Influence of Stabilized Urea Nitrogen on Turfgrass Performance and Nitrogen Volatilization

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The goal of this research was to evaluate the effectiveness of urease and denitrification inhibitors for use in the turfgrass fertilizer. The objectives of this research were to 1) measure the effect of different stabilized urea products on turfgrass performance and 2) measure how the urease and denitrification inhibitor affect nitrogen volatilization.

Methods

This study was conducted on a mature Kentucky bluegrass research plot at the John Seaton Anderson Turfgrass Research Center in Mead, NE. The plot was mowed at 2.5 inches twice weekly and irrigated three times a week to replace 80% of pET. Soil tests indicated the turf area had sufficient levels of phosphorus and potassium. Individual plots measured 5 x 5 feet. The experimental design was a randomized complete block design with three replicate blocks. Fertilizer treatments included a non-fertilizer control (to assess background soil mineralization), urea, ammonium sulfate, UFlexx, UMaxx, EC Grow A, and EC Grow B. Fertilizers were applied at 1.0 lbs N/1000 ft^2 with a shaker jar on 22 May, 24 July, and 11 September 2014. Visual quality, rated on a 1 to 9 scale where 1 represented dead, 9 perfect, and 6 minimally acceptable lawn visual qualities, and color, measured as chlorophyll index with a Spectrum Technologies FieldScout CM1000 on a 0 to 999 scale, were recorded weekly. Clipping yield was measured by mowing one 5 foot pass down the center of each plot with a John Deere walking rotary mower. Clippings were collected, dried at 60°C in an oven for 48 hours, and weighed approximately weekly during the summer and every other week in the fall. Final measurements occurred on 6 November 2014.

Relative nitrogen volatilization was measured from the plots receiving urea, UFlexx, UMaxx, EC Grow A, and EC Grow B following the second fertilizer application in July. Ammonia gas was trapped with modified mason jars (Ball 16 oz jars). The mason jars had the glass bottoms removed and were tightly pressed into the grass canopy. Small plastic dishes containing 10 ml of sulfuric acid were secured under each lid. Ammonia gas dissolved into the sulfuric acid and was protonated into ammonium. Traps were emptied and moved to a different spot within each plot every three days for three weeks. Finally, samples submitted to Ward Labs for analysis NH_4-N concentration.

Repeated measures statistical analysis was conducted in JMP11 Pro and means were separated with Fisher's protected LSD.

Results

Color and Quality

There were little differences in color and turfgrass visual quality rating between the different fertilizer products tested (Table 1). When averaged across the growing season, all fertilizer products had significantly similar color and similar visual quality with urea having slightly better color on average than UMAXX, UFLEXX, ammonium sulfate, polymer/sulfur coated urea, and EC Grow product A (Table 1). EC Grow product B and NTB50 had similar average quality rating as the urea and all other fertilizer treatments. The treatment by date interaction can most likely be attributed to soil mineralization and, to a lesser extent, other fertilizer sources (i.e. atmospheric deposition and marginal amounts of nitrogen in the irrigation water). This caused the color and visual quality of the non-fertilized control to increase in August and then quickly decline during fall (Fig. 1 and 2). This suggests that fertilizer application in mid-summer are inefficient as soil mineralization supplied the turf requirement for nitrogen. Differences in fertilizer performance were generally within the margin error of over the course of the study error (Fig. 1 and 2). Fertilizer differences were most apparent at the end of the growing season when urea and NBT50 had greater color and visual quality than all other fertilizer sources except for UFLEXX.

Clipping Yield

Clipping yield measurement mirrored the color and visual quality rating data. Averaged across the entire season, there were no significant differences between fertilizer products (Table 1). Clipping yields of the fertilized plots diverged from the non-fertilized control shortly after fertilizer application and then started to converge with the non-fertilized control eight weeks after each application (Fig. 3). There was little meaningful difference between the different fertilizer sources. Interestingly, visual quality and color of the non-fertilized control approached the fertilizer treatments while clipping yield was still greater than the non-fertilized control in August. This suggests nitrogen requirements to maximize yield are different than requirements to maximize color and visual quality.

Relative Volatilization

Relative volatilization was very low for all treatments evaluated. Volatilization was measured on a non-fertilized reference plot and three replicates of select fertilizer products. Those reference values were similar to fertilized plots. Unfortunately, the first measurement of the volatilization study needed to be omitted due to a combination of acid trap failures on a few plots and an unknown complication with samples at Ward Labs. On average, all fertilizer products had the same amount of relative volatilization as the urea control on all days. The one exception was the UFLEXX which had higher amounts of volatilization between 15 and 18 days after application compared to the urea only and EC Grow product A. The low levels of volatilization were likely the result of the wet growing conditions at the time of the study that limit potential urea volatilization. If conducted again, the plots would not be irrigated following fertilizer application to increase the likelihood of nitrogen volatilization.

