1977 TURFGRASS SOILS RESEARCH REPORT
NITROGEN CARRIER EVALUATIONS

P. E. Rieke and R. A. Bay
Department of Crop and Soil Sciences
Michigan State University

Evaluations of nitrogen carriers were conducted again at East Lansing and at Traverse City in 1977. The philosophy followed in these nitrogen carrier evaluations is that a carrier is studied more extensively if there is private funding for study of that carrier. These are compared against "standard" carriers which are being used commercially and from which the nitrogen response can normally be predicted. Occasionally as time and plot area allow, a commercially available complete fertilizer is included in the study, but this is rare. If a particular product is included in a study this does not suggest endorsement of that product by Michigan State University; and if a product is not studied this does not imply that it would not perform well. The objective of these studies is to better understand the type of nitrogen response which will result under field conditions from some of the newer and less studied nitrogen carriers.

The evaluation of response is based on the visual turfgrass quality. Ratings are composed of a combined evaluation of color, density and vigor. A rating of 1 to 3 is considered acceptable, while a rating of 5 indicates a significant decline in the above factors and a rating of 9 indicates essentially no green color with very poor density of plants. A rating of 1 would indicate a very dark green color and in some cases may promote too much growth.

The data in Table 1 summarize the results from treatments applied to the green at Traverse City. Appreciation is expressed to Ed Karcheski, Golf Course Superintendent at the Traverse City Country Club and to the club for the use of these facilities for research. The nitrogen was applied at an annual rate of 6 pounds per 1000 square feet, divided into 1 pound applications per month or 2 pounds every other month beginning May 14. There were 4 replications of each treatment. The soil is a sand which is well irrigated.

The sulfur coated urea in this study is from Canadian Industries, Limited (CIL). There was a standard particle size fertilizer and a fine grade for use on greens. The 20-0-15 and 20-5-10 are complete fertilizers containing sulfur coated urea from CIL. The 18-5-9 is from the Anderson's Company and the 30-3-10 from FDS Fertilizers, both of which contain some sulfur coated urea as the slow release nitrogen source. The IBDU is the coarse grade from Swifts. The two experimental liquids are two different formulations of soluble nitrogen sources and contain some P_2O_5 and K_2O. The urea-Terrazole materials are experimentals from Olin-Mathison, with the Terrazole presumably providing nitrification inhibition.

All carriers performed well but ureaformaldehyde, especially the standard 38% which resulted in poorer ratings. The powder form of urea-formaldehyde gave faster and more efficient response than the standard grade. The powder form is being utilized effectively in liquid applications to commercial turfs where proper equipment for agitation and spraying is used. Foliar and dry applications of ammonium nitrate and urea gave similar results. The sulfur coated urea treatments resulted in good ratings as has been observed in previous years. On the green the finer particle grade was slightly better than the coarser grade.

The monthly applications of most materials gave more consistent ratings than bimonthly applications for all carriers, but especially for those materials which provide a shorter term response. No attempt was made to evaluate if any fertilizer had been picked up by the mower. The first mowing after fertilization the

clippings are returned; after that all clippings (and any fertilizer) would be removed.

The results of the nitrogen carrier study on the bentgrass green at East Lansing are shown in Table 2. The soil is 2 parts coarse sand, 1 part peat and 1 part fine sandy loam. The ratings taken June 12 were not used to calculate the averages for the year, but it is interesting to note that within 5 days after application in early June the urea and sulfur-coated urea treatments gave significant responses. The extended period between the August 5 treatment and the October 2 rating resulted in poorer ratings in October for those materials containing more water soluble nitrogen. The cooler soil temperatures at the time of the October 5 treatment caused the poorer ratings observed for the organic carriers, Milorganite and 27-0-0 (the latter an experimental fertilizer from Lakeshore-LESCO) while those treatments with the most water soluble nitrogen gave the best ratings on the November 1 evaluation date. There was some phytotoxicity evident on the urea-Terrazole treated plots during late summer apparently from the July 15 treatment. This injury was not observed on any of the other studies either on bentgrass or Kentucky bluegrass during 1977.

Four pounds of nitrogen per 1000 square feet was applied during the year on predominantly red fescue turf at Traverse City (Table 3). Most carriers performed more uniformly when applied as 1 pound of N on 4 dates than when applied as 2 pounds of N on 2 dates. The only exception was on the first date of evaluation (June 4), 3 weeks after the first application when the lower application rates in May gave poorer ratings. The response to carriers with more water soluble nitrogen tended to be depleted between the May 12 and August 4 application dates when 2 pounds N was applied in May as would be expected. The heavy rainfall at Traverse City during late August and early September apparently tended to leach the nitrogen from the plots receiving the more water soluble carriers as reflected in the poorer ratings on the September 27 evaluation date.

