The programs which provide modest N in the summer (0.5 pound N per 1000 sq. ft. per month in June, July and August with 1 pound in September and 1 in November) provide the most uniform quality turf. The total N application for the year is 3.5 pounds per 1000 sq. ft. The program which gives 4 pounds N annually with 1 pound applications in April, May and June results in ratings which are too high and would make the turf more susceptible to stresses of traffic, high temperature and moisture limitations.

WETTING AGENT STUDIES

Several wetting agents were applied to Penncross creeping bentgrass greens at the Hancock Turfgrass Research Center and on two predominantly Kentucky bluegrass fairways growing on light sandy loam soils at the Candlestone Golf Club at Belding. Appreciation is expressed to the LESCO company for financial support and Superintendent Rick Krampe for use of the fairway areas. The objective was to evaluate LESCO'S Lescowet with several other wetting agents on the prevention of localized dry spots.

Although there was imminent development of localized dry spots on the two fairways at Candlestone at the time of treatment (mid July) environmental conditions were not conducive for further development of the problem subsequent to treatment. As a result, there were no differences to record either in turf quality, wilting tendency or in soil moisture in samples taken from the fairway.

Other studies were established at the Hancock Turfgrass Research Center on Penncross creeping bentgrass greens growing on a loamy sand soil. Treatments were applied in late July and repeated as shown in the accompanying tables two weeks later in early August. Again climatic conditions were not conducive to development of the localized dry spot conditions so no differences were recorded among the various treatments in terms of localized dry spots or in wilting tendency. There was a significant response in dew control, however. The treatments were applied either to plot areas which were irrigated to replace approximately 80% of open pan evaporation or which received no irrigation except at the time of application to prevent burn. The irrigated plots received irrigation during early morning which reduced dew formation to some degree. As a result, differences were smaller than on the plots which were irrigated only on wilt. The plots which received irrigation to replace 80% of open pan evaporation (Table 5) manifested some differences among wetting agents with Lescowet and AquaGro reducing dew the most. Without the supplemental irrigation, dew formation differences were highly significant (Table 6). After 1 day only AquaGro-Dry showed no difference from the check. After 2 days, differences were still evident, but smaller in magnitude. After 5 days, only Lescowet and AquaGro gave meaningful differences. After 2 weeks, differences were very small and not meaningful.

In a second study (Table 7) similar data were obtained. Of interest were the responses to AquaGro-Dry. Although there was little response in dew control from the dry material within a day or two of treatment, after 2 weeks there were lower dew ratings compared to the check. This would be expected as the material is applied dry. It must be dissolved into applied water and then diffused into the turf. This gives a longer term release pattern, but will

not provide as much active ingredient in the turf at the time of the application, of course.

In the above study, the treatments were not watered in to determine the degree of phytotoxicity of each of the materials. Obviously this would not be a recommended practice, but this does provide some idea of the relative potential for phytotoxicity. The phytotoxicity data are given in Table 8. AquaGro and Lescowet caused the greatest phytotoxicity when not watered in. Our general recommendation is to apply wetting agents to turf which are not in a condition of moisture stress, then water in immediately. Unless absolutely necessary, it is best to never apply wetting agents when temperatures are going to be above 85, and it is best to treat in the evening. It may be necessary to irrigate the area lightly before treatment so the grass is not in a condition of wilt.

SOIL pH CONTROL

The plots treated with lime and sulfur in 1981 continue to show some changes with time. Of particular note is the increase in soil pH on the sulfur treated plots as well as on the check. Apparently the major factor is the hardness of the irrigation water applied to the turf. The pH data are in Table 9. Further, the loss in the bases, calcium and magnesium are dramatically increased from the high sulfur plots (Table 10). If the turf manager wants to achieve and keep a low pH, more frequent soil testing should be practiced to prevent a deficiency of magnesium. Also, the pH change occurs first in the surface layer and gradually moves downward. This surface acidification could lead to stress on the turf so the use of sulfur to acidify soils should be done cautiously.

