

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<sub>2</sub>O 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<sub>2</sub>O 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<sub>2</sub> 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 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 <sup>#</sup>	7.8ae	6.7bg	5.8e
Oxamide (6-16)*	1.5	3.2ij	4.0ok	3.5l	6.7d
Oxamide (20)*	1.0	6.7cf	7.3bf	6.3di	4.8hi
Urea	0.5				
Oxamide (20)*	0.5	6.7cf	7.5af	6.2ej	4.3ik
Urea	1.0				
Oxamide (6-16)*	1.0	5.0fh	5.3ij	5.8gj	6.3d
Urea	0.5				
Oxamide (6-16)*	0.5	5.8eg	5.8gj	5.5ik	5.3fg
Urea	1.0				
FLUF*	1.5	6.5df	7.0cg	6.3di	4.8hi
FLUF*	1.0	5.8eg	6.5ei	6.3di	4.3ik
Urea	0.5				
FLUF*	0.5	7.2be	7.5af	6.0fj	4.0jk
Urea	1.0				
Powder blue*	1.5	4.0hi	4.8jk	4.8k	4.7hi
Powder blue*	1.0	6.0eg	6.7ei	5.7hk	4.3ik
Urea	0.5				
Powder blue*	0.5	6.8be	6.7ei	5.3jk	4.0jk
Urea	1.0				
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	1.5	8.5ab	8.3ac	6.5ch	4.5ij
Dwell*	1.0				
Urea	1.5	8.5ab	8.5ab	6.8bf	5.0gh
Dwell*	3.0				
IBDU (coarse)*	1.5	1.8j	4.8jk	6.7bg	7.5c
IBDU (coarse)*	1.0	3.3ij	5.3ij	6.7bg	6.5d
Urea	0.5				

Table 4, continued

Carrier	<u>N rate</u> 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	5.3 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.

Carrier	Treatment		K soil test
	$K_2O$ Rate lbs/M	Date of application	lbs/A
Muriate	1	June	76gh <sup>#</sup>
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.

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