In a second study at Traverse City on Kentucky bluegrass (Table 4) there was little difference in the response observed between sulfur coated urea from CIL (Canadian Industries, Limited) and TVA (provided by LESCO). As in other studies this year IBDU gave slow responses in the spring and early summer when there was more limited rainfall but performed well in late summer and early fall where there was more rainfall.

In Table 5 the results are summarized from the 1977 nitrogen carrier study at East Lansing on Merion Kentucky bluegrass. At some times during the season there was no difference among any of the treatments. No ratings were taken at these times for this reason, especially in late August when all carriers were giving good response. Then with the extensive rainfall in early September the nitrogen from all treatments seemed to be depleted. Again there were essentially no differences apparent among treatments. The late application in October did not give differential responses by November 1. Clippings are returned to these plots grown on a very good soil. This reduced the relative response predicted since the nitrogen in the clippings is recycled. The residual response in the spring of 1978 will be evaluated.

In summary most of the carriers performed well if applied at rates and times appropriate for the conditions and the carrier. These data help up to understand the relative response rate so we can predict how a given carrier will respond under a given set of conditions.

Effect of Mowing, Traffic and Clipping Return on Nitrogen Release from Sulfur Coated Ureas

When applying slow release nitrogen carriers which have a relatively large particle size to a green there is a good possibility of the fertilizer being picked

up with the clippings. For this reason the clippings are often returned for one or two mowings after application to a green. In addition there is concern for the effect of mowing and traffic on the coating of coated fertilizers. If the coating is broken the soluble fertilizer on the inside is readily available and the fertilizer loses its slow release characteristic.

A study was designed to evaluate the effect of traffic and clipping removal from a green on the nitrogen response from sulfur coated ureas. Treatments were applied September 26, 1977. The traffic treatments applied were none; 25 passes over every spot on the plot by golf shoe traffic; and 3 passes with a water weighted Ryan vibrating roller to which golf shoe soles have been attached. The fertilizer was applied, followed by the traffic treatments. Then the plots were irrigated. The next day the plots were mowed with clipping removal or return.

Three weeks after application the quality ratings shown in Table 6 were taken. The reader is cautioned that this is a preliminary report and the study should be repeated. But from these data it is apparent that intense traffic on the turf causes some breaking of the coatings. This allows the nitrogen contained in the particle to be watered into the turf and leads to the turf response. Thus the quality ratings were better when the plots received traffic after application, especially the intense roller traffic. Also, returning clippings resulted in a greater turf improvement for the coarser particles from TVA and CIL-standard size fertilizer than for the fine grade CIL sulfur coated urea. This is reasonable since the smaller particles would not be as susceptible to mower pickup and probably to traffic damage. The reader is reminded that the coarser particle materials are not designed for use on greens and the manufacturers do not recommend the use of the coarse particle grades on greens.

Low Soil Potassium Effects on Seedhead Formation

After 13 years of clipping removal from Merion Kentucky bluegrass plots which were treated with a wide range of nitrogen rates, a significant depletion of soil potassium occurred. In the past greater moisture stress and wilting was observed on the low potassium plots which was reported at previous conferences. In June of 1977 it was observed that there was greater seedhead formation on the plots with lower soil potassium levels (less 100 pounds per acre exchangeable potassium with neutral normal ammonium acetate). We do not have evidence that this response holds true for other grasses but it is suggested that the turf manager should keep soil potassium levels adequate if seedhead formation is considered undesirable. The level of available soil potassium can best be determined by soil testing.

Wetting Agents Effects on Hydrophobic Sands

A study of wetting agent treatment effects on rewetting of the hydrophobic sand condition was initiated at Boyne Highlands on June 9. The results are summarized in Table 7. Hydro-Wet and Aqua-Gro gave the best improvement in rewetting as evidenced by quality ratings and percent soil moisture. These results are consistent with those from previous years. Amway and Wex wetting agents also provided some improvement in quality ratings compared to the untreated check for some treatments on some dates. Higher rates and more frequent applications of the Amway and Wex materials will be needed apparently for the same degree of response compared to Hydro-Wet and Aqua-Gro. Variability among plots reduced the level of significance among treatments as had been observed in the past.

