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Growth Response of Bentgrass to Polymer Coated Urea

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Bentgrass 생육에 미치는 Polymer Coated Urea의 효과

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ABSTRACT

The objective of this study was to observe the differences in growth of creeping bentgrass turf to 'polymer coated urea fertilizer' and 'uncoated urea fertilizer', and to analyze durability of fertilizer effect with the 'polymer coated urea'. The experiment was initiated on June 3, 1996, at the Iowa State University Horticulture Research Station, north of Ames, Iowa. The experiment was conducted on an area of 'Penneagle' Creeping bentgrass(*Agrostis palustris*) maintained at fairway mowing height (1.3cm). The study was repeated at the same arrangement beginning on July 25, 1996. Visual quality data, clipping fresh and dry weight, and nitrogen(N) content in the clippings were taken weekly.

Quality of the turf increased with increasing N rate. While quality ratings were higher for turf receiving polymer coated urea than for turf receiving uncoated urea at several times following treatment, but not significant. Fresh and dry clipping weights were quite variable during the trial. Visual quality rating and clipping yields improved with increasing rates of N but these differences were not statically significant between polymer coated and uncoated urea treatment. The durability of fertilizer efficiency in polymer coated urea was not last longer compare with uncoated urea from two weeks after treatment. Higher rates of N application increased the concentration of N in tissue but no significant differences between turf plots receiving polymer coated and uncoated urea.

Key words: Polymer coated urea, Creeping bentgrass, Fertilizer, Turfgrass.

INTRODUCTION

Nitrogen(N) is the key nutrient in a turfgrass fertility program. Turfgrass requires more nitrogen than any other essential elements. On a dry weight basis, a healthy turfgrass plant is composed of 3 to 5 percent nitrogen(Hall, 1931; Escritt 1964; Emmons, 1995). It is a component of chlorophyll, proteins, amino acids, enzymes, and numerous other plant substances(Welton *et al.*, 1940; Roberts *et al.*, 1960; Beard, 1961, 1973; Davis, 1962, 1965; Oertli, 1963; Goss, 1965; Hodges, 1965; Emmons, 1995). Nitrogen carriers can be subdivided into two groups-quickly available or slowly available nitrogen carriers. Water-soluble nitrogen, quickly available carriers, can be absorbed by turfgrass roots as long as there is sufficient moisture in the soil. Turfgrass responds rapidly after their application but the response is relatively short term. These water-soluble nitrogen commonly requires a frequent fertilization while some slowly available nitrogen carriers have advantages such as the reduced loss of nitrogen from leaching and, possibly, gaseous loss due to volatilization and denitrification(Turgeon, 1991). Ureaformaldehyde(UF), sulfur-coated urea(SCU), and isobutylidenediurea(IBDU) are examples of slowly available nitrogen carriers. All are produced by chemical processes which result in a certain percentage of the nitrogen in urea becoming temporarily unavailable for the turfgrass use(Emmons, 1995; Turgeon, 1991). Especially, SCU has recently become popular as a slow-release turfgrass fertilizer. It is formed by coating urea granules with sulfur and a thin coating of sealant.

The objective of this study was to compare the response of creeping bentgrass turf to 'uncoated urea' and to 'polymer coated urea', an experimental product produced from Aquitrols Corporation and to analyze durability of fertilizer efficiency in the polymer coated urea. The polymer coated urea represents a proprietary method of improving the efficiency of nitrogen use from the urea.

MATERIALS AND METHODS

This study was initiated on June 3, 1996, at the Iowa State University Horticulture Research Station north of Ames, Iowa. The experiment was conducted on an area of 'Penneagle' Creeping bentgrass(*Agrostis palustris*) maintained at fairway mowing height (1.3cm). The study was repeated at the same plots with the same randomization beginning on July 25, 1996. The size of individual experiment plot was 1.5m × 1.5m. There were seven treatments including both polymer coated and uncoated urea at the rate of 2.5g, 3.7g, and 4.9g of N/m^2 (Table 1). The study was arranged in a randomized complete block design with four replications. All fertilizers were applied in the granular form using plastic lined cardboard shakers with holes punched into the lid. These dispensers allowed uniform application to the individual plots. Each plot was watered immediately after treatment.

