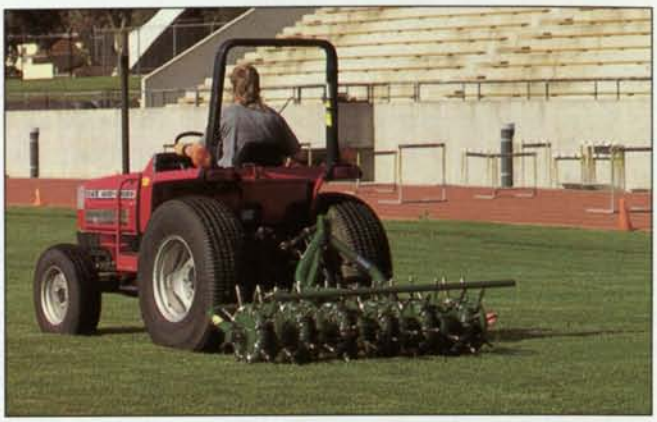

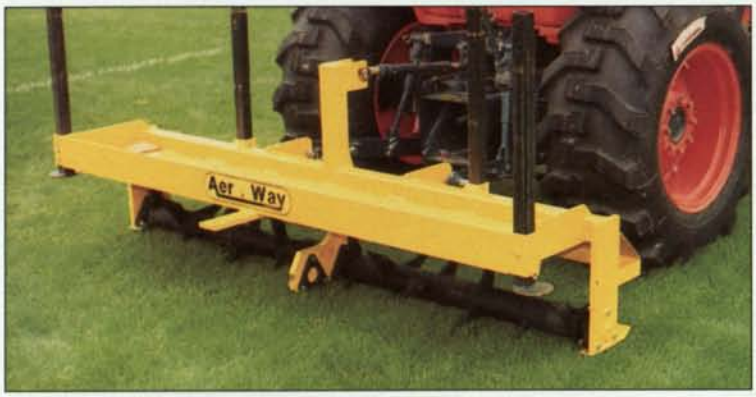

Soil aeration (above) not only reduces compaction but also helps turf stand up to stress, including heavy use. Hollow tines or spoons remove a "core" of soil (below) that is deposited on the soil surface and becomes topdressing over the turf. Shallow aeration equipment (left) may use solid spikes that punch holes in the soil, creating openings without removing soil.

Aeration Strategies to Reduce Compaction

By Dr. Gil Landry

Compaction is one of turf's hidden enemies. As soil particles are pushed closer together, pore space diminishes, increasing soil density. Air, water and nutrient movement are decreased by the lack of pore space. Percolation and infiltration are reduced. Turf roots struggle in the restrictive soil environment.

Compaction reduces turf quality and athletic-field playing conditions. Top growth slows, resulting in less cushioning for players. Weeds like goosegrass and annual bluegrass become a problem. The compacted soil itself forms a harder surface due to the increased density of soil particles.

Soil aeration is an important tool in a turf-maintenance program. It not only reduces compaction, but also helps turf stand up to stress, including heavy use. Aeration opens channels in the soil through which air, water and nutrients can move more freely. Percolation and infiltration are improved. Deep rooting is encouraged. Aeration also "softens" hard soil by increasing pore space, enabling the soil to "give" in response to impact, an excellent benefit for sports turf fields. The most effective aeration strategies meet the needs of the turf without disrupting its aesthetic appeal or the field-use requirements.

Assess Current Conditions

Unlike soil pH or fertility, soil compaction is not easy to quantify. Inspect turf for such signs of stress as thinning, lack of vigor or fading color. Note sections that react most quickly to high temperatures or lack of moisture. Check spots where turf shows weed invasion, insect or disease damage or less response to fertilization.

Look for factors other than compaction that can contribute to turf stress. Such situations might include high spots that receive inadequate moisture and dry out quickly, low spots where drainage is poor and excess moisture puddles, areas of heavy thatch buildup, or sections with buried rocks or debris.

