/8") applied in 7 increments per day. In the other treatment, we irrigated to replace only as much moisture as was lost via evapotranspiration (ET) on the previous day. We hypothesized that this amount of water would be sufficient even for the turf establishment period. To estimate ET, we used the Penman-Monteith model and local climate data from the University of Minnesota weather station. Emissions of the N trace gases nitrous oxide and nitric oxide were measured by placing chambers on the soil surface and sampling of the air within the chambers.

In the fall 2003, creeping bentgrass was seeded in replicated USGA putting green plots (10 ft. x 10 ft.) at the TROE Center. The plots of both treatments were fertilized with 0.5 lbs N/1000 sq. ft. (10-4-16) every 10 days after an initial application of 1 lb N/1000 sq. ft. as 9-18-18 starter fertilizer.

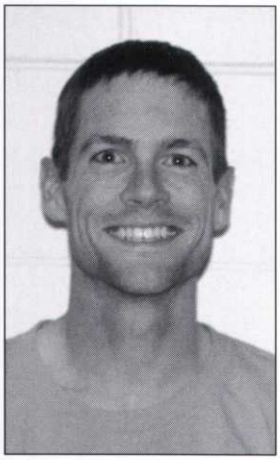
After two months of grow-in, from end of August until the end of October, there were no differences in appearance of the newly established turf between the irrigation treatments. The amount of water applied in the treatment at a fixed daily rate was about four times greater than in the treatment to replace moisture lost through ET. In the fixed rate treatment, 33% of the amount of N applied as fertilizer was collected in the lysimeters (on a per area basis). In the ET replacement treatment, 19% of the amount of N applied as fertilizer was collected. This substantial amount of nitrate leaching even in the ET replacement treatment was probably due to rapid percolation of irrigation water through the sand medium during a time when root length density was low. In the fixed rate treatment, 9% of the phosphate applied as fertilizer versus 1 % in the ET replacement treatment was collected in the lysimeters.

Emissions of nitrous oxide gas in both treatments were never above background levels. In contrast, emissions of nitric oxide were highly elevated immediately after fertilizer applications. Nitric oxide is a reactant during the formation of ozone, which is a pollutant of the troposphere and a greenhouse gas. These nitric oxide emissions could also represent a significant loss of fertilizer N. In the current season, we plan to make frequent gas emission measurements to obtain better estimates of these gaseous N losses. We hypothesize that nitrate and phosphate leaching in 2004 will be lower since root systems will be more developed and fertilizer applications less frequent.

Andrew Hollman Joins Staff At the University of Minnesota

Turfgrass Scientist
University of Minnesota

I grew up in Greenfield, Wisconsin, a southwest suburb of Milwaukee. From a young age on, I had plenty of experiences with horticulture, which subconsciously shaped by career desires. Every spring and throughout the summer I would help my dad plant and take care of the garden in the back yard. I also helped my maternal grandparents with their garden. On a quarter acre of land they were able to grow apples, pears, cherries, peaches, plums, pecans, walnuts, raspberries, strawberries, rhubarb and a plethora of flowers. My paternal grandparents lived in Florida, and on an equally small lot grew grapefruits, oranges, tangerines, lemons, papayas and this coarse prickly grass that was painful to walk on barefoot. It wasn't until college, that I realized my grandparents prickly grass was St. Augustine grass.



Andrew B. Hollman

I went to college at the University of Wisconsin-Madison. My major was Molecular Biology and I had plans to go on to medical school. During the summers though, I continued to work in horticulture. As I approached the summer after my junior year, I realized that I needed some experiences on my resume that would benefit a medical school application. When looking for jobs though, nothing interested me, so I applied for a job at the O.J. Noer Turfgrass Research Facility. The job was filled, but I was offered a job as an undergraduate research assistant. At this time I realized that I enjoyed working with plants a lot better than working with people, so I added horticulture as a major. The study I would conduct for the next three summers was looking at the management requirements of 'A-4' and 'G-2' creeping bentgrass in comparison to 'Penncross' and 'DW-184', a new perennial Poa annua. During this time I was asked to pursue a Master's degree by Dr. John Stier at University of Wisconsin-Madison. So after I finished my B.S. in Horticulture and Molecular biology in 2001, I started my graduate program at Madison.

