Turf Nitrogen and Phosphorus Management Practice, To Help Protect Surface Water Quality

By Robert J. Mugaas, Michael L. Agnew and Nick E. Christians

Few soils have enough natural nitrogen (N) fertility to maintain desired turfgrass quality and recuperative ability throughout the growing season. Nitrogen shortages can lead to slow growth, yellowing of the plants, thinning out of the turf and increased incidence of some diseases. However, excessively high levels of N can lead to excessive shoot and leaf growth, reduced root growth, low plant carbohydrate (food) reserves, increased susceptability to environmental stress and some diseases. One of the first important considerations in using N fertilizers responsibly is to match the site conditions and the desired maintenance program with proper N fertilizer sources.

Nitrogen Fertilizer Sources

Nitrogen fertilizer sources are often categorized as inorganic types or organic types. A brief description of several N sources is given in Table 1.

Inorganic fertilizers such as ammonium nitrate and ammonium sulfate are all water soluble or *quick-release* N sources. That is, N becomes available as soon as water is applied to the turf. Their response is quite predictable and results are fairly immediate. However, their burn potential is quite high and the effects are rather short-lived. On sandy soils, high application rates of these products combined with high irrigation or rainfall amounts may result in higher N losses due to leaching. Leaching is the movement of water and possibly nutrients down into and potentially beyond the turfgrass rootzone. Once beyond the rootzone, nitrates can continue moving through the soil and may find their way into water sources.

Organic fertilizer products, natural or synthetic, are those containing carbon (C) in their chemical structure. Nitrogen from natural organic sources becomes available only after the product begins to breakdown due to soil microbial action. These are considered *slow-release* N sources as N is gradually released to the soil solution and becomes available for plant use. Soil temperature and moisture are key factors governing the microbial activity and thereby the N release. Compared to quick-release sources, these have a lower leaf-burn potential and can be applied at slightly higher rates without damaging the turf.

The primary synthetic organic fertilizer product is urea. It is considered a quick-release N product with a relatively high foliar burn potential. Urea has been further processed and/or combined with other materials giving these products more or less of a slow-release characteristic. Their N release is dependent on soil chemical and/or microbial action, have a fairly low leaf burn potential and can be applied at slightly higher rates than quick-release N sources.

Nitrogen Fertilizer Use

The amount of N required by a lawn or turfgrass area depends on the type of grass plants present and the management practices used. High maintenance lawns often contain the more vigorous improved Kentucky bluegrass and turf-type perennial ryegrass varieties. These lawns will perform better when adequate water and fertilizer are regularly provided. Low maintenance lawns usually consist of common types of bluegrass in combination with a mixture of other grasses. These lawns grow and spread more slowly and usually receive little extra water or N fertilizer. Table 2 describes the annual application of N requirements for these lawn types and how leaving the clippings on the lawn impact the yearly N requirements.

On highly leachable soils, sands and sandy loams, the above recommended N application rates may result in excessive loss of nitrate-N due to leaching. Where soluble N sources are used on these soil types, reducing the N rates to 0.25 to 0.5 lb. N / 1000 ft^2 per application may minimize potential nitrate-N leaching. If, frequent, lower N rate applications are not practical, slow-release N sources may be a better choice for these soils. This practice is adaptable to late season N fertilization and may be especially true where sandy soils are in close proximity to surface or groundwater resources.

Watering practices that result in water movement beyond the rootzone may increase potential nitrate-N leaching. Frequent, daily irrigation during cool moist periods can also increase the leaching potential. Irrigation practices that take into consideration the grass plant's needs during any particular climate condition will be more effective. Adding enough water to compensate for that removed by plant uptake and evaporation will minimize potential N pollution problems from leaching. Sloped areas may require more frequent but smaller amounts of water per application as they will be

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Editor's Note

Last winter Bob Mugaas, Hennepin County extension horticulturist, had the opportunity to spend a study leave at Iowa State University researching scientific literature to find out what is known about present lawn practices and their impact on water quality.

The "Turf Nitrogen and Phosphorus Management Practices" article, which begins on this page, and another on "Responsible Turf Pesticide Use" to be carried in the November issue, are a result of that work by Mugaas, Michael L. Agnew, extension horticulturist/turf, and Nick E. Christians, professor of horticulture, at Iowa State University.

