Soils Research Report: Late Season Nitrogen Fertilization, Nitrogen Carrier Evaluations, and Plot Establishment

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Major efforts in 1981 were placed on completing the soil modification for greens establishment at the Hancock Turfgrass Research Center. The plots to be used for greens irrigation research were constructed essentially according to the specifications designed by the U.S.G.A. including tile, pea gravel layer and topsoil mix. There was no sand layer included between the topsoil mix and the pea gravel. The plot areas drain well, but the border areas tend to pond water for a period of time where subsoil was brought to the surface during installation of the irrigation system. This subsoil material caused the soil surface to be sealed and limits infiltration rate. In normal construction this should not present a problem, since irrigation installation would occur on the perimeter of the green. An exception might be a football field or other large turf area in which irrigation lines and heads will be found in the middle of the field and where sandy soil mixes are used.

Three other greens were established on different soils. One was directly on the sandy loam topsoil existing on the site. Another was on 2NS (coarse mix) sand with peat worked into the upper 4-6 inches, and the third was built as a Purr-wick green with dune sand (predominantly medium and fine sands) with the plastic liner and tile drainage. Establishment rate of seeded Penncross creeping bentgrass was fastest on the topsoil followed by the U.S.G.A. mix. The establishment rate was much slower on the two sand greens, especially on the Purr-wick sand. This was likely due to lower nitrogen availability caused by leaching from the sands and no topsoil in the mix to provide some nitrogen and cation exchange capacity. We do not think that irrigation was a factor as the plots were irrigated independently. Clearly more frequent nitrogen fertilization will be needed on these sandy soils.

Appreciation is gratefully acknowledged to the Standard Sand Corporation which donated all the sand used in modifying the soils for the greens; the Michigan Turfgrass Foundation which paid for transportation of the sand, and much of the labor cost; irrigation companies who provided irrigation equipment and some of the labor for installation; and many individual members of the Michigan Turfgrass Foundation who donated use of equipment and/or personal labor. Special thanks to Ron Foote, superintendent at Forest Akers Golf Course, M.S.U., for loaning use of the soil shredder used for mixing all the soil, and for helpful advice given willingly. Without this kind of widespread support, we could not have the quality plots on which we will be conducting turf research for many years.

Late season nitrogen fertilization and nitrogen carrier evaluation

A large late season (or dormant nitrogen fertilization) study was initiated in October, 1980 on a Penncross creeping bentgrass putting green at the Soils Research Farm in East Lansing. Treatments are shown in Table 1. Plot size was 3 feet by 6 feet. All treatments were applied by hand. Turf responses were typical of those observed in earlier studies and in other studies given later in this report. One observation which was very apparent was that those plots fertilized with the completely soluble N sources (ammonium nitrate and urea) at the 2 pound rate gave very quick response to the October 15 fertilization as might be expected. The grass became very green and succulent. There was a period of several weeks before there was a hard freeze. When the hard freeze came in late November, significant injury to the leaf tissue occurred on these plots. The

Table 1. 1980-81 Fall Nitrogen Responses on a Penncross bentgrass green at East Lansing. Averages for 3 replications.

