TURFGRASS SOIL MANAGEMENT RESEARCH REPORT - 1995

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GREENS ROLLING STUDY

A new greens rolling study was initiated in 1995 at the Hancock Turfgrass Research Center. The study was conducted on three greens soil mixes on plots that were established in 1993. The three soils are: 1) an 85% sand, 15% peat green built to U.S.G.A. specifications; 2) an 80% sand, 10% peat, 10% soil green with a perched water table; and 3) a native soil push-up green (sandy loam-sandy clay loam) with no perched water table. There are three replications of each soil type. Each soil type section measures 60 feet by 60 feet. Furthermore, each section was split to accommodate two greens giving us a total of 18 greens. One of the two greens in each section was rolled three times/week with an Olathe roller and the other green was utilized as a check(i.e. not rolled). The grass is Penncross creeping bentgrass mowed at 5/32 inch.

Ball roll was determined on 12 dates in 1995 on the day of rolling treatment. The greens were rolled in the morning with Stimpmeter readings taken late morning to early afternoon. Given statistical significance a difference of six inches is acknowledged as the smallest difference that can be noticed by most golfers. That is, while differences of less than six inches might have statistical significance it is not regarded as having any detectable significance for the golfers. Data for the effect of rolling are given in Tables 1-5. Table 1 gives the Stimpmeter data for the day of rolling. On all dates the rolled plots had statistically greater distances than the unrolled plots. The season average for the greens rolling saw an increase in green speed of 1 foot. This data corroborates past studies that have been done with greens rolling.

Stimpmeter readings were also taken on Days 1 and 2 after rolling treatment for five dates during the season with data shown in Tables 2 and 3, respectively. Day 1 after rolling the seasonal average distances were 8.70 feet for the rolled greens and 8.24 feet for the unrolled greens, thus one day after rolling the difference was just under 6 inches. However, in Table 2 notice on three of the five dates(July 25, 27, and August 24) there were significant statistical differences. On two of those three dates a detectable increase in green speed existed on the rolled plots. In other greens rolling studies conducted around the country it was concluded that a detectable increase in green speed only existed on the day the greens were rolled. In the previous studies that have been published an Olathe roller had not been used. Unpublished data from a 1993 green speed study conducted at MSU found that a day after rolling an increase in green speed of 6 " or greater occurred on some dates with the Olathe roller that did not exist with the triplex type rollers.

By Day 2 there were only two dates for which there were significant differences, both in August. All dates indicated an increased ball roll of less than 6 ". The seasonal averages showed a difference of about 3 inches thus the effect of rolling did not last up to 48 hours after treatment.

The effect of soil type on seasonal green speed was negligible (Table 4) on the day of rolling. On Day 1 after rolling there was a slightly higher distance on the U.S.G.A. greens (Table 5), followed by no difference on Day 2 after rolling (Table 6). The effect of soil on turf color and quality ratings (Table 7) was small, although the soil green tended to have lower quality at certain times. There appears to be no consistent pattern.

During the season there was disease activity on the plots. Only limited amounts of fungicides were applied to determine if there was any effect of treatment on incidence of diseases. Table 8 gives disease ratings. There were no significant differences in the amount of dollar spot, brown patch, or yellow tuft, although the number of dollar spots counted on August 15 and September 1 were considerably higher for the unrolled plots. In a traffic study done several years ago, the use of a heavy vibrating roller (with golf shoe soles and spikes attached) caused significant increases in dollar spot. The interpretation was that the roller was spreading the dollar spot organism from one plot to another. Perhaps there was injury caused by the roller, making the grass more susceptible to infection. But in this study there was no significant effect of rolling on dollar spot.

There was some tendency for more dollar spot on the U.S.G.A. soil than on the other soils (Table 9), with significant differences on June 7 and September 1. Although the data were not statistically different on July 27 and August 15, there were much higher numbers on both dates for the sand:peat green. The 80:10:10 soil had a few more dollar spots that the native soil, but differences were not significant. The greater number of dollar spots on the sandier soil most likely reflects a lower amount of nitrogen available to the turf. There was no yellow tuft on the sand:peat green, while a few spots were present on the other soils.