A similar study was established on the Bay Pointe Golf Course where hydrophobic spots had developed in late May and early June. However, the hydrophobic condition disappeared before any treatment differences occurred. Appreciation is expressed to Mert Nye of Boyne Highlands and Don LaFond of Bay Pointe for use of these plot areas.

Two home lawns were treated with wetting agents and combinations of wetting agents and Tersan 1991. One lawn was heavily infested with Fusarium blight, the other was not. There was no apparent difference among any of the treatments. Apparently conditions conducive to development of the disease or recovery from past injury did not occur.

Table 1. 1977 Nitrogen Carrier Study on a creeping bentgrass green at Traverse City. The nitrogen was applied at the rate of 6 pounds of N per 1000 square feet, divided into equal monthly or bimonthly applications beginning May 14. Bimonthly applications were made on May 14, June 29 and September 7. Averages of 4 replications.

TREATMENT		Turfgrass Quality Ratings (1 = ideal; 9 = poor)						
Carrier	Time of Application	June 4	June 29	Aug 4	Sept 7	Sept 28	Oct 20	Average
Urea (dry)	Monthly	2.8 j-j*	2.0 a-b	3.1 d-g	3.0 d-h	3.0 f-j	3.9 e-h	3.0
	Bimonthly	1.6 a-d	4.1 h-k	3.1 d-g	4.1 k-m	2.4 b-f	5.4 k-l	3.5
Urea (foliar)	Monthly	2.8 h-j	2.4 a-d	3.6 f-j	3.4 f-j	3.4 i-l	4.4 g-i	3.3
Ammonium nitrate (dry)	Monthly	2.9 i-k	2.4 a-d	4.1 h-l	3.3 f-j	3.1 g-k	5.0 i-k	3.5
	Bimonthly	1.9 b-f	5.5 m	3.0 c-g	4.1 k-m	1.8 a-b	5.3 j-l	3.6
Ammonium nitrate (foliar)	Monthly	2.5 g-j	2.0 a-b	4.1 h-l	3.0 d-h	3.6 j-m	4.5 h-j	3.3
S-coated urea (CIL)	Monthly	2.6 h-j	2.8 b-f	3.5 e-i	2.8 c-f	3.0 f-j	2.6 b-c	2.9
(32-0-0) standard	Bimonthly	1.9 b-f	4.9 h-l	2.8 b-e	3.5 g-k	2.5 c-g	4.6 h-k	3.4
S-coated urea (CIL)	Monthly	2.5 g-j	2.3 a-d	2.4 a-d	2.0 a-b	2.8 e-i	2.6 b-c	2.4
(32-0-0) Fine	Bimonthly	1.5 a-c	3.4 e-h	3.0 c-g	3.5 g-k	2.4 b-f	4.6 h-k	3.1
20-0-15 (CIL)	Monthly	2.8 h-j	3.1 d-g	2.0 a-b	1.6 a	2.6 d-h	2.1 a-b	2.4
	Bimonthly	1.8 a-e	4.1 h-k	2.9 c-f	3.0 d-h	2.6 d-h	4.1 f-i	3.1
20-5-10 (CIL)	Monthly	2.6 h-j	3.1 d-g	2.5 a-d	2.5 b-e	2.5 c-q	2.9 b-d	2.7
	Bimonthly	1.8 a-e	4.3 h-l	1.8 a	3.3 f-j	2.1 a-e	3.9 e-h	2.8
18-5-9 (Tee Time)	Monthly	2.8 h-j	2.8 b-f	4.0 h-l	3.5 g-k	2.5 c-q	3.9 e-h	3.2
	Bimonthly	1.6 a-d	3.9 g-j	2.8 b-e	4.4 l-m	2.0 a-e	5.3 j-l	3.3
30-3-10 (FDS)	Monthly	3.0 j-l	2.4 a-d	3.4 e-h	3.0 d-h	3.0 f-j	3.6 d-g	3.1
	Bimonthly	2.1 d-h	5.1 l-m	3.1 d-g	3.9 j-k	2.0 a-d	4.5 h-j	3.5

Table 1 (Con't)