Treatment			Evaluation date (9-1;9=dark green)			
Carrier	N rate lbs/M	Date of application	11/20/80	12/17/80	4/8/81	5/13/81
Milorganite	1	Oct 15	3.5mp#	3.5ru	3.0uw	4.0qr
Milorganite	1	Nov 1	3.3np	2.7wx	2.7wx	3.8rs
Milorganite	1	Nov 15	3.2op	2.7wx	2.3xy	3.5s
Milorganite	2	Oct 15	4.3kl	4.3oq	4.3pq	6.7h
Milorganite	2	Nov 1	3.8lo	3.7rt	4.2pr	6.3hi
Milorganite	2	Nov 15	3.3np	2.8vx	3.5su	6.0ij
10-1-8*	1	Oct 15	5.8gh	5.3jl	5.3lm	5.0o
10-1-8	1	Nov 1	4.3kl	4.3oq	5.0mo	5.3mo
10-1-8	1	Nov 15	3.0p	3.2tw	5.0mo	5.2no
10-1-8	2	Oct 15	7.3bd	7.2df	7.5bd	8.0de
10-1-8	2	Nov 1	5.5hi	5.8hj	7.3ce	8.3bd
10-1-8	2	Nov 15	3.5mp	3.7rt	6.5gi	8.0de
Urea	1	Oct 15	6.3eg	5.8hj	5.0mo	5.0o
Urea	1	Nov 1	4.7jk	4.8lo	5.2mn	5.0o
Urea	1	Nov 15	3.5mp	3.7rt	5.2mn	5.7km
Urea	2	Oct 15	7.8eg	7.5de	7.2cf	7.5fg
Urea	2	Nov 1	6.3eg	6.2gi	7.2cf	8.5ac
Urea	2	Nov 15	4.2km	7.3oq	6.5gi	8.2cd
Urea-Dwell*	1	Oct 15	6.3eg	5.7il	5.3lm	5.7km
Urea-Dwell	1	Nov 1	4.3kl	4.7mo	5.2mn	5.7km
Urea-Dwell	1	Nov 15	3.3np	3.7rt	5.2mn	5.7km
Urea-Dwell	2	Oct 15	7.5bc	7.0ef	7.0dg	8.3bd
Urea-Dwell	2	Nov 1	5.8gh	5.8hj	7.0dg	8.5ac
Urea-Dwell	2	Nov 15	4.0kn	4.0pr	6.2hj	8.7ab
14-0-0*	1	Oct 15	7.5bc	6.7fg	5.8jl	4.5p
14-0-0	1	Nov 1	7.0ce	7.7cd	6.8eg	4.5p
14-0-0	1	Nov 15	5.2hj	8.2bc	8.0b	5.3mo
14-0-0	2	Oct 15	9.0a	8.2bc	6.7fh	7.3fg
14-0-0	2	Nov 1	9.0a	8.5ab	7.3ce	7.3fg
14-0-0	2	Nov 15	7.0ce	9.0a	9.0a	8.0de
18-4-10*	1	Oct 15	5.0ig	4.3oq	3.5su	4.0qr
18-4-10	1	Nov 1	4.2km	3.3sv	2.8vx	4.0qr
18-4-10	1	Nov 15	3.0p	2.8vx	2.7wx	4.5p
18-4-10	2	Oct 15	7.0ce	6.2gi	5.5km	7.2g
18-4-10	2	Nov 1	5.5hi	5.0ln.	4.7np	7.2g
18-4-10	2	Nov 15	3.2op	3.3sv	4.0qs	7.5fg

Table 1. Continued.

Carrier	N rate lbs/M	Date of application	11/20/80	12/17/80	4/8/81	5/13/81
Ammonium nitrate	1	Oct 15	6.3eg	5.8hj	4.7np	5.5lm
Ammonium nitrate	1	Nov 1	5.0ij	5.2km	5.2mn	6.0ij
Ammonium nitrate	1	Nov 15	3.3np	3.8qs	5.3lm	6.2ij
Ammonium nitrate	2	Oct 15	7.8b	7.0ef	7.7bc	8.3bd
Ammonium nitrate	2	Nov 1	6.7df	6.2gi	7.5bd	8.5ac
Ammonium nitrate	2	Nov 15	3.8lo	4.3pr	7.2cf	8.5ac
20-0-16*	1	Oct 15	4.7jk	3.8qs	4.0qs	4.5p
20-0-16	1	Nov 1	3.8lo	3.3sv	3.7rt	4.5p
20-0-16	1	Nov 15	3.2op	2.8vx	3.7rt	5.0o
20-0-16	2	Oct 15	6.2fg	4.7mo	5.2mn	7.7ef
20-0-16	2	Nov 1	5.5hi	4.5np	5.0mn	8.0de
20-0-16	2	Nov 15	3.2op	3.7rt	4.3pq	7.7ef
S. coated urea#	1	Oct 15	5.3hj	5.3jl	4.5oq	5.7km
S. coated urea	1	Nov 1	4.0kn	4.5np	4.2pr	5.8jl
S. coated urea	1	Nov 15	3.0p	3.3sv	4.0qs	6.2ij
S. coated urea	2	Oct 15	7.3bd	6.3gh	6.5gi	8.8a
S. coated urea	2	Nov 1	5.5hi	5.2km	6.2hj	8.8a
S. coated urea	2	Nov 15	3.7lp	3.7rt	6.0ij	8.8a
IBDU-fine	1	Oct 15	3.2op	3.0ux	2.8vx	5.0o
IBDU-fine	1	Nov 1	3.0p	2.5x	1.8yz	4.3pq
IBDU-fine	1	Nov 15	3.0p	2.5x	1.8z	3.5s
IBDU-fine	2	Oct 15	4.2km	3.5ru	4.5oq	7.7ef
IBDU-fine	2	Nov 1	3.5mp	2.8vx	4.2pr	7.2g
IBDU-fine	2	Nov 15	3.3np	2.5x	3.3tv	6.0ik

*Carriers are 10-1-8 from Milwaukee Sewage Commission; Dwell from Olin-Matheson Co.; 14-0-0 (Iron-S) from Scott's; 18-4-10 from Lebanon Co.; 20-0-16 from Lakeshore Equipment Co.; S-coated urea - special grade for greens from CIL.

