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Calcium Nitrate Promotes Best Perennial Ryegrass Stand

By Min Liu

Many different sources of N (nitrogen) are used in the turfgrass industry. They are generally classified as quick-release and slow-release sources. Quick release N sources are water soluble and contain N in the NO_3^- (nitrate) or NH_4^+ (ammonia) form. Nitrate-N is immediately available for plant uptake but is also easily leached from the soil. Ammonium nitrate is less prone to leaching but more prone to volatilization.

Nitrification of NH_4^+ to NO_3^- is fairly rapid in most soil conditions, and acidity will be generated during the process. Plant uptake of N in the form of NH_4^+ verses NO_3^- will have consequences on the pH of the surrounding soil solution. Riley and Barber (1969) reported a pH increase of the root-soil interface environment was associated with the supply of NO_3^- in the soil solution.

Different N sources and rates influence turfgrass growth. Hummel (1980), using several N sources, reported that 97 kg of N per hectare provided darker color and more rapid establishment of Kentucky bluegrass than 48 kg of N per hectare. Root growth will increase as N levels increase above zero (Canway, 1984). However, high levels of available N will stimulate shoot production and growth, thus limiting the quantity of stored carbohydrates available for protein synthesis. High available N has been shown to cause a distinct suppression in root growth (Schmidt and Blaser, 1967). The objective of this study is to investigate the effect of N source and rate on perennial ryegrass shoot growth, tissue N concentration, turf quality and sand media pH.

Material and methods

Ammonium sulfate [$(NH_4)_2SO_4$], ammonium chloride (NH_4Cl) and calcium nitrate [$Ca(NO_3)_2$] were the three N sources used. Four rates of each N source were selected: 2.5; 5; 10; 20 grams N per square meter. Treatments with three replications were arranged in a randomized complete block design. USGA-uncoated sand was used as the growth medium. The container was 6-inches tall and 6 inches in diameter with five small holes at the bottom for free air exchange. Calculated quantity of water was added to each pot to bring the water content to the field capacity. The moisture level was maintained approximately at 80 percent field capacity during the whole study period.

Ryegrass seeds were applied at 2.1 grams to each pot for germination. Fertilizer treatments were applied to corresponding pots in liquid form with a hand held boom sprayer four days after seed germination.

Clippings for dry matter production were taken twice during the study, once the dry matter production reached harvestable quantities. The turf quality was recorded each time prior to the harvest. Turfgrass was clipped at about 8 millimeters with hand scissors. Plant tissue was dried at 70 degrees Celsius for a period of 48 hours, ground to 2 mm mesh size. Total N in plant tissue was analyzed.

Soil samples were collected at the end of the study by taking a single core sample (3-centimeter diameter) from each pot. Soil samples were air-dried and screened through a 2-mm sieve. Soil was analyzed for pH (2:1 water to soil ratio). Statistical analysis was performed using SAS for Analysis of Variances (SAS institute, 1987). Single degree of freedom contrasts were used to separate the means based on the general linear model procedure.

Influences of N source and rate

The tissue N concentration increased with the increased N applications from 2.5 grams to 20 grams N per square meter across all three N sources (Figure 1).

The highest tissue concentration was 5.6 percent gained by application of NH_4Cl at rate of 20 grams N per square meter. The contrast procedure in the statistical analysis software revealed that the growth rate and N uptake were significantly influenced by N source with a statistical p value, representing the probability of error, of less than 0.01 (Table 1). The NH_4Cl treated pots gained the lowest growth rate and $Ca(NO_3)_2$ treated pots had the highest growth rate among the three N sources, which may explain the general low tissue N concentrations when subject to $Ca(NO_3)_2$.

