TURFGRASS SOIL MANAGEMENT RESEARCH REPORT - 1993

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NITROGEN FERTILITY EVALUATIONS

Three different nitrogen carrier evaluations were conducted at the Hancock Turfgrass Research Center in 1993. All three turfs were growing on loam soil. One was done on a tall fescue turf mowed at 2 inches. The turf was established in 1991. Plot size was 4 feet by 12 feet with 4 replications of each treatment. Treatments applied are shown in Table 1. The nitrogen carriers listed in the table were applied at 1.5 lbs. N per 1000 sq. ft. on May 27, July 8 and August 11.

The second study was conducted on an annual bluegrass fairway turf mowed at 5/8 in. Plot size and replication was the same as for the tall fescue study. Nitrogen was applied as the carriers shown in Table 3 at the rate of 1 lb. N per 1000 sq. ft. on May 26, June 29, July 23 and September 16.

A third study was conducted on Kentucky bluegrass mowed at 2 inches. Plot size and replication was the same as for the tall fescue study. The carriers shown in Table 4 were applied on June 29 at the rates of 1, 2 or 4 lbs. N per 1000 sq. ft. No further N was applied throughout the season.

All plots were rated periodically for turf quality, a combined evaluation of color, density and growth. In addition, clipping weights were collected on several dates and weighed for each study. Each year we subject the plots to dry down periods to determine if particular carriers or fertility programs are more susceptible to moisture stress. Because of extensive rainfall during 1993, there was little difference among plots in susceptibility to wilting.

The Scott's carriers are polymer-coated nitrogen carriers. The 40-0-0 has a thinner coating with a little higher N content while the 38.5-0-0 has the thickest coating and should have the longest N response. SCU is sulfur-coated urea. Herbruck's fertilizers are experimentals manufactured from poultry waste. Nutralene is a slow release carrier from the Nor-Am Co. Once is a polymer-coated carrier from Grace-Sierra. The Grace fertilizers are soluble experimentals from Grace-Sierra. The UHS carriers are polymer-coated carriers, 2002 should have a 2 month linear release while 2004 should have a 4 month release period. Ringer is a natural organic fertilizer from the Ringer Corp. Sustane is a poultry waste-based fertilizer.

As observed in recent studies, the coated fertilizers performed well on the tall fescue plots (Table 1). When a thicker coating is present this causes a slower nitrogen release rate giving a slower response. However, these materials gave good long term responses. An example is Scott's 38.5-0-0 which was slower to give response than the 40-0-0 which has a thinner coating. Another example is the UHS 2002 which is faster releasing of the UHS materials. The early release pattern was slow, but gave good responses at the end of the season. Because of cool, wet conditions earlier in the test period most of the natural organics started very slowly. An exception is Herbruck's 10-3-4 which gave good ratings early in the season but did not rank quite as high later. Herbruck's 10-2-8 had a problem in manufacturing and performed poorly throughout the season. Generally, the soluble fertilizers, urea and the Grace experimentals gave good ratings but ranked a bit lower later in the period. With

10-2-8 had a problem in manufacturing and performed poorly throughout the season. Generally, the soluble fertilizers, urea and the Grace experimentals gave good ratings but ranked a bit lower later in the period. With the exception of a few dates Nutralene performed well.

Clipping weights were obtained on these plots on 4 dates during the growing season (Table 2). The data reflect in general the quality rating data in Table 1.

Table 1. Evaluation of Nitrogen Carrier Effects on a Tall Fescue Lawn
Quality Ratings: 1 = poor, 9 = excellent
Treatments applied May 27, July 8, and August 11, 1993 at the rate of 1.5 pounds of nitrogen per 1000 sq. feet