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

injury resulted in some discoloration, but no permanent injury occurred as these plots had good color the next spring. Obviously, timing of the late season N application is dependent on the N carrier. Slow release materials must be applied earlier than completely soluble carriers to get the same response in November. These plots were not treated for snowmold control to see if snowmold susceptibility might change with N treatment. There was essentially no snowmold on the plot area in the spring, so no differences were recorded.

Another study was on late season nitrogen-potassium balance on the Penncross green. All combinations of 0 and 1 pound of N with 0, 1 and 2 pounds of K_2O were applied on November 10. No snowmold treatment was applied to this plot area, but since there was no snowmold of consequence on the plots no differences could be recorded due to N-K_2O balance. Only nitrogen responses occurred.

Late season N studies on carriers and timing of application were again conducted on Poa annua fairways. The treatments applied are shown in Tables 2 and 3. These studies were conducted with Dan Garson and Gary Thommes, students working on a special study basis. Appreciation is expressed to Kurt Thuemmel, superintendent at Walnut Hills Country Club, and Mark Magee, superintendent at the Country Club of Lansing for their cooperation in these studies. The nitrogen was applied at 1.5 pounds per 1000 square feet. Plot size was 5 feet by 7 feet. All fertilizers were weighed previously and applied by hand.

As observed in other studies, slow release carriers such as IBDU and Milorganite must be applied earlier in the fall to allow for release of available N before mid-November for late fall uptake and response. Note that December applications still did not give much response by mid-May, but did by June (Country Club of Lansing).

Sulfur-coated urea gave good responses with the CIL material responding faster than the LESCO source with the latter giving longer response in the late spring and early summer. There was a noticeable pattern of green spots from the LESCO source in June at the Country Club of Lansing. The CIL treated plots did have a few smaller green spots, but these were not as noticeable. The larger sulfur-coated urea particles from LESCO were apparently just releasing the N from scattered particles later in the season when the rest of the N had been utilized. This could be overcome by another N fertilization.

A study of several slow release nitrogen sources was initiated in July on a blend of Kentucky bluegrasses on the grounds at the Traverse City Country Club. Appreciation is expressed to Tom Mead and Steve White for their cooperation in this and other studies conducted there. The N carriers (Table 4) are: 1) oxamide with two different size ranges, a finer grade (passing a 20 mesh screen) which will give a faster response, and a coarser grade (6-16 mesh); 2) FLUF (flowable ureaformaldehyde) applied as a liquid with a CO_2 sprayer; 3) Powder Blue, fine grade ureaformaldehyde (applied dry mixed with sand); 4) 10-1-4, a flowable complete fertilizer; 5) several carriers containing sulfur-coated urea from LESCO; 6) sulfur-coated urea from CIL (32-0-0); 7) IBDU (coarse); 7) 24-4-12, containing IBDU as part of the N; 8) 18-5-9, containing ureaformaldehyde as part of the N; and 9) Dwell-treated urea with Dwell serving as a nitrification inhibitor.

Turf responses (Table 4) were generally as expected. For uniform responses, both short-term and long-term, the slower releasing materials mixed with soluble N gave the most uniform ratings. The slower responding materials gave the longest responses as would be expected. Note ratings for IBDU and coarse oxamide compared to other materials in November. FLUF clearly gives a faster response than Powder blue. The sulfur-coated urea materials gave responses intermediate between the slow releasing sources and soluble N (urea). Dwell-treated urea did give a longer response than urea alone, indicating some inhibition of nitrification did occur. Complete fertilizers (24-4-12 and 18-5-9) gave both short- and long term responses, although 18-5-9 contains more soluble N than 24-4-12, so the response

Table 2. 1980-81 Fall Nitrogen Responses on a *Poa annua* fairway at the Walnut Hills Country Club, East Lansing. Averages for 3 replications. Nitrogen applied at 1.5 pounds per 1000 square feet.