GOLF SPIKE STUDY

On August 1 a demonstration was initiated for visitors of the August 17th Field Day to observe the impact that three different golf shoe spikes had on the greens described above. Soft Spikes and Green Spikes were donated by the prospective companies and the MTF donated money for the purchase of three identical pairs of golf shoes. Soft Spikes were screwed into one pair of shoes, Green Spikes in another, and metal spikes remained in the third pair. For 17 straight days an individual made the same amount of passes(20 to 40 passes daily) on each 1' x 15' plot with the appropriate shoe. We never anticipated collecting data from these plots as they were initiated for demonstration purposes. However, Field Day was literally awash in 1995 when flooding was caused by the 1.4 inches of rain that fell that morning. So on August 18 ball roll data was taken on all 54 plots using a Stimpmeter so the time and effort put into the study was not a complete waste of time.

Data are given in Table 10. Numbers reflect the averages for the golf spike data the soil types data and the rolling data. The data cannot be analyzed statistically by traditional methods because complexity of the design. As has been determined in other studies around the country the metal spikes gave lower ball roll distances than the Soft Spikes and Green Spikes. Visually, the steel spikes resulted in more surface disruption of the green with spike marks and lifting of bentgrass stolons. It was interesting to note that on August 18 the USGA green was approximately a foot faster than the other two soil type greens. This differed from the greens rolling study for which no differences existed in green speed among soil types. However, no traffic was applied to that study in 1995. It was determined to run the demonstration again to see if we could duplicate the results. The Stimpmeter readings taken in September fluctuated more with inconclusive results although the USGA green gave the highest readings.

PHOSPHORUS SOIL TEST CORRELATION ON A SAND:PEAT GREEN

This study was established in 1993 on the 85% sand, 15% peat green built to U.S.G.A. specifications described above. The grass is Penncross creeping bentgrass mowed at 3/16 inch. When the study began there was serious phosphorus deficiency evident and Bray P_1 phosphorus tests of about 4 lbs per acre. Treatment 1 receives no phosphorus; treatment 2 receives 1 lb. P_2O_5 per 1000 sq. ft. annually; treatment 3, 2 lbs. annually; treatment 4, 4 lbs. annually; treatment 5, 4 lbs. P_2O_5 in 1993 only with no further applications; treatment 6 is treated annually at the rate recommended by the Bray P_1 phosphorus soil test; treatment 7 is treated annually at the rate recommended by the Olsen phosphorus test. Plot size is 4 ft. by 12 ft. with 3 replications.

Table 11 gives the treatments, the Bray soil tests at the end of each season, the amount of phosphate applied each year, the Olsen soil tests for 1995, and the phosphate recommended for 1996. The check plot has shown no change in phosphorus test over the three years (4 to 5 lbs P per acre). Applying 1 lb. P_2O_5 annually increased the test from 4 to about 9. With 2 lbs. applied annually, the test increased to about 28 lbs. P. When 4 lbs. are applied annually, the test increased to 12 lbs. after one year, 32 lbs. after two years, and 62 lbs. at the end of 1995. The recommendation for next year is only 0.5 for 1996. When the Bray and Olsen tests are used for recommendations the soil tests have increased gradually, with both having recommended the same amount of phosphate for a total of 10 lbs. over the three years. Comparing this to the 4 lbs. P_2O_5 annual treatment which received a total of 12 lbs. over the three years, the soil tests are at 62 for this treatment and 47 for the two soil test treatments. These data are remarkably consistent and give us confidence that the soil test recommendations based on these two tests are giving dependable results. Although the Bray and Olsen tests have not increased the P soil tests as fast as might be preferred.

