2015 AQUATROLS FERTILIZER EVALUATION
SUPPLEMENTAL REPORT

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The goal of this study was to evaluate the performance of three different fall-applied nitrogen fertilizers coated with two different Aquatrols products for turfgrass under drought stress. The performance of the coated fertilizers was compared to non-coated controls of the same N source, as well as non-fertilized control plots. Specifically, the objectives were to see whether these products affected 1) turf quality, 2) visual color, 3) chlorphyll index, 4) soil volumetric water content (VWC), and 5) occurrence of localized dry spot. This is a follow-up to the study described in the 2015 Aquatrols Report, which was applied to a creeping bentgrass fairway in July of 2015.

Methods

This study was conducted on a Kentucky bluegrass research plot at the East Campus Turfgrass Research Center in Lincoln, NE. The turf was mowed at 2.5 inches weekly and irrigation was withheld to encourage drought stress. Nitrogen fertilizer and wetting agents were withheld from the plot space for at least three months prior to initiation of the study. Individual plots measured 5 x 5 feet. The experiment was a randomized complete block design with three replications. Fertilizer treatments are descried in Table 1, and each product was applied once on 21 September at a rate of 1 lb N/1000 ft^2 with a shaker jar. Visual quality and color were rated on a 1 to 9 scale where 1 represented dead turf, 9 represented perfect turf, and 6 was minimally acceptable. The chlorophyll index was measured with a Spectrum Technologies FieldScout CM1000 on a 0 to 999 scale. Data were collected approximately weekly from the initial date of application until 3 November, 2015.

Analysis of variance (ANOVA) was conducted using repeated measures in JMP11 Pro, and means were separated with Fisher's protected LSD. The figures in the results show the fertilizer treatments split by N carrier for ease of interpretation. However, Fisher's protected LSD was calculated from all of the plots combined, so the LSD bars allow for comparison across Figures 1-3 and Figures 5-7.

Results

Visual quality and color was between 6.5 and 7.0 for all plots prior to application of fertilizers, and the non-fertilized control ranged from 6.9 to 7.4 with no significant differences among rating dates (Fig. 1). Averaged over all rating dates, plots treated with Urea 3107 had significantly higher mean quality than plots treated with Urea, but was only different from the non-fertilized control on the 5 Oct. rating date (Table 2, Fig. 1). Plots treated with Urea and Urea 3107 had an increase in quality by the second rating date on 5 Oct. On 19 Oct., Urea 3107 remained one of the top performers with a mean quality above 7.8, while Urea remained at a quality of approximately 7.0. Visual quality of plots treated with Urea 2045 increased slowly

from a quality of 7.0 to 7.3 over a period of approximately 30 days. Chlorophyll index results mirrored visual quality, with Urea 3107 being among the top performers of the urea treatments (Fig, 2).

Duration applied alone was one of the top performers for visual quality and chlorophyll index, although only better than the non-fertilized control on the 5 Oct. rating date (Fig. 1). There were no differences in the performance of Duration 2045 or Duration 3107 compared to Duration, and these treatments were also not different from the control. All performed equally as well as Duration. Chlorophyll index mirrored quality data, with no differences among Duration treatments (Fig. 2).

MU and MU 3107 treatments were among the lower-performing fertilizer treatments. These plots remained at or below a quality of 7.0 for the duration of the study, and had chlorophyll index values that were significantly lower than many other treatments. By contrast, MU 2045 was among the top performers with quality ratings rising above 7.6 after the fertilizer application, and this quality was sustained throughout the duration of the study. MU 2045 had a greater mean quality than the non-fertilized control on the 5 Oct. rating date, and quality was greater than the MU and MU 3107 treatments on all three rating dates after the application on 21 Sept. The response of the turf to MU is not surprising, considering that this N source is slow-release and requires microbial activity for its breakdown. The cool air and soil temperatures during Sept. and Oct. likely limited the release of this fertilizer. However, the fact that MU 2045 elicited a very strong quality response suggests that the wetting agent coating enhanced the soil microclimate to facilitate microbial activity and breakdown of methylene-urea chains.

Plots became drought stressed in mid- to late-October, with some individual plots exhibiting drought stress on as much as 50% of the plot space. None of the fertilizer treatments had drought stress symptoms that were different from the control, but there were differences among fertilizers (Fig. 3). Among urea-based fertilizers, plots treated with Urea 3107 had significantly less visible drought stress than those treated with Urea. There were no differences among Duration-based treatments, but Duration 3107 had significantly more visible drought stress than many of the other fertilizer treatments. MU-based treatments were not different with respect to visible drought stress, but MU 2045 had significantly less than many of the other fertilizer treatments.