For my Master's research I had two main projects. One project examined the freezing tolerance of newer cultivars of tall fescue and the effect that age, freezing temperature and freeze duration had on survival and quality. The second project investigated the use of Randomly Amplified Polymorphic DNA (RAPD) markers to evaluate the genetic diversity of velvet bentgrass and differentiate bentgrass species. All during my graduate career at Madison, my career goal was to stay involved in turf research. Since I really enjoyed working with plants and conducting the experiments, I imagined that a position as a turfgrass technician or scientist was what I would look for. When I started looking for a job there were four such positions available around the country. After interviewing for the Minnesota job though, I knew that I didn't want to go anywhere else. Dr. Brian Horgan, Dr. Eric Watkins and I got along well and their enthusiasm for turfgrass research really showed through. Luckily they offered me the job. Although friends and family may question my decision to move to a state that is colder and has a longer winter than Wisconsin, at least I can walk on the grass barefoot.

Selecting for Improved Perennial Ryegrass Cultivars

By N.J. Ehlke, E. Watkins, D.L. Wyse, D.J. Vellekson, and K.J. Betts
University of Minnesota

There is a large team effort to develop improved cultivars of perennial ryegrass with improved winter hardiness, turf quality, disease resistance and herbicide tolerance. Developing elite turf-type perennial ryegrass varieties would expand Minnesota's grass seed producer's options, extend the range of adaption, and improve persistence in the turf environment. Initially, elite perennial ryegrass varieties and experimental lines were crossed with NK200, an older variety with acceptable winter hardiness but poor turf quality including coarse leaf texture and crown rust susceptibility.

Progeny from the crosses were evaluated and plants which combined winter hardiness and turf quality were selected for further evaluation and breeding activities. Turf plots were established in 2002 of experimental populations selected for excellent turf quality and increased winter hardiness (Table 1 and 2).

Our evaluations indicate that winter hardiness can be improved to levels higher than is currently available in ryegrass cultivars. To date, we have two populations of perennial ryegrass with superior winter hardiness that are currently being released by the University of Minnesota and seed should be commercially available to turf managers in 2005.

Research has also focused on developing herbicide tolerant perennial ryegrass using a naturally occurring, herbicide resistant gene identified in annual ryegrass using traditional plant breeding methods. The first herbicide tolerant variety was released by the University of Minnesota in 2001 and is called P101. Commercial seed production was initiated in northern Minnesota and seed was commercially available starting in the Fall, 2003. P101 has a moderate level of winter hardiness and turf quality, but improved rust resistance. Plant breeding efforts have continued and the second generation cultivar, P201, was released in 2003. P201 is herbicide tolerant with significant improvements in turf quality and winter hardiness over P101. Seed should be commercially available by 2006.

Breeding activities have been conducted cooperatively with Rutgers University to improve the level of turf quality and disease resistance in our perennial ryegrass breeding populations. Through two cycles of crossing our breeding populations with the elite breeding populations from Rutgers, we have been able to incorporate resistance to gray leaf spot, a devastating new disease of perennial ryegrass, and substantially improve the turf quality of our breeding populations. Currently, these populations are in field evaluations to continue our selection program to improve winter hardiness and resistance to rust while maintaining high turf quality.

Table 1.
2002 Perennial Ryegrass Turf Trial - St. Paul Campus

2003 Ratings

Entry	Mean Turt Quality	Winter Injury
Private Cultivars:		
Affinity	3.8	4.7
Blackhawk	3.4	5.0
Brightstar SLT	4.2	3.7
Brightstar II	4.6	3.3
Citation fore	4.7	3.3
NK-200	3.2	4.0
Paragon	4.1	4.0
Pinnacle	3.6	4.3
Prowler	3.7	3.3
University of Minnesota Cultivars and Experimental Populations:		
P101	4.4	4.0
P201	4.6	4.3
Spreader2	5.3	5.0
TQ x SP	4.7	3.0
MHT x Rutgers	5.7	6.0
Spreader x Rutgers	6.9	4.0
Wh select	3.7	5.0
WH x TQ	3.6	5.0

Turf quality rating:
1 = poor to 9 = excellent
Winter hardiness rating:
1 = dead to 9 = no injury
Seeding date: 8/22/02

Table 2.