Treatment	6-1	6-3	6-10	6-18	7-6	7-12	7-21	7-23	7-29	8-3	8-10	8-25	9-28
Scotts 40-0-0	6.6 abc	7.0 a	8.3 abc	6.8 bcde	7.5 abc	7.1 ab	8.0 a	8.0 a	7.5 a	8.3 ab	6.6 bcde	8.0 a	8.0 bcd
Scotts 39-0-0	6.5 bcd	6.9 ab	7.9 cde	6.6 bcde	7.4 bc	7.1 ab	8.0 a	8.0 a	7.5 a	8.4 a	6.6 bcde	7.6 ab	8.0 bcd
Scotts 38.5-0-0	6.6 abc	6.6 bc	7.8 def	6.5 cde	7.8 ab	7.4 a	8.0 a	7.9 a	7.5 a	8.4 a	7.1 ab	7.8 ab	8.8 a
SCU 32-0-0	6.8 ab	7.0 a	8.0 abc	7.0 abc	7.5 abc	7.0 ab	8.0 a	8.0 a	7.5 a	8.3 ab	6.9 abcd	7.9 a	8.1 abcd
Herbrucks 10-2-8	6.3 d	6.5 c	7.0 g	5.1 f	5.8 e	4.1 e	4.5 c	5.3 c	5.1 c	6.6 c	4.6 f	5.6 d	7.0 f
Herbrucks 10-3-4	6.5 bcd	6.9 ab	8.4 ab	7.1 abc	6.9 d	6.8 b	8.0 a	8.0 a	7.1 ab	7.8 b	6.3 e	7.9 a	7.5 def
Nutralene 40-0-0	6.6 abc	7.0 a	7.8 def	6.5 cde	7.1 cd	6.8 b	8.0 a	7.9 a	7.5 a	8.3 ab	6.3 e	8.0 a	8.1 abcd
Once 35-0-6	6.6 abc	7.0 a	7.6 def	6.3 de	7.9 a	7.1 ab	7.9 a	8.0 a	7.5 a	8.5 a	7.3 a	8.0 a	8.5 ab
Urea 46-0-0	6.9 a	7.0 a	8.4 ab	7.3 ab	7.4 bc	7.3 a	8.0 a	8.0 a	7.5 a	8.1 ab	6.6 bcde	7.9 a	8.0 bcdf
Grace 15-5-25	6.6 abc	7.0 a	8.5 a	7.5 a	7.1 cd	7.0 ab	8.0 a	8.0 a	7.4 ab	8.0 ab	6.5 cde	7.3 bc	7.3 ef
Grace 18-5-17	6.5 bcd	6.9 ab	8.5 a	7.1 abc	7.1 cd	7.0 ad	8.0 a	8.1 a	7.5 a	8.5 a	6.8 abcde	7.0 c	7.3 ef
UHS 25-5-10 2002	6.4 cd	6.5 c	7.6 def	6.9 abcd	7.9 a	7.3 a	8.0 a	8.0 a	7.5 a	8.5 a	7.0 abc	7.6 ab	8.3 abc
Ringer 10-2-6	6.3 d	6.0 d	7.5 ef	6.8 bcde	7.4 bc	6.0 c	8.0 a	7.9 a	7.5 a	8.4 a	6.6 bcde	8.0 a	8.1 abcd
Sustane 5-2-4	6.3 d	6.1 d	7.4 fg	6.1 e	6.9 d	5.4 d	6.8 b	7.0 b	6.9 b	8.0 ab	6.4 de	7.8 ab	7.8 cde

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

When higher analysis, large particle fertilizers are applied to annual bluegrass mowed at 3/4 inch a mottled response occurred (Table 3). It was clear that the coated fertilizers were giving significant release of nitrogen, but the resulting spotty response was caused by the fertilizer granules being too far apart when applied at 1 lb. N per 1000 sq. ft. As a result the natural organics, the solubles and Nutralene gave better relative responses than was observed in the study on tall fescue. We have consistently seen that when the high analysis fertilizers are applied to grass mowed at 2 inches or more, there is no mottled response to the fertilizer. However, even urea causes the mottled response on greens and fairway turf mowed at 3/4 inch or shorter. Fertilizer companies have developed smaller granules to alleviate this problem. The smaller granules permit closer spacing at a given rate of nitrogen, reducing the potential for the mottling.

One other response of note with the coated fertilizers applied to the annual bluegrass fairway plots was that as the nitrogen was being released in the spots where the granules were located, the grass was very green and highly susceptible to wilt. During dry down periods, these green spots always wilted first. This is consistent with observations made many times that grass which has been fertilized with high rates of nitrogen that result in high amounts of nitrogen in the plant are always more susceptible to moisture stress. For this reason it is very important that the fertilizer program be designed to provide a modest amount of nitrogen to the turf during temperature and moisture stress periods.