Treatment		Evaluation date (9-1;9-dark green)					
Carrier	Date of application	10/31/80	11/18/80	12/17/80	4/6/81	4/22/81	5/15/81
IBDU	Oct 15	5.8f[#]	5.7i	5.8hm	5.7ij	6.7g	7.2hk
IBDU	Nov 1	5.5fg	4.7kl	5.0lp	5.5jl	7.3ef	7.2hk
IBDU	Nov 15	5.3g	4.0m	3.7qt	4.5m	6.0h	6.5km
IBDU	Dec 1	5.3g	4.0m	3.2t	2.7n	5.5h	5.3n
S.C. Urea (CIL)*	Oct 15	8.2b	8.5bc	7.7bd	6.8df	8.3ac	8.0cg
S.C. Urea (CIL)	Nov 1	5.5fg	7.2f	7.3df	6.7dg	8.7a	7.8dh
S.C. Urea (CIL)	Nov 15	5.3g	4.0m	5.5in	6.8df	8.3ac	8.3ae
S.C. Urea (CIL)	Dec 1	5.3g	4.0m	3.5rt	5.7ij	7.7ce	8.5ad
18-5-9*	Oct 15	8.3b	8.3cd	6.5ei	4.8lm	7.2eg	6.3lm
18-5-9	Nov 1	5.3g	7.2f	8.3ac	7.2ce	8.2ac	7.0il
18-5-9	Nov 15	5.3g	4.8kl	5.2kp	7.7ac	8.7a	7.8dh
18-5-9	Dec 1	5.2g	4.0m	4.3os	6.5eh	7.7ce	7.3gj
Milorganite	Oct 15	6.3e	6.5gh	6.3gk	6.8df	7.2eg	7.0il
Milorganite	Nov 1	5.5fg	5.2j	4.8mp	6.7dg	7.3ef	7.7ei
Milorganite	Nov 15	5.5fg	4.0m	3.5rt	6.2fj	7.3ef	8.2bf
Milorganite	Dec 1	5.2g	4.0m	3.3st	4.8lm	6.7g	6.8jl
Urea*	Oct 15	9.0a	9.0a	6.8dh	4.8lm	7.2eg	6.0m
Urea	Nov 1	5.5fg	8.2cd	8.5ab	6.2fj	7.7ce	6.8jl
Urea	Nov 15	5.2g	4.7kl	5.8hm	7.8ac	8.2ac	7.3gj
Urea	Dec 1	5.2g	4.0m	4.2ps	6.8df	7.2eg	7.5fj
Dwell*-Urea	Oct 15	8.7a	8.5bc	7.2dg	5.8hj	7.5de	7.3gj
Dwell-Urea	Nov 1	5.3g	7.8e	8.3ac	6.7dg	8.3ac	7.5fj
Dwell-Urea	Nov 15	5.3g	4.7kl	6.2gk	7.7ac	8.3ac	7.7ei
Dwell-Urea	Dec 1	5.5fg	4.0m	4.5nr	6.2fj	7.5de	7.3gj

Table 2. Continued.

Carrier	Date of application	10/31/80	11/18/80	12/17/80	4/6/81	4/22/81	5/15/81
31-3-10*	Oct 15	7.8c	7.8e	6.3fj	6.3fi	7.3ef	6.3lm
31-3-10	Nov 1	5.5fg	6.7g	7.5ce	7.2ce	8.0bd	6.0m
31-3-10	Nov 15	5.5fg	4.0m	5.3jo	6.8df	8.5ab	7.8dh
31-3-10	Dec 1	5.3g	4.0m	3.7qt	5.0km	7.2eg	7.5fj
24-4-12*	Oct 15	7.3d	8.0de	6.0hl	6.0gj	7.8ce	7.0il
24-4-12	Nov 1	5.5fg	6.8g	7.2dg	6.2fj	8.3ac	7.8dh
24-4-12	Nov 15	5.2g	4.0m	5.0lp	6.7dg	7.8ce	7.3gj
24-4-12	Dec 1	5.3g	4.0m	3.5rt	5.5jl	7.7ce	6.8jl
Ammonium nitrate	Oct 15	9.0a	8.7ab	6.8dh	4.7m	6.8fg	6.3lm
Ammonium nitrate	Nov 1	5.3g	7.8e	9.0a	6.8df	8.2ac	6.5km
Ammonium nitrate	Nov 15	5.3g	5.0jk	5.8hm	8.0ab	8.7a	7.3gj
Ammonium nitrate	Dec 1	5.5fg	4.0m	4.3os	6.2fj	7.5de	7.5fj
S.C. Urea (LESCO)*	Nov 1	5.5fg	6.2h	6.3fj	7.3bd	8.7a	8.7ac
S.C. Urea (LESCO)	Nov 15	5.3g	4.0m	4.3os	6.7dg	8.0bd	9.0a
S.C. Urea (LESCO)	Dec 1	5.5fg	4.0m	3.3st	5.8hj	7.8ce	8.5ad
28-0-10*	Nov 1	5.7f	5.8i	5.2kp	6.8df	8.5ab	8.2bf
28-0-10	Nov 15	5.5fg	4.0m	4.2ps	6.8df	8.3ac	8.5ad
28-0-10	Dec 1	5.5fg	4.0m	3.3st	5.8hj	8.3ac	8.8ab
Check		5.3g	4.0m	3.2t	2.3n	3.8i	3.8o

*Carriers are S.C. Urea (sulfur coated urea), regular grade, from CIL; 18-5-9 from Lebanon Co.; Dwell from Olin-Matheson Co.; 31-3-10 from Scott's; 24-4-12 from Estech; S.C. Urea from LESCO; 28-0-10 from LESCO.

