1980 Turfgrass Soils Research Report: Timing of Nitrogen Applications, Comparing Nitrogen Carriers and pH Control

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The field research efforts in turfgrass soil management during 1981 centered on several studies on timing of nitrogen carriers on turfgrass responses while expending considerable effort on soil modification at the new Hancock Research Center. The extensive rainfall during the summer of 1980 interfered often with the soil modification efforts.

Late Fall N on Poa annua

The effect of late fall timing of nitrogen carrier applications on Poa annua fairways was continued in the fall of 1979. Appreciation is expressed to Kurt Thuemmel, superintendent at Walnut Hills Country Club and Richard Bell and Mark Magee, superintendents at the Country Club of Lansing for their cooperation in this research. Treatments, given in Tables 1 and 2, were initiated October 1 at each site. The nitrogen rate was 1.5 pounds per 1000 square feet. Responses substantiate that the slower releasing nitrogen sources, such as IBDU and Milorganite must be applied much earlier than soluble N sources to attain the same response in November and the following spring.

The sulfur-coated urea from CIL generally responded faster than that from lakeshore (LESCO), but the latter material gave a longer response the next spring. The use of Dwell (a nitrification inhibitor from Olin-Mathison) on urea extended the N response from urea, particularly into the next spring. Fertilizers containing both soluble and slow release N (24-4-12, containing IBDU from Estech and 18-5-9, containing ureaformaldehyde N from Lebanon) gave favorable responses and were intermediate between urea and the slow release sources as would be expected.

One interesting observation was the injury caused by a PMA application to the Poa annua at the Country Club of Lansing. The rating was observed in December of 1979 and rated in April, 1980. Those treatments giving the fastest responses and resulting in the most succulent turf showed the greatest injury. The injury occurred shortly after the PMA application and was not significant on the plots receiving N later in the fall. This points out one significant reason for not using a strictly slow release N source early enough to get a significant response yet that fall. In this regard a fertilizer containing both slower and faster acting N may be preferred. This could be applied at such a time that the late fall response would be adequate yet not seriously increase the potential for low temperature or chemical injury. For these combination products we would suggest the date of application be November 5-10, depending on the season. If the weather stays warm this could be delayed a week, for example. For northern Michigan, November 1 may be an appropriate date for late fall N response while in southeast Michigan November 15 may be better.

Timing of N Carriers on Kentucky Bluegrass

Tables 3 through 8 show data from n timing and rate studies on several Kentucky bluegrass cultivars at Traverse City. These plots are located on the Traverse City Country Club grounds. Appreciation is expressed to Tom Mead for his cooperation in maintaining these plots.

Generally, the plots receiving higher nitrogen result in higher quality ratings for these grasses growing on sand soil with good irrigation. There were

some significant exceptions, however. Fylking was highly susceptible to Fusarium blight injury. Although there was not a clear response in susceptibility to Fusarium blight observed due to heavy spring nitrogen, we do strongly suggest N programs which emphasize fall and late fall N (1 pound N each in September and November) with lighter rates of N starting in late May to June (0.5 pound N per 1000 square feet) monthly until the September treatment). This N program accompanied by adequate irrigation should result in a Kentucky bluegrass turf which is less susceptible to Fusarium blight.

One problem which should be emphasized is that once significant thinning has occurred from Fusarium blight or from other causes it may be necessary to alter the N fertility program to utilize more spring N to encourage the grass to grow and fill in those open areas left by the disease. The Fylking plots at Traverse City are an example. When little or no N was applied to the thinned plots in the spring the quality ratings (Table 3) were very poor in contrast to those receiving liberal spring N (contrast treatment 8 with treatments 5, 6 and 7). The percent of dead grass on August 11 also was reflected in the quality ratings. It is pointed out that much of the recovery which occurred was caused by the nitrogen response of volunteer grasses (fine fescue and Poa annua), however, and not the Fylking. Overseeding with a more desirable cultivar would be suggested for such a diseased turf.