Says Mugaas: "A larger, more comprehensive publication will be forthcoming this fall. It is hoped that this information about turf fertilizer and pesticide practices and their impact on water quality will help you communicate with greater knowledge about these issues.)

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more vulnerable to runoff before ample water has infiltrated into the soil.

Irrigation of 0.25 to 0.5 inches immediately after an application of a quick-release N source will help move the N into the surface soil where it can potentially be used by the grass plant. Also, it will be somewhat protected from runoff and possible volatilization back to the atmosphere.

Grass clippings should be returned to the lawn area to decompose and recycle nutrients back to the turf area. They should not be blown or raked into street gutters or onto sidewalks and driveways where they may be carried in runoff to surface water areas. Nutrients released to the water environment through decomposition may be responsible for causing undesirable algae and vegetative growth.

NEVER apply N fertilizers to water resources directly or apply them to frozen ground.

Nitrogen fertilizer product knowledge and being familiar with the site may help minimize or even eliminate potential adverse impacts on water quality. In addition, always follow manufacturers' guidelines or consult with local extension turf specialists for appropriate application rates.

TABLE 1 **Characteristics of Common Turfgrass N Sources**

Fertilizer Source	N content %	Leaching Potential	Burn Potential	Low Temp. Response	Residual Effect
Inorganic					
Ammonium nitrate	33-34	High	High	Rapid	Short
Calcium nitrate	16	High	High	Rapid	Short
Ammonium sulfate	21	High	High	Rapid	Short
Organic - Natural					
Activated sewage sludge	6	Very Low	Very Low	Very Low	Long
Manures	3-10	Very Low	Very Low	Very Low	Long
Other natural products	3-10	Very Low	Very Low	Very Low	Long
Organic - Synthetic					
Urea	45-46	Moderate	High	Rapid	Short
Urea solutions	12-14	Moderate	High	Rapid	Short
Sulfur coated urea	14-38	Low	Low	Moderate	Moderate
Resin coated urea	24-35	Low	Low	Moderate	Long
Isobutylidene diurea (IBDU)	30-31	Mod. Low	Low	Moderate	Moderate
Methylene ureas and Ureaformaldehyde*	38	Low	Low	Low	Mod. Long to Long

** Some products may contain urea in addition to the ureaformaldehyde component.*

TABLE 2. **Annual Nitrogen Requirements and Application Timing for Lawns in the Upper Midwest**

	Nitrogen (N) to apply lbs. N/1000 ft²	Timing of Applications*
High maintenance lawn		
(Irrigation, clippings removed)	4	May - June, Aug., Sept., Oct. - Nov.
(Irrigation, clippings not removed)	3	May - June, Aug., Oct. - Nov.
Low maintenance lawn		
(No irrigation, clippings removed)	2	Aug., Oct. - Nov.
(No irrigation, clippings not removed)	1	September

* *Assume 1 lb. N/1000 ft² of a soluble, quick-release N source applied at each application.*

Note: Lower more frequent rates of a quick-release N fertilizer can be used on sandy to sandy loam soil. Slow-release N fertilizers could also be substituted for the quick-release types. Follow manufacturers and/or Extension suggestions for proper application rates.

Phosphorus

Phosphorus (P) is an essential nutrient contained in every living grass plant cell. The amount of P needed by the grass plant is significantly less than nitrogen or potassium. It is considered to have positive effects on turfgrass establishment, rooting and increased root branching, maturation and seed head production. Phosphorus is particularly important during early grass seedling growth and development stages.

While P is an important nutrient for grasses and other green plants, it is also an important nutrient for algae and weeds in our lake systems. Phosphorus is often the least abundant and therefore growth-limiting plant nutrient in fresh-

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water lakes. Lake enrichment with P can cause undesireable algae "blooms" and vigorous growth of other lake weeds, a process termed eutrophication. For this reason, much concern has been raised about the contribution of lawn and garden fertilizers to lake pollution.

Offsite Movement of Phosphorus

Phosphates, (P combined with oxygen), are removed from the soil solution and immobilized in the soil. Consequently, P is not prone to leaching and poses little or no threat to groundwater resources.

