Getting a Head Start on Summer: Aeration Programs for Healthier Greens

by Larry J. Stowell, Ph.D. and Wendy Gelernter, Ph.D.

Bottom line

The two-part greens aeration program outlined below can help improve turf health, especially during the summer months, by alleviating compaction, improving infiltration and increasing gas exchange.

I. In April (when turf is growing rapidly and will recover quickly), implement the spring cultivation program below:

- *Core aerify to a depth of about 3 inches using 5/8-inch hollow core tines. Remove the cores (Figure 1).*
- *Apply ¼ inch dry sand that meets USGA particle size specifications (primarily 0.25 and 0.5 mm particle size*); use a dry USGA specification root zone sand *(Figure 2).*
- *Deep tine aerify to a depth of 9 inches using a vertidrain or similar tool with ¾ inch solid tines (figure 3).*
- *Sweep or blow the sand to fill holes completely (Figure 4).*

II. From April through October, aerify monthly using ¼ inch solid tines on a 2X2 inch spacing. This non-disruptive process will improve gas exchange, thus decreasing the build-up of damaging levels of carbon dioxide in the soil.

Spring Cultivation Program

Figure 1. Turf is core aerified with 5/8" hollow core tines, to a depth of 3 inches. Cores are then removed.

Figure 2. Sand is applied following 5/8" hollow core aeration. Sand must be dry.

Figure 3. Deep tine aeration following sand application. The ¾ inch solid tines produce holes that are 9" deep.

Figure 4. Sand is swept into holes following deep tine aeration. Blowers can also be used in this step.

Figure 5. Appearance of green following the final sand sweeping and blowing step. A healthy green will take 10 to 14 days to recover from deep tine aeration.

The benefits of aeration

It's been said frequently, but we'll say here it again. The best way to combat damage from turf disease, weeds, insects, traffic, extreme weather and other stresses is to have healthy, vigorously growing turf. And one of the key cultural practices that promotes healthy turf is aeration, which acts to:

Relieve compaction: Soil compaction is the major cause of decreased water infiltration, decreased ability of roots to penetrate the soil and limited gas exchange between the soil surface and the atmosphere. Yet compaction is also one of the unchangeable facts of life that golf course superintendents must face, since it is primarily a result of foot traffic from golfers. Aeration, particularly deep tine aeration, is the most effective method – and at this point the only method – which we have for relieving compaction, short of re-building the green. In many ways, aeration allows us to re-build the green on a continuous and relatively non-disruptive basis. The data shown in Figure 7 illustrates the dramatic drop in compaction that occurs in the sand filled holes formed by deep tine aeration.

Figure 6. One of the benefits of aeration is decreased compaction in the aeration holes, which allows deeper rooting – even poa roots can reach lengths of 2 inches or more within the sand filled holes.

Figure 7. Candlewood Country Club, Mike Caranci, superintendent. Compaction levels (measured in psi [pounds per square inch]) following aeration. Compaction was measured with a Daiki recording cone penetrometer. Readings (each point on the graph represents the average of three readings) were taken one day after implementation of the spring cultivation program described above. "Between" refers to readings taken between aeration and vertidrain holes. "Aeration" refers to readings taken directly in sand-filled aeration holes (5/8" hollow core aeration). "Vertidrain" refers to readings taken directly in sand-filled vertidrain holes (3/4" holes). Note that only the vertidrain treatment reduced penetrometer readings to an acceptable level (less than 400 psi).

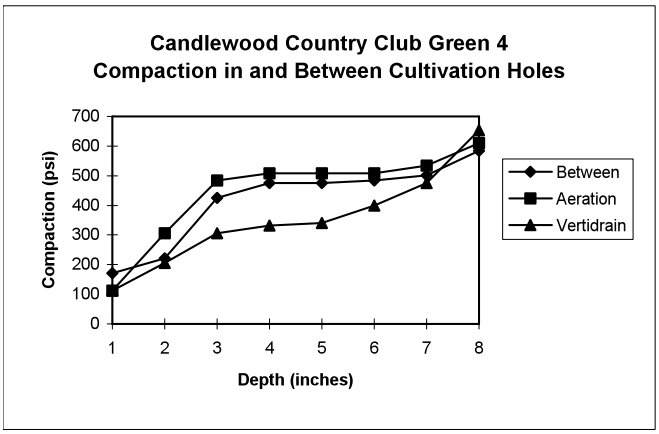

Figure 8. The bottom of this turf plug shows how successive years of aeration have produced a matrix of low compaction areas (in recent aeration holes) and high compaction areas (between aeration holes). This is a highly desirable situation, because by taking the brunt of the pressure from foot and equipment traffic, the high compacted areas actually protect the sand filled aeration holes from becoming compacted.

