1976 TURFGRASS SOILS REPORT - NITROGEN CARRIER EVALUATIONS LONG-TERM FERTILITY EFFECTS, AND WETTING AGENTS

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Several nitrogen carriers were applied to a Penncross and Emerald creeping bentgrass putting green on sand at Traverse City. The treatments were applied as outlined in Table 1. All plots received 6 pounds N per 1000 sq ft per year but were divided in either 6 one-pound N applications or 3 two-pound applications. The 45-0-0 is urea; 33-0-0 is ammonium nitrate; Milorganite is a sewege sludge from the Milwaukee Sewerage Commission; UF is ureaformaldehyde (38-0-0); UF-fine is a powdered form of ureaformaldehyde; the sulfur-coated urea is a straight nitrogen carrier (32-0-0) and a complete fertilizer (20-5-10) from Canadian Industries Limited; IBDU is isobutylidenediurea (31-0-0) from Swift's. There were 6 replications of each treatment (3 replications on each grass).

There were no apparent differences in the response to fertilizers observed on Penncross or Emerald so all results were averaged from the 6 replications. Although the dry applications of urea and ammonium nitrate resulted in slightly better quality ratings than the foliar applications the differences were very small and were attributed to a minor lack of uniformity of application of the foliar treatments. All the foliar applications were irrigated after treatment to reduce foliar burn.

All carriers except ureaformaldehyde gave good responses. As observed in previous Michigan studies the regular ureaformaldehyde does not give a full response especially during the first few years. Note that the powder form of UF performed well by the July observation date and continued well throughout the remainder of the season. The sulfur-coated urea resulted in good overall quality ratings.

In a comparison of foliar and dry applications of ammonium nitrate and urea at Traverse City the dry applications gave slightly better results although differences were small and not meaningful (Table 2). The difference was due to the lack of uniform response since the equipment used did not adapt well to the shape of the plot, thus the liquid fertilizer was not applied as uniformly as the dry application. In all cases there was no meaningful difference in turf response between ammonium nitrate and urea when the turf was irrigated right after fertilizer application. The 1975 study showed that the ammonium nitrate caused significantly more foliar burn than urea when applied at the same nitrogen rate.

In 1971, plugs of Poa annua were planted into a Merion Kentucky bluegrass sod at East Lansing and mowed at 3/4 inch. Treatments (3 replications each) shown in Tables 3 to 6 were initiated in 1972. In October, 1976 density counts were obtained from each plot. The objective was to evaluate the effects of fertility programs on the competitive ability between the two grasses.

Higher annual nitrogen rates and high spring nitrogen treatments have resulted in more Poa annua (Table 3). There has been considerable encroachment of Poa trivialis into certain plots especially those treated with Milorganite. When the counts of volunteer Poa trivialis and bentgrass were disregarded the percentage of Poa annua in the plots treated with 8 pounds N as Milorganite per 1000 square feet annually had over 90% Poa annua. The plots receiving an August treatment of ammonium nitrate had about the same amount of Poa annua as the untreated checks. This would suggest that either the nitrogen was not used as effectively

due to leaching in the fall or that Poa annua does not compete as well with Merion in the fall.

The balance between P and K did not affect the amount of Poa annua in the turf (Table 4), although there was some variability in the data. There was a marked effect of P treatments when calcium arsenate had been applied to the turf (Table 5). Thus heavy phosphorus applications can overcome the influence of calcium arsenate. Since calcium arsenate is not being used today as a somewhat selective control for Poa annua the practical application of these data is that if one wishes to negate the effect of past treatments of calcium arsenate the easiest solution is high phosphorus applications. This has been suggested by Daniel and others.

In his Ph.D. thesis here at M.S.U., Bob Carrow reported that soil pH had a significant influence on the effectiveness of a calcium arsenate in controlling Poa annua based on his greenhouse and lab studies. Table 6 shows that when the turf had been treated with a very modest amount of calcium arsenate (10 pounds per 1000 square feet since 1971) applying limestone raised soil pH sufficiently to increase the amount of Poa annua in the turf. Raising the pH reduces the solubility of the arsenate thus reducing its toxicity to Poa annua. But when a higher rate of calcium arsenate had been applied (20 pounds total) soil pH was not important. Practically this means that maintaining soil pH near neutral is important in preventing the arsenate from having a continuing toxicity to Poa annua (and other species). The combination of phosphorus applications and keeping the pH near neutral should be most effective. One should not use sulfur to acidify the soil where calcium arsenate has been used in the past.