#Quality ratings in columns followed by the same numbers are not significantly different from each other using Duncan's Multiple Range Test at the 5% level.

Table 3. 1980-81 Fall Nitrogen REsponses on a *Poa annua* fairway at the Country Club of Lansing. Averages for 3 replications. Nitrogen applied at 1.5 pounds per 1000 square feet.

Treatment		Evaluation date (9-1;9=dark green)					
Carrier	Date of application	11/6/80	11/20/80	12/9/80	4/13/81	5/4/81	6/5/81
IBDU	Oct 15	5.3f	6.2ef	6.3fh	6.67ag	6.67be	6.00bg
IBDU	Nov 1	5.0fg	4.8ij	4.8kn	5.17df	6.17cg	7.17af
IBDU	Nov 15	5.0fg	4.7ij	3.7pr	5.17df	5.83dg	6.83ag
IBDU	Dec 1	5.0fg	4.7ij	3.3qr	3.83fg	5.00fg	6.83ag
S.C. Urea (CIL)*	Oct 15	7.0cd	8.3b	8.2bc	8.00ab	8.33a	7.00af
S.C. Urea (CIL)	Nov 1	5.0fg	5.8g	6.5fg	7.50ac	7.83ab	7.33ae
S.C. Urea (CIL)	Nov 15	5.0fg	4.7ij	4.7ln	4.67ef	4.67g	5.33dh
S.C. Urea (CIL)	Dec 1	5.0fg	4.5j	3.7pr	5.83af	6.67be	8.33ac
18-5-9*	Oct 15	7.8b	8.3b	8.5ab	6.67ae	7.17ae	5.83ch
18-5-9	Nov 1	5.0fg	6.7cd	7.2de	7.50ac	7.67ac	5.67ch
18-5-9	Nov 15	5.0fg	4.7ij	5.3jl	7.00ad	6.83ae	7.17af
18-5-9	Dec 1	4.8g	4.7ij	3.8pr	6.33ae	6.17cg	7.67ad
Milorganite	Oct 15	5.7e	6.0fg	6.0gi	7.83ac	7.00ae	7.00af
Milorganite	Nov 1	5.0fg	5.2h	4.8kn	7.17ad	6.83ae	6.67ag
Milorganite	Nov 15	5.0fg	4.5j	3.3qr	6.67ae	6.17cg	7.67ae
Milorganite	Dec 1	5.0fg	4.5j	3.3qr	5.83bf	5.67eg	7.50ae
Urea*	Oct 15	8.7a	8.8a	9.0a	6.50ae	6.83ae	4.50fh
Urea	Nov 1	5.0fg	7.0c	7.2de	7.67ac	6.50bf	5.83ch
Urea	Nov 15	5.0fg	4.7ij	5.8hj	7.17ad	6.67be	6.50ag
Urea	Dec 1	5.2f	4.7ij	4.2np	5.83bf	6.00dg	6.50ag
Dwell*-Urea	Oct 15	8.5a	8.7a	8.8ab	7.17ad	7.00ae	6.33ag
Dwell-Urea	Nov 1	5.0fg	6.5de	7.2de	7.00ad	7.17ae	7.50ae
Dwell-Urea	Nov 15	5.0fg	4.7ij	5.3jl	7.17ad	7.17ae	7.33af
Dwell-Urea	Dec 1	5.0fg	4.7ij	4.0oq	6.33ae	6.50bf	6.50ag

Table 3. Continued.

Carrier	Date of application	11/6/80	11/20/80	12/9/80	4/13/81	5/4/81	6/5/81
31-3-10*	Oct 15	6.8d	8.0b	7.8cd	6.67ae	6.83ae	6.50ag
31-3-10	Nov 1	5.0fg	5.7g	6.2fh	7.00ad	6.17cg	6.17ag
31-3-10	Nov 15	5.0fg	4.7ij	4.5mo	6.67ae	6.67be	7.50ae
31-3-10	Dec 1	5.0fg	4.5j	3.7pr	6.00af	6.50bf	7.00af
24-4-12*	Oct 15	7.3c	8.2b	7.8cd	7.17ad	7.67ac	6.67ag
24-4-12	Nov 1	4.8g	6.2ef	6.7ef	7.50ac	7.00ae	7.00af
24-4-12	Nov 15	4.8g	4.7ij	5.2jm	6.33ae	7.00ae	7.50ae
24-4-12	Dec 1	5.0fg	4.7ij	3.7pr	6.00af	6.83ae	7.50ae
Ammonium nitrate	Oct 15	8.7a	8.8a	8.8ab	5.83bf	6.67be	5.00eh
Ammonium nitrate	Nov 1	4.8g	6.5de	6.8ef	7.5ac	6.83ae	6.00bg
Ammonium nitrate	Dec 1	5.0fg	4.7ij	3.8pr	7.00ad	6.67be	6.67ag
S.C. Urea (LESCO)*	Nov 1	5.0fg	5.3h	4.8kn	6.33ae	7.33ad	8.83ab
S.C. Urea (LESCO)	Nov 15	5.0fg	4.5j	4.0oq	6.50ae	7.17ae	8.17ad
S.C. Urea (LESCO)	Dec 1	4.8g	4.7ij	3.5pr	5.67ad	7.00ae	8.17ad
28-0-10*	Nov 1	5.0fg	6.0fg	5.5ik	7.33ad	7.83ab	9.00a
28-0-10	Nov 15	4.8g	4.7ij	4.0oq	6.67ae	7.33ad	9.00a
28-0-10	Dec 1	5.0fg	4.5j	3.3qr	6.00af	7.17ae	8.83ab
Check		4.8g	4.5j	3.2r	2.00g	2.83h	4.50fh