The effect of timing of fall applications of nitrogen applied as urea on Nugget Kentucky bluegrass is given in Table 9. These rates of N are quite high, but it is clear that the spring residual effect from the fall N is excellent even when applied as early as September 1. There was no snowmold observed on any of these plots.

Several nitrogen carriers were evaluated on a blend of Kentucky bluegrasses grown on sand soil at Traverse City. The plots were irrigated as needed to prevent serious wilt. Appreciation is expressed to Tom Mead, golf superintendent at the Traverse City Country Club for his cooperation on this project. Dwell is a nitrification inhibitor. Urea-treated Dwell gave somewhat slower but longer responses compared to urea alone. The Dwell was applied at 1 pound active ingredient per acre. IBDU responded typically with very slow short term response, but excellent long term residual effects (note the November 5 rating). When IBDU was mixed with soluble N (see 24-4-12 ratings) there was good response, both short and long term. The sulfur-coated urea products (CIL, 18-8-18, 9-6-18, 28-3-9) gave good season long response. The combined treatment of 1.5 pounds N each from powder blue and urea gave good season long response. Other materials responded as expected.

A timing of N fertilization study on Nugget Kentucky bluegrass in the shade was conducted at the shade research area (90+% shade). Clearly fertilization programs which emphasize spring N are detrimental to turf quality during the summer (Table 11). A drought condition in mid-summer resulted in severe wilting and thinning of the plots receiving N in April and May. Those plots receiving N in early October provided the best turf year round. It should be pointed out, however, that the untreated plots ranked about as well as other treatments, emphasizing the importance of using little or no N under intense shade conditions. When the same treatments were applied to A-20-6 Kentucky bluegrass (Table 12) in an adjacent area which received a little more sunlight, the results were not as marked as with Nugget.

Using Sulfur to Reduce Soil pH

Applying elemental sulfur to lower soil pH on the sand at Traverse City (Table 13) reduced soil pH most dramatically when applied as flowers of sulfur

Table 3. Cultivar-Nitrogen Study on Fylking Kentucky bluegrass at Traverse City. All nitrogen applied as urea except as noted.

Treatment	Visual Turfgrass Quality Rating (9 = best)							% dead grass[W]
lbs N/M as shown	6/12/80	7/10/80	7/22/80	8/11/80	8/28/80	9/8/80	11/5/80	8/11/80
(1) May-0.9; Sept-0.9	2.7 E*	4.3 BC	2.2 BC	3.0 CD	2.0 CE	3.3 BD	1.5 B	34 B
(2) May-0.9; Jun-0.9; Aug-0.9; Sep-0.9	3.7 D	4.3 BC	3.2 AD	4.2 BC	3.3 BD	3.3 BD	2.0 AB	28 AB
(3) May-1.2; Jun-1.2; Sep-1.2	3.5 DE	5.2 B	3.3 AC	4.2 BC	3.0 BD	3.8 BC	2.2 AB	27 AB
(4) May-1.2; Aug-1.2; Sep-1.2	4.5 BD	5.2 B	2.8 BD	3.8 BC	2.5 C#	4.3 AB	2.3 AB	30 AB
(5) Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[X]	4.0 CD	2.3 C	1.8 CD	1.8 D	1.8 CE	2.5 CD	1.7 B	56 C
(6) Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[Y]	5.0 BC	3.2 BC	1.7 CD	2.0 D	1.7 DE	2.2 CD	1.3 B	58 C
(7) Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[Z]	4.2 BD	2.3 C	1.5 D	1.5 D	1.2 E	2.0 D	1.3 B	61 C
(8) May-1.4; Jun-1.4; Jul-1.4; Aug-1.4; Sep-1.4	6.5 A	7.2 A	4.8 A	6.8 A	5.5 A	5.7 A	3.0 A	14 A
(9) May-2.3; Jun-2.3; Sep-2.3	6.2 A	7.3 A	3.8 AB	5.0 B	4.2 AB	4.7 AB	2.0 AB	16 A
(10) Jun-2.3; Jul-2.3; Aug-2.3	5.2 B	5.2 B	3.2 AD	3.7 BC	3.5 BC	5.0 AB	2.3 AB	40 B

*Treatment means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

[W]Relative Fusarium blieht injury (9 = most injury)

[X]November nitrogen applied as IBDU.