Where no other contributing factors are discovered, compare stressed turf with areas of thriving turf. Are the grass varieties and soil types the same? Do both areas receive the same maintenance, including fertilization and irrigation?

Compare turf-use patterns. Sections subjected to the most activity will be the most susceptible to compaction — for example, between the hash marks on a football field or the goal mouths of a soccer field.

Degree and Depth of Compaction

Use a soil probe, shovel or pentameter to check the degree and depth of compaction. Soil should be moist during this process. The greater the degree of compaction at a specific point, the more difficult it will be to sink the probe into the soil.

Foot traffic and sports activity normally will cause the greatest compaction in the top two or three inches of soil. Con-

struction equipment or frequent traffic by maintenance equipment can cause deeper compaction. Core aeration, repeated to the same depth, may cause a layer of compaction at the penetration depth.

Examine the core of soil removed for changes in texture or color. Clay soils and other fine-textured silt soils are more easily compacted than those with a higher sand content.

Different soil textures and/or colors within the soil-probe sample could signal a layering condition. When layering occurs, soil moisture movement, air movement and rooting may be disrupted. Aeration and topdressing can help alleviate this condition.

Check turf root growth. Shallow roots or poor root development can indicate the depth of compaction or a change in soil texture.

Cultivation may not be the answer. Improved drainage or soil modification may be necessary, or perhaps better traffic and irrigation control are sufficient. In most cases, a combination of cultivation and these practices will be needed.

Explore Aeration Options

Shallow aeration is provided by equipment that reaches into the top three or four inches of soil. Deep aeration is provided by equipment that reaches deeper than four inches.

Shallow aeration equipment may use solid spikes or hollow tines or spoons. Solid spikes punch holes in the soil, creating openings without removing soil. Hollow tines or spoons remove a "core" of soil that is deposited on the soil surface and then becomes topdressing over the turf. Deep aeration equipment may move the soil with a vibrating or lifting action, or it may spike or slice into the soil with little movement.

Any tool used to penetrate the soil will cause some compaction. The question should be whether it relieves more compaction than it causes. Hollow tines or spoons that remove soil cause less compaction around and below the tine than do solid tines. Also, cultivating with different types of equipment and to different depths should minimize compaction from cultivation. Normal coring will not increase weed problems after a preemergence herbicide is applied.

Another consideration is the depth to which the aeration method is effective. Obviously, even in shallow aeration, the procedure must work deeply enough in the soil to reach the level of compaction. With deep compaction a hardpan layer can form, stopping the movement of air, water and nutrients below that depth. Though temporary relief can be achieved with frequent, shallow aeration, eventually that hardpan barrier must be penetrated for proper turf growth. With subsurface aeration, determine whether loosening or vibration of the soil will be needed, rather than penetration alone, to break the compaction barrier effectively.

The greater the degree of change in existing conditions, the greater and longer lasting the effect. Core aeration is more effective than spike aeration and has longer-lasting benefits; deep shatter aeration has a greater and longer-lasting effect than deep slicing or spiking, which causes little soil movement.

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Soil Aeration

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Consider the extent of the problem. How much effect is compaction having on turf growth and recovery?

If turf on a field is severely thinned or has worn away completely, players may be exposed to potential injury. In that case immediate action, such as resodding, may be required. If damage is minor, less disruptive practices can be used.

Match Method to Turf Conditions

No one cultivation option is right for all conditions or time periods. Matching the method to turf growth cycles, weather conditions and scheduled use will mean using different types of cultivation at different times during the year. Ideally, an annual deep cultivation should be combined with a shallow aeration program to achieve the best results.

Turf use and aesthetics must be considered. The more disruptive a procedure is, the longer the turf will take to recover. The heavy schedule of sports-field use dictates that procedures that cause extensive surface damage will be used less frequently than procedures that cause minimal surface damage.