A different approach was taken in the study shown in Table 4. Several coated fertilizer products were applied on June 29 to a Kentucky bluegrass turf at rates of 1, 2 or 4 lbs. per 1000 sq. ft. Earlier in the period the highest rate of nitrogen gave the best responses as would be expected. However, by the end of the test period in September, there were few major differences, even at the 1 lb. rate. This may have been due to the extensive rainfall received during the summer and fall. Whenever turf receives extensive rainfall or irrigation the responses to nitrogen applications are smaller than when the turf is kept drier. All these coated products performed well. Clipping weight data in Table 5 reveal the same trends for this study. By the end of the season (September) there were no differences among clipping weights. This lack of differences at the end of the season was surprising considering that a 4 lb. N rate was included in the study. Perhaps the regular rainfall during the summer of 1993 caused depletion of the nitrogen more quickly than normal. Another possibility is that there was enough nitrogen present from all treatments that no differences occurred, although this seems unlikely.

A study evaluating the effect of timing and rate of nitrogen applied as urea on an annual bluegrass fairway turf was established in 1992. The treatments are shown in Table 6. Plot size is 4 ft. by 12 ft. with 4 replications. Quality rating data reflect treatments and are not reported here. As noted in other studies of nitrogen applications on annual bluegrass, this grass responds quickly to applied nitrogen, but turns yellow as soon as the available nitrogen level is low. No other grass has given this dramatic response to nitrogen. This supports the importance of providing nitrogen at modest, but regular rates for annual bluegrass turfs. In May, the annual bluegrass had fairly heavy seedhead production. Seedhead density counts were obtained with a grid, giving percent of plants with seedheads. The data are given in Table 6. The check plot had significantly fewer seedheads than plots receiving nitrogen. However, the tendency for more seedheads on plots receiving high annual rates of nitrogen or a late fall application of nitrogen was not as evident as has been observed on 2 previous occasions.

Table 2. TALL FESCUE NITROGEN CARRIER STUDY 1993
Clipping Weights In Grams
Treatments Were Applied May 27, July 8, and August 11 1993 at the rate of 1.5 pounds of nitrogen per 1000 sq. feet

TREATMENTS	6-17	7-6	9-2	9-20
SCOTTS 40-0-0	28.2 a	48.4 abc	30.7 abc	26.8 bcd
SCOTTS 39-0-0	31.4 a	49.5 ab	26.4 c	27.0 bcd
SCOTTS 38.5-0-0	29.6 a	47.6 abcd	30.5 abc	28.7 ab
SCU 32-0-0	25.0 a	41.2 abcdef	33.1 ab	26.2 bcd
HERBRUCKS 10-2-8	24.1 a	37.4 bcdef	17.2 d	16.6 g
HERBRUCKS 10-3-4	20.8 a	41.6 abcdef	32.5 ab	25.2 bcde
NUTRALENE 40-0-0	25.2 a	30.6 f	31.1 abc	25.6 bcd
ONCE 35-0-6	25.2 a	54.1 a	34.2 a	31.9 a
UREA 46-0-0	23.2 a	45.0 abcde	34.3 a	24.8 cde
GRACE 15-5-25	23.8 a	33.4 ef	26.2 c	20.8 f
GRACE 18-5-17	23.0 a	35.7 cdef	28.2 bc	21.4 ef
UHS 25-5-10 2002	25.0 a	44.3 abcde	28.8 abc	27.9 bc
RINGER 10-2-6	20.0 a	40.6 bcdef	31.7 abc	23.9 def
SUSTANE 5-2-4	24.2 a	34.9 def	28.5 abc	24.1 def

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

Table 3. Evaluation of Nitrogen Carrier Effects on Annual Bluegrass Fairway Turf
Quality Ratings: 1 = poor, 9 = excellent
Treatments were applied May 26, June 29, July 23, and September 16, 1993 at the rate of 1 pound of nitrogen per 1000 sq. feet.

