TURF AND THE ENVIRONMENT

The failure to match material and demand results in unnecessary nitrogen loss. To prevent leaching, landscapers need to balance plant need with the type and amount of nitrogen to be applied.

by W. Michael Sullivan, Ph.D., University of Rhode Island

Since the early 1970s, pesticide and fertilizer use on turf has steadily increased, thanks in part to an expanded lawn care industry. The development of the turfgrass management industry in the neighborhoods of America has created an avalanche of questions about the safety of lawn care practices.

The obvious nature of the service truck in suburbia and rampant "chemophobia" creates many questions. Peoples' fears, together with a simple cause-and-effect viewpoint, have resulted in many communities and states instituting lawn care regulations and laws. While these fears are often real, in many cases they are based more on unfounded beliefs, fueled by media coverage that alleges the adverse effects of a product or application. Such titillating stories with emotional pleas cut at the heart of all peoples.

Cause for concern

The green industry and the public should see eye-to-eye on many points:

- Notification is warranted where individuals may be impacted.
- Clear and concise responses should be given to many questions.
- Industry representatives should be aware of research documenting the potential hazards and safety of their activities.

Yet the public must acknowledge that the growth of turfgrass management, with its high dependence on agrichemicals, increases the possibility of off-site losses and subsequent environmental contamination. Turf care chemicals are often applied in close proximity to cart paths, walkways, driveways and sidewalks, increasing the potential for surface runoff.

Turfgrass, especially in residential situations, is frequently established on thin, coarse and low organic matter soil material and therefore has a high leaching potential.

Nitrogen a major component

Fertilizer nitrogen is the single largest chemical used in most turfgrass management programs. Turfgrass managers need greater understanding and ability to answer questions regarding environmental contamination.

Excessive nitrate-N in water supplies can cause animal and human health problems. Nitrate-N is a drinking water contaminant with a U.S. Drinking Water Standard of 10 mg/1 (ppm). Mammals consuming water with elevated N levels can have a reduced oxygen level in their blood stream. Infants, pregnant and nursing mothers, young children and the elderly are susceptible to harm.

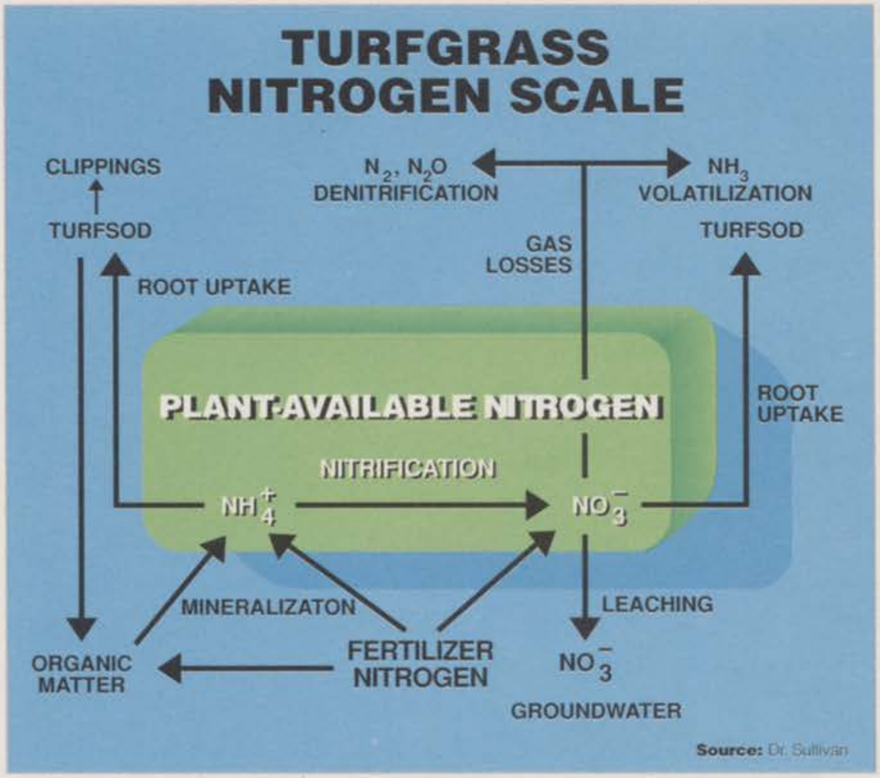
Nitrogen inputs to water, especially coastal bays and estruaries, have been found to accelerate eutrophication. Water quality degradation can result from N concentrations much less than the drinking water standard. Algae and water plants quickly respond to increased N with very rapid growth. This growth causes oxygen depletion which, in advanced stages, kills fish and plants resulting in strong odors and filling of the water body with decomposing materials.

Nitrogen movement

The first order of business in understanding the potential impact of N in the environment is to quickly review nitrogen movement in turf. Nitrogen readily changes form and cycles within the turfgrass. You can see the many places where N exists in Fig. 1.