[Y]November nitrogen applied as ammonium nitrate.

[Z]November nitrogen applied as 18-5-9 (Lebanon).

Table 4. Cultivar-Nitrogen Study on Adelphi Kentucky bluegrass at Traverse City. All nitrogen applied as urea except as noted.

Treatment		Visual Turfgrass Quality Ratings (9 = best)						
	lbs N/M as shown	6/10/80	7/10/80	7/22/80	8/11/80	8/28/80	9/8/80	11/5/80
(1)	May-0.9; Sep-0.9	5.7 F*	6.8 BE	6.0 E	6.5 D	5.5 C	5.2 F	6.7 D
(2)	May-0.9; Jun-0.9; Aug-0.9; Sep-0.9	6.3 E	7.0 BD	7.7 C	6.7 D	6.5 AC	5.8 DF	7.3 C
(3)	May-1.2; Jun-1.2; Sep-1.2	6.7 D	7.2 AC	8.7 AB	6.8 D	7.0 AB	6.5 BD	7.5 BC
(4)	May-1.2; Aug-1.2; Sep-1.2	7.0 CD	7.5 AB	7.2 D	7.0 CD	6.5 AC	6.3 BE	7.8 B
(5)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[x]	7.5 B	5.7 F	7.2 D	7.5 BC	6.3 AC	6.0 CE	7.2 C
(6)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[y]	8.0 A	6.0 DF	7.0 D	7.7 B	6.2 BC	5.7 EF	7.2 C
(7)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[z]	7.5 B	6.2 CF	7.0 D	8.5 A	6.7 AB	6.5 BD	7.2 C
(8)	May-1.4; Jun-1.4; Jul-1.4; Aug-1.4; Sep-1.4	8.2 A	7.5 AB	8.8 AB	7.7 B	7.3 A	7.8 A	8.8 A
(9)	May-2.3; Jun-2.3; Sep-2.3	8.0 A	8.2 A	8.5 B	7.8 B	6.8 AB	7.0 B	8.5 A
(10)	Jun-2.3; Jul-2.3; Aug-2.3	7.2 BC	5.8 EF	9.0 A	8.8 A	6.7 AB	6.7 BC	7.5 BC

*Treatment means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

[x]November nitrogen applied as IBDU.

[y]November nitrogen applied as ammonium nitrate.

[z]November nitrogen applied as 18-5-9 (Lebanon).

Table 5. Cultivar-Nitrogen Study on Majestic Kentucky bluegrass at Traverse City. All nitrogen applied as urea except as noted.