TREATMENTS	6-1	6-3	6-10	6-18	6-29	7-6	7-9	7-15	7-26	7-29	8-13	8-25
SCOTTS 40-0-0	6.1 C	5.6 DE	6.6 C	3.9 FG	5.0 BC	4.5 C	4.5 C	4.5 BCD	5.7 DE	5.1 DE	5.7 F	5.6 BCD
SCOTTS 39-0-0	5.9 CD	5.3 DEF	6.5 CD	3.5 GH	4.5 C	4.1 C	4.5 C	4.6 BC	5.7 DE	5.0 DE	5.7 F	5.3 CDE
SCOTTS 38.5-0-0	5.9 CD	5.1 EF	6.1 DE	3.9 FGH	4.5 C	3.9 C	5.0 C	3.7 DE	5.5 E	5.3 CDE	5.7 F	5.5 CDE
SCU 32-0-0	6.6 B	6.5 C	7.1 B	4.8 DE	5.6 A	4.3 C	4.7 C	5.5 A	6.5 A	5.7 BCD	6.6 BCD	5.8 BC
HERBRUCKS 10-2-8	5.5 DE	4.9 F	5.5 G	4.6 E	4.0 D	4.5 C	4.9 C	3.3 E	4.5 F	4.8 E	5.6 F	4.6 E
HERBRUCKS 10-3-4	7.6 A	7.1 AB	7.6 A	6.1 A	4.0 D	5.9 B	6.3 A	4.9 AB	6.4 AB	6.1 ABC	6.8 ABC	5.9 ABC
NUTRALENE 40-0-0	6.1 C	5.8 D	6.8 BC	5.5 BC	4.7 C	5.8 B	5.6 B	5.1 AB	6.1 ABCD	6.9 A	7.1 AB	6.1 ABC
UHS 25-5-10 2002	5.5 DE	5.5 DE	5.6 FG	4.1 F	4.8 C	3.9 C	5.0 C	3.9 CDE	5.9 BCDE	5.0 DE	5.9 EF	5.3 CDE
MILORGANITE 6-2-0	5.0 F	4.8 F	5.8 EFG	5.1 CD	4.8 C	5.8 B	6.1 A	5.0 AB	5.8 CDE	6.3 AB	7.1 AB	6.5 AB
ONCE 35-0-6	6.0 C	5.8 D	6.0 EF	3.4 H	4.5 C	3.9 C	5.0 C	4.7 BC	5.5 E	5.2 DE	6.0 DEF	5.7 BCD
UREA 46-0-0	7.8 A	6.8 BC	7.6 A	5.9 AB	4.0 D	7.3 A	6.0 AB	5.1 AB	6.3 ABC	6.4 AB	7.3 A	6.5 AB
GRACE 15-5-25	8.0 A	7.5 A	7.9 A	5.9 AB	4.0 D	7.0 A	6.0 AB	4.9 AB	6.1 ABCD	6.3 AB	6.4 CDE	4.8 DE
SUSTANE 5-2-4	5.1 EF	4.8 F	5.6 FG	5.4 BC	5.4 AB	5.6 B	6.0 AB	4.9 AB	5.7 DE	6.6 A	7.0 ABC	6.8 A

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

Table 4. Long Term Study of Nitrogen Carriers on Kentucky Bluegrass, 1993
Quality Ratings: 1 = Poor, 9 = Excellent. Application Date, June 29

Treatment	rate	7-7	7-9	7-12	7-21	7-26	7-29	8-10	9-1	9-14	9-28
UHS 25-5-10 2002	1#/M	7.3 fg	6.8 d	7.0 fg	7.7 ab	7.7 bc	7.7 cd	6.8 ab	8.7 ab	7.7 ab	7.0 c
UHS 25-5-10 2002	2#/M	8.3 abc	7.2 bcd	7.7 cde	8.0 a	8.0 a	8.0 abc	7.3 bcd	8.5 b	7.5 bc	7.0 c
UHS 25-5-10 2002	4#/M	8.5 ab	7.5 abc	8.0 abcd	8.0 a	8.0 a	8.7 ab	8.2 a	8.7 ab	7.8 ab	7.7 ab
Once 39-0-0	1#/M	7.2 fg	7.2 bcd	7.7 ef	7.3 ab	7.5 c	7.7 cd	6.2 ef	8.7 ab	7.7 ab	7.3 bc
Once 39-0-0	2#/M	8.0 cd	7.5 abc	7.8 bcd	8.0 a	8.0 a	8.0 abc	7.2 cd	8.7 ab	7.7 ab	7.0 c
Once 39-0-0	4#/M	8.2 bcd	8.0 a	8.5 a	8.0 a	8.0 a	8.3 a	8.5 a	8.8 ab	8.0 a	7.7 ab
Scotts 39-0-0	1#/M	8.0 cd	7.0 cd	7.0 fg	7.7 ab	7.5 c	7.7 cd	6.8 de	8.3 ab	7.5 bc	7.0 c
Scotts 39-0-0	2#/M	8.5 ab	7.7 ab	8.7 abc	7.3 ab	7.8 ab	8.7 ab	7.8 abc	8.7 ab	7.2 c	7.7 ab
Scotts 39-0-0	4#/M	8.5 ab	7.7 ab	8.3 ab	7.7 ab	7.8 ab	8.3 a	8.5 a	8.7 ab	7.8 ab	8.0 a
SCU	1#/M	7.8 de	7.0 cd	7.0 fg	7.3 ab	7.5 c	7.7 cd	6.7 def	8.5 b	7.5 bc	7.0 c
SCU	2#/M	8.3 abc	7.7 bcd	7.5 def	8.0 a	7.5 c	7.5 d	7.2 cd	8.7 ab	7.8 ab	7.0 c
SCU	4#/M	8.7 a	7.8 a	8.3 ab	7.7 ab	8.0 a	8.0 abc	8.2 a	8.7 ab	7.7 ab	8.0 a
UHS 25-5-10 2004	1#/M	7.0 g	6.7 d	6.5 g	7.0 b	7.5 c	7.5 d	6.0 f	8.5 b	7.5 bc	7.0 c
UHS 25-5-10 2004	2#/M	7.5 ef	6.8 d	7.2 ef	7.3 ab	7.5 c	7.5 d	7.0 e	8.5 b	7.5 bc	7.0 c
UHS 25-5-10 2004	4#/M	8.0 cd	7.5 abc	8.0 abcd	8.0 a	8.0 a	7.8 bcd	8.0 ab	9.0 a	7.5 bc	7.0c