The speed with which the fertilizer N transforms to nitrate N will vary with fertilizer form, soil temperature, and moisture. Quick-release materials like ammonium nitrate contain some nitrate at application but require little more than moist, warm soil and naturally

FIGURE 1.



occurring bacteria to transform all N to nitrate within several days.

Slow-release N

The slower release products are transformed to ammoniacal and nitrate-N in complex pathways. Generally the transformation involves overcoming either a physical barrier between the fertilizer and the environment or a requirement for a number of chemical and microbial transformations.

The traditional concerns of fertilizer selection should be expanded to include leaching potential. The information contained in Table 1 provides additional factors to consider when choosing one fertilizer form over another.

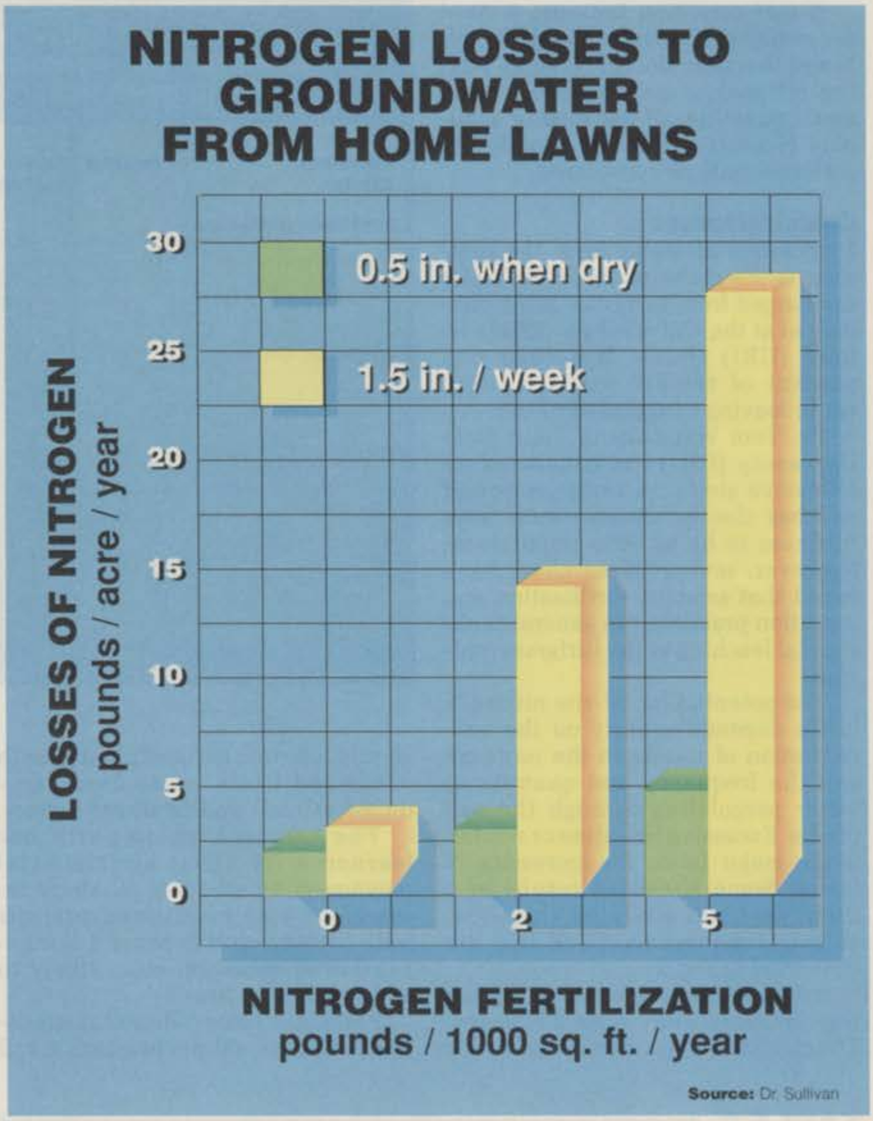
The leaching potential of a product is a result of the residual strength of the fertilizer N material and its nitrate evolution in relation to plant demand. Ammoniacal N can be absorbed by plants and microbes. It usually is not found in very great quantities because of almost immediate transformation to nitrate.

Mobile in soil

Regardless of the formulation applied, nitrate N that is not taken up by either growing plants or soil microorganisms moves readily with soil water. It is a mobile anion which moves rapidly from the root zone to groundwater.

The ideal match of turfgrass and fertilizer occurs when the fertilizer results in nitrate N production identical to plant demand. Nitrogen loss is minimized by having adequate N available during growth periods and little N available at rest or dormancy periods.

FIGURE 2.



Water management critical

Careful attention should be paid to soil water status at the time of, and immediately after, pesticide or fertilizer application.

To reduce potential of agrichemical losses, soil water should be maintained at a slight deficit. A small soil water deficit will not inhibit plant growth and will create a storage buffer to accommodate unanticipated heavy rainfall or excessive irrigation practice.

