Attack Compaction With Deep and Shallow Aeration

By Dr. Gil Landry

By its very nature, sports turf is developed to be used intensively. Such use requires intensive cultivation programs to relieve "the pain." The development of new cultivation equipment is giving sports turf managers more options to contend with the chief nemesis — compaction and all the problems that accompany it — of their facilities. For years, standard aerators provided cultivation to a depth of 3 to 4 inches. Recently, equipment that provides cultivation down to 16 inches below the surface has been developed.

Soil compaction symptoms include slowed turf growth, reduced quality (turf color and density), frequent drought stress and encroachment from weeds like crabgrass, goosegrass, annual bluegrass, prostrate knotweed or smartweed. These symptoms may be subtle and make diagnosis of the problem difficult. Other common indications of turf decline may appear, such as greater susceptibility

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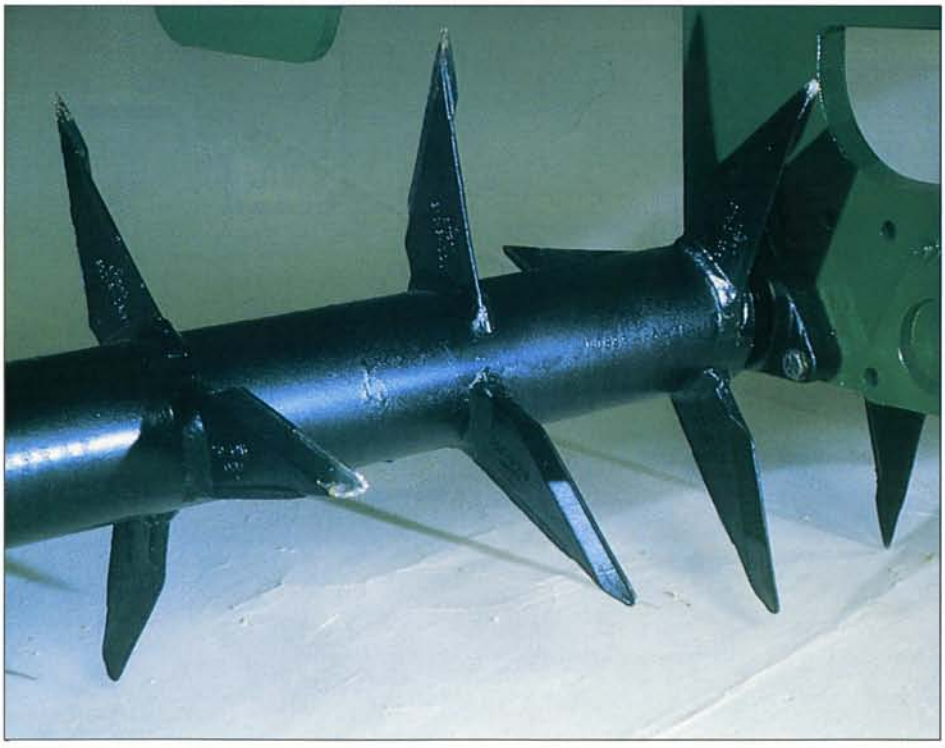
In addition to a host of aerators that can reach various depths, there are a number of tine options, from hollow to slicing, that can be used to address site-specific problems. Photos courtesy: John Deere Company.



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to insects and diseases and less growth after fertilization.

Roots Of Compaction

Soil compaction results in increased soil density and strength and decreased pore space. With less pore space, soil oxygen levels are lowered. Plant-available water is reduced, as is infiltration and percolation. Runoff is increased. Compacted soils have higher summer temperatures and increased water use.

Most compaction from normal use occurs in the top 1 to 3 inches of the soil surface. The degree of soil compaction that occurs depends on soil texture, soil moisture when used, and, obviously, the amount of weight applied. Soils with high silt and clay contents compact easier than dry soils. Heavy-weight college football players cause more compaction than the lighter-weight youth league soccer players. Cleated shoes increase compaction more than flat shoes because the full weight of the player is distributed on the reduced surface area of the cleats.

Soil compaction caused by equipment will extend deeper into the soil. Heavy equipment used during construction can develop subsurface compaction, as can repeated cultivation to the same depth to relieve surface compaction. This subsurface compaction, similar to the "hardpan" condition typical of agricultural soils, can form a barrier preventing adequate water, air, and nutrient movement.

Getting Specific

To cope with the compaction challenge, turf managers must identify the problem, choose from the method or methods for correcting it, decide on correct timing and frequency of cultivation, and evaluate the results.

Identifying the problem requires accurate evaluation of surface and subsurface conditions using a soil probe or shovel. Make sure the soil is moist, then the note the soil resistance to a soil probe and at what depth in the soil profile the resistance occurs. The greater the resistance, the greater the compaction. Pull out a core or section of the soil. Examine the soil texture and soil color, and identify the depth at which texture and color variations appear. Note root development and rooting patterns. Compare results from several locations throughout the field. Compaction generally will be greatest in high-use areas.