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

TOPDRESSING AND HYDROJECT STUDIES

A long term topdressing study including treatments with straight sand, 80% sand/ 20% peat, or 60% sand/20% peat/20% soil was continued 1993 on a putting green at the Hancock Turfgrass Research Center. The topdressing treatments were applied at light and frequent intervals (3 cu. ft. per 1000 sq. ft. every 3 weeks during the growing season) or 12 cu. ft. each spring and fall. Another plot is aerified spring and fall, followed by sand topdressing at the 12 cu. ft. rate. Quality rating data were taken in 1993 with results similar to those observed in the past so these data are not reported here. The infrequent topdressing at high rates has given very distinct layers of sand and thatch.

In late 1992, cultivation with the Hydroject was started by treating the north 1/2 of each plot approximately weekly. Where the Hydroject has been used there are columns of sand which penetrate from near the surface down to the depth of where the water pulse reaches. Originally, we had thought the Hydroject would not affect such layers. But with regular use of the Hydroject, these columns of sand can break through the layers created by the poor topdressing program and provide better opportunity for water movement in the profile. If such layers exist, the use of tine cultivation followed by topdressing is still considered the best means of dealing with layers, but regular use of the Hydroject may also be of value in disrupting the effects of such layers.

Although 1993 was a generally wet season, there was some development of localized dry spot on these topdressing plots. Soil core samples were collected in August from each plot and allowed to dry in the laboratory. A small drop of water was applied at specific depths on these cores and the time for the water droplet to disappear into the soil was recorded. The data are given in Table 7. When straight sand was used for topdressing, the time required for water droplet to disappear was longer for the thatch layer and the surface 3 inches of soil than when some soil was included in the topdressing mix. The longer the time needed for the water droplet to penetrate into the soil core, the more hydrophobic is the soil. On plots topdressed with sand alone where the Hydroject had been used regularly, the time for the water droplet to penetrate in the thatch or surface layer of soil was reduced. There was a trend for the same response when the other soil materials were used for topdressing, but the differences were not significant. Deeper in the soil (3-6 inch depth) there was no indication of a hydrophobic condition. This is consistent with field observations that where localized dry spots occur the hydrophobic condition is usually limited to the thatch and top inch or so of the soil. In this case, it is assumed the Hydroject is permitting a little more water penetration, resulting in better wetting of the soil. When the soil is kept more moist there will be a reduced susceptibility to development of the hydrophobic condition.

There were several times during the year when dollarspot became very active on these plots. Dollarspot counts were taken on July 14 and September 9 (Table 8). Although there were few significant differences, it is clear that the treatments with light, frequent topdressings with sand or sand/peat tended to have higher numbers of dollarspots than when topdressed spring and fall. Differences between the timing of topdressings was not as great when some soil (sand/peat/soil mix) was included in the topdressing material. There was a slight trend for plots receiving the Hydroject treatments to have less dollarspot, but differences were small and mostly occurred for the light, frequent topdressing with sand or sand/peat.

