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Minimizing Nitrogen Losses

by Ralph E. Engel

Nitrogen costs and "darts from the environmentalists" for using nitrogen have become familiar to turf growers. But the fact remains, we cannot grow turf cover for vital areas without some use of nitrogen (N). Also, we know too much N can harm turf. As turf growers, we are on the side of conservative N use. Yet loss of this nutrient after applications on turf has had too little attention.

Fertilizer nitrogen is costly and its loss into the air or water is often a needless expense if not an environmental hazard. While those of us in turf are concerned with the environment, it seems fair to say, the relative threat and amount of nitrogen pollution from turf is not understood by many and is often blown out of proportion. If nitrogen must be reduced in the environment, other methods of solving this problem that do not block achieving valuable turf cover must be utilized.

This paper deals with nitrogen loss in both dissolved and gaseous states. We wish to help both professional and amateur turfgrowers minimize this loss.

Leaching of nitrogen causes our most common and severe losses of this nutrient. We have been correctly taught that soluble nitrogen caused the largest losses. Of this group, nitrates move most readily. Leaching of ammonium forms of nitrogen is much less by comparison.

Grass cover is efficient in reducing leaching of nitrates and other soluble nitrogen forms. The grass, soil organisms and organic matter of soil do this with surprising efficiency. Avoiding

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Reasons Why Preemerge Crabgrass Control Is Inconsistent

by Ralph E. Engel

While most everyone in turfgrowing appreciates the usefulness of preemerge crabgrass herbicides, we often suffer the disappointments of poor or no control. How much can we expect and how can we get the best possible results? As with all things biological, the answer is complex.

I will list a variety of factors that are involved in the success and failure with preemerge. You the reader may wish to give thought to several which concern your program.

Some of the factors that influence performance of our preemerge herbicides are:

(1) Differences in herbicidal efficiency.

(2) Differences in herbicidal persistence.

(3) Differences in herbicidal solubility and movement.

(4) Differences in reaction of the turfgrasses. Oxadiazon, which is very risky business on bentgrass, is one of the most effective on Kentucky bluegrass-ryegrass. Siduron, which is not strong on control, is considered the only safe preemerge for new seeding. Use preemerge carefully on new varieties and species of grass.

(5) Soil differences. Sandy soils warm more quickly and thus may need treatment earlier. Soils high in clay and organic matter slow the movement of herbicides. Differences in soil pH will affect the action of some herbicides.

(6) Thatch material will fix some herbicides, and also will influence temperatures that determine germination.

(7) Methods and rate of application. Apply within the recommended rates. Repeated applications may be helpful for difficult areas, such as places with thin turf or heavy traffic. But they should be limited to trial uses of the safer preemerge turf conditions. Most repeat application tests have not offered general promise.*

(8) Either granular or spray applications work for some preemerge herbicides. Several have performed best with granular preparations and a few fail as a spray.

(9) Temperature has various effects on the herbicide, germination of the seed and the crabgrass seedling.

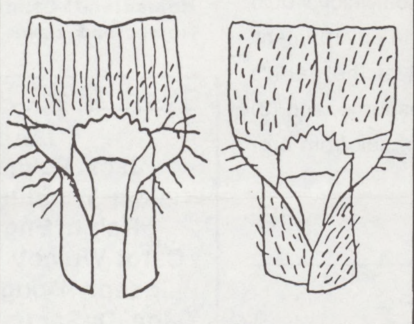
CLAUDE PHILLIPS

Figure 1. Schematic drawing of the ligule areas of Crabgrass Digitaria ischaemum (left), which germinates earlier than D. sanguinalis.

(10) Timing the application with the season. The correct time is narrower for some herbicides than others.

(11) Formation of the preemerge barrier — a chemical shield is needed at the proper depth to control the germinating crabgrass. While research on this aspect is largely lacking, it seems appropriate to have a modest "watering-in" to get the herbicide to the soil surface and disperse the chemical into a continuous barrier. In tests I have conducted, it appeared that several herbicides required application

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* More will be given on rate, date, and methods of preemerge application in a 1989m issue of Greenworld.