An irrigation program designed to maintain soil moisture at around 85 percent of field capacity would provide a modest storage capacity. In contrast, a turfgrass rootzone maintained at field capacity is a prime candidate to have all nitrate-N and other fully soluble and mobile elements readily flushed from it.

Any regular flushing of a heavily loaded root zone thus leads to lost fertilizer, lost investment and a high potential for environmental contamination.

—Dr. Sullivan□

Earlier this year Roch Gaussoin, Ph.D., in his article, "Early-season Fertilization" (LANDSCAPE MANAGEMENT, February, 1990) offered some recommendations on managing both cool- and warm-season turfgrass. His advice to match product, growth period and turfgrass needs was sound.

Dr. Richard Hull at the University of Rhode Island has conducted work that reinforces Dr. Gaussoin's comments. His project documents how different fertilizer materials can result in greatly different losses and that it's essential to consider balancing plant need and product.

Less growth, less N

Turfgrass that is not growing vigorously has reduced N need. The data in Table 2 clearly shows how the failure to match material and demand results in unnecessary nitrogen loss. The losses are expensive and attributable to excess nitrate supply in relation to plant demand.

If turf condition indicates a need for nitrogen, a program should be followed that provides for N needs. During off-peak growth periods, using small quantities of the readily available N sources that are rapidly absorbed should be considered.

Chemical losses

Percolation of water from the rootzone is the major pathway for water discharged from turfgrass. Work conducted at the University of Rhode Island (URI) shows less than one percent of rainfall and irrigation water leaving turfgrass as runoff.

Dr. Tom Watschke of Penn State University (PSU) has conducted an extensive study on turfgrass runoff and has clearly shown runoff from turfgrass to be of little importance. However, several researchers have found that selected fertilization and irrigation practices can generate substantial leaching of the turfgrass rootzone.

The potential for off-site nitrate-N losses depends entirely on the concentration of nitrate in the rootzone and the frequency and quantity of water percolating through the soil profile. Excessive irrigation or rainfall is the major factor for increasing N losses. Some N-related results of a three year URI study on irrigation, chemical management and turf are contained in Fig. 2.

Irrigation management is a great way to dramatically reduce N losses. The careful management of soil water should take into account plant growth needs and likely water needs, predicted rainfall and fertilizer history.

The research community has learned a lot about agrichemcial movement by studying N. Many researchers and monitoring projects have focused on N because it is inexpensive to measure, more likely to move and more heavily

Pesticides have different degradation pathways, affinity to attach to soil or organic matter, movement pathways and absorption characteristics by plants or microbes. A number of studies involving pesticide percolation, particularly with those thought to be highly mobile, have shown little to be concerned with.

Encouraging results

Recent work with 2,4-D and dicamba at PSU and the URI has shown only limited pesticide movement. Even rain or irrigation events which produced runoff or percolate immediately after application moved very small amount of product.

PSU efforts showed that only 1 to 2 percent of 2,4-D and dicamba moved if excessive rain or irrigation occurred shortly after application. Research at URI and a number of other locations identifies only very limited movement in percolate water.

The URI work followed the movement of 2,4-D and dicamba applied at rates up to three times the normal application. Over 90 percent of all water samples leaving plots with the higher pesticide rates contained no pesticide or less than 1 part per billion of contamination. Further work has shown that healthy turfgrass creates an environment ideal for the retention and degradation of these pesticides. **LM**

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TABLE 1.

Classification, burn potential, low temperature response and residential effect of common turfgrass nitrogen sources.

Fertilizer choice	N content %	Burn potential	Leaching potential	Low Temp Response	Residual Effect
Synthetic Inorganic					
Ammonium nitrate	34	High	High	Rapid	Short
Calcium nitrate	16	Very High	High	Rapid	Short
Ammonium sulfate	21	Very High	Mod. High	Rapid	Short
Synthetic Organic					
Urea	45	High	Mod. Low	Rapid	Short
Urea solutions	30	High	Mod. Low	Rapid	Short
Sulfer coated urea	35	Low	Low	Moderate	Moderate
Isobutylidene diurea	30	Low	Mod. Low	Moderate	Moderate
Methylene ureas	42	Low	Low	Low	M-Long
Ureaformaldehyde	30	Low	Low	Low	Long
Natural Organic					
Activated sewage sludge	6	Very Low	Very Low	Very Low	Long

Source: Dr. Sullivan

TABLE 2.

Total nitrogen loss due to leaching during the winter-spring season following a late fall application

GRASS	FERTILIZER*	NITROGEN LEACHED lbs/ 1000 FT^2	% lost
Kentucky bluegrass	NH_4NO_3	2.7	54.1
	Urea	0.7	13.6
	UF	o.2	3.8
Chewings fescue	NH_4NO_3	2.3	45.4
	Urea	1.7	33.1
	UF	<0.1	0.8
Perenial ryegrass	NH_4NO_3	2.0	40.0
	Urea	1.0	20.7
	UF	0.1	2.3

*N Applied at 5lbs/ 1000 FT on 16 November 1988. Hull 1989

Source: Dr. Sullivan