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	4.6 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 a	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.

Treatment No	Annual N	Application Date April	May	June	July	Aug	Sept	Nov	Seedheads %[a]	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.