Rainfall was sporadic during this study and supplemental irrigation was applied to provide adequate moisture and to maintain the grass in good growing condition.

Visual quality data were taken weekly as were fresh clippings and dry clipping weights. Deviations from this schedule were necessary to adjust for adverse weather conditions and data collection was sometimes delayed to allow the grass to accumulate sufficient growth for clipping collection.

Visual quality assessments were based on color, and uniformity and recorded using a scale of 9 to 1(9=best, 6=acceptable, and 1=poorest quality). Mowing height for collecting clippings was 1.3cm. Fresh clippings from a single mower strip for each plot were placed into paper sacks and dried at 80℃ for 36 hours prior to weighing.

Data were analyzed with the statistical analysis system (SAS) using the analysis of variance(ANOVA) procedure. Least significant difference(LSD) tests were used to compare means among the treatments.

RESULTS AND DISCUSSIONS

1. The June treatment

Significant differences in visual quality were observed among treatments on June 17 and June 24(Table 1). Quality increased with increasing N rate. While quality ratings were numerically higher for turf receiving polymer coated urea than for turf receiving uncoated urea at several times following treatment, these differences were not significant.

Fresh and dry clipping weights were quite variable during the trial(Table 2 and 3), but June 24 was the only date at which significant difference was observed. Clipping yields increased with increasing rates of N. But no clear differences were apparent between the

Table 1. Visual quality[1] of creeping bentgrass in response to polymer coated and uncoated urea fertilizers for the period of June 3 to July 9, 1996

Treatments	g N /m²	6/10	6/17	6/24	7/2	7/9
Control	0.0	3.31	3.5	3.8	5.0	5.8
Uncoated fertilizer	2.5	5.3	5.3	4.5	6.3	6.3
Polymer coated fertilizer	2.5	4.5	5.3	4.8	6.5	6.8
Uncoated fertilizer	3.7	5.0	6.0	5.5	5.5	6.8
Polymer coated fertilizer	3.7	5.0	5.3	6.0	6.3	6.0
Uncoated fertilizer	4.9	4.8	5.8	6.0	6.3	6.5
Polymer coated fertilizer	4.9	5.0	6.3	6.0	6.3	7.0
LSD(0.05)	–	1.2*	1.1**	1.3**	NS	NS

Visual quality[1]: Visual quality values are based on a scale of 9 to 1 : 9=best quality, 6=lowest acceptable quality, and 1=poorest quality.

** : Mean separation within column by least significant difference, 0.01 probability level.

* : Mean separation within column by least significant difference, 0.05 probability level.

NS : Not significantly different at the 0.05 probability level.

Table 2. Clipping fresh weight(g) of creeping bentgrass in response to polymer coated and uncoated urea fertilizer for the period of June 3 to July 9, 1996

Treatments	g N/m²	6/13	6/24	7/2	7/9
Control	0.0	3.8	38.8	23.3	15.7
Uncoated fertilizer	2.5	5.3	109.7	38.8	28.0
Polymer coated fertilizer	2.5	5.2	125.4	45.9	23.3
Uncoated fertilizer	3.7	12.6	176.1	61.9	29.3
Polymer coated fertilizer	3.7	10.6	181.6	50.0	32.5
Uncoated fertilizer	4.9	23.3	215.6	80.7	39.3
Polymer coated fertilizer	4.9	12.0	192.5	63.6	32.4
LSD(0.05)	–	NS	108.5*	NS	NS

* : Mean separation within column by least significant difference at the 0.05 probability level.
NS: Not significantly different at the 0.05 probability level.

