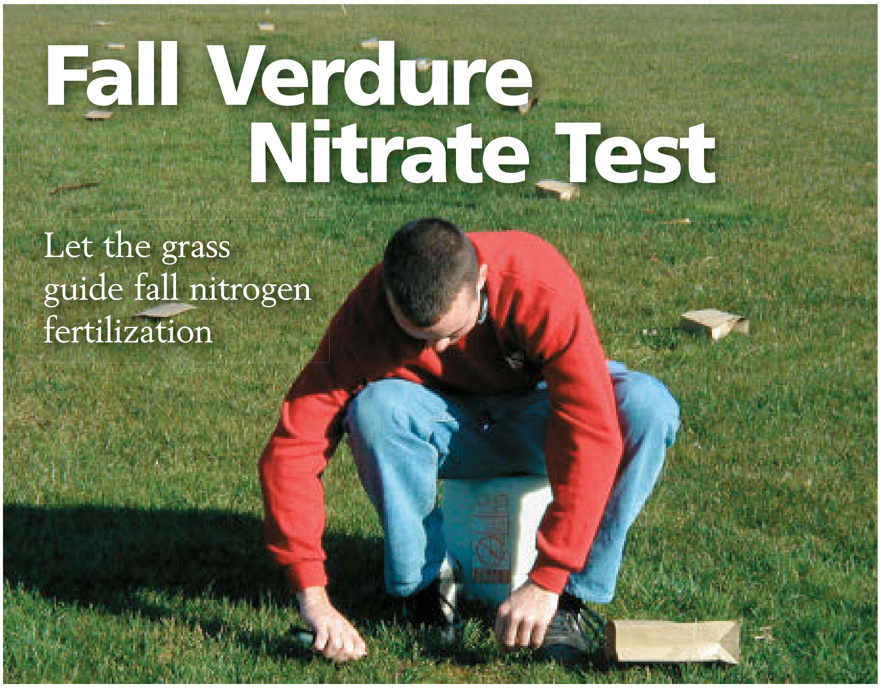
TURFGRASS TRENDS

FERTILIZATION

Fall Verdure Nitrate Test

Let the grass guide fall nitrogen fertilization



By Karl Guillard, Thomas F. Morris and Thomas J. Barry

Have you diligently followed the nitrogen (N) recommendations suggested by previous research studies or experience for your fall application? If you did, you're not alone. That's the fertilization paradigm most golf course superintendents have accepted and practiced since the late 1960s and early 1970s when the agronomic benefits from fall N applications were reported for turf. Since then, fall fertilization has become the foundation of N management for maintaining high-quality turf for many different uses, particularly in northern temperate climates.

But, have you ever questioned these recommendations or noticed that the N recommendations for fall fertilization are suspiciously uniform and consistent for different turf species and across wide geographical regions with different climates and soils?

The standard fall fertilization recommendation is usually 1 pound N per 1,000 square feet, give or take a quarter-pound or so depending on formulation, and applied anytime from September into December (timing of application is a separate but related issue that needs to be addressed in a future article).

Given that you have undoubtedly seen different

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Thomas J. Barry collects verdure plant tissue samples on research plots at the University of Connecticut during the fall that will be analyzed for concentrations of nitrate-nitrogren. The verdure is considered the aboveground parts of the turf plant remaining after mowing.

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responses of turf to the same N rate on your own managed grounds for different species and within a much smaller area than an entire geographical region, how can this universal and similar recommendation be logical or even correct? We're not questioning the agronomic benefits from application of fall N where needed. However, as scientists, we don't accept that a common or universal N rate recommendation is a logical or correct approach for fall fertilization of all turf across many species, climates and soils. Because of this, we set out to find a better way to guide N recommendations for fall fertilization of turf.

In our climate, spring green-up typically occurs sometime in March to early April. We have always been intrigued at the suddenness of this event, as if a switch has been turned on to initiate the green-up almost overnight. While observing this rapid green-up, we wondered where the plant was obtaining the N to synthesize leaf chlorophyll and proteins in the new spring growth.