The results of 12 years of nitrogen fertility treatments at Traverse City are given in Tables 7 and 8 for Merion Kentucky bluegrass and Pennlawn creeping red fescue, respectively. Multiple applications of ammonium nitrate and Milorganite gave slightly better quality ratings than when all the nitrogen was applied in April on the Merion.

The higher nitrogen rates increased the amount of Poa annua slightly in Merion but significantly in the red fescue turf. Obviously the red fescue does not compete as well with Poa annua as does Merion. The Poa annua encroachment was natural with seeds carried on mowers from adjacent fairways. The use of Milorganite resulted in markedly increased percentages of Poa annua in the turf, especially in the Merion block.

Returning the clippings to a Merion Kentucky bluegrass turf over a 13 year period has resulted in considerable encroachment of Poa annua when mowed at 1 inch (Table 9). When clippings are removed at the 1 inch height or when mowed at 2 inches (regardless of clipping removal or return) there was no appreciable Poa annua. Poa annua is more competitive with Merion at the shorter mowing height. Returning clippings provides a continuing source of Poa annua seeds once the grass has begun encroachment. There may be some disease relationships as well since greater stripe smut injury was observed in 1975 on the plots where clippings were returned than where clippings are removed. Nitrogen rate has had no effect on the amount of Poa annua in the turf in this study.

Although no wetting agent treatments were applied during 1976 the residual effects of 1975 treatments of wetting agents at Boyne Highlands near Harbor Springs continue to substantiate earlier results. Hydro-Wet and Aqua-Gro are the only wetting agents among those studied which have any residual effects in correcting the hydrophobic soil condition. Hydro-Wet is slightly more effective than Aqua-Gro when applied at comparable rates. These two wetting agents provide short-term turf recovery if the treatment is applied before the hydrophobic condition has become serious. If some of the turf has already died from moisture stress, however, the recovery will require a longer period of time - up to several

months. In addition, the hydrophobic condition apparently redevelops with time necessitating retreatment every year or two depending on the severity of the problem, and the effectiveness of the treatment.

In 1964 Merion Kentucky bluegrass plots were established with sod or seeded. Nitrogen treatments were applied at rates ranging from 0 to 14 pounds (each divided into 6 monthly applications) per 1000 square feet annually. The study was concluded in 1976. There has been differential encroachment of weedy grass species into the plots. The plots which were originally seeded (Table 10) have had considerable weedy grass encroachment at the lower nitrogen rates. Under the conditions of clipping removal from these plots an annual nitrogen rate of 6 pounds was necessary to keep at least 90% Kentucky bluegrass in the turf. The plots which had received no nitrogen at all had a high concentration of timothy with some orchard grass and red fescue. When 2 or 4 pounds N were applied annually red fescue increased while other volunteer species decreased. These volunteer grass species were not apparent in the turf during the first 7 or 8 years of the study.

The sodded plots had essentially no weedy grasses present at the conclusion of the study (Table 11). These results substantiate that Merion is a cultivar which responds well to higher nitrogen rates. This applies when there is no disease development. Merion is susceptible to Fusarium blight and stripe smut, both of which tend to increase in severity with higher nitrogen fertilization.

Another conclusion is that the sodded turf was more resistant to weedy grass encroachment than the seeded turf. Throughout the study the sodded plots required about 2 pounds less nitrogen annually to attain a similar quality of turf.

Nugget Kentucky bluegrass plots were sodded in 1974 in the M.S.U. Shade Trial area. The treatments shown in Tables 12 and 13 were initiated in 1975 and continued through 1976. Better turf resulted (Table 12) when the turf was mowed at 2.5 inches (compared to 1.5 inches); when annual nitrogen rates of 1.5 pounds per 1000 square feet were applied (compared to higher nitrogen rates); and when the plots were treated with fungicides for powdery mildew and Fusarium blight.

Applying the nitrogen in March improved turf cover slightly over plots receiving a comparable nitrogen rate split in to April and September treatments (Table 13). But the highest percent of turf cover occurred when the nitrogen was all applied in October. These results need to be substantiated before October fertilization under heavily shaded conditions can be recommended but it would seem wise to fertilize shaded turfs at an appropriate time so the turf could take advantage of those periods when there is more sunlight penetration (before leaf development in the spring or after leaf fall in autumn). Certainly a 3 pound nitrogen treatment at one time (as used in this study) would not be recommended. If one application of nitrogen is desired per year perhaps 1 to 1.5 pounds could be applied under shaded turfs after leaf fall. Remember that leaf removal is essential for maintaining the best turf density possible under the shade conditions.

