Nitrogen Release and Mineralization Rates of Various Fertilizers Applied on Kentucky Bluegrass

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Introduction

Enhanced efficiency fertilizers (EEF) allow increased plant uptake and reduce the potential of nutrient losses to the environment. This can be achieved by considering a controlled/slow release fertilizer or by using nitrification/urease inhibitors, which slow the conversion of nitrogen. Humic substances are organic compounds that have been shown to improve nutrient availability for plant absorption, increased soil water holding capacity, and increased cation exchange capacity of soils. There are many claims of the benefits of humic products on turfgrass, which include increased nutrient uptake and efficiency and increased effectiveness of fertilizers. The objective of this study is to determine if the addition of humic substances and poly/humic coatings can be classified as an enhanced efficiency fertilizer. This is part of the first year of a two-year study.

Materials and Methods

Research was conducted at the Iowa State University Horticulture Research Station, Ames, Iowa, on Kentucky bluegrass (*Poa pratensis* L.) on a native soil. Turf was maintained at a 3-in. mowing height and received irrigation as needed.

Two experiments were conducted: 1) mesh bag technique to determine the percent of nitrogen (N) released of the fertilizers used in this study; and 2) ion exchange resin membranes (ion strips) to determine N mineralization rate.

The mesh bag technique experimental design was a randomized complete block with four replications. Treatments included humic-coated urea (HCU); poly-coated humic-coated urea (PCHCU); urea + humic dispersing granules (HDG); XCU (slow-release fertilizer); Uflexx (stabilized nitrogen fertilizer); and urea. Mesh bags were made of polyethylene (1mm^2 hole openings) and filled with 3.5 g N. Fertilizer treatments were in separate mesh bags. Each fertilizer treatment had seven individual mesh bags and were buried April 15, 2019. Mesh bags were collected 7, 14, 28, 56, 84, 112, and 168 days after being buried (DAB). Fertilizer was removed from mesh bags, separated from the soil, and then weighed. Percent N released was determined using the weight-loss method.

The ion strip experimental design was a randomized complete block with four replications. Ion strips were used to determine the amount of inorganic N accumulated over time. Ion strips act as “super sinks” for inorganic N in the soil. The dimensions of the ion strips were 2 x 4 cm. One cation and one anion ion strip were placed in the soil in randomly assigned locations within each plot. Fertilizer treatments were applied to the surface of each plot. Fertilizer treatments included the same as the mesh bag technique along with a nontreated control (Table 1). Ion strips were collected and replaced monthly. Collected ion strips were cleaned using deionized water and extracted using 2 M KCl. Ammonium and nitrate concentrations were measured using colorimetric analysis on a microplate reader. Turfgrass visual quality ratings (1-9, 6 minimally acceptable) were taken biweekly April-November 2019.

Visual quality data were analyzed using SAS at the 0.05 level of significance and means separated with Fisher's LSD (least significant difference).

Results and Discussion

Only PCHCU and XCU had fertilizer remaining in the mesh bag after the first collection date (7 DAB). PCHCU had a slower N release rate compared with XCU (Figure 1). XCU released 80 percent of the N before 40 DAB. PCHCU reached about 80 percent N released around 160 DAB.

The slow-release properties of the PCHCU and XCU also can be seen in visual turf quality ratings (Table 2). All fertilizer treatments had higher turf quality compared with the nontreated 28 days after treatment (DAT). However, by 56 DAT, PCHCU and XCU had the highest turf quality relative to the other treatments. The fertilizer treatment effect dissipated by 170 DAT and all treatments were similar to each other including the nontreated.

Each study will be repeated over two years. Additional analysis will occur after the second year data have been collected.

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Table 1. List of fertilizer treatments and fertilizer application rates, ISU Horticulture Research Station, Ames, IA.

Treatment	Application rate[1]
Humic coated urea	1 lb N 1,000 sq ft^{-1}
Poly-coated humic-coated urea (PCHCU)	1 lb N 1,000 sq ft^{-1}
Urea + humic dispersing granules	1 lb N 1,000 sq ft^{-1} + 0.92 lb HDG 1,000 sq ft^{-1}
XCU	1 lb N 1,000 sq ft^{-1}
Uflexx	1 lb N 1,000 sq ft^{-1}
Urea	1 lb N 1,000 sq ft^{-1}
Nontreated	-

[1]Treatments applied April 29, 2019.

Table 2. Effect of various fertilizers on Kentucky bluegrass visual quality, ISU Horticulture Research Station, Ames, IA.

Treatment	28 DAT[1]	56 DAT	170 DAT
Humic coated urea	7.5	7.3	6.8
Poly-coated humic-coated urea (PCHCU)	7.5	8.3	6.8
Urea + humic dispersing granules	7.8	7.0	7.3
XCU	7.3	7.8	7.0
Uflexx	7.8	6.8	7.0
Urea	7.8	7.3	6.5
Nontreated	6.5	5.0	6.3
$LSD_{0.05}$	0.8	0.6	NS[2]

[1]DAT = days after treatment.
[2]NS = nonsignificant.

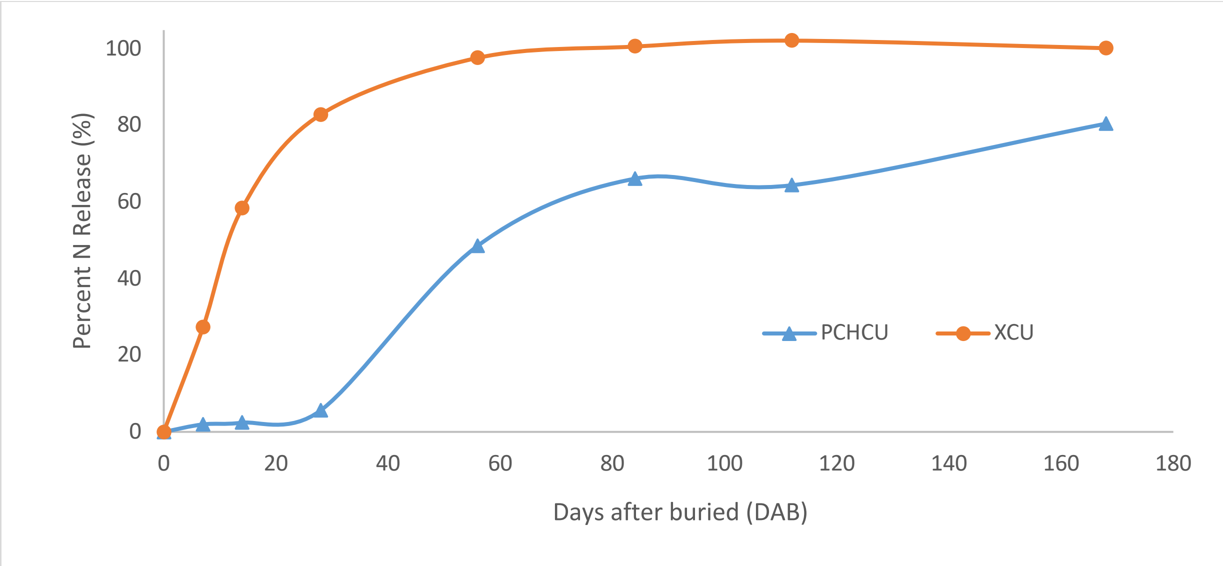

Figure 1. Nitrogen release curve for poly-coated humic-coated urea (PCHCU) and XCU. Percent nitrogen (N) release determined by using the mesh bag weight loss technique, ISU Horticulture Research Station, Ames, IA.