Evaluation of Humic Fertilizers on Kentucky Bluegrass Soil Health

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Introduction

Improving soil health has gained popularity in recent years. Humic substances are organic compounds that have been shown to improve nutrient availability for plant absorption, increase soil water holding capacity, and increase cation exchange capacity of soils. There are many claims of the benefits of humic products on turfgrass, which include a better-developed root system, improved stress tolerances, increased nutrient uptake and efficiency, improved soil structure, and increased effectiveness of fertilizers. However, minimal research has been conducted to substantiate these claims. The objective of this study is to evaluate soil health parameters of a native soil turfgrass fertilized with humic substances.

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.

The experimental design was a randomized complete block with three replications. Fertilizer treatments included 22-0-4 w/black gypsum, poly-coated humic-coated urea (PCHCU; two rates), urea + humic dispersing granules (HDG; two rates), urea, Uflexx (stabilized nitrogen fertilizer), HDG, and a nontreated control (Table 1).

Soil parameters measured included microbial biomass carbon (C) and nitrogen (N), potential net N mineralization, nutrient concentrations, pH, cation exchange capacity (CEC), percent organic matter, volumetric water content, soil compaction, and potential C mineralization. Microbial biomass was determined using the fumigation-extraction method. Microbial biomass carbon and microbial biomass nitrogen were measured using a Shimadzu TOC analyzer. Potential net N mineralization was determined by obtaining inorganic N concentrations before and after a two-week soil incubation. Ammonium and nitrate concentrations were measured using colorimetric analysis on a microplate reader. Turfgrass visual quality (1-9, 6 minimally acceptable) was collected biweekly from April-October 2019 and 2020. Nutrient concentrations, pH, CEC, and organic matter was determined by sending soil samples to Solum, Inc. (Ames, IA) and SureTech Laboratories (Indianapolis, IN). Soil volumetric water content was measured using a FieldScout TDR Meter with 3-in. probes. Soil compaction was measured with a Turf-Tec Penetrometer. Potential C mineralization was determined by measuring the CO_2 produced through a soil incubation. The CO_2 concentration was determined using a LiCor-830 CO_2 analyzer (Lincoln, NE). All data was analyzed using SAS at the 0.05 level of significance and means separated with Fisher's LSD (least significant difference).

Results and Discussion

There was no treatment effect on volumetric water content and soil compaction (data not shown). No differences were found between treatments for microbial biomass C and N, phosphorus and potassium concentrations, pH, CEC, and organic matter (Table 2). However, there was a significant treatment effect for potential net N mineralization. Uflexx provided the greatest potential net N mineralization followed by PCHCU, urea, and 22-0-4 w/BG. Lab work is currently being conducted to determine the potential C mineralization between treatments.

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Table 1. List of fertilizer treatments, application rates, and application timing in 2019 and 2020, Ames, Iowa.

Treatment	Application rate	Application timing
22-0-4 w/black gypsum	1 lb N 1,000 sq. ft.$^{-1}$	April, May, Sept., Oct.
Poly-coated humic-coated urea (PCHCU)	1 lb N 1,000 sq. ft.$^{-1}$	April, May, Sept., Oct.
PCHCU	0.75 lb N 1,000 sq. ft.$^{-1}$	April, May, Sept., Oct.
Urea + humic dispersing granules (HDG)	0.75 lb N 1,000 sq. ft.$^{-1}$ + 0.92 lb HDG 1,000 sq. ft.$^{-1}$	April, May, Sept., Oct.
Urea + HDG	0.50 lb N 1,000 sq. ft.$^{-1}$ + 0.92 lb HDG 1,000 sq. ft.$^{-1}$	April, May, Sept., Oct.
Urea	1 lb N 1,000 sq. ft.$^{-1}$	April, May, Sept., Oct.
Uflexx	1 lb N 1,000 sq. ft.$^{-1}$	April, May, Sept., Oct.
Humic DG	0.92 lb HDG 1,000 sq. ft.$^{-1}$	April, May, Sept., Oct.
Nontreated	-	-

Table 2. Effect of various fertilizers on soil parameters of Kentucky bluegrass on a native soil in 2019 and 2020, Ames, Iowa.

Treatment	Microbial biomass carbon[1]	Microbial biomass nitrogen (N)	Phosphorus[2]	Potassium	pH	CEC	Organic matter	Potential net N mineralization[3]
	mg kg^{-1}	mg kg^{-1}	ppm	ppm		$cmol_c$ kg^{-1}	%	mg N kg^{-1}
22-0-4 w/black gypsum	493[4]	80	17	119	6.9	17	4.5	13.2
Poly-coated humic-coated urea (PCHCU)	546	89	15	101	7.0	16	4.5	14.0
PCHCU	507	82	15	111	7.0	16	4.6	12.4
Urea + humic dispersing granules (HDG)	481	98	14	110	6.9	16	4.2	10.3
Urea + HDG	509	83	15	109	7.0	16	4.3	9.9
Urea	510	85	15	109	6.9	17	4.3	13.3
Uflexx	508	80	19	117	7.1	16	4.3	16.6
Humic DG	521	82	17	122	7.0	16	4.3	11.8
Nontreated	524	90	17	125	7.0	16	4.3	8.8
$LSD_{0.05}$	NS[5]	NS	NS	NS	NS	NS	NS	3.6

[1]Microbial biomass carbon and nitrogen were determined using the fumigation-extraction method.
[2]Soil samples collected on May 13, 2019 and 2020 (after one fertilizer application) and October 31, 2019 and 2020 (end of field season). Phosphorus and potassium concentrations, pH, cation exchange capacity (CEC), and organic matter values determined by Solum, Inc. (Ames, IA) and SureTech Laboratories (Indianapolis, IN).
[3]Potential net N mineralization was measured by inorganic N extraction before and after a 2-week incubation.
[4]No interaction between year, sampling date, and treatment effect, means are pooled across years and dates.
[5]NS = nonsignificant.