Turf color and quality ratings are given in Table 12. The check plot has serious phosphorus deficiency throughout the season. The 1 lb. annual treatment has less serious deficiency symptoms than the check as would be expected, but turf quality is generally unacceptable. When 2 lbs. are applied annually, turf quality was acceptable although the soil tests were still moderately low. It may be that 28 lbs. P per acre is adequate for greens turfs based on turf quality ratings, but there could be stress or disease relationships which would require higher P rates. The plots that were treated with 4 lbs. phosphate at the beginning of the study in 1993 have continued to exhibit phosphorus deficiency symptoms quite often. As has been observed previously, the deficiency symptoms are most evident early in the year but disappear later in the summer. This occurred in 1995 as well.

TOPDRESSING/HYDROJECT TREATMENT STUDY

The long-term greens topdressing study was continued in 1995. Treatments outlined in Table 13 were applied as in the past. The topdressing materials utilized were straight sand; 80% sand, 20% peat; and 60% sand, 20% peat, 20% soil. Treatments are 3 cu. ft. of topdressing material per 1000 sq. ft. applied at 3 week intervals; 12 cu. ft. applied in spring and fall; an untreated check; and the 12 cu. ft. applied in spring and fall after cultivation with a vertical operating aerifier having 1/2 inch tines and a 2-inch by 2-inch spacing. Plot size was 4 ft. by 12 ft. These treatments have been applied since 1986. In 1993, the plots were split with one-half treated weekly with the Hydroject. This was continued in 1995.

Quality rating data were collected in 1995 with numbers similar to those reported in the past. In 1994, there were fewer localized dry spots on the Hyrdoject treated plots. To substantiate this, no irrigation was applied to these plots for extended periods in 1995. Visual estimates of localized dry spots were taken in July, August, and September (Table 13). During July and early August, the extensive wet weather prevented the development of localized dry spots. But in late August and through September, the lack of rainfall permitted drying of the plots. The plots treated with the Hydroject had significantly less localized dry spot development with the greatest differences occurring in September. These numbers are summarized in Table 14. Certainly the Hydroject provides some water to the treated plots, but not nearly enough to meet the evapotranspiration needs of the turf during this period. Our conclusion is that the Hydroject reduces the tendency for development of localized dry spots. We have seen this in some earlier studies. Golf course superintendents have reported less susceptibility to localized dry spots on greens when treated regularly with the Hydroject. In addition, plots which have been topdressed with sand were somewhat more susceptible to localized dry spots than those which received some peat or soil in the topdressing.

Additional data taken included dollar spot counts, dew ratings, and soil moisture content and are reported in Table 15. The soil moisture measurements were done on soil samples taken to a depth of 3 inches with moisture content determined gravimetrically. There was no difference in the dollar spot counts. The dew ratings were not significantly different in the overall study on July 15, but the differences were significant on July 24. On July 21 the Hydroject treated plots had 15.9% moisture and the non-treated plots had 9.1%. On Sept. 19 the % moisture was 19.4% and 12.2%, respectively.

LATE FALL NITROGEN APPLICATIONS ON ANNUAL BLUEGRASS

In Fall, 1994 a study was initiated by two undergraduate students, Marc McMullen and Ed Borst, to evaluate the effect of application of several experimental nitrogen fertilizers on an annual bluegrass fairway turf. The carriers utilized are listed in Table 16. Other than urea, all carriers are experimental nitrogen carriers from the following companies: Lesco, Anderson, and Sherritt. The Sherritt Org. is an organic carrier. These materials were applied at the rate of 1 lb. N per 1000 sq. ft. on the dates shown in Table 16.

Conclusions from this study are consistent with results from studies conducted several years ago. When nitrogen is applied as early as October 15, there is little residual effect the following spring. Applications in early November give somewhat more response the following spring, while when applied in mid-November the spring response is much longer. This is particularly true for the water soluble urea. When soluble N sources are utilized, the N should be applied later in the fall to achieve a good residual color the next spring.