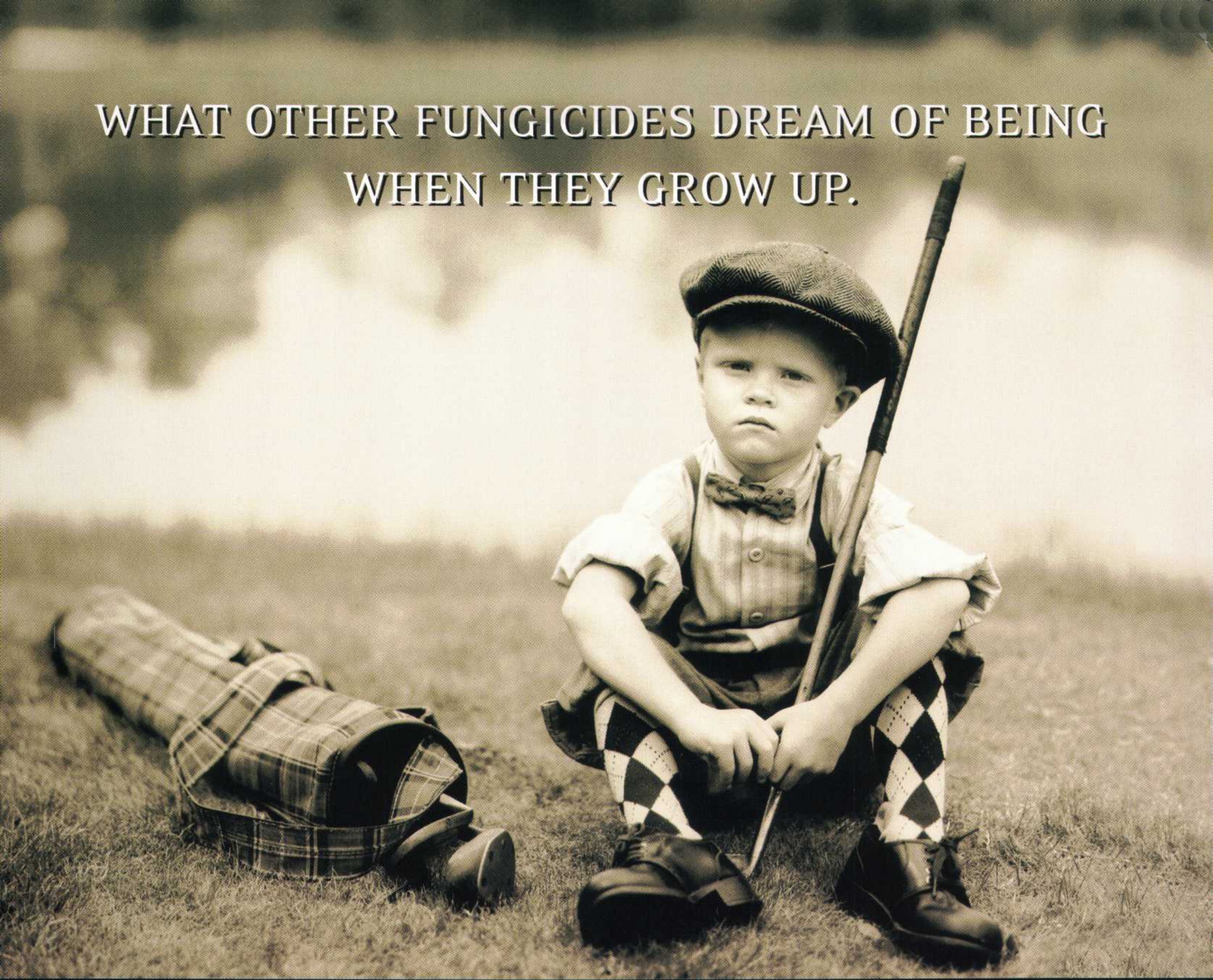
2002 Perennial Ryegrass
Winter Hardiness Evalution

Winter Hardiness

Entry	St. Paul	Roseau	Mean
Private Culitvars:			
Affinity	6.5	0.9	3.7
Brightstar SLT	5.9	1.8	3.8
Citation Fore	6.4	2.1	4.2
NK-200**	6.4	3.0	4.6
University of Minnesota Cultivars and Experimental Populations:			
P101	6.1	1.2	3.6
P201	6.7	2.1	4.4
Spreader2	6.9	2.4	4.2
TQ x SP	7.6	1.7	4.7
Wh select	7.7	3.5	5.6
WH x TQ	7.4	5.3	6.3
LSD @5%	1.2	1.4	1.0

***Winter injury rating scale:**

1= dead to 10 = no injury.
** poor stand of NK-200 which resulted in more winter injury


WHAT OTHER FUNGICIDES DREAM OF BEING
WHEN THEY GROW UP.

