Opportunity Knocks

By Michael Maurer, James Moken and Leon Young

Combination of fertigation and subsurface drip irrigation could provide quality turfgrass while reducing possible nitrate-nitrogen contamination and water use

Limited water supplies and the increased population growth are placing greater demands on available water sources. The continued droughts across much of the Southwest and other regional areas of the United States have led to restrictions on water consumption, especially for landscapes. Subsurface drip irrigation (SDI) offers an attractive alternative to sprinklers for irrigation of turfgrass. SDI minimizes run-off and overspray by putting water at the site of plant uptake: the turfgrass rootzone.

Although sprinkler-irrigated turfgrass still dominates the industry, more turfgrass managers are beginning to use SDI on golf courses, athletic fields and commercial and residential turfgrass. In addition to irrigation, nitrogen (N) fertilization is essential to maintain a high-quality turfgrass. Nitrogen is a key component of fertilization of turfgrass because of its influence on color, growth rate, density and stress tolerance.

However, excessive nitrogen fertilization may adversely affect the environment through possible water contamination. The combination of fertigation (application of fertilizer via the irrigation system) and SDI could provide quality turfgrass while reducing possible nitrate-nitrogen contamination and water use. An increase of fertilizer costs along with limited water resources requires greater consideration to their utilization. The combined use of SDI and fertigation provides such an opportunity for the turfgrass industry. This study was designed to look at a range of fertigation rates and frequency combinations to minimize nitrate-leaching levels, while still producing quality bermudagrass.

Sixty 5-gallon buckets, each considered a lysimeter, were used in the study.

The study was conducted at the Stephen F. Austin State University (SFASU) Mast Arboretum with the experimental setup and sodding in the fall of 2007, and data collection being performed during the 2008 growing season. Sixty 18.9-liter (5-gallon) buckets, each being considered a lysimeter, were used. Holes were drilled 17.78 centimeter (cm) from the top for drip tubing (Toro Dripline with one emitter 3.8 liters per hour [LPH]) so that a single drip emitter was installed at a depth of 15 cm below the surface. A final hole was drilled at the bottom with a stop-cock for collection of leachate.

The buckets were then filled with 2.54 cm of garden pea gravel. A piece of ground-cover cloth was placed on top of the pea gravel and then filled with a sandy-loam soil and sodded with Tifway 419 bermudagrass. Treatments were arranged as three fertigation frequencies (monthly, bi-weekly, weekly) times five nitrogen fertigation rates (0, 12.2, 24.4, 48.8, 97.7 kilograms of nitrogen/hectare/month (kg N/ha/month) or 0, 0.25,0 .5, 1.0 and 2.0 pounds of nitrogen/month/1,000 square feet) factorial design with four replicates per treatment to form a completely randomized block design. One kg/ha equals 0.89 pounds per acre. Nitrogen applications began on March 28, 2008, with all treatments receiving their appropriate urea ammonium nitrate (UAN) dosage. To see the variation in nitrate levels due to the UAN application, an intense four-week (28-day period) soil sampling was performed during the 2008 growing season (July 23 through Aug. 16, 2008). Soil samples were broken into 0 to 15 cm and 15 to 30 cm soil depths.

Leachate was collected three times after rainfall events from three separate fertigation cycles (28 days/cycle) once at four, 13 and 26 days into cycle — April 1, May 7 and Aug. 12, respectively. Leachate was analyzed for nitrate and nitrite being leached and compared to the EPA limits of 10 milligrams (mg)/1 and 1 mg/1 respectively. A biomass collection and several visual quality ratings were performed throughout the 2008 growing season to analyze the health of the turfgrass.

Two- and three-way analysis of variance (ANOVA) were performed on the collected data using the Statistical Analysis Software general linear model (GLM) procedure at the 0.05 probability level with the Tukey multiple-comparison test used to determine differences in means between the treatments.

There was no significant difference in fertigation frequency for any of the data collected, therefore only the rate means are shown.

Soil analysis showed large amounts of nitrate-nitrogen being retained in the soil and not being utilized by the turfgrass at rates of 48.8 and 97.7 kg N/ha/month.

During a natural rain event (Aug. 18, 2008) resulting in 8.28 cm of precipitation, this large buildup of nitrate-nitrogen in the soil was leached, causing excessive nitrate-nitrogen leachate over the EPA limits.

The first two water samples were taken early in the growing season when the applied nitrate-nitrogen was not being effectively used by the turfgrass. This led to higher nitrate-nitrogen leachate values in the lower 12.2 and 24.4 kg N/ha/month rates, which lowered significantly once the turfgrass was fully established. Leaf tissue N levels were 1.3 percent, 3.0 percent, 3.4 percent, 3.5 percent and 4.6 percent for the 0, 12, 24, 49 and 98 kg N/ha/month rates, respectively. The control was significantly lower and the 98 kg N/ha/month rate significantly higher than the other rates. However, all four rates had leaf tissue nitrogen percentages between the 3- to 5-percent sufficiency range for a fairway turfgrass (McCarty, 2001).

Visual quality ratings were highest for the 12.2, 24.4 and 48.8 kg N/ha/month rates compared with the control and 97.7 kg N/ha/month rate (data not shown). Visual quality rating for both the 48.8 and 97.7 kg N/ha/month rates were often lower due to excessive vegetative growth that led to scalping with the weekly clipping. Both these rates, however, did still produce an acceptable quality turfgrass.

When compared with the vegetative growth data, it was generally seen that as vegetative growth increased, visual quality increased as well. However, sometimes the quality of the turfgrass was affected if the growth was excessive. This would show up during the weekly clipping when some of the more vigorous turfgrass would have a scalping effect when clipped.

Results from the study indicate a fertigation rate of 12.2 kg N/ha/month produced a quality turfgrass, while minimizing nitrate-nitrogen leaching in sandy-loam soil. Optimum quality was obtained at the 24.4 and 48.8 kg N/ha/month rates. This range is currently recommended for optimum bermudagrass quality and growth. However, in this study, the 24.4 and 48.8 kg N/ha/month rates produced nitrate leachate levels that were well above EPA limits. These rates may have produced such high nitrate leaching values due to the limited root zone and soil profile of only 30 cm. If a deeper soil profile had been used, leachate values may not have been as high.

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