If the nitrogen is applied about the time growth ceases, soluble nitrogen is taken up by the turf without causing any significant increase in growth (and mowing). This usually occurs in early to mid-November, but varies with the year and location in the state. With more nitrogen in the plant, this increases the potential for photosynthesis during sunny days in November. This should result in an accumulation of carbohydrates since growth has ceased. The greater levels of carbohydrates will be available for the plant the next spring. We are still of the opinion that the N should be predominantly soluble N with no more that 25% slow release N. The objective is to get nitrogen into the plant soon after application. Since winter arrived early in 1995 there may not be as much benefit in increased carbohydrates from late fall N applications in the spring of 1996.

OTHER STUDIES

Several other studies were conducted in 1995. The long-term cultivation study on an annual bluegrass fairway turf had minor differences during the growing season, but nothing of major importance.

The high potassium studies which initiated in 1990 were continued in 1995. Rates of application range from none to 12 lbs. K_2O per 1000 sq. ft. annually. These treatments have been applied to Kentucky bluegrass, annual bluegrass fairway or creeping bentgrass greens turfs. Because of the early cold weather, soil samples were not collected in November, 1995. There were no visual responses of these grasses to the potassium treatments. The plots were subjected to two different dry down cycles, one in July, the second in late August and early September. While some differences in wilting and localized dry spots became evident on the bentgrass plots, there was no apparent relationship to treatment.

The irrigation program modeling study being conducted by Charles Kome for his Ph.D. was completed this year. Although this project was not funded by the M.T.F., the work was done on the plots with the time domain reflectometry (TDR) installation that was part of the study conducted by Mike Saffel which the M.T.F. supported. Kome measured soil moisture with the TDR over three seasons, 1992-1994. The irrigation treatments were: 1) applying .1 inch water daily, regardless of rainfall; 2) returning the soil to field capacity (maximum available water) on a daily basis; and 3) irrigating with 1 inch of water on the appearance of wilt. The soil is a sandy loam, approaching a sandy clay loam. He evaluated two irrigation models currently used for field crops, SCHEDULER from the Soil Conservation Service and modified by Dr. V. F. Bralts and co-workers in the Agricultural Engineering Department at M.S.U., and SALUS which is used by Dr. J. T. Ritchie of the Crop and Soil Sciences Department at M.S.U.

Kome concluded that the TDR is a useful tool to measure soil moisture, consistent with that of Saffel. Both models predicted that both daily irrigation treatments applied too much water, resulting in conditions which would lead to excessive water use and leaching during wet periods. This occurred because in all three years there was greater than normal rainfall. This could be solved for the daily application of .1 inch water by not irrigating during wet periods. During the few extended dry periods, this treatment did not apply enough water to keep the soil moisture in the desired range. By returning the soil to field capacity on a daily basis, the soil was kept near the maximum available water holding capacity on a regular basis. When rainfall occurred, this resulted in excess water conditions. In retrospect, it would have been better to have returned the soil to a lower moisture content, perhaps 80% of field capacity. By doing this, rainfall would not have resulted in the excess water condition unless a heavy rainfall occurred. This research points out the importance of understanding how much water the soil can hold in the root zone and how much water can be expected to be lost by evapotranspiration in order to know how much water should be applied for good water management.

Table 1.

Greens Rolling Study-Stimpmeter Readings, Feet-1995
Day Rolled

Treatment	June 5	June 12	June 14	July 7	July 10	July 12	July 19	July 24	July 26	July 31	Aug. 18	Aug. 23	Season Average
Rolled	8.1 a	7.9 a	9.1 a	10.9 a	10.1 a	11.3 a	10.7 a	10.5 a	9.8 a	8.9 a	9.7 a	10.4 a	9.7 a
Not Rolled	6.9 b	6.7 b	7.9 b	9.9 b	9.3 b	9.9 b	9.3 b	9.4 b	8.5 b	8.2 b	8.6 b	9.12 b	8.67 b

Means in columns followed by the same letter are not significantly different at the 5% level using the LSD mean separation test.*

Table 2.