Conclusions

In general, urea- and Duration-based treatments elicited a stronger turf response than MU-based treatments. The exception was the strong quality response from MU 2045. It is difficult to say which of the two coatings- 2045 or 3107- was more beneficial. In the MU-based fertilizers, MU 2045 had significantly better quality and less drought stress than MU 3107. However, in the urea-based fertilizers, Urea 3107 had the least drought stress and typically exhibited better visual quality. These findings suggest that the optimal wetting agent coating could differ depending on the mechanisms of N release and the chemical properties of the surfactant itself.

Tables and Figures

Table 1. Fertilizer treatments and analyses for 2015 field study. All products were applied on 21 September, 2015.

Treatment	Application Rate
	lbs N/1000 ft^2
Urea	1
Urea 2045	1
Urea 3107	1
Duration	1
Duration 2045	1
Duration 3107	1
MU	1
MU 2045	1
MU 3107	1
Non-fertilized control	1

Table 2. Visual quality, visual color, and chlorophyll index as affected by fertilizer treatment. Values are reported as means averaged over all rating dates.

Fertilizer treatment	Visual Quality	Visual Color	Chlorophyll Index	Volumetric Water Content	LDS
	---------- 1-9 ----------		0-999	g H_2O 100 g^{-1} soil	%
Urea	7.0cd	7.4	503abc	40.3	11.7ab
Urea 2045	7.2abcd	7.2	455bcd	43.4	4.2abc
Urea 3107	7.5ab	7.7	543a	41.6	1.7c
Duration	7.4abc	7.4	517ab	41.8	7.5abc
Duration 2045	7.1abcd	7.0	492abcd	42.5	5.0abc
Duration 3107	7.0cd	6.9	471abcd	41.1	14.2a
MU	6.8d	6.7	433cd	41.8	9.2ab
MU 2045	7.5a	7.6	517ab	40.3	2.5bc
MU 3107	6.8d	6.8	415d	41.2	10.8ab
Non-fertilized control	7.0bcd	7.1	494abcd	40.8	6.7abc
		Abbreviated ANOVA Table			
Source of variation					
Treatment	*	ns	ns	ns	ns
Date	**	***	***	***	***
Treatment x Date	ns	ns	*	ns	*

ns, not significant
LDS, localized dry spot
* Significant at p-values < 0.05
** Significant at p-values < 0.01
*** Significant at p-values <0.001
Numbers followed by different lowercase letters are significantly different