Tissue growth rates with application of NH_4Cl fell continually with higher N rates from 2.5 grams to 20 grams N per square meter. This might be due to toxicity of NH_3 volatilized from NH_4^-. Tissue growth rates decreased with $(NH_4)_2SO_4$ rate increased from 5 to 10 grams N per square meter. This observation was against Hummel in 1980, who reported faster establishment of bluegrass with 10 grams N per square meter than 5 grams N per square meter. This was possibly due to water stress after the first harvest in our study.

The first harvest was taken on Friday, and the pots were subject to a very hot weekend. The pots with higher N rates experienced water shortage because of the elevated osmotic water potential in rootzone. Moreover, the higher rate N application led to good top growth but limited root growth before the first harvest. When subject to water stress it was difficult for limited roots to absorb restrained water they needed.

For the treatments with $Ca(NO_3)_2$, growth rate increased with the increased N rates from 2.5 grams to 10 grams N per square meter, but decreased dramatically from 10 grams to 20 grams N per square meter because of elevated salt stress when water was limited. Compared to $(NH_4)_2SO_4$, the detrimental effect of salt stress was relatively mild because $Ca(NO_3)_2$ has much smaller salt index value.

The NH_4Cl treated pots took up an average 1.4 grams N per square meter across all N rates, which was the lowest compared with 1.9 grams and 2.4 grams N per square meter for $(NH_4)_2SO_4$ and $Ca(NO_3)_2$ respectively. Perennial ryegrass N uptake as influenced by N rate was shown in Fig. 3.

Higher N recovery occurred in the clippings with N application of 2.5 grams N per square meter compared with higher rates of N application. Multiple N applications with relatively small amount each time were beneficial for N recovery in plant uptake. For $(NH_4)_2SO_4$ and $Ca(NO_3)_2$, N uptake increased with N rates from 2.5 grams to 10 grams N per square meter and then decreased from 10 grams to 20 grams N per square meter, suggesting that N application gained no growth beyond the rate of 10 grams N per square meter. For NH_4Cl, N uptake decreased continually with N rate increased from 2.5 grams to 20 grams N per square meter, which was possibly resulted from NH_3 toxicity and elevated salt stress in rootzone.

Turf quality and media pH

Analysis of variance revealed that the turf quality was significantly influenced by N source and rate at probability level of 0.001. Application of $Ca(NO_3)_2$ gained the best turf quality on average with value of 6.8, compared $(NH_4)_2SO_4$ 4.9 and NH_4Cl 3.4, respectively (Figure 2).