The length of the positive effects resulting from each alternative procedure must be weighed. More damage can be tolerated when the benefits of treatment are long lasting.

Procedures that bring soil to the surface must be scheduled when they will not disrupt play. Turf takes time to recover from the disruption caused by core aeration. Even when the cores are dragged back into the soil and any tufts of thatch or grass are removed, the turf will require a recovery period. Grass roots need time to regenerate and spread deeper into the soil before top growth will reflect the benefits of the process.

Shallow spiking will make less of an immediate impact on turf aesthetics and can be used when some relief of compaction is essential during heavy-use periods. Spiking also is less disruptive to turf growth and can be used more frequently than core aeration.

Increasing Aeration Effectiveness

Soil moisture levels are critical during cultivation. Soil that is too dry is hard to penetrate, and procedures are less effective. Soil that is too dry also puts more stress on cultivation equipment. If soil is too wet, there will be little movement in response to cultivation.

Aeration methods that loosen the soil should be timed when moisture levels are slightly below field capacity, such as 24 hours after rainfall or irrigation. Aeration methods that cause little loosening, such as spoon-type tines, should be timed when moisture levels are near field capacity.

Hot, dry weather and strong winds can cause the turf-bordering aeration holes to dry out. Avoid aeration during those periods or arrange irrigation to compensate for moisture loss.

In most cases once holes are made, the longer they remain open to the surface, the longer the effect lasts. Once a hole is sealed, even if only at the surface, the benefits of air and water movement are significantly, if not totally, eliminated. Topdressing with a porous material keeps the holes open. If topdressing is not practical, more frequent cultivation will

be needed to overcome surface sealing.

Timing shallow aeration to periods of active turf growth will enable the turf to recover more quickly. Aeration in conjunction with overseeding and fertilization will increase their effectiveness.

Since significant root growth occurs at lower temperatures than leaf growth, fields that are heavily used going into winter probably should be core-aerated after use, unless winter desiccation is a common problem. Core aeration will improve the water/air relationships during this period and result in healthier turf the following year.

To increase the effectiveness of aeration throughout the soil profile, use a deep-aeration procedure within two weeks following shallow core aeration.

Consider Budget Constraints

With ever-tightening budgets, the ideal aeration program may not be practical. When lack of equipment, personnel or funding limit aeration options, concentrate resources where they will provide the greatest benefits. For example, schedule a complete aeration program for the football field only or for just the area between the hash marks with less frequent aeration of the entire field and surrounding grounds. Schedule regular aeration of park-system playground areas and sports fields, and use aeration as required to avoid turf decline in lesser-used areas.

Develop a reciprocal relationship with other turf professionals, arranging joint purchases of equipment or swapping existing equipment use. Though golf courses, school systems, park systems, municipalities and large commercial properties will have similar needs, different timing of equipment use may make such arrangements workable.

As with all sports turf maintenance practices, constant monitoring is necessary to evaluate the success of the program throughout the year and from year to year. Because quantifying aeration results is difficult, detailed record-keeping will be needed. Record the type and timing of aeration procedures. Since wet soils compact more quickly than dry ones, note irrigation and rainfall in relation to field use. Also keep records of daily temperature ranges, the frequency of games and practices on each field and the times they take place, fertilization schedules, overseeding and topdressing procedures, and any other pertinent activities.

Note the effect of procedures on turf health, including any reductions in irrigation, fertilization, weed, insect and disease control. Budgeting entities are more willing to consider funding for equipment and procedures when they can see documented results.

Be Flexible

Develop a workable cultivation program that meets field needs and your budget, but remember that even the best-prepared plans must be modified at times. Know what options are available and be flexible enough to adjust the plan to meet changing conditions and turf needs. ❑

As extension turfgrass specialist with the University of Georgia, Dr. Gil Landry provides leadership in the development of statewide educational programs in turfgrass management. He is immediate past president of the STMA.