Appreciation is kindly expressed to Ed Karcheski, superintendent of the Traverse City Country Club, and Mert Nye, superintendent of the Boyne Highlands Golf Course for their excellent cooperation in providing the out-state plots areas for the research reported herein.

Table 1. 1976 TRAVERSE CITY NITROGEN CARRIER STUDY ON A PENNCROSS AND EMERALD BENTGRASS PUTTING GREEN. All plots received a total of 6 lbs N per 1000 sq ft for the year. Treatments were initiated in mid-May.

Carrier	Treatment		Visual Quality Rating*				
	Form	Frequency	Jun. 21	Jul. 21	Aug. 18	Sep. 9	Ave.
45-0-0	Dry	2 Months	2.3	1.5	2.5	1.9	2.0
45-0-0	Dry	Monthly	2.3	1.4	2.7	2.4	2.2
45-0-0	Foliar	2 Months	2.7	1.4	2.8	2.1	2.2
45-0-0	Foliar	Monthly	2.3	2.3	2.8	2.7	2.5
33-0-0	Dry	2 Months	3.1	1.8	2.9	2.0	2.4
33-0-0	Dry	Monthly	2.9	1.6	2.8	2.8	2.5
33-0-0	Foliar	2 Months	2.8	1.8	3.0	2.3	2.5
33-0-0	Foliar	Monthly	2.8	2.3	2.6	2.9	2.7
Milorganite	Dry	2 Months	2.8	1.9	2.9	2.5	2.6
Milorganite	Dry	Monthly	2.5	2.7	2.2	3.0	2.5
UF	Dry	2 Months	4.0	2.9	2.8	2.9	3.2
UF	Dry	Apr-Aug	3.0	4.1	3.3	2.9	3.3
UF - Fine	Dry	2 Months	3.6	1.8	2.2	2.8	2.6
UF - Fine	Dry	Apr-Aug	2.6	3.5	2.5	2.2	2.7
S-coated urea (32%)	Dry	2 Months	1.9	1.3	2.8	2.1	2.0
S-coated urea (32%)	Dry	Apr-Aug	1.4	3.0	2.9	1.4	2.2
S-coated (20-5-10)	Dry	2 Months	1.7	3.1	2.6	1.8	2.3
S-coated (20-5-10)	Dry	Apr-Aug	1.0	2.8	2.0	1.0	1.7
IBDU	Dry	2 Months	2.8	2.3	2.5	2.9	2.6
IBDU	Dry	Apr-Aug	1.9	2.9	2.8	2.4	2.5

* 1 = Best

Table 2. 1976 NITROGEN APPLICATION STUDY ON KENTUCKY BLUEGRASS at Traverse City. NITROGEN WAS APPLIED IN MAY, JUNE, AND AUGUST AT THE RATES SHOWN. Averages for 3 replications

CARRIER	N RATE lbs/1000 sq ft	METHOD OF APPLICATION	VISUAL QUALITY RATING (1=Best) Jun 24	Jul 21	Aug 18	Sep 9	Avg.
33-0-0	1	Foliar	3.5	3.0	3.5	3.0	3.3
45-0-0	1	Foliar	3.8	3.0	3.8	2.8	3.4
33-0-0	2	Foliar	1.5	1.5	2.0	1.2	1.6
45-0-0	2	Foliar	1.7	1.5	1.8	1.0	1.5
33-0-0	1	Dry	3.2	2.7	3.3	2.8	3.0
33-0-0	2	Dry	1.0	1.0	1.5	1.0	1.1
45-0-0	2	Dry	1.0	1.0	1.2	1.0	1.1
NONE			7.8	9.0	9.3	9.0	8.9

Table 3. EFFECT OF NITROGEN TREATMENT AND CARRIER ON THE COMPOSITION OF A MIXED *POA ANNUA*-MERION KENTUCKY BLUEGRASS TURF at East Lansing. Counts taken October, 1976.