TREATMENT		Turfgrass Quality Ratings (1 = ideal; 9 = poor)						
Carrier	Time of Application	June 4	June 29	Aug 4	Sept 7	Sept 28	Oct 20	Average
UF-standard	Monthly	4.3 n	5.1 l-m	3.8 g-k	3.6 h-k	5.0 p-q	3.6 d-g	4.2
(38-0-0)	Bimonthly	2.9 i-k	4.3 h-l	3.8 g-k	3.8 i-l	4.3 m-o	3.9 e-h	3.8
UF-Powder Blue	Monthly	4.3 n	4.6 j-m	3.6 f-j	2.9 d-g	4.8 o-q	3.3 c-e	3.9
(38-0-0)	Bimonthly	2.1 d-h	4.3 h-l	3.1 d-g	3.8 i-l	3.9 l-n	4.0 e-h	3.5
Milorganite (6-2-0)	Monthly	2.9 i-k	3.5 f-i	2.4 a-d	2.4 b-d	4.8 o-q	2.6 b-c	3.1
	Bimonthly	2.5 g-j	5.0 k-m	2.4 a-d	3.6 h-k	4.8 o-q	4.0 e-h	3.7
IBDU (31-0-0) Coarse	Monthly	3.9 m-n	3.9 g-j	2.5 a-d	2.4 b-d	3.4 i-l	1.8 a	3.0
	Bimonthly	3.0 j-l	4.4 i-l	2.3 a-c	2.3 b-c	3.8 k-n	2.3 a-b	3.0
Expt'l Liquid B (16%)	Monthly	2.0 c-g	2.0 a-b	3.1 d-g	2.9 d-g	2.6 d-h	3.4 c-f	2.7
	Bimonthly	1.3 a	3.0 c-g	3.1 d-g	3.9 j-l	2.0 a-d	5.1 i-l	3.1
Expt'l Liquid W (16%)	Monthly	2.3 e-i	1.8 a	3.4 e-h	3.1 e-h	2.4 b-f	3.6 d-g	2.8
	Bimonthly	1.4 a-b	4.1 h-k	3.4 e-h	3.6 h-k	1.6 a	5.1 i-l	3.2
Urea-1% Terrazole	Monthly	2.6 h-j	2.3 a-d	3.6 f-j	3.0 d-h	2.6 d-h	4.1 f-h	3.1
	Bimonthly	2.4 f-j	4.5 j-l	2.5 a-d	3.8 i-l	1.8 a-c	5.0 i-k	3.5
Urea-1/2% Terrazole	Monthly	2.9 i-k	2.1 a-c	3.8 g-k	2.9 d-g	3.3 h-l	4.5 h-j	3.2
Urea-1% Terrazole	Monthly	3.5 l-m	2.4 a-d	4.5 k-l	3.3 f-j	3.9 l-n	4.4 g-i	3.7
(3 lbs N/M/Yr)	Bimonthly	3.0 j-l	4.8 j-m	4.1 h-l	4.4 l-m	3.1 q-k	5.1 i-l	4.1
Urea-1/2% Terrazole	Monthly	3.4 k-m	2.3 a-d	4.4 j-l	4.1 k-m	4.4 n-p	5.9 l-m	4.1
(3 lbs N/M/Yr)	Bimonthly	3.0 j-l	5.5 m	4.5 k-l	4.6 m	3.6 j-m	6.4 m	4.6
Urea (3 lbs N/M/Yr)	Monthly	3.4 k-m	2.5 a-e	4.4 j-l	4.4 l-m	5.1 q	5.9 l-m	4.3
	Bimonthly	2.5 g-j	5.1 l-m	4.3 i-l	4.8 m	4.3 m-o	6.6 m	4.6

*

Numbers in vertical columns not followed by the same numbers are significantly different at the 5% level by the Duncan's Multiple Range Test.

Table 2. 1977 Nitrogen Carrier Study on a Cohansey bentgrass green at East Lansing. The nitrogen was applied at the rate of 2 pounds N per 1000 square feet on June 5, July 15 and October 5. Averages of 3 replications.

