three surveys will be combined and reported in the summer/fall of 1998.

GREEN SOIL MIX CULTURAL PRACTICES STUDY

During his/her career the golf course superintendent may have to maintain greens constructed with different soil types or that have received differing topdressing programs. There is a lack of data on the effect of long-term management of putting greens growing on different soils in a situation where comparisons can be made. The objective of this research is to evaluate the effects of turf management programs on turf quality and responses for greens growing on three different soils.

The study was conducted on plots established with funding from the Michigan Turfgrass Foundation in 1993. The three greens mixes 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.

The area was mowed six times a week with a walk behind mower at a cutting height of .157 inch. Topdressing of the entire area with sand was accomplished on a light-frequent basis throughout the growing seasons. Thickness of the sand topdressing/mat layer as measured in the last 3 years is reported in Table 3. Irrigation was applied on a daily light-frequent practice with the exception of dry down periods to permit collecting data on development of localized dry spot. Pesticides were only applied on a curative basis to collecting data on any differences in disease, insect, or weed activity.

Table 3.
Thickness of Sand-Topdressing Layer

August 1995	October 1996	October 1997
14 mm	21 mm	27.5 mm

Traffic to simulate typical wear on putting greens was applied to the plots six times per week with a triplex greens-mower modified with spiked rollers in lieu of reel units. The rollers are 60 cm long and 20 cm in diameter. Six mm spikes are spaced at 2.5 cm intervals on the rollers. Front and rear (5 cm) rollers level each of the three traffic simulator units.

Statistically significant differences in disease pressure, insect activity, and moss and algae growth have been observed. Other interesting trends include development of localized dry spots and the appearance of black layer. The USGA constructed green has had the most dollar spot. However, data presented in Tables 4, 5, and 6 indicate the difference in dollar spot activity between the USGA and 80:10:10 mix is diminishing on non-rolled plots. In 1995 (Table 4) for rolled plots the USGA plots had more dollar spots than the 80:10:10 mix while the native soil had by far the least. On the unrolled plots the trends were similar except for the rating on September 1. In 1996 (Table 5) the same trends continued with the number of dollar spots on the 80:10:10 mix approaching those found on the USGA green only for the late season rating on August 22 when dollarspot activity was very high. This trend continued in 1997 (Table 6) with the exception of June rating when the 80:10:10 non-rolled green produced the greatest dollar spot activity. The number of dollar spots on the 80:10:10 unrolled plots approached those on the USGA green on other rating dates. Only the USGA green had high numbers of dollar spots on the rolled plots, however.

The likely reason for the higher dollar spot activity on the USGA green is the lower organic matter levels in this mix of 85% sand, 15% peat. Both sand and peat have very low nitrogen contents and would provide little nitrogen for the turf, making it more susceptible to dollar spot. The 80:10:10 mix has 10% native soil which would provide some nitrogen. The native soil green had very little dollarspot on most evaluation dates, particularly on the rolled plots.

It is hypothesized that the tendency for smaller differences in dollar spot activity between the USGA

and 80:10:10 non-rolled greens is the result of the light-frequent sand-topdressing program. As a sand layer is built up the turf is growing primarily in a layer of sand that will provide and hold less nitrogen than when some soil is present. It is anticipated that differences among all three root zone mixes will continue to diminish in regard to this disease as the study continues. After three years of topdressing the layer of sand and thatch (mat) is at 27.5 mm (about 1 inch). When most of the roots are found in this layer, fertilization programs must be based on managing a sand green rather than a native soil green. This has been apparent in potassium fertilization studies as well.

Table 4.

Dollar Spot Data 1995

Soil Type	June 17		August 15		September 1	
	rolled	check	rolled	check	rolled	check
USGA	54	54	130	197	486	594
80:10:10	8	11	17	83	88	478
Native	3	3	2	2	30	17

Table 5.

Soil Type	June 14		June 24		August 2		August 22	
	rolled	check	rolled	check	rolled	check	rolled	check
USGA	20.3	41.3	100	152	24	56	201	467
80:10:10	0.3	14.0	3	75	2	23	27	329
Native	0.3	1.7	2	11	1	3	24	73

Table 6.

Dollar Spot Data 1997

Soil Type	June 24		July 23		August 20	
	rolled	check	rolled	check	rolled	check
USGA	28	63	47	111	60	100
80:10:10	4	72	9	97	4	69
Native	6	11	5	11	2	1

The comparison of rolling on differently constructed greens that are sand topdressed is vital, particularly in light of the number of courses having more than one type of green construction present. One half of each plot was rolled with an Olathe roller 3 times per week during the growing season. The impact of lightweight greens rolling caused a major reduction in dollar spot. There is no obvious reason for this response. Rolling firms the surface and reduces the tendency for puffy growth. Other soil measurements (thatch level and composition) may provide further insight into this response. It is clear that rolling has more to offer than increases in green speed.