Greens Rolling Study-Stimpmeter Readings, Feet-1995
One Day After Rolling

Treatment	June 13	July 25	July 27	Aug. 15	Aug. 24	Season Average
Rolled	7.9	8.5 a	8.8 a	8.2	9.9 a	8.70 a
Not Rolled	7.4	8.2 b	8.2 b	8.1	9.2 b	8.24 b

Means in columnsfollowed by the same letter are not significantly different at the 5% level using the LSD mean separation test.*

Table 3.

Greens Rolling Study-Stimpmeter Readings, Feet-1995 Two Days After Rolling						
Treatment	June 14	July 26	July 28	Aug. 25	Aug. 30	Season Average
Rolled	8.2	8.5	9.1	9.9 a	9.4 a	9.2 a
Not Rolled	8.1	8.1	8.8	9.6 b	9.0 b	8.9 b

Means in columns followed by the same letter are not significantly different at the 5% level using the LSD mean separation test.*

Table 4.

Greens Rolling Study-Soil Effect-Stimpmeter Readings,Feet-1995 Day Rolled													
Soil Type	June 5	June 12	June 14	July 7	July 10	July 12	July 19	July 24	July 26	July 31	Aug. 18	Aug. 23	Season Average
USGA	7.4	7.3	8.4	10.3	9.7	10.7	10.1 a	10.4 a	9.4 a	8.8	9.4	9.8	9.3 a
80:10:10	7.5	7.5	8.4	10.3	9.8	10.6	9.8 b	9.9 ab	9.0 b	8.2	9.0	9.6	9.1 b
Native Soil	7.5	7.0	8.7	10.6	9.7	10.6	10.1 a	9.7 b	9.1 ab	8.7	8.9	9.9	9.2 ab

Means in columns followed my the same letter are not significantly different at the 5% level using the LSD means separation test.*

Table 5.

Greens Rolling Study-Soil Effect-Stimpmeter Readings,Feet-1995 One Day After Rolling						
Soil Type	June 13	July 25	July 27	Aug. 15	Aug. 24	Season Average
USGA	7.7	8.8 a	8.8 a	8.5 a	10.0 a	8.7 a
80:10:10	7.6	8.3 b	8.3 b	7.8 b	9.5 ab	8.3 b
Native Soil	7.7	8.0 c	8.5 b	8.1 ab	9.3 b	8.4 b

Means in columns followed my the same letter are not significantly different at the 5% level using the LSD means separation test.*

Table 6.

Greens Rolling Study-Soil Effect-Stimpmeter Readings,Feet-1995 Two Days After Rolling						
Soil Type	June 14	July 26	July 28	Aug. 25	Aug. 30	Season Average
USGA	8.1	8.5	9.0	9.8	9.4	9.2
80:10:10	8.1	8.3	8.8	9.8	9.1	9.0
Native Soil	8.1	8.1	9.2	9.6	9.2	9.0

Means in columns followed my the same letter are not significantly different at the 5% level using the LSD means separation test.*

Table 7.

Greens Rolling Study-Color and Quality Ratings-1995								
	Color Ratings (9 = Best)				Quality Ratings (9 = Best)			
Soil Type	July 5	Aug.14	Aug.28	Sept.14	June 5	July 5	Aug.28	Sept.14
U.S.G.A	6.4	6.5	6.7	7.4	6.3 a	5.3	5.8 b	6.4 a
80:10:10	7.3	6.7	6.8	7.1	5.7 b	6.5	6.8 a	6.3 a
Native Soil	6.8	6.7	6.3	6.8	4.6 c	5.6	6.1 b	5.7 b

Means in columns followed my the same letter are not significantly different at the 5% level using the LSD means separation test.*

Table 8.

Greens Rolling Study-Disease Counts-Rolling Effect 1995						
	Dollar Spot Counts				Brown Patch	Yellow Tuft
Treatment	June 7	July 27	Aug.15	Sept.1	Aug.16	Sept.14
Rolled	21.9	225.9	49.6	201.4	2.6	4.6
Not Rolled	22.8	253.8	83.0	363.3	8.3	4.9

Means in columns followed my the same letter are not significantly different at the 5% level using the LSD means separation test.*

Table 9.