Treatment		Visual Turfgrass Quality Rating (9 = best)						
	lbs N/M as shown	6/12/80	7/10/80	7/22/80	8/11/80	8/28/80	9/8/80	11/5/80
(1)	May-0.9; Sep-0.9	6.0 C*	7.0 BC	7.2 C	6.8 D	7.0 AB	5.0 BC	4.3 B
(2)	May-0.9; Jun-0.9; Aug-0.9; Sep-0.9	6.2 C	6.3 CD	8.0 B	7.3 CD	6.0 BC	5.0 BC	4.7 AB
(3)	May-1.2; Jun-1.2; Sep-1.2	6.7 B	7.0 BC	8.8 A	7.8 AC	7.7 A	5.7 B	4.8 AB
(4)	May-1.2; Aug-1.2; Sep-1.2	7.0 B	7.5 AB	8.0 B	7.8 AC	6.7 AB	5.0 BC	4.7 AB
(5)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[x]	7.7 A	5.7 DE	7.5 C	8.2 AB	6.0 AB	4.5 C	4.2 B
(6)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[y]	8.0 A	5.8 DE	7.5 C	8.0 AC	6.7 AB	5.3 BC	4.5 AB
(7)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[z]	7.7 A	5.7 DE	7.5 C	8.2 AB	7.7 A	5.7 B	4.5 AB
(8)	May-1.4; Jun-1.4; Jul-1.4; Aug-1.4; Sep-1.4	8.0 A	7.7 AB	9.0 A	7.5 BC	5.3 B	5.8 B	5.2 A
(9)	May-2.3; Jun-2.3; Sep-2.3	8.0 A	8.3 A	8.7 A	7.3 CD	7.3 A	7.3 A	5.2 A
(10)	Jun-2.3; Jul-2.3; Aug-2.3	7.0 B	5.2 E	8.8 A	8.3 A	5.3 B	5.8 B	4.8 AB

*Treatment means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

[x]November nitrogen applied as IBDU.

[y]November nitrogen applied as ammonium nitrate.

[z]November nitrogen applied as 18-5-9 (Lebanon).

Table 6. Cultivar-Nitrogen Study on Nuggett Kentucky bluegrass at Traverse City. All nitrogen applied as urea except as noted.

Treatment		Visual Turfgrass Quality Rating (9 = best)						
	lbs N/M as shown	6/12/80	7/10/80	7/22/80	8/11/80	8/28/80	9/8/80	11/5/80
(1)	May-0.9; Sep-0.9	8.3 C*	7.7 AC	6.3 F	6.5 F	5.5 D	4.3 D	6.3 E
(2)	May-0.9; Jun-0.9; Aug-0.9; Sep-0.9	8.5 BC	7.3 AD	7.3 E	7.5 BC	6.3 BC	5.3 BD	6.7 D
(3)	May-1.2; Jun-1.2; Sep-1.2	8.5 BC	7.3 AD	8.5 BC	7.7 B	6.8 AC	5.8 AC	7.2 BC
(4)	May-1.2; Aug-1.2; Sep-1.2	9.0 A	8.0 AB	8.0 D	7.0 DE	6.5 BC	6.0 AC	7.0 CD
(5)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[x]	9.0 A	7.0 BD	7.0 E	7.3 CD	6.3 BD	5.0 CD	6.7 D
(6)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[y]	9.0 A	6.5 D	7.2 E	7.5 BC	6.0 CD	4.5 D	6.8 D
(7)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[z]	9.0 A	6.7 CD	7.0 E	8.5 A	7.8 A	6.3 AB	7.5 AB
(8)	May-1.4; Jun-1.4; Jul-1.4; Aug-1.4; Sep-1.4	9.0 A	8.0 AB	9.0 A	7.2 CD	7.2 AB	6.8 A	7.8 A
(9)	May-2.3; Jun-2.3; Sep-2.3	9.0 A	8.3 A	8.2 CD	6.8 EF	6.3 BD	5.8 AC	7.0 CD
(10)	Jun-2.3; Jul-2.3; Aug-2.3	8.7 AB	6.8 CD	8.8 AB	7.2 CD	7.3 AB	6.5 A	7.3 BC

*Treatment means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

[x]November nitrogen applied as IBDU.

[y]November nitrogen applied as ammonium nitrate.

[z]November nitrogen applied as 18-5-9 (Lebanon).

Table 7 . Cultivar-Nitrogen Study on Parade Kentucky bluegrass at Traverse City. All nitrogen applied as urea except as noted.