Tables and Figures

Table 1. The effect of fertilizer treatment on turfgrass visual quality, chlorophyll index, clipping yield, and volatilization when pooled across the entire season.

Fertilizer Treatment	Visual Quality	Chlorophyll index	Clipping Yield	Volatilization
	1-9 scale	0-999 scale	dry g m^{-2}	mg NH_4-N m^{-2} d^{-1}
Urea	6.97a	523a	30.6a	0.85
EC Grow B	6.83ab	508a	30.6a	0.94
NTB50	6.70abc	504a	30.4a	na
UFLEXX	6.67bc	493a	33.0a	1.05
UMAXX	6.67bc	498a	30.9a	0.97
Ammonium sulfate	6.65bc	493a	32.9a	na
Poly/sulfur coat urea	6.61bc	497a	32.0a	na
EC Grow A	6.48bc	493a	32.0a	0.97
Non-fertilized control	5.49c	406b	18.7b	na
		Abbreviated ANOVA Table		
Source of variation				
Treatment	***	***	***	ns
Date	***	***	***	***
Treatment x date	***	***	***	*

ns, not significant; na, not applicable

* Significant at p-values < 0.05

*** significant at p-values <0.001

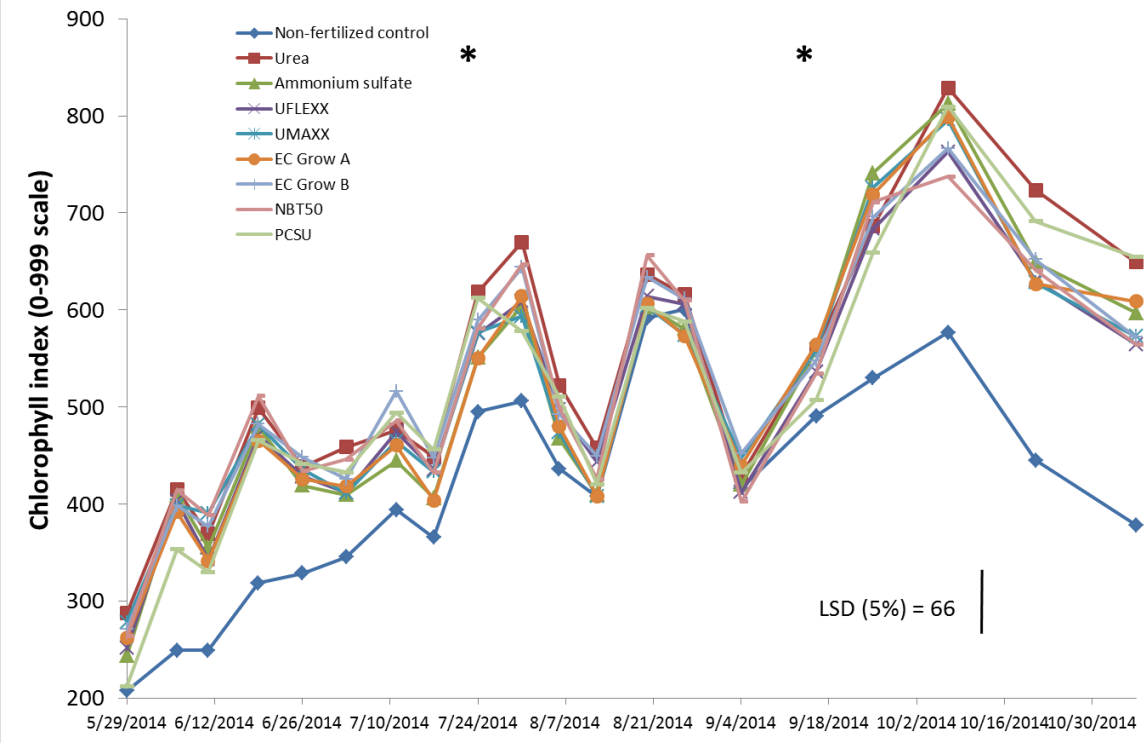

Figure 1. Turfgrass color, measured as chlorophyll index, as a result of fertilizer treatment and date. Asterisks indicate fertilizer application with the first application on 22 May 2014.