OPINIONS AND COMMENTS

Turf Nitrogen
—An Environmental Plus—

Nitrogen is an element of living tissue and abounds in the earth's atmosphere. Large portions of nitrogen that accrue in turf from many sources are immobilized in the sod. Nitrogen applied to turf in small apllications is held with great efficiency as compared with cultivated crops. The total nitrogen escaping from turf sod is small compared with nitrogen fixed naturally in the soil, contained in rainwater and wasted food, produced by combustion motors, or washed from natural plant foliage. The quantity of nitrogen from these and other sources greatly exceeds that used on turf. While considerable nitrogen can be carried in water, when has a dangerous case of nitrogen poisoning been found in New Jersey? Turf does not appear to be a logical or major contributor to nitrogen problems.

While nitrogen losses from turf do occur, banning turfgrass cover is not justified where this commodity is needed (1) to fix nitrogen in topsoil which would otherwise escape into the environment, (2) to aid development of the earth's most valuable topsoil resource, and (3) to protect many acres of soil from erosion

♦ REE

Grow angry slowly —
there is plenty of time.
Ralph Waldo Emerson

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Washington Twp. Parks & Recreation
Westside Gardens
Wilfred MacDonald, Incorporated
Wilpat Turf Sprinklers, Incorporated
Woodbridge Center
Woodruff/Lerco Lawns of So. Jersey
World Class Lawns
Yardley Country Club

OPINIONS AND COMMENTS

Turf Survival — 60th Anniversary —

One thing that has not changed with turf over the years is the discussion by growers of the ravages of summer and the comparison of past good and bad summers. In earlier years of Green World and before, I commonly discussed "the horrible 100 days" (longer for those in more southern latitudes). I recall one season when New Jersey had over 30 days with 90° F. or above. Since we experienced a record-smashing number of these days in 1988, this year might well be called "the year of the devil" weather. Weather in the 90° F. range may not sound severe to those who grow bentgrass in more southern latitudes. We sympathize with these folks, but the long periods of 90-100% humidity on the mid-Altlantic coast with 90-95° F. are "no picnic."

The 1928 season has always been considered the worst failure year for golf turf. It was so bad that golf courses asked for research and classes on turf. I knew a few veterans of 1928 in my first years. They never forgot that experience and attended classes and meetings faithfully throughout their careers.

The bad season of 1988 had a surprising number of courses with no serious turf loss. This would not have happened without the improvements in turfgrowing that have occured since 1928. Some of the improvements include better waters systems, better disease and insect controls, better grasses, and most of all, golf course superintendents' greater expertise on how to use these things. I do not wish to belittle those earlier golf course superintendents. They deserve the greatest respect for their diligent labor, their tremendous dedication and their spark that started turfgrass research and education in New Jersey. Those men of 60 years ago deserved a medal.

Unfortunately, the research and necessary knowledge are far from complete on growing fine turf. Added to this is the nature of the work which demands a balance of very delicate decisions.

There is a trace of luck in maintaining consistently high quality fine turf. This means most superintendents can scarcely go through days, weeks or months of difficult summer weather without struggling or suffering some turf failure.

While new techniques will develop and some may contribute greatly, fine turf is so delicate that it will always be necessary to use the greatest care with watering, disease control, nitrogen use, mowing, use of chemicals and new techniques. Nevertheless, pinpointing the cause of turf problems still holds benefits. The 1988 summer was not the wettest on record, but some turf suffered from poor drainage during the rains of late July. Most golf courses can benefit from off-season drainage correction or improvement in their irrigation system. These strategies can help your work through the "thrills" awaiting you in the 1989 season.

◆ REE

"Will the Earth's Greenhouse Problems Please Stand Up"

We have heard "acid rain" and the "protective ozone layer" mentioned as probelms for the earth and its inhabitants. Scientists report that methane, a trace gas of the atmosphere, has doubled in recent years. It is consdered second only to carbon dioxide as a contributor to the "greenhouse effect." This layer absorbs heat that would escape into space. Decaying organic matter in wet areas produces methane. The acreage of rice paddies is increasing one per cent per year. Ruminants contribute. It is estimated that cattle lose fifteen percent of their dietary energy as methane. Scientists from the National Center for Atmospheric Research in Boulder, Colorado estimate termites to be responsbile for 25 to 30 percent of the methane in the atmosphere. A study in Texas indicated the weight of termites below ground was greater than the weight of cattle above ground.