Scott Austin and Bill McDonald Win MGCSA Spring Mixer at Glencoe CC

Scott Austin, CGCS, Midland Hills Country Club, and Bill MacDonald, E-Z-GO, combined to win the first mixer of the year with a net score of 58 at Glencoe Country Club on May 10th. Host Superintendent Jeff Vinkemeier paired with Barry Provo, Deer Run Golf Course, to shoot a net 64 which was good for second place.

Host Superintendent Jeff Vinkemeier

Thanks go out to Jeff Vinkemeier and his staff for supplying the MGCSA with great accommodations for the event. Glencoe Country Club offered tight fairways and plenty of trees. The MGCSA also appreciates the generosity of the staff and members of Glencoe Country Club for offering their course to our membership.

Paul Zunker, LifeLine, Inc., gave a talk about "AED"s on the Greens." Automated external defibrillators are becoming necessary at all public places.

Special thanks to our affiliate members who sponsored tees, greens, long drives and our lunch. The sponsoring companies were Agrotain International, MTI Distributing, BASF, Bayer Environmental Science, Leitner Company, Plaisted Companies, Pro Source One, Greenseth Golf, Inc., Superior Turf Products, Simplot Partners, Hartman Companies, Dow Agrosciences, Cleary Chemical, Cycleworks, GreenImage, Tessman Seed Company, HydroLogic, Midwest Putting Greens, Lesco and Twin City Hydro Seeding.

Jeff Schaefer Wins BASF Event At North Oaks

Jeff Schaefer, Assistant Superintendent at North Oaks, pictured in the middle, shot a net 68, which proved to be the best net score of the day, to win a trip for two to historic Pinehurst Country Club to compete in the BASF People vs. Pro tournament. Jeff is pictured with BASF representative David Oberle, left, and North Oaks' Jack MacKenzie, CGCS.

Fine Fescues and Colonial Bentgrasses For Golf Course Fairways

By Dr. Brian Horgan, University of Minnesota
John Stier, University of Wisconsin-Madison

Project Funded by: Golf Course Superintendents Association of America

Rationale and Problem Description

Fine fescues and colonial bentgrasses have been used for years on fairways and roughs of golf courses in the United Kingdom. In recent years fine fescues have been commonly used as un-mown rough and in a few cases on fairways in the US (Anonymous, 1989, Stier, 2002). Colonial bentgrass was used in the U.S. during the early 20th century as a component of South German bentgrass. Advances in creeping bentgrass, Kentucky bluegrass, and perennial ryegrass along with availability of irrigation systems and improved turf chemicals led to the relatively high input fairways currently used across much of the northern U.S. and Canada. However, tremendous improvements have been made in fine fescue and colonial bentgrass germplasm during the last decade, which provide better turf quality than older cultivars.

Public pressure to reduce potable water and chemical usage, including synthetic fertilizers, will require a fundamental change in the way golf courses are designed, permitted, and managed. Specifically, grass systems that require less intensive inputs compared to conventional grasses need to be evaluated (Kenna and Horst, 1993). Fine fescues have significantly less water and lower fertility requirements than most other turfgrasses (Bourgoin, B., 1997, Kenna and Horst, 1993). In northern golf courses, snow mold diseases require preventive fungicide applications, often at high rates, which is not compatible with environmental concerns and may become restricted due to the Food Quality Protection Act. Recent golf course projects have indicated that fine fescues are resistant to all snow molds; colonial bentgrasses have better resistance and shorter recovery time to snow mold damage than creeping bentgrass (Casler et al., 2001). Dollar spot is the most costly disease on turfgrass in the US (more fungicides are used for its control than any other disease), but both fine fescues and colonial bentgrass have greater tolerance to dollar spot than creeping bentgrass (Brilman, 2001; Newman et al., 1989). Wear tolerance has often been cited as a factor for turfgrass selection, but the newer cultivars of fine fescue and colonial bentgrass may provide suitable wear tolerance. Recent cultivar trials have shown colonial bentgrass has better wear tolerance at fairway height than creeping bentgrass (Bonos et al., 2001) and Chewings and hard fescue are more wear tolerant than other fine fescues (Bonos et al., 2001, Stier et al., 2002).