Measurements of available soil nitrate during the few days of green-up revealed almost non-detectable concentrations of nitrate-N, or concentrations considered to be much below typical background values. In our climate, we receive significant amounts of unfrozen precipitation during the winter. With our sandy loam soils, any nitrate remaining in the soil from the fall is lost by leaching.

It is also known that for nitrate to be taken up by turf, water must be moving through the plant (driven by evapotranspiration — ET — factors) through the transpiration process. Turfgrass ET values during early spring in southern New England are meager at best, and not much water is moving through the plant at this time. Therefore, faced with low ET and almost no soil nitrate, we ruled out plant uptake of soil nitrate as the main source of N for spring green-up for our conditions.

Our attention turned to the grass plant. The most plausible explanation for the primary source of N for spring green-up under our conditions before any fertilizer is applied was the grass plant itself. We hypothesized that N taken up during the fall was being stored over winter, and then used for growth during the following spring green-up. Research has shown that annual grasses, such as corn, wheat and barley, store N as nitrate in the bases of stems and shoots. Measurement of this nitrate pool has been used as an indicator of soil N availability for these grasses and subsequently as a guide for N fertilization.

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Perennial grasses can also store N as nitrate, but storage of nitrate is typically minimal during the active growing season because of frequent mowing, which leads to the rapid assimilation of nitrate into leaf proteins as new leaf blades are formed. In northern climates, however, fall marks the period when new leaf blade formation in perennial turfgrasses declines as the onset of winter dormancy begins. It is during this time that we think N storage as nitrate increases in the turf plant because the amount of N assimilated into leaf proteins is reduced because of a decline in overall leaf formation.

Our hypothesis is that this stored nitrate may be the primary source of N for the turf plant at the onset of new growth in the spring after winter dormancy. We also think that a measure of this nitrate pool could be used to improve the management of fall N for turfgrasses.

We developed a theoretical model for turf spring color in relation to fall verdure

This photo details the removal of the verdure plant tissue down to ground level. The verdure is considered the aboveground parts of the turf plant remaining after mowing.

nitrate-N concentrations. The verdure in turf is the aboveground parts of the turf plant remaining after mowing. We thought the verdure would be a better tissue to measure for nitrate than leaf tissue, because nitrate assimilation is relatively rapid in leaves.

If perennial turfgrass plants do store nitrate in the fall, we thought it would be most likely stored in the verdure shoot bases than in the leaves, and therefore a more stable pool of nitrate than the leaves.

Based on our theoretical model, spring turf color response will rapidly increase starting from low verdure nitrate-N concentrations (below optimum; deficient) in the fall, then the rate of response will begin to slow as the verdure nitrate-N concentration approaches optimum (also called the critical level).

At the optimum critical level and beyond, the response will plateau or flatten out — increasing the concentration of nitrate-N concentrations in the verdure plant tissue beyond the optimum critical level by fertilizing with N will not increase the grass color in the spring; the maximum color response has been reached.

Research at the University of Connecticut suggests that nitrate will accumulate in the shoot bases of perennial turfgrasses during the fall. We collected samples of the verdure and extracted the nitrate from the dried tissue.

Our preliminary data fit the theoretical model, and suggest that spring turf color will be maximized when the previous fall verdure nitrate-N concentrations are between 500 and 1,500 parts per million on a dry-weight basis. Earlier verdure tissue sampling (September) would use the higher end of this range (1,500 ppm dry-weight basis), whereas later sampling (October) would use the lower end of the range (500 ppm dry-weight basis).

We think this test has considerable value in developing more efficient and environmentally sound fall N fertilization practices for turfgrasses. It should help prevent excess application of N fertilizers in the fall when the probability for leaching losses is high in our climate, and offer budgetary savings on fertilizer costs.

On the other hand, it should also suggest when N fertilization may be needed for optimum turf quality. We raise caution, however, because our critical range of values is preliminary and more research is required for different grass species, soils and climates. Further evaluation of this approach will be ongoing, which is likely to change the critical values.

Although this research was conducted for taller-cut turf (2 to 2.5 inches), it should work with short-cut turf as well. The next steps for research are to determine if clippings can be used instead of verdure. This would make the logistics of sample collection much easier for both tall- and short-cut turf.

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