Optimization of Foliar Nitrogen Nutrition to Improve Turf Performance Under Energy Stress

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Objectives:

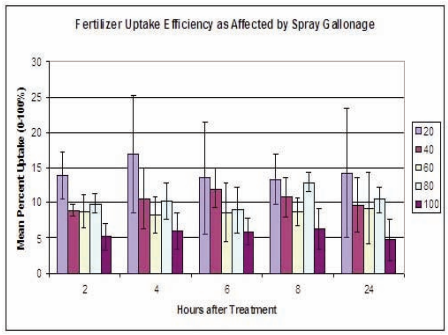
1. To determine the efficiency of ammoniacal-N uptake in the field from foliar feeding, particularly when done in combination with other turf care products.
2. To determine the positive or negative benefits of foliar ammoniacal-N applications on highly managed turfgrass
3. To determine fertilizer use efficiency through foliar feeding versus conventional fertilization.
4. To determine the effect of foliar ammoniacal-N applications on root and shoot growth, development, and performance in the field
5. To determine if the practice of foliar application of nitrogen fertilizer to a crop that has a portion of its foliage removed frequently is useful.

Start Date: 2007
Project Duration: three years
Total Funding: $88,810

Plants primarily assimilate nitrogen through root uptake of nitrate from the soil solution. Plants must convert nitrate to ammonia before it can be incorporated into nucleic acids, proteins, and other nitrogen containing compounds. It is estimated that plants can use almost 25% of their photosynthetically derived energy in this conversion process.

One possible way to reduce this energy-intensive process is to provide nitrogen in the ammonium form, typically as urea or ammonium sulfate. Our research seeks to understand the practice of foliar fertilization and determine the positive or negative impacts of this process. By applying fertilizers enriched with a stable, non-radioactive isotope of nitrogen (^{15}N) as a tracer, nitrogen use can be directly tracked throughout the plant.

Beginning in early 2008, we analyzed the tissue from several experiments conducted in the summer of 2007 that compared urea and ammonium sulfate applied to creeping bentgrass maintained at a 0.5" height of cut. The application rate of each fertilizer was 0.2 lbs N/1000 ft^2 with a spray volume of 40 GPA. Studies on the time course of ^{15}N absorption suggest that nitrogen applied to the foliage is absorbed by the plant within 4-6 hours. We have measured uptake efficiencies from 10-35% under field conditions, suggesting that uptake efficiency in the field can be quite variable.



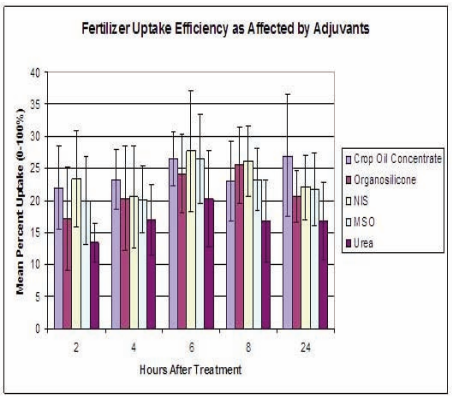
Mean fertilizer uptake over a 24-hour period as affected by spray gallonage (20, 40, 60, 80, and 100 GPA). Error bars indicate one standard deviation.

Our studies to determine the effect of spray gallonage on uptake efficiency indicate that lower spray gallonages increase uptake of foliar applied N. Results suggest that applying fertilizer at gallonages above 20 GPA does not result in significant foliar feeding.

Studies to determine if tank-mixing adjuvants with fertilizer would increase uptake efficiency indicated that the addition of an adjuvant to foliar-applied fertilizer significantly increased uptake efficiency although results did not indicate that a particular class of adjuvant is most effective. Results of other tank-mixing studies suggest that tank-mixing of fertilizer with other leaf-applied chemicals may affect uptake efficiency.

In the summer of 2008, we initiated a field study to determine whether foliar applications of NH_4-N have a positive effect on plant metabolism. Plots of creeping bentgrass (*Agrostis stolonifera* L. 'Penn A-4') were maintained at three heights of cut, 0.125, 0.1 and 0.085", on a native soil putting green topdressed (10-day intervals) with sand and treated with foliar nitrogen. Foliar urea (as an NH_3-N source), and calcium nitrate (as a NO_3- source), are being applied weekly at annual rates of application of 2.4 lbs N/1000 ft^2/year.

Nitrogen applications are divided evenly into weekly applications applied in April through October. Clippings are collected once per week during the study, and the plot area is mowed six days per week. For evaluation and comparison of traditional soil applied N-fertilization, both forms of N fertilizer are applied weekly as a soil drench at the same annual N rates as the foliar applications.



Mean fertilizer uptake over a 24-hour period as affected by adjuvants. Error bars indicate one standard deviation.

Data collected include leaf tissue N concentration, clipping production, percent coverage, turf quality, turf color, chlorophyll concentration, root mass, and disease incidence.

Summary Points

- Foliar applied N enters the leaf within 4-6 hours of application.
- Lower spray gallonages are more effective at promoting N-uptake through the leaf.
- Addition of an adjuvant for foliar fertilization is recommended for optimizing foliar N-uptake of urea.
- Tank-mixing fertilizer with commonly leaf-applied chemicals has limited impact on N-uptake through the leaf.