Offsite transport of P to surface waters tends to be associated with sediment erosion. Phosphorus is carried along with the soil (silt and clay fractions primarily) and organic matter sediments to which it is adsorbed. Phosphorus may also be carried by wind erosion and later deposited into lakes. Living plants such as trees, shrubs and turfed areas around lakes can help stablize the soil against wind and water erosion. Also, they can act as filters to help remove these fine soil particles from the air, thus trapping both the soil particles and any associated nutrients adsorbed onto them.

Phosphorus Management Practices

Phosphorus fertilizer additions to turf areas should be based on a reliable soil test. These can usually be obtained from soil testing labs at the land grant universities or through private soil testing laboratories.

Since P is quickly immobilized in the soil, it does not pose a threat to water resources from leaching. Where sediment is eroded from the site, it is likely that some amount of P will be carried with it. In established turfgrass areas, runoff potential is quite low due to the dense turfgrass canopy and extensive fibrous root systems. Therefore, where P is applied to turfgrass areas, it should be watered into the soil where it is immobilized and generally protected from loss by runoff.

During the winter months, leaves, dead grass plant parts and other organic debris may, upon breakdown due to freezing and thawing actions, release soluble forms of phosphate (and nitrates). These potentially can run-off from frozen ground, especially slopes, during spring snowmelt and early spring rains and possibly be carried into surface water areas. Thus, raking the lawn in the fall to remove excess organic debris may also be beneficial from a water quality standpoint. Grass clippings, leaf litter and other forms of organic debris should be removed and kept off of hard surface areas they can be carried in runoff to surface water areas. Obviously, these same materials should not be dumped on or near shoreline areas where nutrients released during decomposition can move directly into the water.

Since P is very immobile in the soil, it is often advisable to add some P at the time of establishment even though soil P levels may be adequate for an established turf. This will ensure some available P near the soil surface for the very young developing grass roots. Protecting newly seeded areas, especially slopes, with some type of mulch cover during establishment will help prevent runoff and erosion of soil and possible nutrients. Applying P to an established turf following core cultivation will help get P down into the soil, thereby protecting it from loss by runoff.

General Fertilization Practices

In addition to the specific nitrogen and phosphorus management practices already mentioned, following are some general lawn fertilization practices which can help reduce potential water pollution.

1. Be careful to never directly deposit or inadvertently apply fertilizer materials into lake areas.
2. Fill granular fertilizer spreaders on a hard surface where any spills can be easily cleaned up. NEVER wash off fertilizer spills into the street or other hard surface area where they can easily get into storm sewers and ultimately into surface water areas. Wash off granular fertilizer spreaders over turfed areas to prevent runoff of fertilizer material from hard surfaces. Fill and clean liquid fertilizer applicators over turfed areas for similar reasons.
3. Close the gate on the fertilizer spreader when crossing hard surface areas or go back and sweep up the material and re-use it another time or put it back into the spreader.
4. Drop spreaders are more precise but slower than rotary type spreaders. Near shoreline areas, apply fertilizer around the perimeter of the property with a drop spreader to create a "buffer" zone. The rest of the area further away from the shoreline can be fertilized with a rotary spreader. Since the perimeter has already been done with the drop spreader, it is not necessary to try to get close to the shore potentially, getting the fertilizer into the water. The same kinds of precautions should be taken when using liquid applications.
5. Avoid getting fertilizer into natural drainage areas or pathways on a property. These may not necessarily be hard-surfaced areas and can carry fertilizer directly into the surface water area before having the chance to infiltrate into the surrounding turf/soil area.
6. For shoreline areas, a "buffer zone" of unmanaged grasses or possibly natural vegetation could be left growing around the shoreline. This can help prevent soil erosion and may also retain some of the nutrients that might otherwise enter the lake.

Improper management or use of turf fertilizers may contribute to potential pollution of surface and ground water resources. However, combining appropriate landscape management practices with a modest lawn fertilizer program may further reduce surface water pollution.

