Data on the depth of penetration of the various tines are given in Table 10. With many aerifiers the weight needed to penetrate soil effectively varies with the unit and soil condition. In dry and highly compacted soils some units do not penetrate well. Although the data have not been analyzed statistically, the depth of penetration was not dramatically reduced on the more compacted sites for the aerifiers utilized. By removing some of the tines from the Dedoes unit the depth of penetration was increased slightly on both sites (2.0 vs 2.8 inches on the "normal" soil and 1.8 vs 2.7 inches on the "compacted" site). When greater penetration is desired an alternative is to selectively remove some of the tines, more weight or wait until the soil has a higher moisture content. Of course, aerifying should not normally be practiced when the soil is very wet.

The Ride-Aire does not penetrate as deeply as other units as might be expected. The Aer-Way unit leaves a hole that is triangular in shape. Average figures were 5.0 inches deep by 6.9 inches long. The width was 1/4 to 3/8 inch wide. The Verti-Drain is a much larger unit which makes a deeper hole (9 inches average with the solid tines) on the "normal" site compared to other units. On the "compacted" site the average depth was reduced to 8.5 inches with the 4 inch linear spacing between holes. When the hollow tines were utilized the average depth was 6.2 inches with the 4 inch linear spacing on "normal" soil and reduced to 5.9 inches on "compacted" soil.

As might be expected the deeper and larger tines remove more soil when using hollow tines. The closer spacing of the Dedoes "standard" setup removes more soil, but doesn't go as deep compared to the less intense "diamond" spacing. These figures are based on dry weights of soil cores removed from a 4 square foot area and represents an average of 4 areas sampled for each treatment. The Ride-Aire removed the least soil among the units studied and the Verti-Drain removed the greatest amount at the 2.5 inch linear spacing as would be expected.

These observations are based on physical measurements only. No data were taken with regard to rooting responses, turf quality or effects on soil properties, partly because the treatments were applied late in the season when equipment was available. Determination of which unit(s) is most effective would depend on the depth of penetration desired; whether soil cores need to be removed from the site or deposited back into the thatch; cost of the equipment; speed of operation; durability of the equipment and soil conditions, among other factors.

EFFECT OF SAND AID AND TOPDRESSING PROGRAM ON A PENNCROSS CREEPING BENTGRASS GREEN

A long term study was initiated in May, 1985 at the Hancock Turfgrass Research Center to evaluate the effects of the use of Sand Aid as an amendment in topdressing and core cultivation programs for putting greens. The treatments outlined in Tables 11 and 12 were applied to a Purr-Wick green (dune sand) and on a "USGA~ green, respectively. A third study was conducted on a green growing on fine sandy loam soil with treatments 1) 15 pounds Sand Aid after coring; 2) 30 pounds Sand Aid after coring; and 3) coring only. Coring treatments were applied in May, June and September on all cored plots using a Ryan's Green Aire with 1/2 inch hollow tines. Plot size was 4 feet by

Table 10. Depth of aerifier tine penetration on loam soil. Perennial ryegrass turf. October, 1985. Hancock Turfgrass Research Center. Averages for a minimum of 24 measurements.

Aerifier	Depth, inches "Normal" Soil	Depth, inches "Compacted" Soil	Soil wt, gms 4 sq. ft.
Dedues - standard spacing	2.0	1.8	418
- diamond spacing	2.8	2.7	643
Ryan Ride Aire	1.8	1.5	270
Air Way	5.0	---	---
Verti Drain - 4" solid	9.0	8.5	---
2.5" solid	8.9	---	---
4" hollow	6.2	5.9	---
2.5" hollow	6.1	---	1647

Table 11. Effect of Sand-Aid and Topdressing treatment on quality of Penncross creeping bentgrass turf grown on a Purwick green (dune sand). Treatments initiated May 23, 1985. Hancock Turfgrass Research Center. Averages for 3 replications.