Table 3. Clipping dry weight(g) of creeping bentgrass in response to polymer coated and uncoated urea fertilizers for the period of June 3 to 9, 1996

Treatments	g N/m²	6/13	6/24	7/2	7/9
Control	0.0	0.9	9.7	5.9	3.6
Uncoated fertilizer	2.5	1.6	25.5	10.2	5.9
Polymer coated fertilizer	2.5	1.5	28.8	12.2	5.7
Uncoated fertilizer	3.7	3.1	37.4	22.1	7.2
Polymer coated fertilizer	3.7	2.7	39.1	13.6	8.3
Uncoated fertilizer	4.9	7.0	44.1	20.1	9.8
Polymer coated fertilizer	4.9	3.1	40.8	22.3	8.2
LSD(0.05)	–	NS	17.8*	NS	NS

* : Mean separation within column by least significant difference at the 0.05 probability level.
NS: Not significantly different at the 0.05 probability level.

Table 4. Nitrogen content(%) in the clippings for the period of June 3 to July 9, 1996

Treatments	g N/m²	6/13	6/24	7/2	7/9	Mean
Control	0.0	3.100	3.081	3.127	3.256	3.141
Uncoated fertilizer	2.5	3.968	3.900	3.452	3.571	3.723
Polymer coated fertilizer	2.5	3.998	3.911	3.591	3.720	3.805
Uncoated fertilizer	3.7	4.653	3.909	3.517	3.548	3.907
Polymer coated fertilizer	3.7	4.348	4.215	3.616	3.709	3.972
Uncoated fertilizer	4.9	4.613	4.333	3.625	3.633	4.051
Polymer coated fertilizer	4.9	4.327	4.253	3.754	3.732	4.016
LSD(0.05)	–	–	–	–	–	0.517*

* : Mean separation within column by least significant difference at the 0.05 probability level.

turf receiving polymer coated and uncoated urea. The durability of fertilizer efficiency in the polymer coated urea did not last longer than that of uncoated urea.

Tissue from the four replications were combined for N analysis at each of the testing data(Table 4). No analysis of variance was possible for the individual testing data. An

analysis of variance was performed on the combined data. Increasing rates of N increased N tissue concentration. There were no significant differences between grass plots receiving polymer coated and uncoated urea although grass in plots receiving polymer coated urea generally had numerically higher N concentrations

2. The July/August retreatment

Significant differences in risual quality were observed at every observation dates following treatment(Table 5). As was the case following the first treatment, quality increased with increasing rate of N, but no differences were observed between plots receiving polymer coated and uncoated urea.

Significant differences were also found among treatments in fresh and dry clipping weights at each of the dates collection(Table 6 and 7). As was the case with the quality data, clipping yields increased with increasing rates of N but there were no significant

Table 5. Visual quality[1] of creeping bentgrass in response to polymer coated and uncoated urea fertilizers for the period of August 1 to 22, 1996

Treatments	g N/m²	8/1	8/8	8/15	8/22
Control	0.0	4.8	4.5	6.0	5.8
Uncoated fertilizer	2.5	6.0	6.8	7.5	7.5
Polymer coated fertilizer	2.5	6.5	7.5	8.0	8.0
Uncoated fertilizer	3.7	6.8	7.0	8.5	8.3
Polymer coated fertilizer	3.7	6.8	7.5	7.8	7.8
Uncoated fertilizer	4.9	7.0	8.8	8.8	8.3
Polymer coated fertilizer	4.9	6.8	8.8	8.8	8.5
LSD(0.05)	–	1.2**	1.2**	1.1*	1.6*

Visual quality[1]: Visual quality values are based on a scale of 9 to 1 : 9=best quality, 6=lowest acceptable quality, and 1=poorest quality.

** : Mean separation within column by least significant difference at the 0.01 probability level.

* : Mean separation within column by least significant difference at the 0.05 probability level.

Table 6. Clipping fresh weight(g) of creeping bentgrass in response to polymer coated and uncoated urea fertilizer for the period of August 1 to 22, 1996

Treatments	g N/m²	8/1	8/8	8/15	8/22
Control	0.0	29.4	15.3	13.5	14.4
Uncoated fertilizer	2.5	66.5	46.5	26.5	21.2
Polymer coated fertilizer	2.5	66.7	45.1	27.3	19.8
Uncoated fertilizer	3.7	72.0	60.3	40.5	29.4
Polymer coated fertilizer	3.7	76.0	65.5	38.6	27.7
Uncoated fertilizer	4.9	84.2	84.4	50.3	32.5
Polymer coated fertilizer	4.9	80.3	79.3	50.5	35.9
LSD(0.05)	–	18.6**	28.7**	18.2**	12.4*

** : Mean separation within column by least significant difference at the 0.01 probability level.

* : Mean separation within column by least significant difference at the 0.05 probability level.