Nitrogen Carrier	Turfgrass Quality Ratings (1 = ideal; 9 = poor)						
	June 12	Jul 2	Aug 5	Oct 2	Nov 1	Dec 5	Average
Urea	2.8 b-c*	1.8 a-b	2.3 b-c	4.3 f	1.5 a-c	1.5 a-b	2.3
Urea-1/2% Terrazole	1.8 a	2.3 b-c	2.3 b-c	3.8 e-f	1.8 a-d	1.5 a-b	2.3
Urea-1% Terrazole	2.3 a-c	3.0 d-e	2.5 b-c	3.5 d-e	1.3 a-b	1.5 a-b	2.4
Sulfur-coated urea (CIL)†	3.2 c-d	1.7 a	1.8 a-b	2.8 c-d	2.0 b-d	1.8 a-b	2.0
20-5-10 (CIL)	3.2 c-d	2.5 c-d	1.2 a	3.0 d	2.2 c-d	1.8 a-b	2.1
20-0-15 (CIL)	5.2 e	3.2 e	1.8 a-b	2.8 c-d	2.5 d	2.8 b-c	2.6
18-5-9 (Tee Time)	2.5 a-c	2.2 a-c	3.2 c-d	4.2 e-f	1.2 a	1.2 a	2.4
30-3-10 (FDS)	2.7 a-c	2.3 b-c	2.0 a-b	4.2 e-f	1.5 a-c	1.3 a-b	2.3
27-0-0 (LESCO-experimental)	7.8 f	4.5 f	5.0 g	2.8 c-d	5.3 f	5.3 e-f	4.6
Milorganite (6-2-0-)	7.7 f	3.3 e	2.5 b-c	1.7 a	5.0 f	3.8 c-d	3.3
IBDU (31-0-0) Coarse	7.8 f	2.5 c-d	1.2 a	1.8 a	3.8 e	3.7 c-d	2.6

† The sulfur-coated urea used was the fine grade for use on greens.

* Numbers in vertical columns not followed by the same letter are significantly different at the 5% level by the Duncan's Multiple Range Test.

Table 3. 1977 Nitrogen Carrier Study on a Predominantly Red Fescue Turf at Traverse City. Averages for 3 replications.

TREATMENT					TURFGRASS QUALITY RATING (1 = ideal; 9 = poor)					
	N applied - lbs/1000 sq ft									
Carrier	May 12	Jun 4	Aug 4	Sept 27	Jun 4	Jun 29	Aug 4	Sept 27	Oct 30	Average
Urea	1	1	1	1	3.8 d-e*	2.2 a-b	2.8 a-b	3.7 g	1.8 c-3	2.9
	2		2		2.0 a-b	3.3 d-e	3.5 c-e	3.3 f-g	1.2 a-b	2.7
Urea - 1/2% Terrazole	1	1	1	1	3.8 d-e	2.3 a-b	2.7 a-b	3.2 e-g	1.7 b-d	2.7
	2		2		2.2 a-b	3.3 d-e	3.0 b-c	3.0 d-g	1.5 a-c	2.6
Urea - 1% Terrazole	1	1	1	1	4.0 d-e	2.5 b	2.3 a	2.5 a-e	1.7 b-d	2.5
	2		2		2.3 b-c	3.3 d-e	3.0 b-c	2.5 a-e	1.3 a-c	2.5
Sulfur-coated Urea (CIL)	1	1	1	1	4.0 d-e	2.2 a-b	3.0 b-c	2.5 a-e	2.3 e	2.7
	2		2		2.3 b-c	2.5 b	3.2 b-d	2.5 a-e	1.7 b-d	2.4
S-coated urea (CIL) Fine	1	1	1	1	4.0 d-e	2.2 a-b	2.7 a-b	1.8 a	1.7 b-d	2.5
	2		2		2.3 b-c	2.7 b-c	3.0 b-c	2.8 c-f	1.0 a	2.4
25-4-10	1	1	1	1	3.8 d-e	2.3 a-b	2.3 a	2.0 a-b	1.7 b-d	2.4
	2		2		2.0 a-b	2.7 b-c	2.8 a-b	2.0 a-b	1.0 a	2.1
18-5-9 (Tee Time)	1	1	1	1	4.0 d-e	2.5 b	2.7 a-b	2.8 c-f	1.8 c-e	2.8
	2		2		2.3 b-c	3.5 d-f	3.8 d-e	2.7 b-f	1.5 a-c	2.7
30-3-10 (FDS)	1	1	1	1	3.8 d-e	2.2 a-b	3.0 b-c	3.0 d-g	1.8 c-e	2.8
	2		2		2.2 a-b	3.8 e-f	3.8 e	3.2 e-g	1.2 a-b	2-8
20-0-15 (CIL)	2		2		1.8 a	2.7 b-c	2.8 a-b	2.2 a-c	1.7 b-d	2.2
20-5-10 (CIL)	2		2		2.2 a-b	2.7 b-c	3.2 b-d	2.3 a-d	1.0 a	2.3
IBDU (31-0-0)	2		2		3.8 d-c	4.0 f	3.0 b-c	2.2 a-c	3.2 f	3.2
UF (38-0-0)	2		2		3.8 d-e	4.8 g	4.0 e	2.0 a-b	3.0 f	3.5
Milorganite	1	1	1	1	4.2 e	3.2 c-d	2.8 a-b	2.0 a-b	4.2 g	3.3
33-0-0	1	1	1	1	3.7 c-d	1.8 a	2.7 a-b	3.2 e-g	1.7 b-d	2.6
Liquid B (16%)	1	1	1	1	4.0 d-e	2.0 a-b	3.0 b-c	3.0 d-g	1.8 c-e	2.8
Liquid W (16%)	1	1	1	1	4.0 d-e	2.0 a-b	3.0 b-c	2.7 b-f	2.2 d-e	2.8