Treatment			Turf Quality Ratings (9=darkest green)				
Sand Aid	Auxiliary	Frequency	May 25	July 30	Sep 8	Sep 22	Sep 28
30 lbs/M	After coring	May, June, Sept	7.0 b	7.3 ac	8.3 a	8.0 a	8.0 a
15 lbs/M	Ater coring	May, June, Sept	7.0 b	7.2 bc	7.7 ab	7.8 a	7.8 ab
None	Coring only	May, June, Sept	6.0 c	7.0 c	7.8 ab	7.8 a	7.8 ab
5% volume	Sand T.D.	every 3 weeks	8.0 a	7.8 ab	7.5 b	7.7 a	7.5 bc
10% volume	Sand T.D.	every 3 weeks	7.0 b	7.5 ac	7.5 b	7.8 a	7.5 bc
None	Sand T.D.	every 3 weeks	7.0 b	8.0 a	7.2 b	6.5 b	7.2 c
None	None	----	7.0 b	7.5 ac	7.5 b	7.0 ab	7.5 bc

Table 12. Effect of Sand-Aid and topdressing treatment on quality of Penncross creeping bentgrass turf grown on a "USGA" soil. Treatments initiated May 24, 1985. Averages for 3 replications. Hancock Turfgrass Research Center.

Treatment			Turf Quality Rating (9=darkest green)				
Sand Aid	Auxiliary	Frequency	Jun 25	July 30	Aug 25	Sept 8	Sept 22
30 lbs/M	After coring	May,Jun,Sep	8.0 a	7.7 a	no	8.0 a	6.7 ac
15 lbs/M	After coring	May,Jun,Sep	8.0 a	7.2 a	differ-	8.0 a	6.3 bc
None	Coring only	May,Jun,Sep	7.0 b	7.2 a	ences	7.5 ab	6.0 c
5% volume	Sand T.D.	every 3 wks	7.0 b	7.3 a	ob-	7.7 a	7.5 a
10% volume	Sand T.D.	every 3 wks	7.0 b	7.6 a	served	7.0 ab	6.3 bc
None	Sand T.D.	every 3 wks	7.0 b	7.2 a		7.5 ab	7.2 ab
None	None	----	7.0 b	7.3 a		6.5 b	6.5 ac

6 feet with 3 replications. Financial support for this project from the Emerald Isle Corporation is gratefully acknowledged.

Data in Tables 11 and 12 suggest there were no consistent differences in turfgrass quality ratings during 1985. On some dates plots receiving Sand Aid did rank higher than certain untreated plots, but the trend was not consistent across all dates. There were no differences observed at any time during the year on the plots on the soil green. Our hypothesis is that any consistent differences observed will likely occur over a period of time (perhaps 2 to 3 years) and that the greatest benefit will occur on greens high in sand content or which have been sand topdressed. This study will be continued.

OTHER STUDIES

Several other long term studies are being continued although no data are being reported here. This includes the pH control study comparing lime and sulfur treatments on soil pH and changes which occur with time. The wear simulator which was utilized in research extensively by James Beard and his students here at MSU was utilized in a study to evaluate the effects of different fertilizers and nutrient rates on wear tolerance of perennial ryegrass and Kentucky bluegrass. Variability in data was high enough that we felt it was best not to report results yet. We are taking steps to improve the wear simulator for our studies.

The nitrogen-potassium balance study on the irrigation green is continuing. No unusual differences occurred this year.

Two out state sites were selected to evaluate turf responses to very low soil phosphorus levels. One on a condominium site in Novi, the other on a golf course fairway at Crystal Mountain. Treatments were applied during the summer. Soil samples will be taken in 1986 for testing purposes and turf responses will be evaluated. There are many turf sites in Michigan which have very high soil phosphorus levels while there are others which have very low soil phosphorus levels. We cannot afford to have phosphorus limiting considering the cost of other materials. It is preferable to use soil tests as the base to determine phosphorus needs, but without soil tests it would be wise to use a low rate (such as 1/2 pound P_2O_5 per 1000 square feet annually) on sites where there is no topsoil and the turf was established on a compacted subsoil. We do strongly recommend the use of soil tests to determine the need for phosphorus on turfs along lakes and streams. Use phosphorus very sparingly on such sites.