*Carriers are S.C. Urea (sulfur coated urea), regular grade, from CIL; 18-5-9 from Lebanon Co.; Dwell from Olin-Matheson Co.; 31-3-10 from Scott's; 24-4-12 from Estech; S.C. Urea from LESCO; 28-0-10 from LESCO.

#Quality ratings in columns followed by the same numbers are not significantly different from each other using Duncan's Multiple Range Test at the 5% level.

Table 4. 1981 N Carrier Study - Traverse City - Kentucky Bluegrass Blend. Treatments applied July 16. Averages of 3 replications. N applied at 1.5 pounds per 1000 square feet.

Treatment		Evaluation date (9-1;9=dark green)			
Carrier	N rate lbs/M	July 30	Aug 15	Sept 16	Nov 18
Oxamide (20)*	1.5	5.5eh#	7.8ae	6.7bg	5.8e
Oxamide (6-16)*	1.5	3.2ij	4.0ok	3.5l	6.7d
Oxamide (20)* Urea	1.0 0.5	6.7cf	7.3bf	6.3di	4.8hi
Oxamide (20)* Urea	0.5 1.0	6.7cf	7.5af	6.2ej	4.3ik
Oxamide (6-16)* Urea	1.0 0.5	5.0fh	5.3ij	5.8gj	6.3d
Oxamide (6-16)* Urea	0.5 1.0	5.8eg	5.8gj	5.5ik	5.3fg
FLUF*	1.5	6.5df	7.0cg	6.3di	4.8hi
FLUF* Urea	1.0 0.5	5.8eg	6.5ei	6.3di	4.3ik
FLUF* Urea	0.5 1.0	7.2be	7.5af	6.0fj	4.0jk
Powder blue*	1.5	4.0hi	4.8jk	4.8k	4.7hi
Powder blue* Urea	1.0 0.5	6.0eg	6.7ei	5.7hk	4.3ik
Powder blue* Urea	0.5 1.0	6.8be	6.7ei	5.3jk	4.0jk
10-1-4 (Cleary)	1.5	6.7cf	7.0cg	5.3jk	4.0jk
20-6-12 (LESCO)	1.5	5.8eg	7.2bg	7.2ad	5.8e
28-3-9 (LESCO)	1.5	6.3ef	7.0cg	6.8bf	5.3fg
36-0-0 (LESCO)	1.5	5.7eh	6.5ei	7.0ae	5.5ef
28-0-10 (LESCO)	1.5	5.0fh	6.2fi	7.5ab	5.7ef
32-0-0 (CIL)	1.5	7.2be	7.7ae	7.5ab	5.3fg
Urea	1.5	8.5ab	8.8a	5.3jk	3.5l
Urea Dwell*	1.5 1.0	8.5ab	8.3ac	6.5ch	4.5ij
Urea Dwell*	1.5 3.0	8.5ab	8.5ab	6.8bf	5.0gh
IBDU (coarse)*	1.5	1.8j	4.8jk	6.7bg	7.5c
IBDU (coarse)* Urea	1.0 0.5	3.3ij	5.3ij	6.7bg	6.5d

Table 4, continued

Carrier	N rate lbs/M	July 30	Aug 15	Sept 16	Nov 18
24-4-12*	1.5	6.0eg	6.0eg	6.8bf	5.5ef
18-5-9*	1.5	8.2ad	8.2ad	6.8bf	4.7hi
Ammonium nitrate	1.5	9.0a	8.8a	5.3jk	3.8kl

*Carriers are Oxamide from Estech; FLUF from Cleary; Powder blue from Boots-Hercules; Dwell from Olin-Matheson; IBDU from Estech; 24-4-12 from Estech; and 18-5-9 from Lebanon.