Greens Rolling Study-Disease Counts-Soil Effect 1995						
	Dollar Spot Counts				Brown Patch	Yellow Tuft
Soil Type	June 7	July 27	Aug.15	Sept.1	Aug.16	Sept.14
USGA	54 a	540	163	540 a	2	0 b
80:10:10	10 b	172	33	283 ab	9	5 a
Native Soil	3 b	7	2	23 b	5	6 a

Means in columns followed my the same letter are not significantly different at the 5% level using the LSD means separation test.*

Table 10.

1995 Golf Shoe Study-Stimpmeter Readings, Feet										
Spikes	Aug.18	Sept.15		Soil Types	Aug.18	Sept.15			Aug.18	Sept.15
Metal	7.68	9.47		USGA	8.80	10.40		Rolled	8.46	10.45
Soft	8.30	10.30		80:10:10	7.83	9.60		Unrolled	7.72	9.56
Green	8.28	10.26		Push-up	7.64	10.00				

Table 11.

USGA Green Phosphorus Correlation Study

	1993		1994	1994		1995	1995		1995	1996
Treatment	P_2O_5[X] Applied lbs/1000	**Bray Soil Test lbs/acre**	P_2O_5 Recommended lbs/1000	P_2O_5 Applied lbs/1000	**Bray Soil Test lbs/acre**	P_2O_5 Recommended lbs/1000	P_2O_5 Applied lbs/1000	**Bray Soil Test lbs/acre**	Olsen Soil Test lbs/acre	P_2O_5 Recommended lbs/1000
1	0	**3.7 b**	4.0	0	**4.0 b**	4.0	0	**5.0 d**	6.0 c	4.0
2	1	**4.0 b**	4.0	1	**3.3 b**	4.0	1	**9.3 cd**	8.0 bc	4.0
3	2	**5.0 b**	4.0	2	**8.3 b**	4.0	2	**28.3 bc**	16.0 b	3.0
4	4	**12.3 a**	4.0	4	**32.3 a**	2.5	4	**62.0 a**	33.0 a	0.5
5	4	**14.7 a**	3.5	0	**9.3 b**	4.0	0	**10.7 cd**	8.0 bc	3.5
6	3.5[Y]	**14.7 a**	3.5	3.5	**26.3 a**	3.0	3	**46.7 ab**	30.0 a	1.0
7	3.5[Z]	**11.7 a**	3.5	3.5	**29.3 a**	3.0	3	**47.0 ab**	29.0 a	1.5

Means in columns followed by the same letter are not significantly different at the 5% level using the LSD range test.*

X - Annual application
Y - Bray recommendation
Z - Olsen recommendation

Table 12.

USGA Green Phosphorus Correlation Study, 1995
Color & Quality Ratings

P_2O_5 Applied lbs/1000	Quality Ratings (9 = Best)					
	May 1	June 1	July 1	Aug. 1	Sept. 1	Season Average
0# / Year	1.17 e	1.00 d	1.50 c	1.67 b	2.50 b	1.57 c
1# / Year	4.83 d	4.50 c	6.50 ab	7.00 a	6.67 a	5.90 b
2# / Year	6.17 ab	6.50 a	7.00 a	7.17 a	6.83 a	6.73 a
4# / Year	6.17 ab	6.50 a	7.00 a	7.33 a	6.83 a	6.77 a
4# in 1993 only	5.33 c	5.67 b	5.83 b	7.00 a	6.50 a	6.07 b
Bray Soil Test	5.83 b	6.50 a	7.00 a	7.50 a	7.00 a	6.77 a
Olsen Soil Test	6.33 a	6.50 a	7.00 a	7.33 a	6.83 a	6.80 a

Means in columns followed by the same letter are not significantly different at the 5% level using the LSD range test.*

Table 13.