As more turf managers are using the Hydroject there is greater confidence in how to use this tool in different situations. Some golf course superintendents have used the Hydroject as often as once a week for more difficult soil situations. Others may be using it every 2 to 3 weeks. A few use it only 2 or 3 times a year. The appropriate frequency depends on the soil conditions which exist and the use of the turf. Several superintendents with whom we have visited who have used the Hydroject at 1 to 2 week intervals are very pleased with the results. Based on data collected the past 2 years at Forest Akers East Golf Course, Chris Miller has observed that the effect of softening the surface of a putting green was lost within a few days, so regular treatment may be necessary to maintain a uniform surface. There may be some greens where the Hydroject is not the appropriate tool to use because of soil conditions. But the Hydroject can be used during the peak playing season with little surface disruption when some relief of compaction is needed. If, with frequent use of the Hydroject considerable soil is brought to the surface of a green which is being topdressed with sand, it would be necessary to reduce the intensity of the treatment. This can be accomplished by reducing the frequency of treatment or using the faster speed which provides a wider spacing between holes or both. The appropriate program for cultivation with the Hydroject, other cultivation tool or a combination of these must be adapted to the specific conditions which exist.

TALL FESCUE FAIRWAY COMPACTION STUDY

A study was initiated in 1992 to determine if tall fescue could be mowed at fairway height and maintain a reasonable quality turf. The plots are mowed at 3/4 inch. Three compaction levels are included in the study: none, 3 passes weekly with a vibrating power roller and 6 passes weekly. In general, there is little difference in turf quality ratings among the treatments. Using a grid, the percentage of both bare soil exposed and annual bluegrass in the plot area was determined (Table 9). Density counts taken May 4 indicated the check plot had less bare soil (1.7%), rolled three times weekly had 4.0% and 6 times weekly was 6.3%. The percentage of annual bluegrass was counted on May 4 and July 27. While there was a trend for more annual bluegrass on the plots receiving the compaction treatment there were no significant differences observed. The increase in annual bluegrass has not been as rapid as we had expected for tall fescue mowed at this height and with this compaction treatment. The compaction treatments have increased the surface hardness of the turf as measured by the Clegg device.

Table 5. Long Term Study of Nitrogen Carriers on Kentucky Bluegrass, 1993
Clipping Weights In Grams, Treatments Applied June

Treatment	rate	7-13	8-4	8-31	9-14
UHS 25-5-10 2002	1#/M	32.26 EFG	28.57 BCDE	35.97 B	46.77 A
UHS 25-5-10 2002	2#/M	36.57 DEF	31.30 ABCD	41.52 AB	55.45 A
UHS 25-5-10 2002	4#/M	41.69 BCDE	41.25 A	46.53 AB	46.26 A
Once 39-0-0	1#/M	28.30 FG	17.13 E	42.90 AB	39.90 A
Once 39-0-0	2#/M	39.18 CDE	21.32 CDE	42.10 AB	38.92 A
Once 39-0-0	4#/M	49.46 AB	33.11 ABC	49.49 AB	58.25 A
Scotts 39-0-0	1#/M	34.36 EF	29.78 ABCD	40.29 AB	45.28 A
Scotts 39-0-0	2#/M	45.43 ABCD	34.36 AB	39.42 AB	42.64 A
Scotts 39-0-0	4#/M	51.54 A	37.99 AB	55.89 A	43.52 A
SCU	1#/M	32.57 EFG	19.06 DE	38.21 AB	47.41 A
SCU	2#/M	46.78 ABC	30.86 ABCD	48.26 AB	52.97 A
SCU	4#/M	47.10 ABC	30.46 ABCD	46.86 AB	49.08 A
UHS 25-5-10 2004	1#/M	23.64 G	17.22 E	35.34 B	43.32 A
UHS 25-5-10 2004	2#/M	34.60 EF	27.39 BCDE	41.69 AB	43.16 A
UHS 25-5-10 2004	4#/M	45.22 ABCD	39.29 AB	46.66 AB	46.52 A

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

Table 6. Annual bluegrass - urea timing study and effects on seedhead ratings, May 11, 1993.

