THE ENDLESS WEB OF COMPACTION

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Incorporating one or more cultivation practices into your turf management program is recommended for turf grown on compactible soil. The poorer the soil, the more frequently it should be aerified.

By Dr. Ali Harivandi

Heavy traffic on highly used turf sites often results in significant turf damage. Soil compaction is a stress that never directly kills the plant. Instead, it predisposes turfgrass to a variety of other stresses that can cause injury. Several identifiable problems are associated with heavy traffic on turf: turfgrass wear, soil displacement, turf removal or divots, and most important of all, soil compaction.

Although soil compaction is less visible than the others mentioned above, it is certainly the most damaging to turf. Compaction restricts the growth of turf roots and shoots, and eventually causes the turf plant's death. To understand soil compaction as major turf stress, knowing how compaction affects soil physical properties is essential.

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Compaction

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Compaction Problems

Problems associated with compaction include:

- Bulk density is increased in compacted soils. As bulk density increases, large, non-capillary pores become smaller, capillary pore spaces.
- Although the water-holding capacity of the soil generally increases as compaction increases, water infiltration and percolation are reduced. Decreased water infiltration makes proper irrigation difficult. Standing water on the soil surface and excessive runoff on slopes contribute to inefficient water use. Standing water due to lack of infiltration on compacted soils not only increases water loss due to evaporation, but also enhances turf disease incidence.
- Lack of water percolation on heavy soils creates poor soil drainage.
- Compacted soil may also be drier in summer due to drainage. These soils, being drier than non-compacted soils, generally heat up more rapidly, which cause wilting, drought, and high temperature injuries.
- Compacted soils, having absorbed and held much more water in the winter, warm up more slowly in spring than non-compacted soils. This may be important to areas planted with warm-season grasses, which require high soil temperatures in spring to come-out of dormancy and to green up.
- Oxygen diffusion rate (ODR) in compacted soil is severely reduced. Therefore, oxygen levels in the root zone become limited for root growth and development, since roots need oxygen for respiration. Without respiration, nutrient uptake by the roots is curtailed and turf plants suffer from nutrient deficiencies.
- Water absorption by the roots is also reduced at limited oxygen levels. Since microorganism activity is also reduced because of insufficient oxygen in compacted soils, the availability of nutrients, e.g. nitrogen, sulfur, etc., is also curtailed. This is especially important where slow-release fertilizers (e.g. urea-formaldehyde) are used. Decreased microorganism activity also can result in low thatch decomposition and thus thatch buildup.
- In hardened (tight), compacted soils, root growth may be completely stopped or greatly reduced.
- Turf establishment, whether by seeding or vegetative methods, is hindered.
- Turf wear-tolerance is decreased.
- Turf recuperative potential is reduced.

Symptoms of Compaction

- Turf develops shallow roots.
- Roots are generally thicker and shorter in compacted soils than they are in non-compacted soils.
- Shoot growth is reduced.
- Tiller, rhizome, stolon, and leaf growth is reduced and fewer are developed.

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- Grass stands have lower density and gradually thin out as compaction increases.
- Turf is often invaded by compaction-adapted weeds such as knotweed, annual bluegrass, goosegrass and clover.

Prevention and Correction

- Avoid repeated traffic over the same site.
- Reduce traffic by the use of paths.
- Channel traffic with the use of proper design.
- Use maintenance vehicles with pneumatic tires.
- Change mowing patterns often to reduce the operation of mowers on the same route.
- Increase the height of cut to increase wearability and the root depth where traffic is unavoidable.
- Minimize traffic when soil is wet or near field capacity.
- Develop a soil medium that is relatively resistant to compaction. Sands and loamy sands are least likely to compact, while high silt and clay soils are easily compacted.
- Partial soil modification with physical amendments such as sand, calcined clay, organic matter, etc., may decrease compactability of turf soil. This effect, however, is often short-term and not effective in sites under heavy traffic. Addition of sand to clay soils may actually increase the compactability and destroy the soil structure due to the development of "cementing" conditions. Very little data is available to support any positive effects of chemical amendments such as gypsum in correcting compaction problems.
- Under very heavy traffic and use, complete modification or replacement of soil is the only way to prevent compaction. Examples of complete modification include the University of California, Riverside, pure sand golf green and athletic fields, the PAT™ system, and the USGA Green Section golf greens.
- Incorporate one or more cultivation practices such as coring, grooving, slicing, and spiking into your turf-management program as routine practice when turf is grown on compactible soil. Of these practices, coring is considered the most effective and long-lasting.

Any form of cultivation should be practiced when turfgrass is growing vigorously and can recover from injuries. For cool-season grasses, this period coincides with early to mid-spring and late summer to mid-fall and, for warm-season grasses, the non-dormant season.

Cultivation practices are damaging to soil structure if done when the soil is too wet, and are ineffective when the soil is too dry. Although the frequency of any aerification practice is determined primarily by the magnitude of the traffic and the severity of compaction, agronomically speaking, a heavily trafficked area cannot be over-aerified. (The poorer the soil condition, the more frequently it should be aerified.) Aerification should be avoided, however, during high-temperature periods, when soil is too wet in the winter, and during the period of peak annual weed seed germination.

No single practice is effective in correcting compaction problems. Instead, several must be combined for a successful maintenance program. ❑

Editor's Note: Dr. Ali Harivandi is with the University of California, Riverside, Cooperative Extension. This article was adapted from a session presented on compaction at the University of California, Riverside, during the 1993 Sports Turf Management for Professionals clinic.