*

Numbers in vertical columns not followed by the same letter are significantly different at the 5% level.

Table 4. 1977 Nitrogen Carrier Study on Kentucky Bluegrass at Traverse City. The nitrogen was applied at the rate of 1 or 2 pounds N per 1000 square feet on June 4. Averages of 3 replications.

TREATMENT		Turfgrass Quality Rating (1 = ideal; 9 = poor)				
Carrier	N Rate lbs/1000 sq. feet	June 29	Aug 4	Sept 27	Oct 20	Average
Urea	1	1.7 a-c*	2.8 b-c	4.3 h	4.0 d-e	3.2
	2	1.3 a	1.3 a	3.0 d-f	3.2 b-d	2.2
S-coated urea (TVA) (36-0-0)	1	2.5 d-f	2.8 b-c	3.3 e-g	3.3 b-d	3.0
	2	2.2 b-d	1.7 a	2.5 b-e	2.5 b	2.2
S-coated urea (CIL) (32-0-0) Standard	1	2.7 d-g	2.8 b-c	2.5 b-e	3.7 c-e	2.9
	2	2.0 a-d	1.5 a	1.8 a-b	2.7 b	2.0
S-coated urea (CIL) (32-0-0) Fine	1	3.3 g-i	3.2 c	2.8 c-f	3.7 c-e	3.3
	2	1.5 a-b	1.5 a	2.0 b-c	2.7 b	1.9
27-0-0 (LESCO)	1	3.0 e-h	4.2 d	4.2 g-h	4.5 e	4.0
	2	2.3 c-e	2.5 b	3.2 e-f	3.2 b-d	2.8
IBDU (31-0-0) Coarse	1	4.2 i	3.2 c	2.2 b-d	3.0 b-c	3.1
	2	3.2 f-h	1.5 a	1.0 a	1.7 a	1.8
Milorganite	1	3.7 h-i	3.2 c	3.5 f-h	4.0 d-e	3.6
	2	2.3 c-e	1.8 a	2.7 b-f	2.7 b	2.4

* Numbers in vertical columns not followed by the same letter are significantly different at the 5% level by the Duncan's Multiple Range Test.

Table 5. 1977 Nitrogen Carrier Study on Merion Kentucky Bluegrass at East Lansing. Nitrogen was applied at the rates shown on June 4 and October 20. Averages for 3 replications.

TREATMENT		Turfgrass Quality Rating (1 = ideal; 9 = poor)				
Carrier	N Rate lbs/1000 sq. ft.	Jun 17	Jul 2	Aug 8	Nov 6	Average
Urea	1	2.2 d-f	3.3 e-h	4.3 k-l	4.8 j-k	3.7
	2	1.0 a	1.3 a	3.0 e-h	3.7 f-i	2.3
Urea-1/2% Terrazole	1	2.0 c-e	3.5 e-h	3.7 h-k	4.2 h-j	2.3
	2	1.3 a-b	2.0 a-c	2.7 c-g	3.3 d-g	2.3
Urea-1% Terrazole	1	2.2 d-f	3.2 d-g	3.5 g-j	3.8 g-i	3.1
	2	1.3 a-b	1.7 a	2.0 a-c	3.0 c-f	2.0
S-coated urea 32-0-0 (CIL)	1	2.7 f-g	4.3 h-j	3.7 h-k	3.3 d-g	3.5
	2	1.7 b-d	1.8 a-b	2.3 b-e	2.2 a-b	2.0
S-coated urea Fine (CIL)	1	2.0 c-e	3.2 d-g	3.2 f-h	2.8 b-e	2.8
	2	1.5 a-c	2.2 a-d	2.8 d-g	2.7 a-d	2.3
25-4-10 (CIL)	1	2.5 f	3.0 c-f	3.0 e-h	3.2 c-g	2.9
	2	1.3 a-b	1.8 a-b	1.5 a	2.0 a	1.7
20-5-10 (CIL)	1	2.7 f-g	4.2 g-j	2.8 d-g	3.2 c-g	3.2
	2	2.0 c-e	3.2 d-g	2.2 a-d	2.8 b-e	2.5
20-0-15 (CIL)	1	2.7 f-g	4.2 g-j	3.2	d-g	3.4
	2	2.0 c-e	3.3 e-h	2.0 a-c	2.5 a-c	2.5
18-5-9 (Tee Time)	1	2.3 e-f	3.2 d-g	4.0 i-k	5.2 k	3.7
	2	1.5 a-c	2.0 a-c	2.8 d-g	3.7 f-i	2.5