Authors

Robert J. Mugaas,
Henn. County Extension Horticulturist,
University of Minnesota
Michael L. Agnew,
Extension Horticulturist-Turf,
Iowa State University
Nick E. Christians,
Professor of Horticulture,
Iowa State University

A joint publication of Iowa State University Extension and University of Minnesota Extension.

In Brief . . .

• **Water Fact:** Approximately 42 percent of household water is used for landscaping, and landscapes are typically overwatered by 20 to 40 percent. All outdoor landscaping in California, for instance, accounts for 2.5 percent of the state's water use.

• **Traces of herbicides were found in rainwater samples from 23 states in a study recently completed by the U.S. Geological Survey.** The herbicides detected included atrazine, alachlor, metalachlor and a degradation product of atrazine. The main source of the herbicide pollution is believed to be agricultural pesticide use.

This is the first major study to confirm that pesticides can be transported through vaporization into the atmosphere. Although turf applications were not believed to have contributed to the pesticides found in the rainwater samples, superintendents should be prepared to answer questions from concerned citizens and members.

MEMBERSHIP REPORT

NEW MEMBERS—AUGUST 22, 1991

Daniel Augdahl	Interlachen Country Club	Class D
Allen Jaques	Dellwood Hills Golf Club	C
Jeffrey Johnson	Midland Hills Country Club	D
Dan Levendowski	Anoka Technical College	E
Janelle Lord	Rochester Golf & C.C.	D
Mike Pierce	Coffee Mill Golf & C.C.	B
Robert Sill	Coffee Mill Golf & C.C.	B
Eric Peterson	Town and Country Club	C
Richard Skluzacek	Kasco Marine, Inc.	F

RECLASSIFICATION—AUGUST 22, 1991

James Gardner	Rochester Golf & C.C.	B to A
Kelly Johnson	River Oaks Golf Course	F to B
Jack Krech	Watonwan Country Club	BII to B
Chris Leach	Oxbow Country Club	C to BII
Eric Rosenberg	Lidgerwood Golf Club	C to BII
David Solga	Golden Valley Country Club	BII to C

Mike Olson, Membership Chairman

Honors Course Honored by USGA For Conservation Activities

The Honors Course in Ooltewah, Tenn. has been chosen as the first golf course recognized for its conservation efforts under the USGA sponsored Audubon Cooperative Sanctuary Program for Golf Courses.

In recognition of its achievement, The Honors Course, site of the 1991 U.S. Amateur Championship, was awarded an original oil painting by artist Adriano Manocchia depicting a view of the ninth hole, capturing its natural habitat, its nest boxes and its wildlife, such as the eastern bluebird, pileated woodpecker and mockingbird.

The Audubon Cooperative Sanctuary Program is sponsored by the USGA and administered by the Audubon Society of New York State. It seeks to protect and enhance wildlife habitat on existing and planned golf courses, enhance the image of golf courses as sanctuaries for wildlife and encourage all those associated with the game to become more knowledgeable about environmental issues and take an active role in conservation practices on golf courses.

Several factors contributed to the decision to recognize the practices of The Honors Course.

The course was constructed in harmony with the existing site topography, thereby minimizing the negative environmental impact of excessive soil disturbance. Naturalized tall grasses are encouraged to grow in areas between greens, tees and landing areas. Native shrubs and tall grasses border the roughs, streams and pond shorelines. Nesting boxes for birds are located throughout the course and the superintendent, David Stone, an avid naturalist, has instituted several programs to help identify, monitor and encourage a variety of wildlife species utilizing the course environment.

Further information about this program may be obtained by contacting the Audubon Society of New York State, Inc. or the USGA.

Audubon Society of New York State, Inc.
Hollycock Hollow Sanctuary
Route 2, Box 131
Selkirk, New York 12158
(518) 767-9051

Five hundred limited edition prints, signed and numbered by the artist, are available for sale at a retail price of $195. Proceeds will be used to support the Audubon Cooperative Sanctuary Program. To order a print, contact the USGA order department (1-800-336-4446).

GCSAA Launches Recruitment Campaign

GCSAA's board of directors is seeking the participation of current members and affiliated chapter presidents in a new member recruitment campaign. The campaign "In Search Of" new GCSAA members began in September and runs through November.

