# Making Sense Out of Modified Rootzones

*By Steve Wightman*

Blood carries oxygen and food to the cells of the human body, giving it life. When the blood vessels and arteries become restricted with fatty waste from an improper diet and lack of physical activity, the body weakens. The mere acts of breathing, walking, and moving become more and more difficult, until one day, from food and oxygen starvation, the body dies.

If water is the lifeblood of turgrass, the rootzone contains the vessels and arteries of the plant's life-support system. When the rootzone begins to compact, the flow of water and nutrients begins to slow until one day the plant dies from food and oxygen starvation. Nowhere is the value of a healthy rootzone more evident than under the surface of a heavily used turfgrass area.

Very few native soils, especially those subjected to heavy traffic, make for an adequate rootzone that will allow the turfgrass to thrive. As a result, virtually all native soils subjected to intense traffic require some modification or amendment if the turfgrass is to have a reasonable chance of survival.

A rootzone that is properly designed, installed, maintained, and managed will provide an optimum growing environment for healthy turfgrass, regardless of the activity that takes place above it. A proper rootzone design acknowledges the soil/water relationships in selecting the physical and chemical properties of the rootzone mix. The design addresses drainage without adversely affecting the avenue for the plant's food and water supply. The design utilizes past research and practical applications as criteria for design parameters.

Proper installation or amending procedures for modified root zones will use extreme caution in avoiding soil contamination of the desired rootzone mix. Installation procedures should exactly mirror, not approximate, and proper design.

Maintaining a modified rootzone is not unlike maintaining turfgrass cover; it means providing optimum health and growth capacity. The rootzone is essential to turfgrass plant health, and providing cultural and renovation practices that benefit the plant are, in essence, benefitting the rootzone.

Proper management of a modified rootzone not only includes maintenance procedures, but also the scheduling of those procedures. Timing is everything. Performing a maintenance procedure out of sequence or at the wrong time can be detrimental and even fatal to the turfgrass.

Management also refers to the scheduled use of the turfgrass area. Mismanagement can be equated to field abuse, which is unfortunately more the norm than the exception, particularly in recreational settings. Remember, the more use a field has, the more care it must be given. Sadly, just the opposite is too often true.

**Most modified rootzones take advantage of the various water movement principles in one form or another.**

If a heavily used turfgrass field is constantly subjected to concentrated traffic on an inadequate rootzone, it will fail, regardless of the maintenance practice performed. On the other hand, if a properly modified rootzone supports the field, its chances of survival increase dramatically. With prudent scheduling and an adequate maintenance program, the field's playing standards and aesthetic value are enhanced.

Any turfgrass area, regardless of the rootzone composition, can be beaten to death if there is no time allowed for periodic recovery through the prudent scheduling of use. However, with a modified rootzone that properly addresses drainage and compaction, a sufficient "life insurance policy" is present.

### Soil/Water Relationships

To adequately discuss modified rootzones it's important to first review the characteristics of various soils and how water reacts with them. Understanding the relationship of water and soils can lead to a better appreciation of the importance of a proper rootzone in supporting a heavy-use area.

If turfgrass is to have a fighting chance for survival in high-traffic areas, then the rootzone mix must possess the appropriate amounts of sand, silt, and clay. All soils contain these three components in various amounts and are classified by "texture." Where we normally get into trouble is when the clay content (small particle size) is too high and restricts the flow of water — encouraging compaction.

Sand ranges in particle size from 2.0 mm down to 0.05 mm, while silt is defined as particle sizes from 0.05mm to 0.002mm. Clay is defined as anything smaller than 0.002 mm. Sand particles are further defined as very coarse (2.0 m-1.0 mm), coarse (1.0 mm-0.5 mm), medium (0.5 mm-0.25 mm), fine (0.25 m-0.1 mm), and very fine (0.1 mm-0.05 mm).

The larger the particle size, the quicker the water passes through, so it's possible to create a rootzone of all coarse sand that would most certainly be capable of accepting just about any amount of rainfall. However, the drainage would be so rapid the roots would not be able to pick up the water and nutrients. It would also be next to impossible to play on a turfgrass that had only a coarse sand rootzone because there would be no stability for footing.

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Somewhere between a coarse sand rootzone and a predominantly clay rootzone, there can exist a rootzone that provides the maximum benefits of a well-drained, coarse sand base and clay's nutrient and water retention abilities. But just how much of each texture is ideal?