Treatment		Application Date								Seedheads	
No.	Annual N	April	May	June	July	Aug	Sept	Nov		%*	lbs/1000
1	1	0	.5	0	0	0	.5	0		23.5e	
2	2	0	1	0	0	0	1	0	25.3ce		
3	4	0	1	1	0	1	1	0	24.0de		
4	6	1	1	1	1	1	1	0	26.5be		
5	4	1	1	1	0	0	1	0	26.0ce		

Treatment No.	Treatment Annual N	April	May	June	July	Aug	Sept	Nov	Seedheads %[a]	Seedheads lbs/1000
6	4	0	0	1	.5	.5	1	1	33.5a	
7	4	0	0	1	1	1	1	0	32.8a	
8	4	0	0	.5	.5	.5	.5	2	31.8ab	
9	0	0	0	0	0	0	0	0	14.0f	

a - Percent of plot with annual bluegrass seedheads. Means followed by the same letter are not significantly different at the 5% level using the LSD mean separation test.

Table 7. Effect of Topdressing Program and Hydroject Treatment on Water Droplet Infiltration Time in Seconds, 8/23/93

Treatment	Rate	Rate in ft3	Thatch Layer		1-3 Inch		3-6 Inches	
			No Hydroject	Hydrojected	No Hydroject	Hydrojected	No Hydroject	Hydrojected
Sand	every 3 weeks	3	148.7 abcd	77.3 cde	154.2 abc	150.0 abc	11.9 bcd	36.4 a
Sand	spring/fall	12	155.1 abc	87.7 cde	221.7 a	45.1 cd	2.5 cd	20.2 abc
80 sand: 20 peat	every 3 weeks	3	98.9 bcde	106.1 bcde	106.1 abcd	81.5 bcd	16.7 bcd	18.7 abcd
80 sand: 20 peat	spring/fall	12	108.5 bcde	57.2 e	188.7 ab	50.7 cd	26.6 ab	9.3 bcd
60 sand: 20 peat: 20 soil	every 3 weeks	3	78.1 cde	53.3 e	71.1 bcd	41.6 cd	14.6 bcd	11.1 bcd
60 sand: 20 peat: 20 soil	spring/fall	12	63.9 de	43.4 e	61.0 bcd	18.9 d	7.1 cd	3.5 cd
Control	every 3 weeks	3	8157 cde	219.6 a	25.5 cd	3.2 d	1.2 d	1.0 d
Sand (Aerified)	spring/fall	12	180.9 ab	91.9 cde	75.1 bcd	80.1 bcd	4.8 cd	6.9 cd

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

Table 8. Effects of Topdressing Program and Hydroject Treatment on Dollarspot Counts

Treatment	Frequency	Rate in ft^3	July 14		September 9	
			No Hydroject	Hydroject	No Hydroject	Hydroject
Sand	every 3 weeks	3	56.7 a	38.0 ab	28.3 a	12.3 bcd
Sand	spring/fall	12	8.7 cd	8.3 cd	11.7 bcd	7.7 cd
80 sand: 20 peat	every 3 weeks	3	28.7 bc	14.0 cd	22.7 ab	7.3 cd
80 sand: 20 peat	spring/fall	12	7.7 cd	1.3 d	9.0 cd	1.3 d
60 sand: 20 peat: 20 soil	every 3 weeks	3	16.7 bcd	8.3 cd	16.0 abc	3.7 cd
60 sand: 20 peat: 20 soil	spring/fall	12	4.7 d	2.3 d	7.0 cd	2.7 d
Control	every 3 weeks	3	8.0 cd	4.0 d	8.3 cd	7.7 cd
Sand (Aerified)	spring/fall	12	3.3 d	2.3 d	5.3 cd	2.3 d

Means for a date followed by the same letter are not significantly different at the 5% level using the LSD mean separation test.

Table 9. Effect of a compacting roller on a tall fescue turf mowed at fairway height. Study initiated 1992. Data taken in 1993.

Treatment	Clegg reading May 9	Bare soil,% May 4	Annual bluegrass,% May 4	Aug 27
Check	69a	1.7a	21a	18a
3 passes weekly	80b	4.0b	26a	20a
6 passes weekly	89b	6.3b	30a	24a

HIGH POTASSIUM FERTILIZATION

The study evaluating high annual rates of potash were continued in 1993. Soil test data for the Kentucky bluegrass plot are given in Table 10. Using up to 12 lbs. K_2O per 1000 sq. ft. annually has dramatically increase available soil potassium levels as we have reported previously. What has become more apparent this year is that the potassium test in the 3-6 inch depths has increased greatly. This may have resulted from greater than normal rainfall during 1993. The effect of these high rates of potash on soil calcium levels is negligible, but the soil magnesium tests reflect the increased leaching of magnesium when such high levels of potash are applied. On sandier soils greater attention should be given to monitoring the balance between potassium and magnesium. Similar results were apparent on the other two grasses which have received similar treatments.