The "In Search Of" campaign is designed to involve current GCSAA-member superintendents in promoting the international association's benefits to superintendents who are prospective members. GCSAA mailed a "how-to-recruit" package to all current GCSAA-member superintendents in late August.

The package includes a brochure that outlines techniques for approaching and signing up potential members, as well as copies of the "GCSAA and You" brochure. Recruiters may present this brochure to potential members to provide them with information about the association and its benefits.

At the same time, a separate mailing introducing GCSAA and its benefits was sent directly to prospective members, to help "pave the way" for current members' recruiting efforts.

Advertisements supporting the "In Search Of" campaign were scheduled for the September, October and November issues of *Golf Course Management* magazine. Articles about the recruitment effort will appear in *GCM* and *Newsline,* GCSAA's membership newsletter, during the three-month campaign.

For more information, contact GCSAA's membership department at 913/832-4480.

In Brief . . .

• **Some politicians and environmental groups are calling for a new approach to solving environmental problems.** "Market-based environmental incentives" would operate by making those companies that create environmental problems bear the total cost to society through higher product costs. Costs for waste generation by companies and individuals would be geared to the amount they produce. In the same respect, if a company produced a chemical that contaminated groundwater supplies, that company or companies that manufactured that product would pay for the total cost of cleanup. Keep a close eye on state legislators for market-based approaches that apply to golf courses and development.

1991 MGCSA Monthly Meeting Sites

Date	Location	Sponsor
Oct. 7	Hastings CC (lunch)	R & W Golf Cars
November (first wk.)	Weather permitting, Golf at Faribault G&CC	
November 20-21-22	Annual Conference Northland Inn	

GCSAA Expands Commitment International

The Golf Course Superintendents Association of America (GCSAA) has announced the formation of a new department to develop and implement programs for international members.

Tom Akins, GCSAA director of planning, will head the department and assume the new title of director of planning and international programs.

"This new department is part of GCSAA's commitment to share ideas about sound golf course management with the rest of the world," said John M. Schilling, GCSAA executive director. "For years, GCSAA has been the recognized leader in providing professional and educational opportunities for superintendents in the United States. Formation of this department will allow us to respond to increasing demands worldwide for these same opportunties."

The department already has started the process of surveying a wide range of superintendents, university researchers and golf industry representatives worldwide to ascertain specific course management needs.

"International requests for assistance and information have steadily increased over the last several years," noted Akins. "We're excited about the opportunity to focus our efforts on the international arena and provide tools for superintendents outside of the United States."

Akins noted that GCSAA will examine a number of programming options for interested superintendents and greenskeepers, including education, publications and trade shows.

"Many countries already have established golf federations and associations that are providing quality professional development for their membership," Akins said. "Our desire is to work cooperatively with those associations, lending our expertise while learning from their unique methods."

The addition of the department comes at a time when GCSAA is experiencing growth in its international membership. Of the more than 10,800 current members of GCSAA, 734 live and work in 47 countries outside of the United States.

Golf On Right Course Environmentally

A senior U.S. Environmental Protection Agency (EPA) official has said that America's golf industry must work with environmental authorities to seek "win-win solutions" that will ensure that the game's growth is not inhibited by concerns about development, pesticides and water usage.

Lewis Crampton, EPA associate administrator for communications and public affairs, told a group of golf industry officials that "golf is doing a number of positive things, (but,) if the industry is going to continue to grow. . . golf courses have to be environmentally friendly places."

He cited cooperative efforts by the EPA with the Golf Course Superintendents Association of America (GCSAA), including public education campaigns and efforts to reduce pesticide usage, as evidence that golf is "on the right course."

GCSAA President Stephen G. Cadenelli, CGCS, told the group that, "It's only natural that golf course superintendents be leaders in environmental stewardship."