FIGURE 1

Ryegrass tissue N concentration as influenced by N source and rate

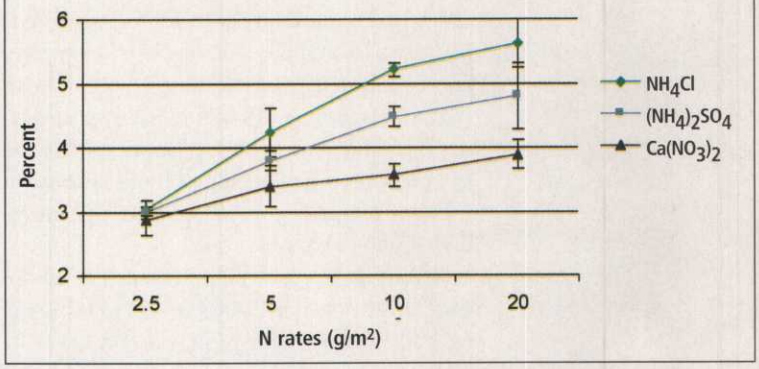


FIGURE 2

Turf quality as influenced by N source and rate

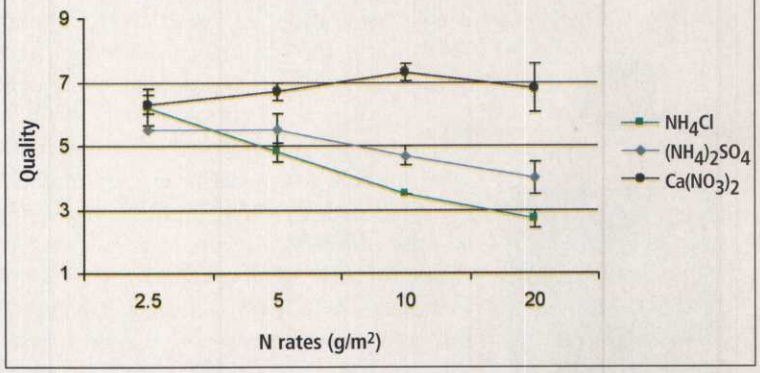
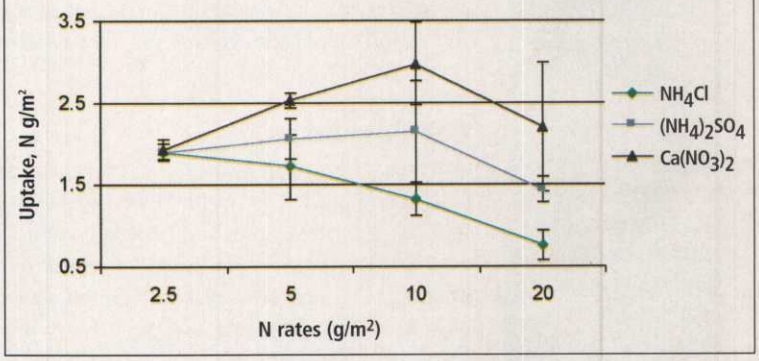


FIGURE 3

Ryegrass N uptake as influenced by N source and rate



The best turf quality on individual treatment was 7.3 attained by application of $Ca(NO_3)_2$ at rate of 10 grams N per square meter. Use of $(NH_4)_2SO_4$ and NH_4Cl in this study generally led to nonsatisfactory turf quality, particularly

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when high rates were applied. This observation was possibly due to higher salt index values for $(NH_4)_2SO_4$ and NH_4Cl and toxicity of NH_3 volatilized from NH_4^+. Therefore, when subject to water shortage and salt stress, N sources with high salt index values like NH_4Cl should be avoided. High rate of NH_4-N applications were not recommended in high pH soils because of NH_3 volatilization, which could be concentrated enough to be toxic.

Analysis of variance revealed that at the probability level of 0.0001 media pH was significantly affected by N source and rate.

The pH of USGA sand was 6.5. At the end of the study, media pH treated with NH_4Cl and $(NH_4)_2SO_4$ dropped to 6.0, while media pH treated with $Ca(NO_3)_2$ rose to 6.8. The media pH dropped with NH_4Cl and $(NH_4)_2SO_4$ application. This was expected because of nitrification process, in which H^+ ions were generated.

Furthermore, plants would exude the H^+ ion when the NH_4^+ ion was taken up. The media pH increased with $Ca(NO_3)_2$ application, which was also reasonable because plant roots would exude OH^- for NO_3^- uptake. For $Ca(NO_3)_2$ treatments, pH slightly increased with N rate increasing from 2.5 grams to 5 grams N per square meter, stayed unchanged to 10 grams N per square meter, and then dropped dramatically after 10 grams N per square meter. This pH changing pattern matched quite well with the corresponding uptake pattern, which suggests the reason for pH change was root OH^- exudation from NO_3^- uptake.

Conclusions

Among the three selected N sources, $Ca(NO_3)_2$ application gave the best turf quality, greatest growth rate and N uptake, which suggests it is a good N choice for perennial ryegrass subject to salt stress and limited water conditions. High N rate of 20 grams N per square meter was detrimental to turf growth.

High rates of NH_4Cl application were not recommended in any circumstance. N source of $(NH_4)_2SO_4$ might be good, but problems in situations with salt stress and water shortage should be anticipated.

Higher N recovery occurred in the clippings with N application rate of 2.5 grams N per square meter compared with higher N rates, suggesting multiple N applications with relatively small quantity each time were recommended for the best N management practice.