WETTING AGENT STUDIES

A study to evaluate the effect of a new wetting agent from the AquaTrols Corp. was initiated in 1993. Treatments were applied to a creeping bentgrass green growing on a sandy loam soil. The treatments shown in Table 11 were applied July 7 and August 16. Aqua Gro L is the present liquid formulation of Aqua Gro while the ACA 864 is a new experimental wetting agent. Again, the regular rainfall in 1993 prevented any appearance of localized dry spots on these plots. No differences in turfgrass quality among plots occurred during the summer. However, soil cores were collected from each plot on August 23 and October 16. In spite of the lack of appearance of localized dry spots, the laboratory test on water droplet penetration time revealed there were differences among treatments in the thatch layer. On both dates the higher rate of the experimental wetting agent provided reduced times for the drops to absorb into the soil core. No other differences occurred. The water droplet penetration time is a practical tool which the turf manager could utilize. A standard soil probe can be used to collect a profile sample. The important step is to allow the core samples to dry without being disturbed. Once dry, a uniform-sized drop of water is added to the core sample at different depths of the core sample, including the thatch layer. Then record the time (in seconds) for the droplet to disappear. This test can give an idea of the relative degree of hydrophobic condition which has developed in the soil at different depths. Several cores should be, and were, tested for a valid test on a given turf site.

MULCHING TREE LEAVES INTO TURF

This study has gained considerable interest from those who handle tree leaves each fall. In one study after 3 full years of mulching tree leaves into turf there has been no significant loss in turf quality. We will be evaluating responses more thoroughly in 1994. These studies are cooperative with Bruce Branham. A more thorough report can be found elsewhere in these proceedings in a paper authored by Thom Nikolai.

OTHER STUDIES

Another study in which there is considerable interest is maintaining sod growing on compacted subsoil. The sod was finally laid on all the plot area in the fall of 1993. The clay subsoil brought onto the site stayed wet much of the summer and was too soft in places to lay sod. The objectives of the research planned on these plots is to determine the effects of several cultural practices on turf quality, stress tolerance, rooting, thatch and disease.

Table 10. High Potassium Study on Kentucky Bluegrass 1993
Initiated in April 1990

Treatment K_2O in lbs/M/year	Potassium Levels lbs/A			Calcium Levels lbs/A			Magnesium Levels lbs/A		
	Thatch	0-3 in.	3-6 in.	Thatch	0-3 in.	3-6 in.	Thatch	0-3 in.	3-6 in.
None	257.8 D	120.3 C	77.78 C	1832 B	1747 A	1400 A	370 A	352 A	280 A
Soil Test KCl carrier	406.5 D	202.0 C	153.3 BC	2000 AB	1768 A	1460 A	370 A	354 A	284 A
4 lbs. KCl carrier	574.5 C	347.5 BC	220.0 BC	1874 B	1895 A	1440 A	344 A	338 A	270 A
8 lbs. KCl carrier	881.8 B	581.3 ABC	454.8 AB	2063 A	1895 A	1440 A	352 A	308 B	228 B
12 lbs. KCl carrier	902.0 B	932.0 A	747.3 A	1832 B	1705 A	1360 A	304 B	294 B	238 B
12 lbs. K_2SO_4 carrier	1086 A	781.3 AB	586.8 A	1895 AB	1811 A	1504 A	302 B	288 B	228 B

Means followed by the same letter are not significantly different at the 5% level using the LSD mean seperation test.

Table 11. Effects of Wetting Agent Treatment on Water Droplet Infiltration Time in Seconds
Wetting Agent Applied July 7 and August 16, 1993

Treatment	Rate	Sample Date 8-23			Sample Date 10-6		
		thatch	0-3 in.	3-6 in.	thatch	0-3 in.	3-6 in.
Control	---	913 a	228 a	2.5 a	1070 a	110.4 a	1.563 b
Aqua Gro L	8oz/M	650 ab	289 a	4.7 a	737.6 ab	144.4 a	1.188 b
ACA 864	6oz/M	91 c	160 a	3.2 a	298.2 b	154.8 a	4.813 a
ACA 864	4oz/M	111 c	194 a	1.2 a	383.8 b	168.6 a	2.625 ab
ACA 864	2oz/M	333 bc	216 a	1.8 a	661.9 ab	165.2 a	1.25 b

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