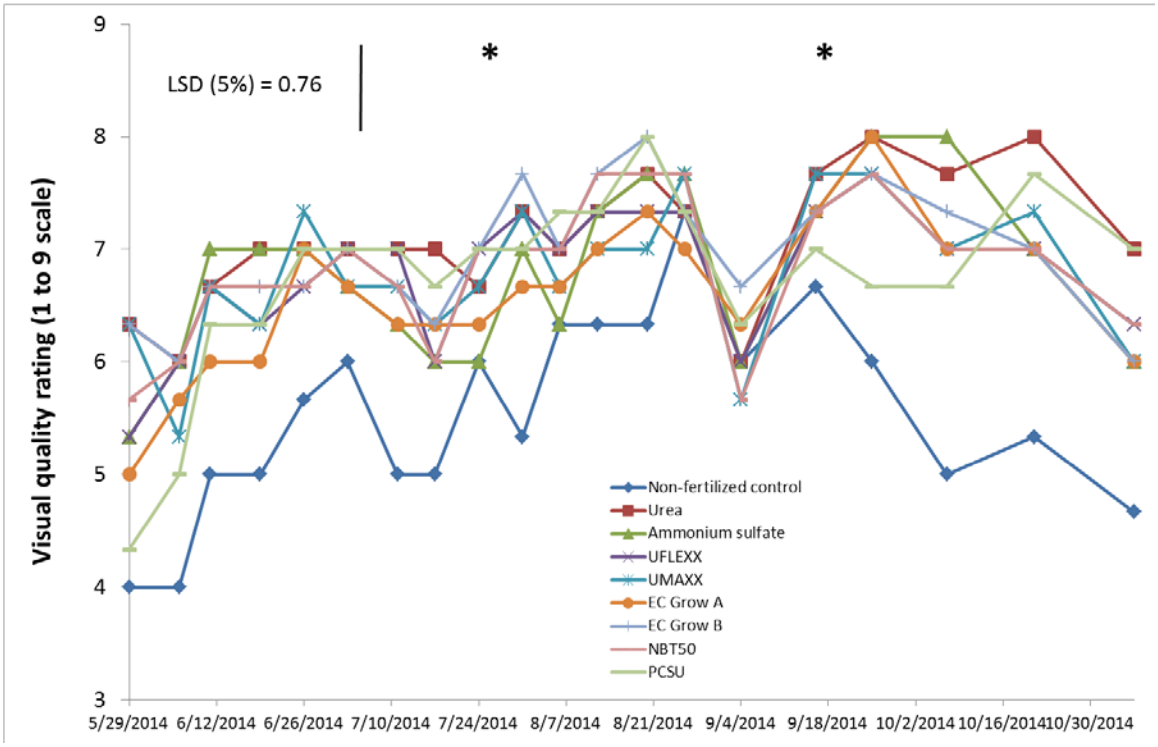

Figure 2. Turfgrass visual quality rating (1 represents dead, 6 minimally acceptable, and 9 perfect lawn quality) as a result of fertilizer treatment and date. Asterisks indicate fertilizer application with the first application on 22 May 2014.

