Leaf Cuticle Characteristics and Foliar Nutrient Uptake by a Cool-season and Warm-season Turfgrass

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Objectives:

1. Determine the seasonal dynamics of the turfgrass cuticle in a cool-season and warm-season turfgrass species managed under putting green conditions.
2. Compare the seasonal uptake of foliar nitrogen by a cool-season and warm-season turfgrass species managed under putting green conditions.

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Project Duration: two years
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Foliar fertilization refers to the process of nutrient uptake through the foliage or other aerial plant parts. As a supplement to traditional root-feeding programs, foliar fertilization has been observed to be an increasingly common practice in today's golf course management. Recent surveys of Arkansas golf course superintendents indicate that nearly all golf course superintendents use foliar fertilization on some area of their golf course, and this method of nutrient application often comprises a major portion of annual nitrogen (N) inputs to putting greens.

Although previous research has documented uptake of N by turfgrass leaves in controlled-environment studies, there have been no studies which demonstrate its potential effectiveness in a field environment. It is known from previous agricultural research that environmental factors and seasonal dynamics of leaf cuticle characteristics can influence the foliar absorption of N solutions. Therefore, the aim of this project is to increase scientific understanding of the turfgrass leaf cuticle, while assessing foliar uptake of N during a two-year putting green research trial.

Experimental areas of 'Penn A1' creeping bentgrass and 'Tifeagle' ultradwarf bermudagrass were developed on an established sand-based putting green in Fayetteville, Arkansas. The greens were maintained according to typical management practices for the region. Foliar uptake of N was studied each month from May to September to determine if foliar uptake was consistent across the growing season.

Foliar nitrogen is applied to the putting green turf and an ammonia volatilization trap is installed after application.

An isotopic tracer technique that allows for positive identification and direct measurement of fertilizer N in the plant tissue was used in the study. ^{15}N-labeled urea solutions were sprayed at two different rates to represent a low and high rate (0.10 or 0.25 lb. N / 1000 ft^2) common to foliar fertilization rates of golf course superintendents. For a 24-hour period after treatment, plots received no irrigation or rainfall in order to track only foliar absorption of N. Plant tissues were sampled at 1, 4, 8, and 24 hours after application in order to develop a time-course analysis of foliar N uptake. In addition, an enclosed chamber with an internal acid trap was installed within the plots after treatment to estimate the volatilization of N as ammonia from the plots.

Results from the first year of monthly foliar urea-N applications indicate that both species proved receptive to foliar uptake and ammonia volatilization losses were minimal (averaged < 2% of applied N). A range of 24-57% of the fertilizer N applied was recovered in leaves/shoots at 1 hour after treatment, while peak foliar absorption was normally observed around 4 hours after treatment.

Foliar uptake (measured as a % of N applied) was significantly reduced at higher application rates. The highest maximum absorption of N applied observed over 24 hours, was in the month of May on bentgrass (76%). Absorption of N by bentgrass leaves was affected by month of year, while ultradwarf bermudagrass was not affected.

On bentgrass, the significant decrease in N recovered within plant tissue as the season progressed (May averaged 59% of applied N across all sampling times, while September averaged 37%), is currently believed to be attributed to leaf cuticle changes that made leaves more hydrophobic and possibly less receptive to nutrient absorption. Continued laboratory investigations are underway to better understand this observed trend.

Golf course superintendents often use foliar fertilization as a primary means of feeding putting greens.

Summary Points

- Both creeping bentgrass and ultradwarf bermudagrass greens are receptive to foliar uptake of urea nitrogen.
- Most of the nitrogen applied to putting green turfgrass foliage is absorbed in the first 4 hours after application.
- Foliar uptake in creeping bentgrass was reduced during warmer months, suggesting a change in the composition of the leaf cuticle.
- Loss of foliar-applied nitrogen to ammonia volatilization appears to be minimal.