A few golf courses are now utilizing fine fescues and/or colonial bentgrass for fairways either to gain permitting approval or to provide a Links-style course. However, research data for cultivar selection are limited to scattered cultivar trials of monostands. Other data show that the attributes of single cultivars are not necessarily additive in mixtures and/or blends, and individual cultivars may not survive (Brede and Duich, 1986). Information on the ideal type of fertilizer is also lacking. Superintendents from the United Kingdom routinely use organic N sources and feel synthetic, water-soluble N sources are not suitable for fine fescue/colonial bentgrass fairways (Stier, 2002). Furthermore, some of the cultivars that perform well at fairway height may have higher N requirements than cultivars not mowed low and subjected to traffic.

Objectives

The objectives of this research are to 1) determine the best cultivars and combination(s) of fine fescue and colonial bentgrass for use as a fairway turf, and 2) evaluate the effect of organic versus water-soluble fertilizer on turf quality and fine fescue/colonial bentgrass competition.

Benefits to Superintendents

The research will start to build a body of literature on the performance of the best fine fescue and colonial bentgrass cultivars for fairway use both alone and in various combinations as influenced by fertilizer type, traffic, and divoting. The data will be useful for superintendents and architects for designing, establishing, and permitting new golf courses or reconstruction projects as it will narrow the potential cultivars and mixes to be considered. The results will also provide guidelines for fertilization of fine fescue, colonial bentgrass, and their mixtures. The disease resistance for snow mold and dollar spot should allow superintendents to use less fungicide on their courses, which is critical as the impact of the Food Quality and Protection Act increasingly restricts fungicide use on amenity turfgrasses. Interest in using turfgrasses that require fewer inputs, particularly in terms of water and fertilizer, will only grow.

MATERIALS AND METHODS

Plot Establishment and Maintenance

Two field trials will be conducted; (1) at the University of Minnesota Turfgrass Research, Outreach and Education (TROE) Center in St. Paul, MN and (2) at the O.J. Noer Turfgrass Research and Educational Facility in Verona, WI. Replicating the research project within the North Central Region in effect allows results to be verified and will strengthen a peer reviewed journal publication.

Plots were established by seed, mulched, and irrigated until established during autumn 2002 at the O.J. Noer Facility and in autumn 2003 at the TROE Center. Starter fertilizer (1:2:1) was applied at the time of seeding to supply approximately 1 lb P2O5 per 1000 ft2 (M). A soluble form of nitrogen will be applied bi-weekly at a rate of 0.5# of N/M until satisfactory ground cover is achieved. All plots will be maintained at 0.75" mowing height and they will be irrigated once

(Continued on Page 18)

Colonial Bentgrasses–

(Continued from Page 17)

weekly at 50% evapotranspiration (ET) once established. Golf cart traffic will be applied from May to September to simulate six golf cart passes each week beginning in the summer 2003 (Stier et al., 2002).

Grass types include two colonial bentgrasses ('Tiger II' and 'SR 7100'), two Chewings fescues ('SR 5100' and 'Longfellow II'), one hard fescue ('SR 3100'), and one strong creeping red fescue ('Jasper II') as monostands, blends and mixtures. Fine fescue and colonial bentgrass mixtures were comprised of 80% fine fescue and 20% colonial bentgrass (by weight) to achieve roughly equivalent amount of plants per unit area and to emulate current practices (Anonymous, 1989; Stier, 2002). Equal parts of each variety of a given species were used in blends. The varieties were selected based on top performance in National Turfgrass Evaluation Program (NTEP) trials and ancillary studies conducted by UW-Madison on golf courses and the O.J. Noer facility between 1992 to 2002. One creeping bentgrass ('Penncross') and a Kentucky bluegrass blend ('Blue Carpet', Olds Seed Solutions) are used for comparisons.