#Quality ratings in columns followed by the same letter are not significantly different at the 5% level using Duncan's Multiple Range Test.

is quicker but does not last as long as 24-4-12.

Table 5 gives the treatments for a study on the effects of mixing N sources on responses of a Kentucky bluegrass blend at the Soils Research Farm in East Lansing. Plot size was 5 feet by 7 feet. Results were evaluated by quality ratings and clipping weights (Table 6). Responses were generally as would be expected, with some times when the response was limited due to the length of time between treatments (only 3 treatments a year). These effects were minimized by the use of IBDU as would be predicted because of its slower and longer release pattern.

The effect of late season nitrogen fertilization and leaf removal on the quality of Pennlawn red fescue in the Shade Plots at East Lansing is given in Table 7. With the intensity of the shade in the area the turf is reasonably thin. The most significant effect on the turf was due to leaf removal. When leaves were removed in the fall, or where they were mulched with a mulching mower, turf quality was acceptable the next spring, regardless of N treatment. Where leaves were left on the site all winter, the turf quality was poor and almost no grass was left on the plots, even where leaves were removed in early April. Leaf removal in the fall shortly after leaf fall is essential for maintaining turf under shaded conditions.

The lack of cation exchange capacity in sand soils results in ready leaching of applied potash. This was demonstrated by a study established at Traverse City. Potash treatments were applied in June and September, as shown in Table 8, on a blend of Kentucky bluegrasses. The sulfur-coated potash is from LESCO. The sulfur-coating should slow the availability of the potash so it will last longer. It is very apparent that the potash is readily leached. As high as 8 pounds of K_2O applied as muriate of potash in June was not detectable by soil test in November. With split spring and fall applications, there was more available in November from the muriate of potash treatment. When sulfur-coated potash was applied in June, there was some residual available yet in November at the higher rates of application. But clearly, split applications of the sulfur-coated potash are still best. These data point out the importance of using several applications of potash per year, especially on sandy soils which are irrigated. These soils do not have sufficient cation exchange capacity to hold the potash, so multiple applications are necessary. The sulfur-coated potash does provide longer availability and is useful on sandy sites particularly.

The nitrogen timing and rate study on the Kentucky bluegrass cultivars at Traverse City was continued in 1981 with no data distinct from previous years. Perhaps the most noticeable result is the amount of encroachment of other grasses into the block of Fylking Kentucky bluegrass, which was thinned by susceptibility to Fusarium blight. It is apparent that some nitrogen is necessary to encourage whatever grass is present to fill in the blighted spots just to keep the area green and with reasonable density of turf.

Table 5. Treatments for effect of nitrogen carrier and timing study on responses of a blend of Adelphi, Baron and Victa Kentucky bluegrasses. East Lansing. Treatments initiated October, 1979.

		Treatment - lbs. N/1000 ft. sq.						
No.	Carrier	May 1	May 15	Jun 1	Jun 15	Aug 1	Sep 1	Oct 15
1	Coarse IBDU			0.75		0.5		2.0
2	60 IBDU:20 CIL:20 Urea			0.75		0.5		2.0
3	40 IBDU:40 CIL:20 Urea			0.75		0.5		2.0
4	20 IBDU:60 CIL:20 Urea			0.75		0.5		2.0
5	CIL			0.75		0.5		2.0
6	24-4-12			0.75		0.5		2.0
7	Coarse IBDU		1.0			0.75		1.5
8	60 IBDU:20 CIL:20 Urea		1.0			0.75		1.5
9	40 IBDU:40 CIL:20 Urea		1.0			0.75		1.5
10	20 IBDU:60 CIL:20 Urea		1.0			0.75		1.5
11	CIL		1.0			0.75		1.5
12	24-4-12		1.0			0.75		1.5
13	Coarse IBDU	1.25			0.75		1.25	
14	60 IBDU:20 CIL:20 Urea	1.25			0.75		1.25	
15	40 IBDU:40 CIL:20 Urea	1.25			0.75		1.25	
16	20 IBDU:60 CIL:20 Urea	1.25			0.75		1.25	
17	CIL	1.25			0.75		1.25	
18	24-4-12	1.25			0.75		1.25	

Table 6. Effect of nitrogen carrier and timing study on responses of a blend of Adelphi, Baron and Victa Kentucky bluegrasses. East Lansing. Treatments shown in Table 5. 5' x 7' plots.