Table 5 (Con't.)

TREATMENT		Turfgrass Quality Rating (1 = ideal; 9 = poor)				
Carrier	N Rate lbs/1000 sq. ft.	Jun 17	Jul 2	Aug 8	Nov 6	Average
30-3-10 (FDS)	1	2.5 f*	3.0 c-f	3.2 g-h	4.7 j-k	3.3
	2	1.3 a-b	1.8 a-b	2.7 c-g	3.0 c-f	2.2
UF (38-0-0) Powder Blue	2	3.2 g-h	4.0 f-i	3.7 h-k	2.8 b-e	3.4
UF (Chip)	2	4.0 i-j	5.5 k-l	4.2 j-l	3.3 d-g	4.3
S-Coated Urea	1	3.5 h-i	5-0 i-k	3.5 g-j	3.5 e-h	3.6
36-0-0 (TVA)	2	3.2 g-h	3.5 e-h	3.5 g-j	2.8 b-e	3.3
IBDU - Coarse	1	4.5 i-k	6.2 l	4.0 i-k	2.8 b-e	3.5
	2	4.0 i-j	5.2 j-l	3.0 e-h	2.0 a	4.4
Liquid B (16% N)	1	1.8 b-e	3.2 d-g	3.2 f-h	4.7 j-k	3.2
	2	1.3 a-b	1.8 a-b	1.8 a-b	3.3 d-g	2.1
Liquid W (16% N)	1	2.3 e-f	3.3 e-h	3.3 f-i	4.3 i-j	3.3
	2	1.8 b-e	2.0 a-c	2.3 b-e	3.5 e-h	2.4
27-0-0 (LESCO)	1	4.7 k	5.8 k-l	4.8 l	4.2 h-j	4.9
	2	3.2 g-h	4.2 g-j	3.5 g-j	3.0 c-f	3.5
18-4-9 (Lebanon)	2	1.8 b-e	3.0 c-f	2.8 d-g	3.0 c-f	2.7
30-3-10 (Scotts)	2	2.0 c-e	2.8 b-e	2.5 b-f	2.5 a-c	2.5
19-5-9 (U.S. Steel)	2	2.0 c-e	3.2 d-g	3.2 f-h	3.2 c-g	2.9
Milorganite	2	3.5 h-i	4.0 f-i	2.3 b-e	3.5 e-h	3.3

* Numbers in vertical columns not followed by the same letter are significantly different at the 5% level by the Duncan's Multiple Range Test.

Table 6. Effect of Traffic and Clipping Removal on Nitrogen Response to Sulfur-Coated Urea applied September 26, 1977 on a Toronto Bentgrass Green at East Lansing. Averages for 3 replications.

CARRIER	TRAFFIC	CLIPPINGS	Quality Ratings (1=Ideal) DATE OF RATING	
			Oct 11	Nov 4
32-0-0 (Fine) (CIL)	None	Remove	2.7 a-d	2.0 b-e
		Leave	2.7 a-d	1.3 a-b
	Foot	Remove	2.5 a-d	2.2 b-f
		Leave	2.5 a-d	1.8 a-d
	Compacter	Remove	2.0 a-b	1.7 a-c
		Leave	2.2 a-b	1.0 a
32-0-0 (Standard) (CIL)	None	Remove	3.7 e-f	3.0 f-h
		Leave	3.2 d-e	3.0 f-h
	Foot	Remove	3.2 d-e	2.3 c-f
		Leave	2.7 a-d	1.7 a-c
	Compacter	Remove	2.8 b-d	2.3 c-f
		Leave	2.5 a-d	1.3 a-b
36-0-0	None	Remove	4.2 f	4.8 i
		Leave	3.5 e-f	2.7 d-f
	Foot	Remove	3.7 e-f	3.7 g-h
		Leave	3.0 c-e	2.5 c-f
	Compacter	Remove	3.2 d-e	2.8 e-g
		Leave	2.3 a-c	1.7 a-c

Table 7. 1977 Wetting Agent Study - Boyne Highlands. Treatments were initiated June 9, 1977. Averages for 4 replications.