Studies and estimates of recent years tell us about different layers in the atmosphere that may change. Can our society fathom the true nature of these atmospheric horizons and can it find ways of managing them? A bigger question might be, "How fast are these changes developing?"

◆ REE

God only asks for 10% of my income, what right does the government have to ask for 30% or more?

Reasons Why Preemerge Crabgrass Control Is Inconsistent

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some days before germination. Others seemed effective when applied closer to crabgrass seedling emergence. Still others appeared to kill by blocking rooting of the crabgrass seedling. In several tests, we were unable to demonstrate major loss of preemerge control by cultivation before or after the herbicide treatment. Added research seems certain to find that cultivation under specific conditions could show reduced crabgrass control. Thus, it seems best to avoid spring cultivation as far as possible when preemerge is used.

(12) While rain or irrigation may serve a purpose in initiating the herbicide action, excessive amounts can leach the preemerge barrier too deep for crabgrass control. Since preemerge herbicides have low solubility, they tolerate appreciable rain or watering. Much research is needed on the amount and timing periods of watering for best results.

Analyzing and Dealing with Poor Results or Failure with Preemerge Programs

When a preemerge does not live up to expectations, several possible explanations include:

•••Preemerge program may be disappointing because the best herbicides do not commonly give 99-100% control. Review the herbicide types for next year.

•••Indeterminate germination that gives several crops of crabgrass seedlings, such as in 1988, occurs frequently in this region. These conditions are far more difficult than seasons with only one flush of germination in May.

•••A lack of consistent and good turf cover can give continuous germination.

•••A high cut or longer unmowed turf may interfere with best results.

•••The prescribed rate of chemical application or other procedures are wrong.

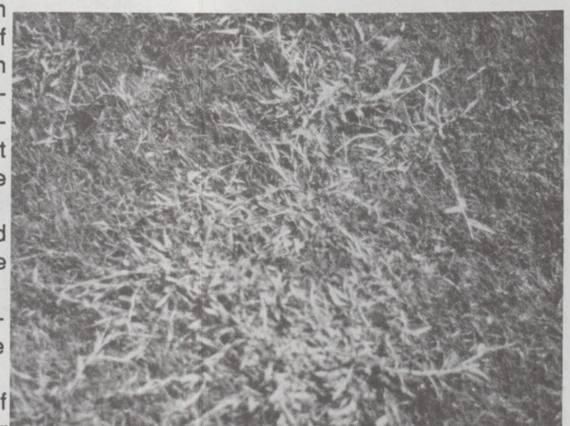

Figure 2. Crabgrass can be prevented from surviving to this size.

Give Preemerge Some Postemerge Help

If the preemerge shows poor control in June and early July, remember the postemerge fenoxaprop-ethyl (Acclaim) gives control of young crabgrass plants. This herbicide can control the young crabgrass that would grow through the rest of the season. This chemical has a good safety margin on the Kentucky bluegrass-ryegrass type turf.

Preemerge crabgrass herbicides are here to stay. A few new and better ones will become available. And with more research and experience, some of our present herbicides can be more useful. We have heard the old familiar recommendation of growing better turf for crabgrass control. This is true, but preemerge gives us a powerful tool to reach the best of control — namely, total control.

•REE

The passion for equality produces uniformity which produces mediocrity.

— Alexis DeTocqueville

Look wise, say nothing, and grunt. Speech was given to conceal thought.

— William Osler

It is a bad plan that admits of no modification.

Minimizing Nitrogen Losses

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large totals of nitrogen in a single application and "watering-in" with only moderate amounts of water or rainfall reduce leaching loss.

Slow release nitrogen can reduce leaching loss, but it does not give more overall growth in many cases. It can release nitrogen when turfgrass may not need it. Also, it is difficult for the grass and soil organisms to get the last bit of slow-release nitrogen (it is estimated that natural organic carriers will retain 1-1.5% nitrogen in the soil after use). While using smaller applications of nitrogen and "proper watering-in" will reduce leaching loss, there can be agronomic benefit from the smaller, more frequent applications on tender fine turf.