Table 7. Clipping by dry weight(g) of creeping bentgrass in response to polymer coated and uncoated urea fertilizers for the period of August 1 to 22, 1996

Treatments	g N/m²	8/1	8/8	8/15	8/22
Control	0.0	7.2	4.6	4.0	4.2
Uncoated fertilizer	2.5	12.9	12.9	7.6	6.5
Polymer coated fertilizer	2.5	12.3	12.3	8.0	6.1
Uncoated fertilizer	3.7	16.1	16.1	11.4	8.7
Polymer coated fertilizer	3.7	16.9	16.9	10.7	8.0
Uncoated fertilizer	4.9	21.4	21.4	13.9	9.6
Polymer coated fertilizer	4.9	20.6	20.6	13.9	10.5
LSD(0.05)	–	4.2*	6.4**	4.3**	3.2**

** : Mean separation within column by least significant difference at the 0.01 probability level.

* : Mean separation within column by least significant difference at the 0.05 probability level.

Table 8. Nitrogen content(%) in the clippings for the period of August 3 to 9, 1996

Treatments	g N/m²	8/1	8/8	8/15	8/22	Mean
Control	0.0	3.596	3.747	3.646	3.242	3.558
Uncoated fertilizer	2.5	4.648	4.068	4.289	4.051	4.264
Polymer coated fertilizer	2.5	4.473	4.485	4.215	4.050	4.306
Uncoated fertilizer	3.7	4.900	5.051	4.457	4.406	4.703
Polymer coated fertilizer	3.7	4.810	4.892	4.750	4.171	4.656
Uncoated fertilizer	4.9	4.938	5.023	4.499	4.741	4.800
Polymer coated fertilizer	4.9	4.934	5.031	4.832	4.554	4.838
LSD(0.05)	–	–	–	–	–	0.384**

** : Mean separation within column by least significant difference at the 0.01 probability level.

differences between polymer coated and uncoated urea treatments at the same rate of N. The durability of fertilizer efficiency in the polymer coated urea was also not last.

Tissue from the four replications were combined for N analysis at each of the testing dates(Table 8). No analysis of variance was possible for the individual testing dates. An analysis of variance was performed on the combined data. Higher rates of N application increased the concentration of N in tissue. There were no significant differences between grass plots receiving polymer coated and uncoated urea.

적 요

본 실험은 'polymer coated urea'와 'uncoated urea'의 비료효율을 비교하고 'polymer coated urea'의 비효지속능력을 분석하기 위하여 1996년 6월과 7, 8월 두 차례에 걸쳐 아이오와 주립대학교 잔디실험농장에서 페어웨이(1.27cm) 높이로 예취관리되고 있는 creeping bentgrass (*Agrostis palustris*) 'Penneagle'에 처리하였다. 실험결과를 요약하면 다음과 같다.

1. 시각적 평가

질소의 시비량이 증가할수록 통계적 유의차로 우수한 수치를 보였지만 polymer coated urea와 uncoated urea의 처리간에는 통계적 유의성이 없었다.

2. 생체중과 건물중

시각적 평가와 같이 질소의 시비량이 많을수록 생체중과 건물중은 통계적 유의성이 있었다. 그러나 polymer coated urea와 uncoated urea의 처리간에 polymer coated urea의 생체중과 건물중이 높은 경향이었지만 통계적 유의성은 없었다. 시비 후 2주부터는 생체중과 건물중이 급격히 감소하는 경향이었고 polymer coated urea의 비효가 uncoated urea와 같이 지속되지 못하는 경향이었다.

3. 질소함량

질소함량은 질소의 시비량이 증가할수록 증가하는 경향이었지만 polymer coated urea와 uncoated urea의 처리간에는 통계적 유의차가 없었다.

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