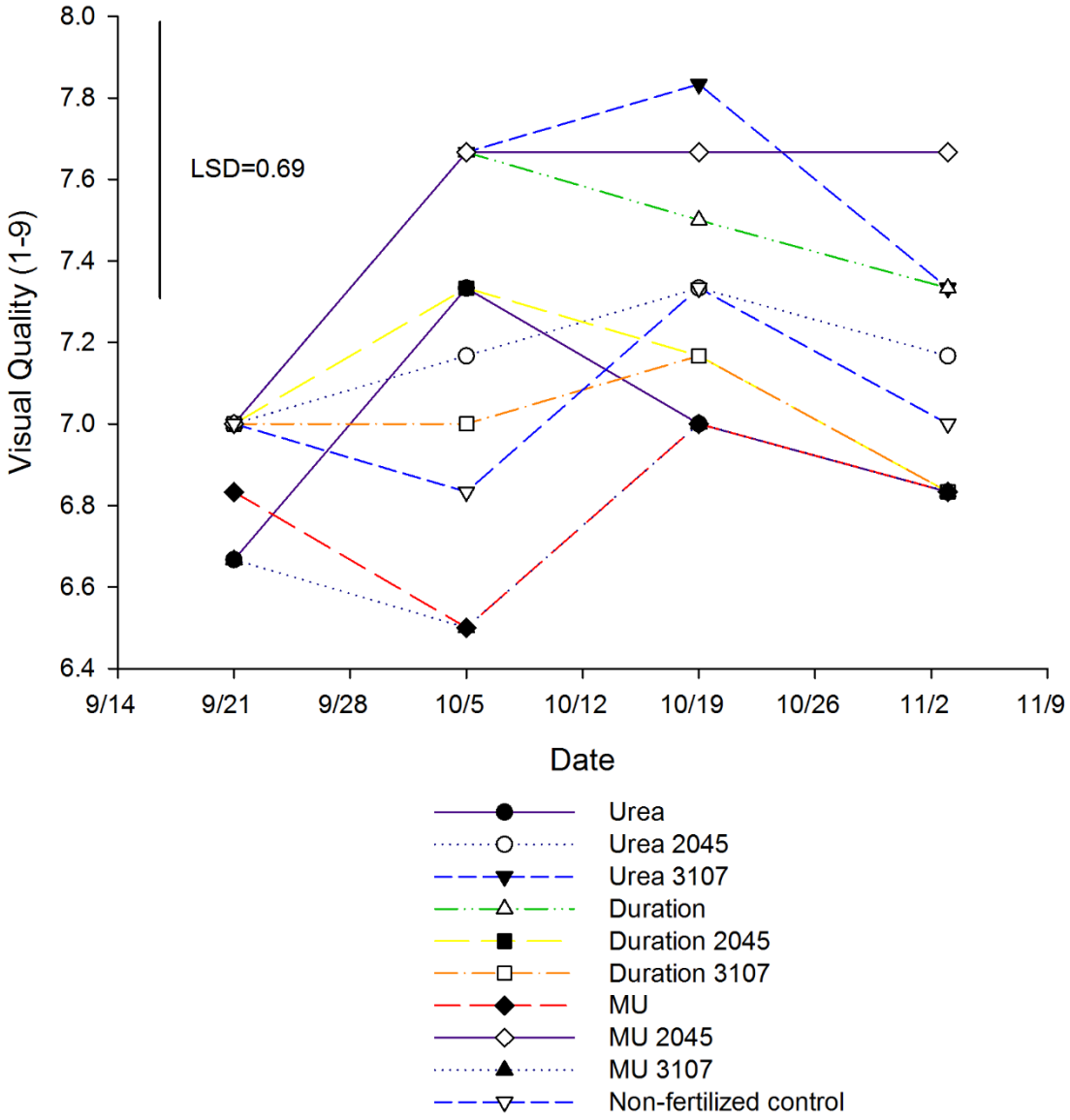

Figure 1. Visual turfgrass quality as affected by fertilizer treatment after a single application on 21 September, 2015.