Improve water and gas movement: In the October, 1998 issue of *PACE Insights,* we discussed the negative impact that high soil carbon dioxide (CO_2)

levels can have on turf health and quality. By "loosening up" the soil particles, aeration allows excess CO_2 gas to escape from the soil, and permits water to infiltrate the soil.

Figure 9. Increased gas exchange in the sand filled aeration hole has alleviated the anaerobic conditions that led to a black layer problem on this green. Additional aeration will be needed to reverse the current situation and to prevent additional black layer formation in the future.

Remove fine organic particles: As greens age, soil microbes break down turf and thatch into organic matter. Although organic matter is usually viewed as beneficial, the very fine particles that form in this process act like silt and can therefore contribute to poor drainage, poor aeration and black layer.

Figure 10. Some evidence of layering should be expected when the spring cultivation program is adopted. However, the layering illustrated in the soil profile below will not result in water movement problems. This is because the sand filled holes are channels that allow water to move downwards from the surface of the green.

Selecting topdressing sands

The main decision encountered when selecting a topdressing sand is whether or not to try to match it to the root zone sand particle size composition. The most important "watch-out" here is to avoid the use of a fine particle size sand overlaid on top of a coarse particle size sand, since this can result in water penetration problems. Fortunately, we have never encountered root zone sands that are coarser than USGA specification sands. Therefore, it is unlikely that you will encounter a problem if you select a topdressing sand that meets USGA root zone specifications.

A USGA specification sand is one that meets the following particle size distribution: Not more than 10% retained on 1.0 and 2.0 mm sieves, a minimum of 60% retained on the 0.50 and 0.25 mm sieves, not more than 20% of the particles retained on the 0.15 mm sieve, and not more than 10% of the particles smaller than 0.15mm. Although there are other parameters used to select a USGA specification root zone sand, the particle size distribution is the most critical component. The additional parameters are optional for selection of a top dressing sand.

Another concern voiced when topdressing sands are selected is the possibility that a solid layer of sand will form on the surface of the green, thus causing water penetration problems. This can be an issue if topdressing and aeration are not periodically conducted together (Figures 11 and 12). However, the use of shallow and deep tine aeration following application of USGA specification sand will create channels for water movement, and will prevent a solid layer of sand from forming (Figures 6 and 13).

Warning: there are no miracle cures

A regular aeration program can solve many problems on golf course greens, but it is not a miracle cure for all that ails you. Greens with poor drainage can rarely be improved by aeration; re-building is usually the only solution there. Similarly, a mismatch between climate and turf variety can only be addressed by changing turf varieties. Most importantly, turf that is struggling and growing slowly due to a variety of stresses – salinity, pest pressure, etc – will not recover well from deep tine aerations. However, when greens are in good shape, a 10 to 14 day recovery period should be expected following deep tine aeration. Recovery from the monthly, ¼ inch tine aerations is almost immediate on healthy greens.

Figure 11. The top few inches of this soil profile illustrate the effects of several years of sand topdressing that was not followed by aeration. The result is a layer of coarser sand particles on top of a layer of a soil layer – a situation which can result in interference with water movement. The best way to address this type of problem is deep tine aerification followed by sand topdressing, which will create deep channels that improve water movement.

Figure 12. A sand topdressing program on this green failed to alleviate black layer because the sand remained at the top of the soil profile. To relieve black layer, it would be necessary to conduct deep tine aeration, followed by sand application to fill the holes. This would allow water movement and gas exchange where the black layer is at its worst – several inches below the soil surface.

Figure 13. After several years of spring cultivations, sand channels created by aeration and sand topdressing heavily populate this green. As a result, water movement and root growth are optimized. Note that older sand channels no longer connect with the soil surface, making them less effective. This is because they gradually become sealed off by the organic matter that is constantly created as old roots and thatch are decomposed. To keep the green functioning optimally, it is important to create new sand channels on a regular (at least annually) basis.