Treatment		Visual Turfgrass Quality Rating (9 = best)						
	lbs N/M as shown	6/12/80	7/10/80	7/22/80	8/11/80	8/28/80	9/8/80	11/5/80
(1)	May-0.9; Sep-0.9	5.8 F*	6.2 B	5.2 D	6.0 D	6.0 E	6.2 DE	5.8 BC
(2)	May-0.9; Jun-0.9; Aug-0.9; Sep-0.9	6.3 E	6.7 B	7.0 C	7.0 C	7.0 C	6.8 CD	5.3 C
(3)	May-1.2; Jun-1.2; Sep-1.2	6.5 E	7.7 A	8.0 B	7.0 C	7.2 C	6.8 CD	6.0 BC
(4)	May-1.2; Aug-1.2; Sep-1.2	7.0 D	8.0 A	7.0 C	7.2 C	7.3 C	7.0 C	6.5 B
(5)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[x]	7.0 D	3.7 C	6.3 C	7.7 BC	7.7 B	7.3 BC	5.2 C
(6)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[y]	7.5 BC	3.8 C	6.7 C	8.2 B	7.8 B	7.7 B	6.0 BC
(7)	Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[z]	7.2 CD	3.5 C	6.7 C	9.0 A	9.0 A	8.7 A	7.7 A
(8)	May-1.4; Jun-1.4; Jul-1.4; Aug-1.4; Sep-1.4	8.3 A	8.2 A	8.7 A	7.3 C	5.8 E	6.2 DE	7.8 A
(9)	May-2.3; Jun-2.3; Sep-2.3	7.0 B	8.3 A	8.0 B	7.0 C	6.5 D	6.0 E	6.0 BC
(10)	Jun-2.3; Jul-2.3; Aug-2.3	6.5 E	4.0 C	8.0 B	7.7 BC	5.7 E	4.8 F	6.5 B

*Treatment means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

[x]November nitrogen applied as IBDU.

[y]November nitrogen applied as ammonium nitrate.

[z]November nitrogen applied as 18-5-9 (Lebanon).

Table 8 . Cultivar-Nitrogen Study on Park Kentucky bluegrass at Traverse City. All nitrogen applied as urea except as noted.

Treatment	Visual Turfgrass Quality Rating (9 = best)							Relative[W] F. blight (9 = most)
lbs N/M as shown	6/12/80	7/10/80	7/22/80	8/11/80	8/28/80	9/8/80	11/5/80	8/28/80
(1) May-0.9; Sep-0.9	2.0 D*	5.5 BC	4.5 F	5.8 D	5.3 E	4.5 D	5.3 D	7.7 BC
(2) May-0.9; Jun-0.9; Aug-0.9; Sep-0.9	2.8 C	6.3 AC	7.3 AC	6.7 BC	6.5 BD	5.3 C	6.3 BC	8.0 AC
(3) May-1.2; Jun-1.2; Sep-1.2	3.2 C	7.0 AB	7.5 AB	7.0 BC	6.5 BD	5.3 C	6.3 BC	8.0 AC
(4) May-1.2; Aug-1.2; Sep-1.2	4.0 B	7.3 AB	6.0 E	6.5 C	5.5 DE	5.7 C	6.7 B	8.3 AB
(5) Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[X]	4.8 A	4.0 C	5.7 E	7.2 BC	6.2 CE	5.5 C	5.8 CD	8.7 A
(6) Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[Y]	4.5 AB	5.5 BC	6.2 DE	7.3 B	5.7 DE	5.7 C	6.0 BC	8.0 AC
(7) Jun-0.5; Jul-0.5; Aug-0.5; Sep-1.0; Nov-1.0[Z]	4.2 AB	6.2 AC	6.7 CD	8.2 A	7.8 A	7.7 A	6.0 BC	8.0 AC
(8) May-1.4; Jun-1.4; Jul-1.4; Aug-1.4; Sep-1.4	4.2 AB	7.3 AB	7.0 BC	6.5 C	7.0 AC	6.5 B	6.5 BC	8.0 AC
(9) May-2.3; Jun-2.3; Sep-2.3	4.3 AB	8.5 A	7.7 A	6.8 BC	7.5 AB	6.7 B	7.5 A	8.7 A
(10) Jun-2.3; Jul-2.3; Aug-2.3	3.0 C	5.0 BC	7.8 A	7.0 BC	6.8 AC	5.7 C	6.7 B	7.3 C

*Treatment means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

[W]Relative Fusarium blight injury (9 = most injury)

[X]November nitrogen applied as IBDU.