Treatment No.	Quality ratings (9 = best)							Clipping weights per plot, gm		
	5/5/80	5/14/80	6/16/80	7/1/80	7/18/80	8/26/80	10/23/80	5/20 80	8/29/80	11/7/80
1	6.5 D*	7.3 CD	8.3 A	7.5 C	4.7 CD	6.5 EG	5.8 nd	229 BE	72.6 AC	20 D
2	7.3 C	7.8 BC	7.7 AB	7.0 D	4.5 D	6.5 EG	5.7	315 A	75.8 AC	22 CD
3	7.5 BC	8.0 B	7.2 BD	6.5 EF	4.2 D	7.7 DG	5.5	281 AC	83.7 AB	24 CD
4	8.0 B	8.3 B	7.2 BD	6.5 EF	4.3 D	6.3 EG	5.2	275 AD	71.4 AC	19 D
5	8.8 A	9.0 A	7.7 AB	6.7 DE	4.2 D	6.0 FG	5.2	281 AC	63.8 C	18 D
6	8.0 B	8.3 B	6.7 CD	6.0 GH	3.5 E	5.8 G	5.5	288 AB	75.7 AC	17 D
7	4.8 FG	5.3 H	7.2 BD	7.0 D	5.8 B	7.0 CG	6.8	176 EF	80.7 AC	22 CD
8	5.0 F	5.7 GH	6.7 CD	6.0 GH	6.8 A	7.7 BD	6.5	180 EF	88.0 AB	24 CD
9	5.7 E	6.0 FG	6.7 CD	5.8 HI	7.0 A	6.7 DG	6.0	230 AE	74.5 AC	23 CD
10	5.7 E	6.5 EF	6.7 CD	5.8 HI	7.0 A	6.3 EG	6.0	192 DF	70.8 AC	19 D
11	6.3 DE	6.7 DE	6.5 D	5.5 IJ	7.0 A	6.3 EG	6.0	201 CF	69. 4 BC	16 D
12	6.0 DE	6.3 EG	5.5 E	6.2 J	6.8 A	6.3 EG	5.5	199 CF	75.8 AC	20 D
13	2.7 K	3.2 K	5.5 E	6.3 FG	5.3 BC	8.8 A	7.5	127 F	78.7 AC	32 BC
14	3.2 JK	3.7 JK	7.0 BD	7.7 BC	a5.3 BC	7.8 AC	8.2	130 F	81.9 AC	38 B
15	3.5 IJ	4.0 IJ	7.3 BC	8.0 B	5.7 B	8.0 AC	8.5	115 F	80.3 AC	39 B
16	3.5 IJ	4.2 IJ	7.5 B	8.5 A	6.0 B	8.0 AC	9.0	127 F	89.4 A	39 B
17	4.2 GH	4.5 I	7.2 BD	8.5 A	6.0 B	8.5 AB	9.0	134 F	85.9 AB	41 B
18	4.0 HI	4.0 IJ	8.3 A	8.8 A	5.5 B	7.3 CE	7.8	141 F	85.3 AB	51 A

*Means in columns followed by the same letter are not significantly different at the 5% level with Duncan's Multiple Range Test. nd = not analyzed statistically.

Table 7. Fall N-Leaf Removal Study on Pennlawn Red Fescue. Crop Science Shade Research Area.

Treatment		Evaluations - May 12, 1981	
N Rate lbs/1000	Leaf removal	Quality rating (9 = best)	Turf cover %
0	Fall	6.5 a*	57 a
1	Fall	5.3 ab	52 a
2	Fall	5.2 ab	56 a
0	Mulched mower	5.3 ab	56 a
1	Mulched mower	6.2 a	67 a
2	Mulched mower	5.8 a	66 a
0	Spring	1.7 c	8 b
1	Spring	2.3 c	3 b
2	Spring	2.7 bc	3 b
0	Leave	2.7 bc	4 b
1	Leave	2.5 c	9 b
2	Leave	2.3 c	3 b

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

Table 8. Residual soil potassium tests on Kalkaska sand at Traverse City. Soils sampled November, 1981. Averages for 3 replications.

Treatment			K soil test
Carrier	K_2O Rate lbs/M	Date of application	lbs/A
Muriate	1	June	76gh#
Muriate	2	June	89fg
Muriate	3	June	84fh
Muriate	4	June	83fh
Muriate	8	June	87fh
Muriate	1,1	June, Sept	120ce
Muriate	2,2	June, Sept	152b
S.C. Potash*	1	June	72gh
S.C. Potash	2	June	81gh
S.C. Potash	3	June	102ef
S.C. Potash	4	June	112de
S.C. Potash	8	June	124cd
S.C. Potash	1,1	June, Sept	135bc
S.C. Potash	2,2	June, Sept	188a
Check	0	-	67h

*S.C. Potash is sulfur coated potash from LESCO.

#Soil test values followed by the same letter are not significantly different at the 5% level using Duncan's Multiple Range Test.