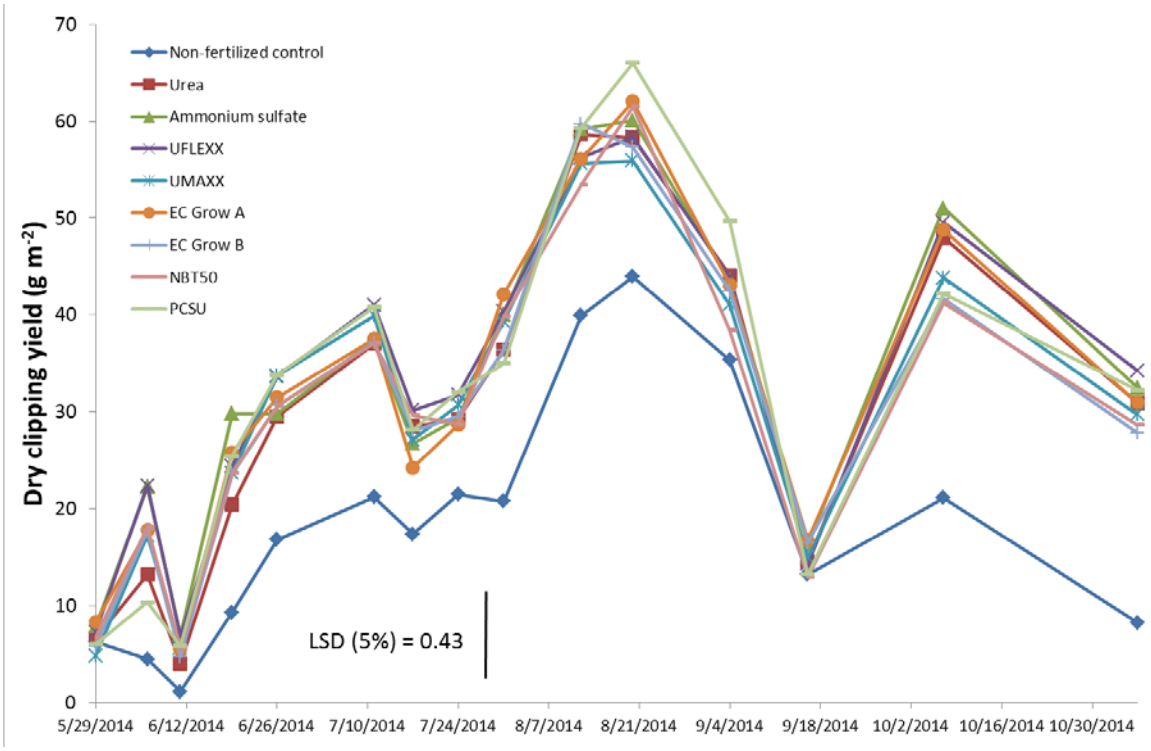

Figure 3. Turfgrass clipping yield as affected by fertilizer treatment and data. Fertilizers were applied on 22 May, 24 July, and 11 September 2014.

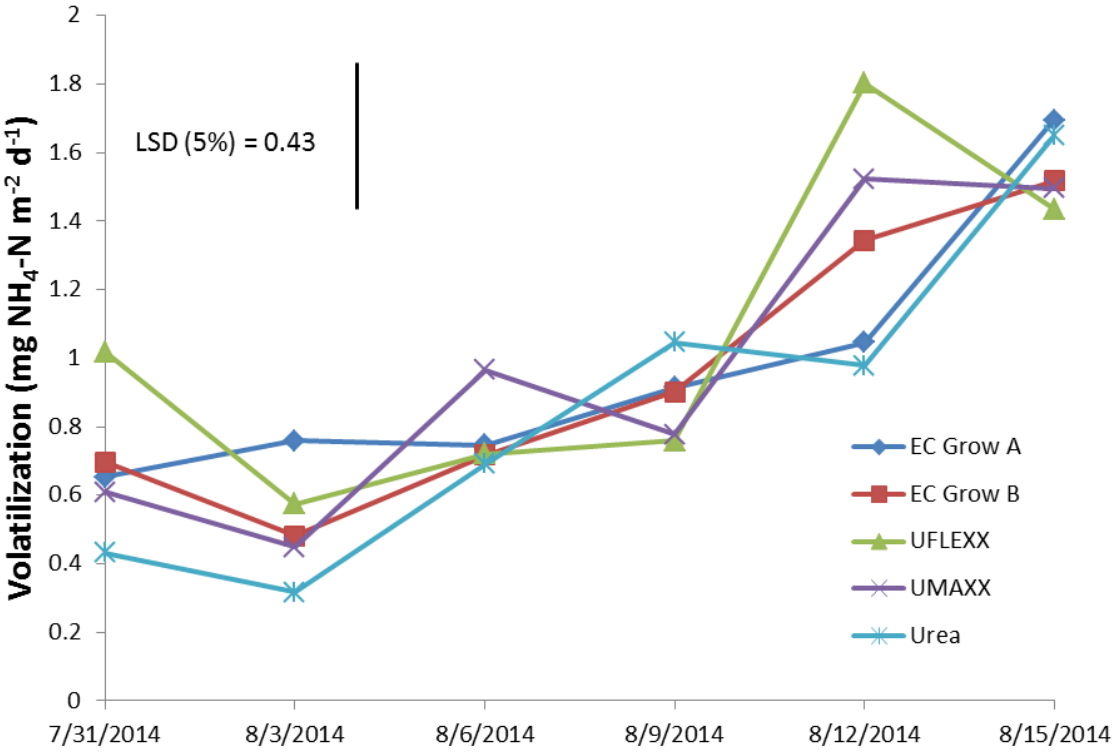

Figure 4. Relative nitrogen volatilization per day as affected by fertilizer treatment and date. Fertilizers were applied on 24 July 2014.