[Y]November nitrogen applied as ammonium nitrate.

[Z]November nitrogen applied as 18-5-9 (Lebanon).

Table 9. Effect of fall nitrogen application on Nugget Kentucky bluegrass quality ratings.

Treatment		Turfgrass quality rating (9 = best)						
N Rate lbs/1000 sq ft	Date(s) of application	Oct 22	Nov 7	Nov 20	Mar 20	May 14	Jun 12	Jun 30
1.0 1.5	Sept 1 Oct 15	8.0 ab*	8.7	8.5	6.2 eg	9.0 a	9.0 a	7.0 gh
1.0 1.5	Sept 15 Nov 1	7.3 bc	7.8	6.2	6.0 ef	9.0 a	9.0 a	8.0 ce
1.5	Sept 1	8.3 ab	8.2	6.5	6.2 eg	7.3 gh	8.8 ab	8.8 ab
2.0	Sept 1	9.0 a	8.7	7.7	7.0 bd	7.8 ef	7.2 gh	7.5 dg
2.0	Sept 15	9.0 a	8.5	7.5	7.0 bd	8.0 de	7.5 fg	8.0 ce
2.0	Oct 1	8.0 ab	8.5	8.3	6.8 ce	8.5 bc	7.7 et	8.0 ce
2.0	Oct 15	6.2 c	8.3	7.2	6.2 eg	8.5 bc	8.0 de	8.0 ce
2.0	Nov 1	4.3 d	6.5	4.7	5.0 h	9.0 a	8.5 bc	8.5 ac
2.0	Nov 15	4.8 d	5.7	3.8	5.0 h	8.7 ab	8.7 ab	9.0 ac

*Means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

Table 10. Evaluations of Nitrogen Carriers on Kentucky Bluegrass at Traverse City. Treatments applied June 12, 1980. Averages of 3 replications.

Treatment		Quality Rating (9 = ideal)		
Carrier	N Rate lbs/1000 sq ft	7/22/80	8/12/80	11/5/80
Urea-dry	3	9.0 a*	8.2 bc	5.2 im
Urea-dry	1.5	7.0 dh	6.7 gh	3.7 o
Urea-spray	3	7.8 be	7.8 be	4.8 kn
Urea-spray	1.5	6.2 gj	6.3 h	3.8 o
Dwell-urea-dry	3	7.8 be	8.0 bd	5.7 gj
Dwell-urea-dry	1.5	6.5 fi	6.8 fh	4.5 mn
Dwell-urea-spray	3	7.2 cg	7.5 cf	5.3 il
Dwell-urea-spray	1.5	7.0 dh	6.2 h	4.7 ln
Powder blue	3	3.2 k	6.2 h	6.2 fh
Powder blue	1.5	1.3 l	4.2 j	4.2 no
IBDU-coarse	3	1.5 l	6.2 h	8.5 a
IBDU-coarse	1.5	1.2 l	5.2 i	7.5 bc
S. coated urea-CIL	3	6.8 eh	8.3 b	5.8 gi
S. coated urea-CIL	1.5	3.5 k	6.7 gh	4.8 kn
18-8-18	3	8.5 ab	8.0 bd	6.3 fg
18-8-18	1.5	6.3 gj	6.2 h	5.2 im
9-6-18	3	8.0 ad	8.5 ab	8.0 ab
9-6-18	1.5	5.3 j	6.8 fh	6.5 ef
Formolene	3	8.2 ac	8.0 bd	5.7 gj
Formolene	1.5	6.3 gj	6.3 h	4.8 kn
Methylolurea	3	8.2 ac	8.0 bd	5.7 gj
Methylolurea	1.5	5.7 ij	6.7 gh	4.5 mn
24-4-12	3	8.2 ac	8.0 bd	7.2 cd
24-4-12	1.5	6.0 hj	6.8 fh	6.2 fh
28-3-9	3	9.0 a	8.3 b	7.0 ce
28-3-9	1.5	7.0 dh	7.3 dg	5.7 gj
14-0-0	3	9.0 a	9.0 a	5.5 hk
14-0-0	1.5	7.5 bf	7.5 cf	4.5 mn
18-5-9	1.5	7.0 dh	7.2 eg	5.3 il
Powder blue	1.5	7.0 dh	7.2 eg	6.7 df
Urea	1.5			