Nitrogen loss in runoff might be classed a leaching loss. As water accumulates on the surface it may carry dissolved nitrogen or sweep (or float) off nitrogen-bearing particles. Good turf cover buffers and cleanses water runoff. Timing nitrogen application with light "watering-in" or with smaller rains helps control this loss.

Gaseous Losses of Nitrogen

Denitrification occurs in soil when oxygen is deficient and soil bacteria separate this component from nitrogen compounds and release nitrogen. Wet soil, stagnant wetness and intense organism activity increase the chance and severity of the problem. No clear figure can be assigned for nitrogen loss from denitrification. It will vary with amount of nitrogen present and the persistence of conditions required for the process. Usually, the losses occur quickly, during a short period of time. With favorable conditions, losses from nitrogen applications can run as high as 40-93% (3).

What are the causes and what can turfgrowers do to minimize this form of nitrogen loss? The denitrifying bacteria develop readily in turf, agricultural fields and in other soils. Most of us have observed the yellowing of plants in spots that stay flooded in corn or tomato fields. These examples demonstrate the importance of drainage and avoiding saturated soils. More specifically for turf, the work of Mancino et al. (3) gives some guides pertaining to turf. They showed denitrification losses increase as soil water increases toward saturation and temperature increases up to 86° F. This potential loss is often overlooked, and is a good reason for reducing excessive wetness of turf soils.

Nitrogen volatilization from urea has been recognized almost from the time of its early use. This type problem was reported in considerable detail 30 years ago (2,5). Losses of 30% from urea fertilization are not uncommon and can reach 50%. Recently, ammonia volatilization has received study as related to turfgrass culture. Some of the conclusions that give guidance on reducing this type loss of nitrogen are:

(a) Ammonia losses were higher from granular than from dissolved urea in most cases (4). Weseley, et al. (6) reported high ammonia volatilization losses from foliar applied urea rather than soil-applied urea where moisture levels favored initial urea hydrolysis and subsequent drying. Volk et al. (5) in an earlier study with urea on bare sandy soil of Florida reported serious losses of nitrogen.

(b) Ammonia volatilization is more severe under alkaline conditions.

(c) Ammonia loss from Kentucky bluegrass cultures increased in controlled growth chambers as temperatures increased from 50° to 72° F. (4).

(d) Ammonia losses from urea in solution on Kentucky bluegrass turf at 68% relative humidity (r.h.) were greater than at 31% r.h. Losses from granular urea were not affected by humidity (4).

(e) Major losses of ammonia from urea applications occur quickly, usually within 24 hours (1).

(f) Bowman et al.(1) reported 36% loss of nitrogen from urea without watering-in. A 3-8% loss and a 1% loss occurred with prompt watering of 0.4 inch and 1.6 inches respectively. Titko et al. (4) reported decreased ammonia losses by watering-in with one inch of water following application.

(g) High nitrogen loss from urea occurs with thatch in Kentucky bluegrass turf.

(h) Weseley (Nebraska) et al. reported high moisture levels on plant tissue (field grown Kentucky bluegrass) favored initial urea hydrolysis (6). Subsequent drying favored ammonia loss. Titko et al. (Ohio) (4) reported a surge in ammonia volatilization following periodic wetting on cultures receiving liquid ammonia

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Minimizing Nitrogen Losses

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treatments in controlled growth chambers. This was not significantly apparent with granular urea application.

Summary

Volatilization of ammonia can give a major loss of nitrogen from turf. This type of loss is most serious with wetter soil, high temperature and thatch. On many turf sites, something more than 1/4 inch of watering is needed promptly to move fertilizer that generates ammonia into the soil. How is your luck in timing fertilization with proper rains?

This paper has emphasized volatilization losses more than leaching and denitrification. Of course, we are not deemphasizing the latter. Moderate watering and drainage are important in minimizing these turf problems. While totals for these two types of losses are difficult to establish, I would speculate that with New Jersey rainfall and irrigation, denitrification totals are higher than anticipated.

The references used in this article are given for those of you who wish to give more study to nitrogen losses.

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