Beginning spring 2004 in Madison and spring 2005 in St. Paul, plots will be split to evaluate the effect of fertility rate and type. Sub-plots will be used to test low and high N rates (1 lb vs. 3 lb N/1000 ft2). Nitrogen will be applied at 0.5 lb N/1000 ft2 in May and September for the low N rate; fertilization for the high N rate will be applied at 0.5 lb N/1000 ft2 monthly during the growing season (May - October). Sub-plots will be split (sub-sub plots) to evaluate the type of N carrier at each rate, organic versus synthetic (Milorganite versus water-soluble). The water-soluble N carrier will be a combination of urea and/or ammonium nitrate combined with a phosphorus source such as superphosphate to achieve a P rate equivalent to Milorganite.

Once plots are established pesticide applications will be applied only as necessary to prevent pest/disease outbreaks which threaten the integrity of the project. There may be one herbicide application made during the establishment year to eliminate broadleaf weeds during grow-in.

Data Collection and Analysis

Turf quality will be evaluated monthly from April to October using a 1 to 9 visual assessment scale once the turf is established. Percent living ground cover will be evaluated three times annually in May, July and September. Disease occurrence will be evaluated on an as need basis and reported as percent damage of each plot. Weed encroachment will be determined by estimating the percent area infested by weeds once each year, generally late summer. Spring greenup will also be evaluated annually following establishment.

Playability and environmental data will also be collected. A divot tool will be used to create divots on each treatment (Calhoun & Branham, 1996) three times annually (May, July and September). Divot recovery will be evaluated by measuring the diameter of the divot on a biweekly basis for a month following the simulation, then on a monthly basis up to six months (the final analysis for September divots will be conducted the following May). Golf ball lie will be evaluated each spring, summer and fall (Cella and Voigt, 2000).

Expected Results / Outcomes

We expect the fine fescue/colonial bentgrass mixture will provide best turf quality, and Chewings fescue will dominate creeping red and hard fescues. We also expect one cultivar of each species may dominate the other cultivar(s) of similar species if the genetic distance is large (J. Stier and G. Jung, unpublished data, 2001). One outcome of the project will be basic information for cultivar, blend and mixture recommendations for fairways. A second outcome will be science-based information for fertilizer selection and rate for fine fescue/colonial bentgrass fairways.

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Corn Gluten Meal Study on Three Turfgrass Populations

By Bob Mugaas and Dr. Brian Horgan
University of Minnesota

Study Initiated 5/14/02

Introduction: Over the last decade, corn gluten meal (CGM) has surfaced as an organic weed control product with potential for being a fertilizer as well. The purpose of this study is to evaluate the effectiveness of CGM as a fertilizer along with any impact on weed suppression or control. Duration of the study is to be seven years. The University of Minnesota's UMORE Park located in Rosemount is the site for this research project.

Turf populations: 3 turf areas of approximately 2200 square feet each were established during the fall of 2001 with treatment applications and research data collection initiated in spring of 2002. The three areas consisted of three different turfgrass mixtures or blends such that CGM could be evaluated for its effects on each. The first area consisted of a mixture of 25% Kentucky bluegrass, 25% fine leaved fescue, 25% perennial ryegrass and 25% annual ryegrass. The second area consisted of 100% Park Kentucky bluegrass. The third area was a blend of 100% fine fescues.

Corn Gluten Meal applications: The treatments being evaluated in this study for fertilizer effects along with any weed suppression are listed below. The rate used, (20# per 1000 ft2), is consistent with that of commercially available CGM products. This rate applies 2# of N per 1000 ft2 per application as the product is considered to be 10% N.

Treatment Descriptions

+ CGM applied once in early to mid May at 20# per 1000 ft2

+ CGM applied twice, once in early to mid-May and again 5 to 6 weeks later; both at 20# of product per 1000 ft2

+ CGM applied once in early to mid-May and early in August; both applications were at 20# of product per 1000 ft2. (Note this is the standard labeled timing for this product.)

+ CGM applied once in early to mid-May, once in early August and once in late October; all application rates were 20# of product per 1000 ft2.

+ CGM applied once in late October at 20# of product per 1000 ft2.

+ Control; no fertilizer applied at any time.

Mowing Treatments

Each treatment is further subdivided into two different mowing heights to compare differences in CGM performance at a low and high mowing height. The lower height used is 1.5 inches and the higher height of cut is 3 inches. Mowing is done on an as needed basis removing no more than about 1/3 of the grass plant height at any one mowing.

Data Collection: Data collection began in the spring of 2002. Information

(Continued on Page 23)

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