Min Liu is a graduating Ph.D. student in the Soil and Water Science Department at the University of Florida, which supported this research. Liu's interests include soil fertility and turfgrass nutrition.

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TURFGRASS TRENDS

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The Company Line

PRODUCTS & SERVICES

The trade-show floor at the Golf Industry Show was busier than a Burger King at lunchtime. Companies made announcements and introduced new products. Here's some of the company news that went on:

▲ Agrium Advanced Technology Debuts

Agrium Inc. made its debut at the Golf Industry Show with the announcement that it's changing its name to Agrium Advanced Technology "to provide smarter ways for our associates and customers to do business," said David Pursell, Agrium Advanced Technologies' vice president of marketing and new product development.

Calgary, Alberta-based Agrium Inc. merged with Pursell Technologies Inc. and Nu-Gro Technologies in the past two years to form what the company calls a new strategic business unit. The company felt its new specialty division needed a new name and a new logo. "Our new name and logo are designed to incorporate the brand awareness of Agrium while creating a distinct and exciting new look for this integrated, unified business segment that is greater than the sum of its parts," Pursell said in a press release.

For more information, visit http://www.agrium.com.

▲ Insecticide Arrives

Meridian has been a long time coming. **Syngenta's** new insecticide received approval after several years from the Environmental Protection Agency shortly before the show. "We worked hard for it," said Joe DiPaola, Ph.D., golf market manager for Syngenta. "We feel good about the timing. It's a solid addition to our portfolio."

Meridian, based on the active ingredient thiamethoxam, controls a broad spectrum of grubs and other insects at low rates through contact and ingestion activity, according to Syngenta. Insects controlled include billbugs and white grubs, Japanese beetles, oriental beetles and European, Southern and Northern masked chafers. It also controls aphids, whiteflies, mealybugs and leafhoppers.

For more information, visit http://www.syngentaprofessionalproducts.com.

New Generation of Seed

Barenbrug USA announced it selected patented Zeba brand seed-coating technology from Absorbent Technologies Inc. (ATI) as part of a new generation of bermudagrass seed. The new Barbados bermudagrass from Barenbrug USA is now available with the Zeba technology built-in to increase germination and improve the seed establishment. Known for its dark-green color, Barbados exhibits a dense sward and strong winter survivability, according to the company. Developed from natural cornstarch, Zeba is the first starch-based, seed-coating treatment available specifically for improved turf production by creating a healthy microenvironment around the seed.

For more information, visit http://www.zeba.com.

▲ Fungicide Approved

BASF announced that triticonazole fungicide received registration from the EPA for broad-spectrum disease control in golf course, commercial and residential lawn care, sports turf and sod farms. BASF is calling the fungicide Trinity. A member of the demethylation inhibitor (DMI) class of chemistry, Trinity fungicide offers excellent preventive and curative control of patch diseases (brown, take-all and summer), anthracnose and dollar spot as well as pink and gray snow mold in northern turf. Trinity fungicide is ideal for disease control on turf, including fairways, BASF said.

Toni Bucci, Ph.D. and business manager for BASF, said the company acquired the rights for the molecule when the company acquired Fipronil from Bayer Environmental Science.

"We're diligent about meeting the needs of our customers," Bucci said. "It doesn't have to be with our own chemistry. If we can do it through an acquisition, that's what we'll do.

For more information, visit http://www.turffacts.com.

Green It Up

Roots Fe Chelate, a water-soluble iron chelate, was introduced from **Novozymes Biologicals**. It's the newest green-up solution for all types of turf, landscape, nursery and arborist professionals. Providing an 18-percent concentration of fully chelated iron in a highly soluble form, Fe Chelate is a dry-powder form of citrate-based chelate fertilizer. The key benefit to the easy-to-handle product is that while it works to improve plant color, it will not harm or stain other surfaces, including concrete, according to the company.

For more information, visit http://www.rootsinc.com.

