TURFGRASS TRENDS

FERTILIZATION

A Precision-Sensing Fertilizer Sprayer

By Justin Moss

Golf course turf is intensively managed in order to provide acceptable playing conditions. Many golf courses consist of bermudagrass (*Cynodon* spp.) tees, fairways and roughs and creeping bentgrass (*Agrostis stolonifera L.*) greens.

Superintendents may apply as much as 49 kilograms (kg) of nitrogen (N) per hectare per month (1 pound per 1,000 square feet) to the turf during the growing season. Nitrogen is typically applied in granular form using a broadcast fertilizer spreader but may also be applied in liquid formulation using a spray rig.

Agricultural researchers recently learned that significant differences in soil test results can occur at distances less than 1 meter (m), or about 39 inches (Raun et al., 1998), and Solie et al. (1999) suggested that soil, plant and indirect measurements should be made at the meter or sub-meter level. Raun et al. (2002) conducted a study to determine the validity of using optically sensed in-season estimates of grain yield (INSEY) and a response index in winter wheat (*Triticum aestivum L.*) at the 1 square meter level.

Nitrogen-use efficiency was improved by greater than 15 percent when N fertilization was based on optically sensed INSEY determined for each square meter and a response index compared to traditional practices at a single N rate. The use of optical sensors may

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Sensors may be used with a variable rate nitrogen applicator (shown here) to maintain healthy turf by applying prescribed rates in areas as small as 2 square feet.

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help golf course managers increase or maintain adequate turfgrass quality while reducing the total amount of N fertilizer applied. However, turfgrass managers are not concerned with increasing yield. Turfgrass managers are concerned with improving or maintaining adequate turfgrass quality for their particular playing conditions.

The red normalized difference vegetative index (RNDVI) can be calculated using the following equation: $NIR_{reflected} - Red_{reflected} / NIR_{reflected} + Red_{reflected}$ where, $NIR_{reflected}$ = magnitude of reflected near infrared light and $Red_{reflected}$ = magnitude of reflected red light.

As recent research has shown, RNDVI may be a useful tool for turfgrass managers to indirectly measure turf quality and turf N status (Bell et al., 2002a; Bell et al., 2002b; Trenholm et al., 1999; Tucker 1979).

The objective of this research was to develop a Nitrogen Fertilization Optimization Algorithm (NFOA) for use in a turfgrass variable rate N applicator (see photograph) on bermudagrass fairways and creeping bentgrass greens in Oklahoma.

Materials and methods

Plots (0.9 x 1.5 m) were established at the Oklahoma State University Turfgrass Research Center in Stillwater, Okla., on a sand-based Crenshaw creeping bentgrass green and a Norge silt loam (fine-silty, mixed, active, thermic Udic Paleustolls) common bermudagrass fairway in a randomized, complete-block design with 10 replications.

The turf was maintained under well-irrigated conditions during the course of the experiment. Treatments consisted of plots fertilized with 0, 12.2, 24.4, 36.6, 48.8 and 61 kg N per hectare (0, 0.25, 0.50, 0.75, 1.0 and 1.25 pounds / 1,000 $feet^2$). The experiment was performed once during August 2004 and repeated during September 2004. Handheld GreenSeeker sensors (from NTech Industries Inc. in Ukiah, Calif.) were used to obtain RNDVI readings twice during each month.

The RNDVI values for each plot were recorded before the experiment and the plots were blocked from lowest RNDVI values to highest RNDVI values. After determining the blocking areas, the fertilizer treatments were randomly assigned to each block. Each treatment was applied using 18-6-15 (2.34 percent ammoniacal N, 5.72 percent urea N, 5.85 percent other water soluble N from methylene ureas and 4.09 percent water-insoluble N) fertilizer. RNDVI readings for each plot were recorded again at 14 days following treatment.

Multiple regression analysis (_ = a + $b_1X_1 + b_2X_2$) was performed with SAS version 8 where _ = RNDVI of turf 14 days following fertilization (Target RNDVI), a = intercept, b_1 = regression coefficient for N application rate, X_1 = N application rate in kg N per hectare, b_2 = regression coefficient for RNDVI prior to fertilization and X_2 = RNDVI prior to fertilization (Current RNDVI).

Results

The results to date indicate that under well-irrigated conditions, RNDVI readings from the GreenSeeker sensors may be very useful for estimating the N application rate required to maintain creeping bentgrass greens and bermudagrass fairways.

These sensors can be used on the go with a variable rate N applicator to maintain healthy turf by applying prescribed rates in areas as small as 2 square feet. Target RNDVI readings could be obtained by maintaining a non-N-limiting plot of turf.

The preliminary NFOA would be as follows:

- determine your target RNDVI; and
- use the appropriate N application rate regression equation.

Further research is needed to determine if the NFOA and the turfgrass variable rate N applicator will provide similar turf quality when compared to a single-rate broadcast N application.

Justin Moss received a bachelor's degree in horticulture in 2000 with an emphasis in turfgrass management. He graduated with a master's degree in horticulture in 2002 and will graduate this year with a Ph.D. in crop science from Oklahoma State University. He plans to attain an assistant professorship with teaching and research responsibilities in horticulture or crop science after graduation.

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