PHOSPHORUS AND POTASSIUM SOIL TEST IN RESPONSE TO FERTILIZER APPLICATIONS

The effect of P_2O_5 and K_2O applications to several soils are summarized in Tables 11 and 12. As observed previously, the dune sand does not hold applied potassium (Table 11). Effective Potash application on sandy soils requires regular applications, a minimum 3 or 4 times a year. When some peat is mixed with the soil the potash holding capacity of the soil media is increased somewhat over the sand, but not as strongly as on the topsoil green (fine sandy loam).

Phosphorus is apparently leached from the dune sand as well (Table 12). After 2 years of application of P_2O_5 to this dune sand, the phosphorus soil tests are still moderately low. There was a very clear deficiency of P on the check plots throughout the year, while deficiency symptoms appeared on the 1 pound application rate per year late in the fall when soils became colder and the uptake of P was not as efficient. Soil tests on the sands should be taken more frequently than on other soils because of the low cation exchange capacity and the higher susceptibility to rapid chemical change and leaching.

Table 5. Effect of several wetting agent materials on Penncross creeping bentgrass maintained with irrigation at replacement of 80% of evaporation. Hancock Turfgrass Research Center. Averages for 3 replications. 1984.

Treatment			Dew Accumulation (1=least; 9=most) Days after treatment			
Material	July	Aug	1	2	5	14
	Rate oz/1000					
Lescowet	4	0	1.0 a[x]	1.5 ab	2.5 bd	4.5 de
Lescowet	4	4	1.0 a	1.3 ab	2.3 bc	4.3 cd
Lescowet	8	0	1.0 a	1.0 a	2.0 ac	4.0 bc
Lescowet	8	8	1.0 a	1.0 a	1.7 ab	4.2 bc
Lescowet	16	0	1.0 a	1.0 a	1.3 a	3.8 ab
Lescowet	16	16	1.0 a	1.0 a	1.0 a	3.7 a
Aqua Gro	8	0	1.3 ab	1.3 ab	1.7 ab	4.2 bc
Aqua Gro	8	8	1.3 ab	1.2 a	1.7 ab	4.2 bc
HydroWet	8	0	1.2 ab	1.8 ac	3.5 cd	4.5 de
HydroWet	8	8	1.3 ab	1.8 ac	3.7 cd	4.7 ef
Basic H	8	0	1.0 a	1.8 ac	3.7 cd	4.7 ef
Basic H	8	8	1.3 ab	1.8 ac	4.0 d	4.5 de
NAIAD	4	0	1.2 ab	2.3 bc	4.0 d	4.8 f
Aqua Gro-Dry	3.5	3.5	2.3 c	3.5 d	4.3 d	4.5 de
Aqua Gro-Dry	7	7	1.8 bc	2.8 cd	3.7 cd	4.2 bc
Control	0	0	3.8 d	4.7 e	4.3 d	4.7 ef

[x]Means in columns followed by the same letter are not significantly different from each other at the 5% level using Duncan's Multiple Range Test.

Table 6. Effect of several wetting agent materials on Penncross creeping bentgrass maintained with irrigation at replacement upon wilt. Hancock Turfgrass Research Center. Averages for 3 replications. 1984.

			Dew Accumulation (1 = least; 9 = most)			
Treatment			Days after treatment			
Material	July	Aug	1	2	5	14
	Rate, oz/1000					
Lescowet	4	0	2.2 bd[x]	3.3 b	3.8 b	6.5 bd
Lescowet	4	4	2.0 bc	3.7 b	5.0 bd	6.7 bd
Lescowet	8	0	1.5 a	3.5 b	4.0 bc	5.8 ac
Lescowet	8	8	1.3 ab	3.0 b	3.8 b	6.0 bc
Lescowet	16	0	1.0 a	1.7 a	1.0 a	5.5 ab
Lescowet	16	16	1.0 a	1.7 a	1.5 a	5.3 a
Aqua Gro	8	0	2.2 bd	3.5 b	3.8 b	6.0 bc
Aqua Gro	8	8	2.2 bd	3.2 b	4.0 bc	6.0 bc
Hydro Wet	8	0	3.2 bd	4.0 b	5.5 cd	6.5 bd
Hydro Wet	8	8	3.2 bd	3.8 b	5.7 d	6.8 cd
Basic H	8	0	2.8 cd	4.0 b	6.2 d	6.8 cd
Basic H	8	8	2.8 cd	4.0 b	5.5 cd	7.0 d
NAIAD	4	0	6.2 e	5.7 c	5.5 cd	6.8 cd
Aqua Gro-Dry	3.5	3.5	8.0 g	7.2 de	6.0 d	6.8 cd
Aqua Gro-Dry	7	7	7.0 ef	6.2 cd	4.0 bc	6.3 bd
Control			7.8 fg	7.5 e	6.5 d	7.0 d

[x]Means in columns followed by the same letter are not significantly different from each other at the 5% level using Duncan's Multiple Range Test.