The most common problem on sports fields is the presence of fine-textured soils or soils with significant proportions of silt and/or clay. The finer the soil particle size, the more closely the particles can be forced together or compacted. Layering within the soil profile is another problem. A difference in particle size between layers of 10 percent or greater causes water to thoroughly saturate across the finer layer before passing into the coarser soil layer.

Cultivation methods that cause minimal surface damage can be scheduled into the few "off days" during active play periods, when core cultivation will be too disruptive.

Once the problem is determined, choose the most effective method or methods to correct it. Cultivation may be only part of the solution. Extensive problems could require improved drainage or soil modification. Better traffic and irrigation control may be necessary. Often, a combination of these practices is needed.

Although any tool used to penetrate the soil will cause some compaction, it should relieve more compaction than it causes. Varying cultivation methods, using different types of equipment to different depths, should minimize any compaction from cultivation.

Deep cultivation to relieve subsurface compaction will affect soil conditions through the entire depth cultivated. Overall field water-holding capacity will be increased; infiltration, percolation and drainage will be improved; and deeper rooting will occur. Normal shallow cultivation followed within two weeks with deep cultivation will provide both surface and subsurface improvements and increase the effectiveness of the deep cultivation.

Compare the options available in surface and subsurface cultivation to turf needs.

Consider how much damage will occur and how that damage will affect play. Though hollow tines or spoons cause less compaction around and below the tines than solid tines, they bring soil to the surface. Active turf growth is necessary to reduce recovery time following the cultivation methods that cause severe surface damage. The greater the damage, the less frequently the practice can be used.

Monitor how long the cultivation effects last. When cultivation methods provide long-lasting benefits, a greater degree of turf damage can be tolerated.

Generally, spacing between shallow aeration holes should be 2 to 3 inches. This often means at least three passes in different directions with most aerators is needed.

At what depth in the soil profile does the compaction occur? To be effective, the cultivation method must extend far enough into the soil to act on the problem.

Vibrating or lifting actions such as that produced by the Verti-Drain, Aera-Vator, Shatter-Core, Aerway, and the Yeager-Twose Turf Conditioner loosen the soil.

Other Pivotal Considerations

It's essential that enough moisture be present in the soil to allow satisfactory penetration during cultivation. Very dry soils resist penetration and limit the effectiveness of the procedure. Cultivation methods that cause loosening work best when soil moisture is slightly less than field capacity. This generally means one day after normal irrigation or rainfall. If the soil is too moist, it won't move properly and no loosening (vibration) will occur. Soil moisture should be closer to field capacity for practices that penetrate with minimal loosening, such as vertically operated tines.

Topdressing extends the effectiveness of cultivation. Generally, the longer cultivation holes remain open to the soil surface, the longer-lasting the effect. The benefits of air and water movement are significantly reduced by sealing the holes, even at the soil surface alone. If topdressing does not take place, more frequent cultivation will be need to overcome surface sealing.

Ideally, cultivation timing and frequency would be determined by the needs of the turf. In the "real world," such practices must be scheduled around field use. But choosing cultivation methods in relation to such other factors as soil moisture, turf rooting patterns, existing turf conditions, and pest or other stress problems will maximize the positive effects. For regularly used fields, three cultivations per year (spring, summer, and fall) are probably a minimum. Scheduling in three to seven days for cultivation during mid-season can be very beneficial, particularly later in the season.

Procedures should be matched to the time needed for recovery. Cultivation methods that cause minimal surface damage can be scheduled into the few "off days" during active play periods, when core cultivation will be too disruptive.

Cultivation methods also should be coordinated with turf growth cycles. Actively growing turf recovers more quickly. Unless winter desiccation is a common problem, time one core cultivation of heavily used field just prior to the onset of winter to take advantage of the significant root growth that occurs at lower temperatures.

The benefits of cultivation may be difficult to evaluate in part because multiple procedures are often needed to produce a significant response. Such benefits as improved infiltration and percolation, looser and more penetrable soil, fewer wet and dry areas, deeper rooting, greater turf vigor, and reduced turf stress may also be hard to measure.

Keep records of the cultivation program throughout the year, and from year to year. Monitor the timing of each method; the play schedule and turf and weather conditions when the procedure occurred and during the follow-up period. Changes in weather patterns or field use from year to year will require adjustments in the cultivation program. Successful sports turf managers understand the constantly changing relationships between grass plants and the soil, and they learn to be flexible. ❑

Editor's Note: As extension turfgrass specialist for the University of Georgia, Dr. Gil Landry provides leadership in the development of statewide programs in turfgrass management. He is immediate past president of the national Sports Turf Managers Association, and has contributed several articles to sportsTURF.