Few color and quality differences occurred between rolled and non-rolled plots with acceptable ratings being recorded on most dates. Color and quality ratings for 1997 are reported in Tables 7 and 8. However, in September of 1996 it was observed that one of the 80:10:10 greens that was rolled 3 times per week began to discolor. Black layer was found on this plot area. For this reason core cultivation planned for the fall of 1996 was canceled to observe if the black layer would form on other plots in 1997. During the summer of 1997 all replications of the 80:10:10 rolled plots formed the black layer. The lower quality ratings on October 10 is associated with the presence of black layer. Quality ratings were often slightly lower on check plots because the rolled plots always displayed less dollar spot and localized dry spot. The reason

that black layer appeared on the 80:10:10 plots and not on the USGA plots in not clear.

Table 7.

Color Ratings 1997 9=excellent, 6 and above is regarded as acceptable.

Soil Type	May 30		June 13		July 11		August 10		October 10	
	rolled	check	rolled	check	rolled	check	rolled	check	rolled	check
USGA	6.9	6.6	7.1	7.0	7.5	7.6	8.0	7.2	7.1	7.2
80:10:10	7.2	7.0	7.5	7.4	7.0	7.5	7.8	7.0	5.9	7.2
Native	7.6	7.6	7.7	7.6	7.6	7.6	8.0	7.4	6.8	6.8

Table 8.

Quality Ratings 1997 9 = excellent, 6 and above is acceptable.

Soil Type	May 30		June 13		July 11		August 10		October 10	
	rolled	check	rolled	check	rolled	check	rolled	check	rolled	check
USGA	6.2	5.8	6.6	6.3	7.8	6.8	7.8	6.9	6.7	6.7
80:10:10	6.9	6.6	7.2	7.0	7.4	6.8	7.5	6.5	5.1	7.1
Native	7.1	7.4	7.3	7.0	7.6	7.1	8.0	7.3	6.4	6.2

Fertilizer studies

Six different fertility programs have been evaluated on these plots. The fertility program design was a 2x3 factorial with two levels of nitrogen (3 or 6 lbs. N/1000 ft^2/ year) and three levels of potassium (soil test recommendations, 4, or 8 lb. K2O/1000 ft^2/ year). The seasons initial and final nitrogen applications were applied as urea. The other nitrogen treatments are made with granular applications of methylene urea. All potassium treatments are applied as sulfate of potash. Data collection from this study included color and quality ratings, annual soil tests, clipping analysis, Stimpmeter ratings, disease counts, and turfgrass rooting. This portion of the study was initiated in August of 1996, thus 1997 has been the first full year of the fertility regime. Fertilizer application dates are reported in Table 9.

Table 9.

Fertilizer Application Dates 1997

Date applied	Pounds of Nitrogen/ft^2		Pounds of Potassium/ft^2		
Annually	6.0 lbs.	3.0 lbs	8.0 lbs.	4.0 lbs.	soil test
May 16th			2.0 lb./ft^2	1.0 lb./ft^2	
May 20th	1.0 lb./ft^2	0.5 lb./ft^2			
June 24th	1.0 lb./ft^2	0.5 lb./ft^2			
July 3rd			1.0 lb./ft^2		1.0 lb./ft^2
July 30th	1.0 lb./ft^2	0.5 lb./ft^2	1.0 lb./ft^2	1.0 lb./ft^2	1.0 lb./ft^2
August22nd	1.0 lb./ft^2	0.5 lb./ft^2			
September 12th			1.0 lb./ft^2		*
October 8th	1.0 lb./ft^2	0.5 lb./ft^2	1.0 lb./ft^2	1.0 lb./ft^2	*
November 26th	1.0 lb./ft^2	0.5 lb./ft^2	2.0 lb./ft^2	1.0 lb./ft^2	*

* Rate varied for each plot depending upon the soil test results from October 1996.

Results

On August 20, 1997 an interaction between soil type, nitrogen level, and light-weight green rolling was observed regarding dollar spot activity. The data is presented in Table 10. A pattern exists regarding soil type, nitrogen rate, and rolling. Not surprisingly, nitrogen rate reduced dollar spot numbers. It is interesting that light weight green rolling had a greater impact on reducing dollar spot than did nitrogen rate.