Table 7. Effect of several wetting agent materials on dew accumulation on Penncross creeping bentgrass maintained under putting green conditions. Treatments were not watered in following application. Averages for 3 replications. 1984

Treatment		Dew Accumulation 1 = least, 9 = most			
		Days after treatment			
Material	July	2	4	14	16
	Rate oz/1000				
Lescowet	8	3.7 bd[x]	6.3 cf	8.3 cd	8.8 de
Lescowet	8	3.3 bc	6.0 ce	8.3 cd	8.7 ce
Lescowet	16	1.7 ab	4.3 bc	8.0 cd	8.3 cd
Lescowet	16	1.7 ab	4.3 bc	7.3 bc	8.2 c
Lescowet	32	1.0 a	2.0 a	6.3 ab	7.3 b
Aqua Gro	8	3.7 bd	5.0 bd	8.3 cd	8.7 ce
Aqua Gro	16	3.0 ac	4.3 bc	7.7 cd	8.2 c
HydroWet	8	6.0 ef	6.7 df	9.0 d	8.8 de
HydroWet	16	4.0 ce	6.3 cf	9.0 d	9.0 e
Basic H	8	7.0 fg	8.0 eg	9.0 d	9.0 e
Basic H	16	6.0 ef	8.0 eg	9.0 d	9.0 e
Aqua Gro-Dry	3.5	6.7 ef	6.0 ce	8.7 cd	8.8 de
Aqua Gro-Dry	7	6.0 cf	5.0 bd	7.3 bc	8.5 ce
Aqua Gro-Dry	10.5	5.0 df	3.7 ab	5.7 a	6.7 a
NAIAD	8	5.7 f	8.3 fg	9.0 d	9.0 e
Control		8.7 g	8.7 g	8.7 cd	9.0 e

[x]Menas in columns followed by the same letter are not significantly different from each other at the 5% level using Duncan's Multiple Range Test.

Table 8. Effect of several wetting agent materials on turf discoloration of Penncross creeping bentgrass maintained under putting green conditions. Treatments were applied July, 1984 and were not watered in following application. Averages for 3 replications.

Treatment		Turf Discoloration			
		Days after treatment			
Material	Rate	2	4	14	16
	oz/1000				
Lescowet	8	2.17 de[x]	2.00 ab	1.17 a	1.17 a
Lescowet	8	3.50 cd	3.83 ce	1.17 a	1.17 a
Lescowet	16	5.33 ef	5.33 ef	2.50 bd	2.33 bc
Lescowet	16	5.67 f	4.67 de	2.67 cd	3.00 c
Lescowet	32	7.50 g	7.33 g	4.17 e	4.00 d
AquaGro	8	3.50 cd	3.50 bd	1.67 ad	1.67 ab
AquaGro	16	5.70 ef	5.00 df	2.83 d	2.67 c
HydroWet	8	2.00 ac	2.00 ab	1.00 a	1.17 a
HydroWet	16	2.00 ac	3.00 bc	1.00 a	1.00 a
Basic H	8	2.00 ac	1.00 a	1.33 ab	1.17 a
Basic H	16	2.33 ac	2.33 ac	1.00 a	1.00 a
AquaGro-Dry	3.5	1.17 a	3.17 bc	1.50 ac	1.33 a
AquaGro-Dry	7	1.67 ab	4.83 de	2.83 d	2.67 c
AquaGro-Dry	10.5	2.83 bd	6.33 fg	5.33 f	4.67 d
NAIAD	8	2.00 ac	2.50 ac	1.00 a	1.00 a
Control		1.00 a	1.00 a	1.00 a	1.00 a

[x]Means in columns followed by the same letter are not significantly different from each other at the 5% level using Duncan's Multiple Range Test.