Don't Guess — Check the Numbers!

Go by the numbers to remove guesswork when it comes to topdressing and core aeration.

BY BOB BRAME

Golf turf professionals understand the importance of putting green topdressing and core aeration operations, but a lack of information combined with golf facility politics can compromise what is actually accomplished. Often the leadership of a facility underestimates the importance of aeration and topdressing programs. Since these programs are critical to the performance of the greens, it is vital that the superintendent does a good job of communicating the need for these admittedly disruptive practices. Physical soil testing can provide scientific evidence of the need to continually cultivate the rootzone and provide a means of measuring the impact of such programs over the long term.

While physical soil tests provide a wealth of complex information, focusing on porosity will help the superintendent explain to the layperson the need for cultivation. A soil profile is comprised of solids and the spaces between the solids — pores. Ideally, there should be a nearly even split between the two categories — 50 percent solids and 50 percent pore space. The solids will be a combination of clay, silt, sand, gravel, and organic matter. Pore spaces will be filled with either air or water. Large pores are where water, oxygen, and roots freely move. Smaller pores, commonly known as capillary pores, hold water. A rootzone with about 25 percent air-filled pores and 25 percent water-filled pores provides a great growing environment for turfgrass plants. The actual makeup of each category will directly impact how water moves through and is retained in the rootzone. This in turn has a tremendous impact on the health and quality of the green. To quantify the amount of solids and pore space in your greens, simply submit an undisturbed column of the soil profile to an accredited physical soil testing laboratory for physical analysis. A complete list of accredited physical soil testing can be found on the website of the American Association of Laboratory Accreditation.

Soil layering within the upper rootzone is indicative of topdressing being out of sync with putting green aging and turf growth. Punching through the layers with core aeration and backfilling the holes with sand helps to increase the percentage of air-filled pore spaces.

Consider, as an example, the top two inches of a green that has a total porosity of 47.2 percent. Although the total porosity is acceptable, the analysis shows that only 1.3 percent is air-filled pore space, while 45.9 percent is capillary (or water-filled) pore space. It is obvious that in this case the vast majority of the pores are filled with water. This means that the upper portion of the rootzone will stay overly wet for extended periods of time. Also, since the water in capillary pores is held very tightly, even an extensive subsurface drainage system will not

When a quality aerator is used and the holes are completely backfilled with topdressing, subsequent playability is good, as is the efficiency of profile modification.

prevent the prolonged saturation of the upper rootzone. The end result will be poor rooting and weak plants. Adding any additional stress, such as hot weather (or, even worse, hot and wet weather), low mowing, excessive traffic, shade, or limited air circulation, to a wet upper rootzone will result in turf decline and poor playing conditions.

Fortunately, a rootzone that holds too much water near the surface can be improved through aeration and topdressing. By removing the cores and backfilling the holes with sand, the percentage of air-filled pores can be increased — at least in the portion of the rootzone penetrated by the aeration tines. While topdressing alone does not penetrate deeply enough to correct an existing accumulation of excess organic matter, the practice is very

The improving uniformity of sand at the top of the profile, as compared to the more pronounced layering further down, confirms the topdressing program is moving in the right direction. Adding physical analysis to visual observations will strengthen the decision-making process regarding future core aeration and surface topdressing between aerations.

Sample ID:		3/21/2011	11/5/2008	
Mix		**#11-G (0-2")**	**#11-G (0-2")**	**USGA Guide**
Clay	<.002 mm	0.70	0.92	<=3%
Silt	.002 - .05 mm	6.60	6.71	<=5%
Sand	.05 - 2.00 mm	92.50	92.02	
Gravel	>2.00 mm	0.20	0.35	<=3%
Organic Matter		3.60	4.51	
Sand Fractions				**USGA Guide**
Fine Gravel	2.00 mm	0.20	0.35	<=3%
Very Coarse Sand	1.00 mm	3.30	3.09	<=10%
Coarse Sand	.5 mm	24.40	21.49	>=60%
Medium Sand	.25 mm	47.20	45.87	
Fine Sand	.15 mm	13.40	16.01	<=20%
Very Fine Sand	.106 mm	3.10	4.22	<=5%
Very Fine Sand	.053 mm	1.10	1.34	
Soil Moisture Measurements				
Sat. Conductivity in/hr		<1	<1	>6
30 cm Moist. Retention		29.70	33.90	
Soil Pore Space				**USGA Guide**
Air Filled		2.60	1.30	15-30%
Capillary		42.30	45.90	15-25%
Total Pore Space		44.90	47.20	35-55%
Soil Density				
Bulk Density		1.43	1.36	
Particle Density		2.58	2.56	

A typical report from a physical soil testing laboratory. Notice the imbalance between air-filled and capillary (water-filled) porosity in the upper two inches of the green's rootzone. Such a rootzone will hold excess water near the putting surface, resulting in greatly increased disease incidence, shorter roots, and a predisposition of the turf to failure in hot, wet weather.

effective in helping to prevent additional organic matter buildup. Thus, the most effective program is one that combines the practices of core removal through aeration, backfilling of aeration holes with sand, and a regular light topdressing program.

Physical analysis of the rootzone should be repeated every couple of years. The initial undisturbed profile analysis serves as the benchmark for any adjustments that need to be made with future core aeration and topdressing between aerations. Resampling at least every two years is recommended to document progress and provide the insight necessary to make appropriate changes in the cultivation program. Sample more often if efforts are being made to correct severe rootzone problems.

To improve the accuracy of physical analysis, be sure to use the same accredited physical analysis laboratory for all submissions, collect the undisturbed profile samples from the same sites and at the same time of year, and submit only one or two representative profiles. In our example, resampling revealed an increase in air-filled pore space from 1.3% to 2.6%, while the capillary pore space fell from 45.9% to 42.3%. This shows that adjustments with core aeration and/or surface topdressing have improved the physical structure, yet not nearly enough. Further expansion of core aeration and topdressing should be incorporated into ongoing maintenance.

The example numbers also suggest value in testing the existing topdressing sand. It is very important to ensure the sand used for the practices described above is sized properly. For example, using a topdressing sand that is too fine could actually make the porosity imbalance worse instead of better. A sample of the topdressing sand can be submitted to the accredited physical analysis laboratory along with the representative undisturbed upper profile samples to determine compatibility.

The importance of monitoring the physical makeup of the rootzone is also discussed in a *Green Section Record* article written by Pat O'Brien and Chris Hartwiger entitled **"Aeration and Topdressing for the 21st Century."** The health, dependability, and playability of putting surfaces is too important for guessing — check the numbers.

BOB BRAME joined the USGA Green Section in May 1990. Core aeration and topdressing programs for putting greens are reviewed and discussed on every Turf Advisory Service visit he makes — with emphasis on checking the numbers.