*Means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

Table 11. Evaluation of nitrogen fertilizer programs on Nuggett Kentucky bluegrass under shaded conditions. East Lansing shade plots. Averages of 3 replications.

Treatment		Visual Turf Quality Rating (9 = best)			
N Rate lbs N/M	Date(s) of application	5/5/80	6/30/80	8/8/80	10/28/80
1	May, Sept	2.5 h*	6.0 bc	3.5 ce	4.3 cd
1	May, Jun, Sept	2.5 h	6.0 bc	3.2 de	3.7 d
1	Sept	2.3 h	7.2 ac	6.7 a	6.0 ad
1	Oct	3.3 g	7.2 ac	8.2 a	7.5 ab
1	Nov	3.3 g	7.5 ac	7.0 a	6.5 ac
1	Apr	5.5 d	6.8 ac	4.7 cd	4.2 cd
2	Sept	2.5 h	7.3 ac	7.5 a	7.8 a
2	Oct	4.0 f	7.7 ab	7.7 a	6.7 ab
2	Nov	4.7 e	8.0 a	7.2 a	6.7 ab
2	Apr	7.7 a	5.8 c	2.7 e	3.8 d
1	Apr, Oct	6.0 b	7.0 ac	6.5 ab	5.3 bd
1.5	Apr, Oct	7.0 b	6.2 bc	5.0 bc	5.5 ad
Check	--	2.5 h	6.8 ac	7.8 a	6.7 ab

*Means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.

Table 12. Evaluation of nitrogen fertilizer programs on A-20-6 Kentucky bluegrass under shaded conditions. East Lansing shade plots. Averages of 3 replications.

Treatment		Visual Turf Quality Rating (9 = ideal)			
N Rate lbs N/M	Date(s) of application	5/5/80	6/30/80	8/8/80	10/28/80
1	May, Sept	3.5 eg*	3.8 d	2.5 d	4.5 b
1	May, Jun, Sept	3.8 ef	4.2 d	3.3 cd	5.2 ab
1	Sept	3.0 gh	6.3 a	6.0 a	5.7 ab
1	Oct	4.0 e	6.0 ab	6.2 a	6.2 a
1	Nov	5.0 d	6.0 ab	5.7 a	5.5 ab
1	Apr	6.2 c	5.5 bc	5.2 ab	5.5 ab
2	Sept	3.3 fh	5.8 ac	5.7 a	5.8 ab
2	Oct	5.8 c	6.3 a	6.2 a	5.7 ab
2	Nov	6.2 c	6.3 a	5.7 a	5.3 ab
2	Apr	8.5 a	4.3 d	3.3 cd	4.7 b
1	Apr, Oct	7.3 b	5.8 ac	4.0 bc	5.0 ab
1.5	Apr, Oct	7.8 b	5.2 c	3.8 cd	5.7 ab
Check	--	2.7 h	6.2 ab	5.3 a	5.7 ab

*Means followed by the same letter in columns are not significantly different from each other using Duncan's New Multiple Range Test at the 5% level.