Great Lakes Topdressing Study
Percent Localized Dry Spot

Treatment	Rate	Frequency	Hydro-ject	July 15	July 18	July 20	July 28	Aug. 1	Aug. 28	Sept. 5	Sept. 14	Sept. 28
Sand	3ft²	3 weeks	yes	0	1	1	11.7	18.5	4	5.7	3 d	4.3 d
Sand	3ft²	3 weeks	no	25	15	16.7	30	18.5	10.7	38.3	66.7 ab	71.7 a
Sand	12ft²	Spr./Fall	yes	0	2.7	1.7	16.7	13.8	3	15.7	7 cd	7.7 d
Sand	12ft²	Spr./Fall	no	25	14.3	20	27	8	30	58.3	85 a	73.3 a
80sand:20peat	3ft²	3 weeks	yes	0	0	1	3.3	7.3	2	1	3.3 d	2 d
80sand:20peat	3ft²	3 weeks	no	0	10	11	25	16.8	6.3	25.7	60 b	65 abc
80sand:20peat	12ft²	Spr./Fall	yes	0	0	0	5	0.8	1.3	2	3 d	1 d
80sand:20peat	12ft²	Spr./Fall	no	0	6.7	6.7	27.7	19.3	4.7	23	55 b	53.3 c
60sand:20peat :20soil	3ft²	3 weeks	yes	0	0	0	3.3	5.9	1	2	4.3 d	1.3 d
60sand:20peat :20soil	3ft²	3 weeks	no	0	0	1	29.7	7.5	2	10	28.3 c	55 bc
60sand:20peat :20soil	12ft²	Spr./Fall	yes	0	1	1	11	28.1	2.7	5.3	6.7 cd	8.3 d
60sand:20peat :20soil	12ft²	Spr./Fall	no	21	10	14.3	40	10.4	23.3	22.7	65 ab	71.7 a
Check	-----	---------	yes	0	0	0	0	23	0	0	0 d	0 d
Check	-----	---------	no	0	0	0	2.7	8.3	0	13.3	18.3 cd	13.7 d

Great Lakes Topdressing Study Percent Localized Dry Spot												
Sand	12ft^2	Spr./Fall	Aerified	0	0	0	11.7	31.7	0.7	8.3	2.7 d	3.3 d
Sand	12ft^2	Spr./Fall	no	0	5	10	51.7	6.7	1.7	23.3	71.7 ab	66.7 ab

Means in columns followed by the same letter are not significantly different at the 5% level using ths LSD means separation test.*

Table 14.

Great Lakes Topdressing Study
Percent Localized Dry Spot

Treatment	July 15	July 18	July 20	July 28	Aug. 1	Aug. 28	Sept. 5	Sept. 14	Sept. 28
Hydrojected weekly	0	0.6	0.6	7.8	2.8	1.8	4.9 b	3.5 b	3.8 b
Not Hydrojected	8.8	7.6	9.8	29.8	23.0	9.8	26.7 a	58.7 a	56.3 a

Means in columns followed by the same letter are not significantly different at the 5% level using the LSD means separation test.*

Table 15.

Great Lakes Topdressing Study

	Dollar Spots per plot	Color Rating 9=best	Dew Rating 1= no dew 9= normal	Dew Rating 1= no dew 9= normal	Gravitational Moisture Content, %	Gravitational Moisture Content, %
Treatment	June 27	July 6	July 15	July 24	July 21	Sept. 19
Hydrojected weekly	68.3	7.0 b	8.6	8.2	15.9 a	19.4 a
Not Hydrojected	76.2	7.4 a	6.9	5.8	9.1 b	12.2 b

Means in columns followed by the same letter are not significantly different at the 5% level using the LSD means separation test.*

Table 16.