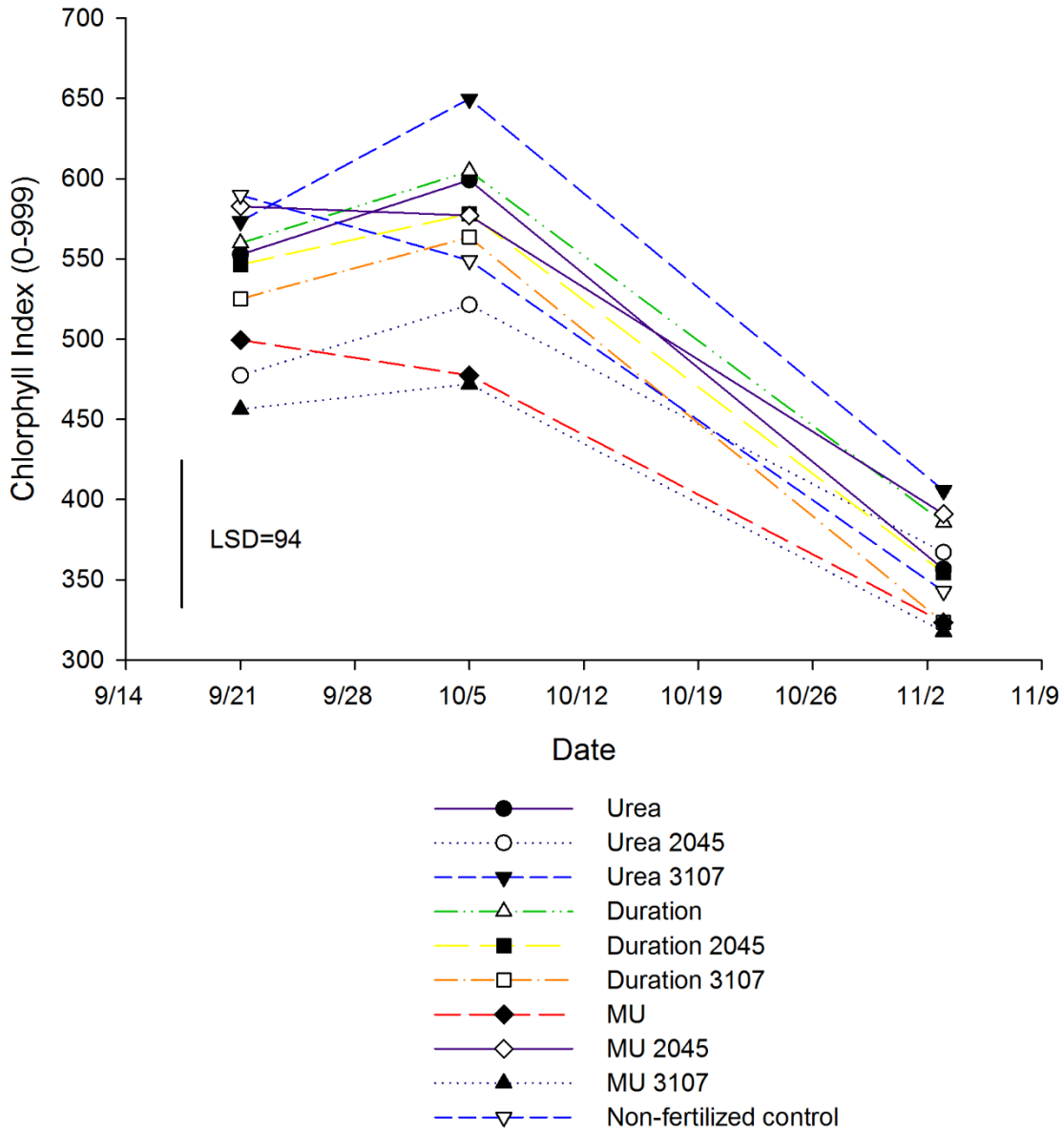

Figure 2. Chlorophyll index as affected by fertilizer treatment after a single application on 21 September, 2015.

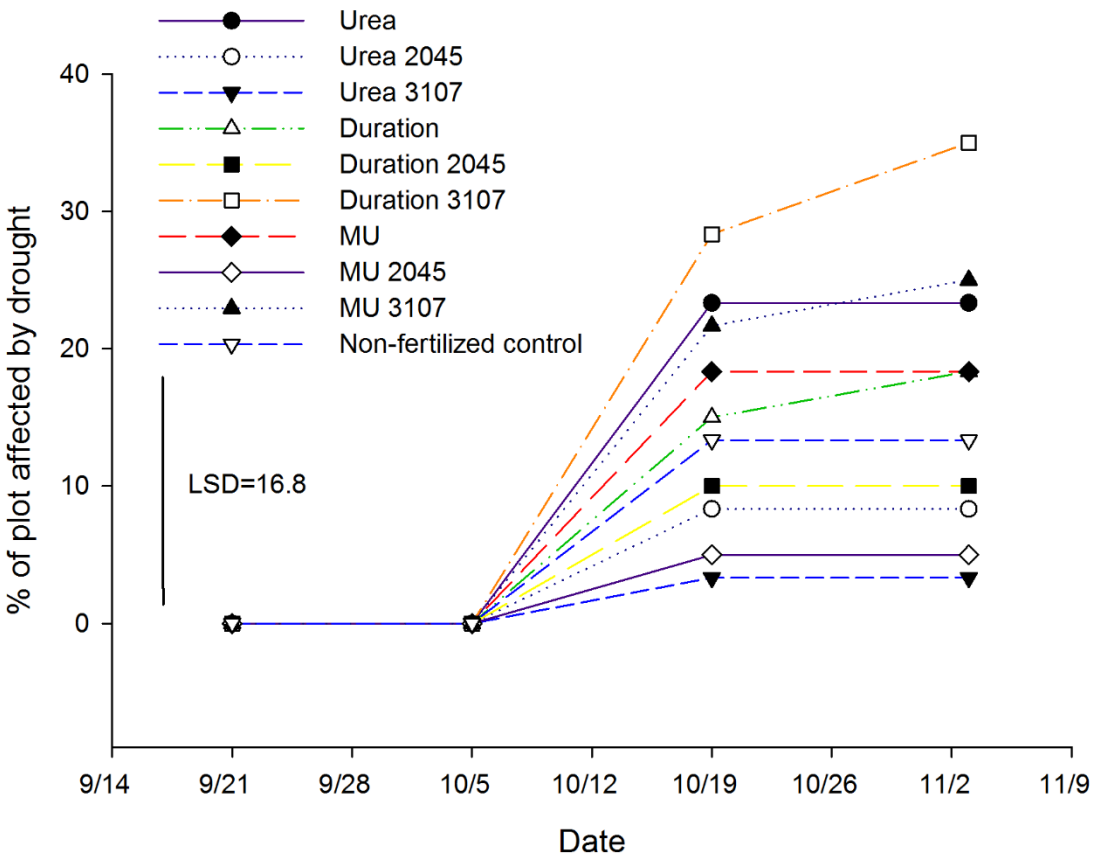

Figure 3. Visual percentage of plot space affected by drought as affected by fertilizer treatment after a single application on 21 September, 2015.