Annual N Rate lbs/1000 sq ft	Carrier	Date of Application	% *Poa annua*	
			Actual	Corrected*
0	-	-	49.0	50.3
2	33-0-0	Monthly	64.7	67.0
4	33-0-0	Monthly	70.0	70.0
6	33-0-0	Monthly	72.7	77.8
8	33-0-0	Monthly	76.0	76.0
12	33-0-0	Monthly	70.5	83.3
4	Milorganite	Monthly	54.5	74.3
8	Milorganite	Monthly	63.2	90.7
4	33-0-0	Apr-May-Aug	60.9	88.4
4	33-0-0	Feb-May-Aug	66.6	80.5
4	33-0-0	Apr-Aug-Sept	41.8	63.0
4	33-0-0	May-Aug-Nov	36.1	55.5
4	33-0-0	May-Jul	50.4	77.8
4	33-0-0	Apr	84.0	88.6
4	33-0-0	Aug	53.1	56.0
4	33-0-0	Apr-Aug	67.7	71.1

* The "Corrected" column considers the percentage of *Poa annua* and Merion only. The "Actual" column reflects the encroachment of bentgrass and *Poa trivialis* into the turf.

Table 4. EFFECT OF PHOSPHORUS-POTASSIUM BALANCE ON THE COMPOSITION OF A MIXED POA ANNUA-MERION KENTUCKY BLUEGRASS TURF at East Lansing. Counts taken October, 1976

N	P	K	Poa annua
lbs/1000 sq ft/year			%
4	0	0	70.0
4	0.5	0	81.6
4	1	0	77.7
4	2	0	90.9
4	0	1	68.6
4	0	2	81.0
4	0	4	83.6
4	1	2	85.8
4	2	4	88.2

Table 5. EFFECT OF CALCIUM ARSENATE AND PHOSPHORUS TREATMENTS ON THE COMPOSITION OF A MIXED POA ANNUA-MERION KENTUCKY BLUEGRASS TURF at East Lansing. Counts taken October, 1976.

N	P	CaAs*	Poa annua
lbs/1000 sq ft/year			%
8	0	10	22.9
4	0	10	17.6
4	5	10	67.5
4	0	20	1.9
4	5	20	58.9

*The calcium arsenate figure is the total applied divided equally between 1972 and 1973.

Table 6. EFFECT OF CALCIUM ARSENATE, LIME AND SULFUR TREATMENTS ON THE COMPOSITION OF A MIXED *POA ANNUA*-MERION KENTUCKY BLUEGRASS TURF at East Lansing. Counts taken October, 1976.

CaAs	Lime	Sulfur	*Poa annua*
Total lbs/1000 sq ft since 1971			%
10	-	-	17.6
10	200	-	41.4
10	400	-	58.5
20	200	-	8.6
20	400	-	9.5
10	-	50	8.6
10	-	100	6.5

Table 7. EFFECTS OF 12 YEARS OF NITROGEN TREATMENTS ON TURFGRASS QUALITY RATINGS AND % OF *POA ANNUA* IN A MERION KENTUCKY BLUEGRASS TURF at Traverse City. Counts taken September, 1976.

Annual N Rate lbs/1000 sq ft	Carrier	Time of Application	*Poa Annua* & *Poa Trivialis* %		Average Turfgrass quality rating
0	-	-	30.7		5.1
4	33-0-0	Monthly	34.2		2.6
8	33-0-0	Monthly	43.2		2.2
12	33-0-0	Monthly	41.5		1.9
8	33-0-0	April	34.4		2.8
8	33-0-0	Apr, Aug	20.2		2.1
8	33-0-0	Apr, June, Aug	40.8		2.3
	Average for 33-0-0			31.8	
8	Milorganite	April	70.9		2.4
8	Milorganite	Apr, Aug	79.2		1.7
8	Milorganite	Apr, June, Aug	94.8		2.0
	Average for Milorganite			81.6	
8	Urea-formaldehyde	April	27.7		2.3
8	Urea-formaldehyde	Apr, Aug	51.7		2.1
8	Urea-formaldehyde	Apr, June, Aug	45.2		2.3
	Average for urea-formaldehyde			41.5	

* (1=best)

Table 8. EFFECT OF 12 YEARS OF NITROGEN TREATMENTS ON % OF *POA ANNUA* IN A PENNLAWN RED FESCUE TURF. Traverse City. Counts taken September, 1976.