1995 Late Fall Nitrogen Carrier Study on Annual Bluegrass Color Ratings
Nitrogen Applied at a Rate of 1 lbs. N / 1000 Ft^2

Treatment	Date Applied	Oct 26 '94	Nov 3 '94	Nov 10 '94	Nov 17 '94	Nov 30 '94	Mar 16 '95	Mar 24 '95	Apr 14 '95	Apr 24 '95
Urea	Oct. 15	6.2 a	6.0 b	6.3 a	6.5 a	5.8 ab	2.7 h	2.5 f	3.2 efg	3.8 ef
Urea	Nov. 3	4.0 d	4.0 e	4.7 defg	5.3 bc	5.5 cd	4.3 bcde	4.3 bc	5.0 bc	4.8 bc
Urea	Nov. 17	4.2 d	4.0 e	4.3 fg	4.3 ef	5.0 cd	5.3 a	5.5 a	5.7 ab	5.3 ab
Lesco 6152	Oct. 15	5.0 c	4.8 d	5.7 bc	6.2 a	6.3 a	3.8 def	3.3 def	4.3 cd	5.2 abc
Lesco 6152	Nov. 3	3.8 d	4.0 e	4.7 defg	5.2 bcd	5.8 ab	5.2 ab	4.8 ab	6.0 a	5.5 a

1995 Late Fall Nitrogen Carrier Study on Annual Bluegrass Color Ratings
Nitrogen Applied at a Rate of 1 lbs. N / 1000 Ft^2

Lesco 6152	Nov. 17	4.0 d	4.0 e	4.2 g	4.2 f	4.3 d	5.3 a	5.3 a	6.3 a	5.5 a
Anderson 418	Oct. 15	6.3 a	6.3 a	6.3 a	6.5 a	6.0 ab	2.5 h	2.7 f	3.7 defg	3.8 ef
Anderson 418	Nov. 3	4.2 d	4.2 e	5.2 cd	5.8 ab	6.0 ab	4.2 cde	3.8 cd	4.0 de	4.2 de
Anderson 418	Nov. 17	4.2 d	4.0 e	4.2 g	4.5 def	4.7 d	5.0 abc	5.3 a	5.8 ab	5.5 a
Nutriganic	Oct. 15	4.8 c	4.7 d	5.0 de	5.0 cde	4.3 d	2.5 h	2.7 f	2.8 g	2.7 h
Nutriganic	Nov. 3	4.0 d	4.0 e	4.8 def	5.3 bc	5.0 cd	3.0 fgh	3.3 def	3.5 defg	3.0 gh
Nutriganic	Nov. 17	4.0 d	4.0 e	4.5 efg	4.5 def	4.8 cd	3.8 def	4.0 bcd	3.8 def	3.5 fg
Sherrit Org.	Oct. 15	6.2 a	6.2 ab	6.3 a	6.3 a	5.8 ab	2.7 h	2.7 f	3.0 fg	3.7 ef
Sherrit Org.	Nov. 3	4.0 d	4.0 e	4.8 def	5.8 ab	6.2 ab	3.7 efg	3.7 cde	3.7 defg	4.2 de
Sherrit Org.	Nov. 17	4.0 d	4.0 e	4.5 efg	4.8 cdef	5.0 cd	4.7 abcd	4.8 ab	5.5 ab	5.5 a
Sherrit 2214	Oct. 15	5.5 b	5.5 c	5.8 ab	6.2 a	6.3 a	2.8 gh	3.2 def	3.7 defg	4.7 cd
Sherrit 2214	Nov. 3	4.0 d	4.0 e	5.2 cd	5.8 ab	6.0 ab	4.0 de	3.8 cd	4.0 de	4.0 ef
Sherrit 2214	Nov. 17	4.2 d	4.0 e	4.2 g	4.3 ef	4.5 d	5.0 abc	4.8 ab	5.7 ab	5.3 ab
Check	-----	4.0 d	4.2 e	4.7 defg	4.50 def	4.5 d	2.5 h	2.8 ef	3.0 fg	2.8 h

Means in columns followed by the same letter are not significantly different at the 5% level using the LSD means separation test.*

***No letters per column indicates statistical strength less than 5%.**