1991 STODOLA SCRAMBLE RESULTS

Low Net

56.5
Oak Ridge C.C.
Team #28

Dave Zimmer
John Hawkinson
Keith Deason
"Red" Pelequin

57.4
Oak Ridge C.C.
Team #25

Jim Sinkel
Skeeter Lane
Steve Odegard
Scott Liestman

59.1
Oak Ridge C.C.
Team #20

Jim Lindblad
Carson Herron
Mike Sill
John Morgan

59.1
Oak Ridge C.C.
Team #33

Greg Hubbard
Norm Finch
Mike Lignay
Kevin Burke

59.2
Golden Valley C.C.
Team #29

Ron Noyce
Jeff Anlauf
Tom Lentz
Ron Grundyson

60.1
Golden Valley C.C.
Team #22

Tom Feriancek
Ben Barthlomeu
John O'Conner
Jeff Fox

Low Gross

61
Oak Ridge C.C.
Team #46

Brad Klein
Pete Lloyd
Bob Aekkerus
Bob Wagner

62
Golden Valley C.C.
Team #30

Norma O'Leary
Mike O'Leary
Jim O'Leary
"Bud" Chapman

63
Golden Valley C.C.
Team #24

Steve Schumacher
Dan Peterson
Steve Willock
Dan Nelson

63
Oak Ridge C.C.
Team #27

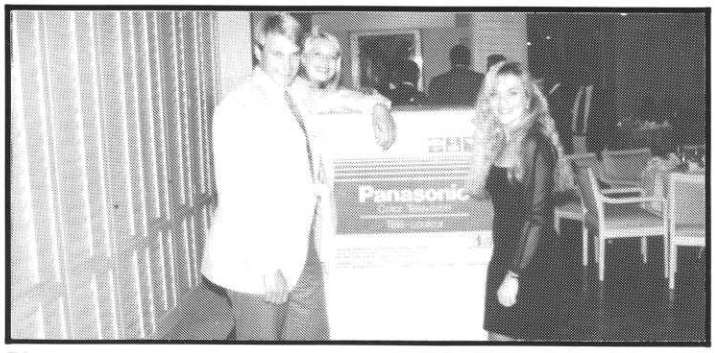
Shane Andrews
Ron Simon
George Vesley
Tom Evenson

63
Oak Ridge C.C.
Team #50

Doug Mahal
Jay Otterlei
Bill Jenkins
Jay Jennings

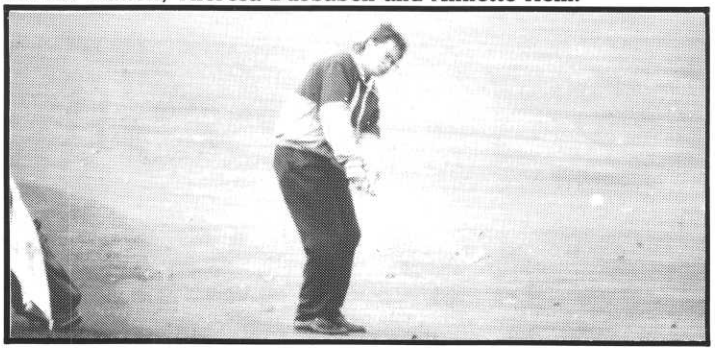
64
Golden Valley C.C.
Team #33

Dave Lohn
Joe Jacobson
Lou Wynia
Jad Bohnam

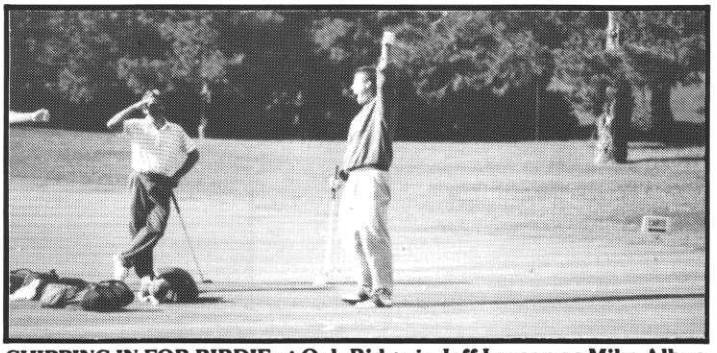


Big T.V. Winner Patrick Walton of Rolling Green C.C. with (L to R) Patrick Walton, Theresa Dusbabek and Annette Hein.

Bud Chapman, Minneapolis Golf Club.



Shane Andrews trying to put it close.



CHIPPING IN FOR BIRDIE at Oak Ridge is Jeff Larson as Mike Albus looks on.

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