Annual N Rate lbs/1000 sq ft	Carrier	Time of Application	*Poa annua* %	
0	-	-	14.7	
1.5	33-0-0	Monthly	27.2	
3.0	33-0-0	Monthly	46.1	
4.5	33-0-0	Monthly	69.8	
3.0	33-0-0	Apr	41.2	
3.0	33-0-0	Apr-Aug	46.1	
3.0	33-0-0	Apr-Jun-Aug	42.6	
	Average for 33-0-0			43.3
3.0	Milorganite	Apr	61.7	
3.0	Milorganite	Apr-Aug	56.6	
3.0	Milorganite	Apr-Jun-Aug	65.8	
	Average for Milorganite			61.4
3.0	Ureaformaldehyde	Apr	38.6	
3.0	Ureaformaldehyde	Apr-Aug	42.3	
3.0	Ureaformaldehyde	Apr-Jun-Aug	47.2	
	Average for Ureaformaldehyde			42.7

Table 9. EFFECT OF NITROGEN RATE, CLIPPING RETURN, AND MOWING HEIGHT ON POA ANNUA ENCROACHMENT INTO MERION KENTUCKY BLUEGRASS TURF at East Lansing. Counts taken October, 1976.

N RATE LBS/1000 SQ FT	MOWING HEIGHT	% POA ANNUA IN TURF			
		1 INCH		2 INCHES	
		LEAVE	REMOVE	LEAVE	REMOVE
4		27.1	2.8	0	0
6		21.7	0.2	0	0
8		38.1	1.4	0	0.1
10		29.9	0.6	0	0
12		32.2	1.8	0.1	0.1
14		27.7	0.1	0	0
AVERAGE		29.4	1.2	0	0

Table 10. ANNUAL NITROGEN RATE EFFECTS ON ENCROACHMENT OF WEEDY GRASSES INTO SEEDED MERION KENTUCKY BLUEGRASS AFTER 12 YEARS OF TREATMENT at East Lansing.

Annual N Rate lbs/1000 sq ft	% Composition				
	Merion	Timothy	Orchard-grass	Red Fescue	Rough Bluegrass
0	37.4	35.6	11.3	10.9	4.8
2	53.1	8.9	1.5	24.1	12.4
4	62.0	9.3	0	20.4	8.3
6	89.1	0.9	0	9.1	0.9
9	92.8	0.5	0	6.7	0
10	97.2	0	0	2.0	0.8
12	97.8	0	0	2.2	0
14	97.4	0	0	2.6	0

Table 11. ANNUAL NITROGEN RATE EFFECTS ON ENCROACHMENT OF WEEDY GRASSES INTO SODDED KENTUCKY BLUEGRASS AFTER 12 YEARS OF TREATMENT at East Lansing.

Annual N Rate lbs/1000 sq ft	% Composition		
	Merion	Red Fescue	Rough Bluegrass
0	99.1	0.5	0.4
2	99.8	0	0.2
4	100.0	0	0
6	100.0	0	0
8	100.0	0	0
10	100.0	0	0
12	100.0	0	0
14	100.0	0	0

Table 12. EFFECT OF NITROGEN TREATMENT, MOWING HEIGHT AND FUNGICIDE TREATMENT ON NUGGET KENTUCKY BLUEGRASS UNDER SHADE at East Lansing.

TREATMENT			9/1/76 RATINGS	
MOWING HEIGHT	N RATE* lbs/1000 sq ft	FUNGICIDE	% COVER	QUALITY
in				
2.5	1.5	NO	50.0	6.3
2.5	1.5	YES	82.5	2.8
2.5	3.0	NO	22.5	7.9
2.5	3.0	YES	81.3	4.0
2.5	6.0	NO	30.0	7.0
2.5	6.0	YES	68.8	5.0
1.5	1.5	NO	32.5	8.1
1.5	1.5	YES	61.3	6.1
1.5	3.0	NO	27.8	7.9
1.5	3.0	YES	34.5	7.8
1.5	6.0	NO	30.5	7.0
1.5	6.0	YES	30.0	7.0

* Nitrogen treatment divided equally into late April and mid-September applications.

Table 13. EFFECT OF NITROGEN TREATMENT, MOWING HEIGHT AND FUNGICIDE TREATMENT ON NUGGET KENTUCKY BLUEGRASS SHADE at East Lansing.

MOWING HEIGHT in	ANNUAL N RATE lbs/1000 sq ft	TIME OF APPLICATION	FUNGICIDE	
			TREATED	UNTREATED
1.5	3.0	APR-SEPT	34.5	27.8
1.5	3.0	MAR	40.0	25.0
1.5	3.0	OCT	85.0	71.7
2.5	3.0	APR-SEPT	81.3	22.5
2.5	3.0	MAR	76.7	46.7