Broad-spectrum Fungicide

Peregrine fungicide is the newest addition to **Phoenix Environmental Care LLC's** line. Peregrine is a broad-spectrum fungicide that controls most major diseases including anthracnose, dollar spot, large brown patch, helminthsporium, pink and gray snow mold and gray leaf spot.

▲ Insecticide

DuPont Professional Products offers Provaunt insecticide, an insect-control solution that provides turf managers with a new chemistry and mode of action for quickly controlling a wide variety of caterpillars and other key pests. Featuring a new active ingredient, new physiological reaction, low application rates and an active ingredient classified as reduced-risk by the EPA, Provaunt will provide effective control of many insect pests including multiple caterpillars, mole crickets, annual bluegrass weevil (ABW) larvae (curative application), European crane fly larvae, potato leafhopper, grasshoppers and European pine sawfly.

Indoxacarb, the active ingredient in Provaunt, is a member of a new class of chemistry, the oxadiazines. Most turf and landscape ornamental insects have never been exposed to this class of chemistry, DuPont said.

For more information, visit http://www2.dupont.com.

Peregrine is a combination of two proven active ingredients — chlorothalonil and thiophanate-methyl. This means that Peregrine has both systemic and contact activity.

For more information, visit http://www.phoenixenvcare.com.

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the $1 car

THE CLUNKERS WE AFFECTIONATELY DISPARAGE EVOKE NOSTALGIA OF A SIMPLER TIME

BY MARK LUCE

On May 20, 2000, I was flying high. The previous day was my 30th birthday, my girlfriend (later to be wife) graduated from college, the enormous party we threw was a hit … and even the cops who came were nice.

That afternoon, I hopped in the car, a red 1986 Honda Prelude (bought for $500), blasted Lucinda Williams' "Car Wheels on the Gravel Road," put on my shades, rolled back the sun roof and headed out on the back roads to Kansas City — AC on, windows down. All was good until the off-the-beaten path ended, and I was forced onto the highway. Within a mile, the red car was dead, victim of a busted timing belt that would run me a grand that my bank account didn't possess.

So I bought a car for a dollar.

I loved it.

There's a picture of it above. It was white with rust highlights, a 1979 Toyota Tercel. It lasted me nearly three years with nothing spent on it but gas and oil. My buddy Charles and his wife, Laura, sent it my way. Laura bought it years before in Terre Haute, Ind., when her car bit the dust on a trip back from law school. They insisted on gifting it on the title; I insisted on paying a token amount — one buck.

The dollar car drove like a dollar car.

The handling was atrocious, with U-joints a-squeakin' and wheels a-rattlin'. The tape deck didn't work; the radio could only pull a couple of FM stations, and the speakers turned what came out of the radio into a sound that resembled Charlie Brown's teacher. The brakes required the force of Fred Flintstone, and the steering wheel shook like a jackhammer. The transmission would labor; the doors wouldn't lock; the glove box wouldn't open; the emergency brake didn't work; I could see the ground when I lifted the floor mats, and the keys would literally fall out of the ignition while I was driving. Once you could bring the beast to a halt, you would have to hold in the brake, fish along the floor for the keys and then reinsert the key to shut it off.

I loved driving it, and to this day it's still the best car I have ever owned.

Eventually, we moved to L.A., so I sold it to my friend Byron for $2. We moved right back, so he sold it back to me for $4. I drove it even after my first child was born until it became clear the now $4 car was unfit for normal travel.

One afternoon I sat on the porch, and a random fellow flat-out offered me $200 for the thing. I told him I would take $100 — even though I felt odd about it, as technically I should have sold it for $8. A week later he walked by and reported that the back axle had broken in two.

Lucky me, as that C-Note was worth about 400 diapers. And memories of the dollar car bring at least that many laughs.

Mark Luce lives in Kansas City, where he's never had a car payment, nor plans to until he buys his Cadillac.

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