Wetting Agent	TREATMENT Ounces per 1000 sq. ft. Jun 9	Jun 29	Aug 10	Sep 8	Turfgrass Quality Rating (1 = ideal; 9 - poor) Jun 29	Aug 4	Sep 8	Oct 21	Average	Soil Moisture August 8
										%
Check	-	-	-	-	7.3 a*	7.5 a	5.6 a	3.9 a	6.1 a	11.6 a-b
Amway	8	-	-	-	5.0 b	6.6 a-b	4.4 a-b	3.4 a-c	4.9 a-b	12.7 a-d
Amway	16	-	-	-	4.5 b-d	5.8 a-c	3.3 b-e	2.5 a-d	4.0 a-f	12.3 a-d
Amway	32	-	-	-	4.0 b-e	6.1 a-b	3.8 a-d	2.8 a-c	4.2 a-f	13.0 a-d
Amway	8	8	-	-	5.0 b	6.5 a-b	4.3 a-b	3.6 a-b	4.9 a-b	11.7 a-c
Amway	16	16	-	-	4.8 b-c	5.5 a-c	4.5 a	3.3 a-c	4.5 a-e	15.0 a-e
Amway	32	32	-	-	4.5 b-d	6.1 a-b	3.6 a-d	2.9 a-c	4.3 a-f	13.1 a-d
Amway	16	16	16	16	4.3 b-e	4.5 b-g	3.4 b-d	2.9 a-c	3.8 b-g	18.4 c-f
Amway	8	8	8	8	4.3 b-e	5.3 a-e	3.1 b-e	2.5 a-d	3.8 b-f	15.4 a-e
Aqua-Gro	8	8	-	-	4.3 b-e	5.0 a-g	3.3 b-e	2.8 a-c	3.8 b-f	15.7 a-e
Aqua-Gro	16	-	-	-	2.3 e	2.4 g-h	2.0 c-e	2.0 b-d	2.2 f-g	19.7 e-f
Aqua-Gro	16	16	-	-	3.8 b-e	5.1 a-f	4.0 a-c	2.4 a-d	3.8 b-f	15.5 a-e
Aqua-Gro	32	-	-	-	2.3 e	2.9 d-h	2.0 c-e	2.5 a-d	2.4 d-g	19.3 d-f
Aqua-Gro	8	8	8	8	3.8 b-e	2.5 f-h	2.1 b-e	1.8 c-d	2.5 c-g	16.9 b-f
Hydro-Wet	16	-	-	-	2.5 d-e	3.1 c-h	1.8 d-e	1.8 c-d	2.3 f-g	17.3 b-f
Hydro-Wet	16	16	-	-	2.8 c-e	2.6 e-h	2.1 b-e	1.8 c-d	2.3 e-g	17.0 a-f
Hydro-Wet	8	8	8	8	2.5 d-e	1.6 h	1.1 e	1.1 d	1.6 g	22.6 f
Wex	8	-	-	-	5.0 b	6.5 a-b	4.1 a-c	3.3 a-c	4.7 a-c	13.8 a-e
Wex	16	-	-	-	4.5 b-d	5.9 a-c	4.1 a-c	3.5 a-b	4.5 a-e	13.8 a-e
Wex	32	-	-	-	3.8 b-e	5.8 a-c	3.9 a-d	3.1 a-c	4.1 a-f	12.7 a-d
Wex	8	8	-	-	5.5 a-b	5.5 a-d	4.4 a-b	3.0 a-c	4.7 a-d	15.5 a-e
Wex	16	16	-	-	4.3 b-e	5.5 a-d	3.8 a-d	3.4 a-c	4.2 a-f	12.7 a-d
Wex	32	32	-	-	4.3 b-e	3.9 b-h	2.8 b-e	2.0 b-d	3.2 b-g	17.9 b-f
Wex	8	8	8	8	5.5 a-b	7.4 a	4.9 a	3.3 a-c	5.3 a-b	10.9 a

* Numbers in vertical columns not followed by the same letter are significantly different at the 5% level by the Duncan's Multiple Range Test.