Although there probably is no single "ideal" rootzone mix for all grasses and circumstances, most would agree that a modified rootzone that adequately addresses compaction, drainage, and healthy growth is as close to ideal as possible.

Research and experience indicate that various combinations of particle sizes can be successful. Since many variables come into play in determining the proper percentages of various particle sizes, the exact recipe for a particular rootzone should involve a soil specialist.

Successful high-traffic rootzones have utilized 85 to 90 percent medium sand (0.5 mm-0.25 mm), 5 to 7 percent clay (less than .002 mm) and 5 to 7 percent decomposed matter. Very fine sands (0.1 mm-0.05 mm) and silt (0.05 mm-0.002 mm) should be avoided as much as possible because they offer very little benefit. This combination yields adequate drainage, water and nutrient retention, soil strength, and soil structure for playability and growth.

### Soil Structure

Soil structure refers to how the soil particles are arranged. Separate particles are combined into larger units that possess different physical properties than the individual particles. Soil structure can be granular, crumb, platy, blocky, columnar, prismatic or sub-angular blocky where larger groups of particles become attached and act as one particle. Granular and crumb structure types are preferred for healthy turfgrass growth.

Soil structure is created by clay and organic material and is enhanced by microbial activity and the decomposition of plant material. Soil structure contributes significantly to favorable soil conditions for turfgrass growth by providing adequate aeration, nutrient and water retention, and oxygen and carbon dioxide exchange within the soil profile.

Most high-traffic turfgrass areas fail because of the destruction of soil structure. The deterioration of the soil structure is a direct result of soil compaction. To prevent compaction potential on high-traffic areas, a high proportion of sand is maintained within the rootzone.

However, this approach to decreasing the compaction potential does not come without a price. Sands have a very small surface area compared to clay for retaining water and nutrients for turfgrass use. This usually means that rootzones with a high sand content require more frequent irrigation and fertilization (there are modified rootzone designs that address this problem).

### Organic Material

Organic matter within the rootzone benefits soil structure and adds resiliency to the soil profile. It benefits turfgrass growth by increasing the soil's water- and nutrient-holding capacity.

The best organic materials for use in a rootzone mix are those that are very well decomposed. Because the process of decomposition requires high levels of nitrogen, incorporating organic matter that is already highly decomposed does not compete with the turfgrass for soil nitrogen.

The amount of organic matter incorporated into the rootzone mix should not exceed 10 percent by volume, or water infiltration and percolation rates could be adversely affected. For high-traffic areas, the organic content should not exceed 5 percent.

### Water Movement

Water is basically lazy and travels toward the path of least resistance. When the soil is well-aggregated and flocculated, water movement is quick and easy. However, when the soil is compacted, water movement is not so easy because the large pore spaces that permit water movement are compressed. By relieving soil compaction, large pore spaces reappear and easy water movement is again restored.

Water not only moves through the soil in a downward direction, dictated by gravity, but it also moves sideways and upwards through the forces of adhesion and cohesion. This becomes a critical function of water movement when the rootzone begins to dry after field capacity (the amount of water held in the soil after free drainage has stopped) has been achieved.

The amount of water held at field capacity is determined by the texture of the soil and the amount of organic material present. Once the soil begins to dry because of evaporation and transpiration, water begins to move to the drier areas in the upper portion of the rootzone. The ability and speed of the water's capillary movement within the rootzone is a direct result of the number and size of pore spaces between soil particles and the existing weather conditions. Coarse sand has larger pore spaces and little surface area, making it difficult for water to "wick" from capillary movement, but it provides better gravity drainage. Greater wicking is achieved by the medium and fine sands. Hot, dry days create more soil drying and greater potential for capillary water movement.

Most modified rootzones take advantage of the various water movement principles in one form or another. Effective rootzone designs utilize optimum particle sizes for both gravity drainage and capillary water movement.

### Maintenance Of Modified Rootzones

The approach to maintaining modified rootzones should be the same as with any other rootzone mix; to promote a vibrant, healthy growing environment for turfgrass. That means all cultural and renovation practices should be performed in a manner that benefits the turfgrass.

Creating a healthy environment requires constant monitoring of root depth and mass, canopy height and mass, adequate soil moisture, adequate soil and plant fertility, a prudent pest management program, thatch control, soil aeration, and drainage capacity. Cultural and renovation practices that address this environment are mowing, irrigation, fertilization, pest control, dethatching, aeration, topdressing, overseeding, and sodding.

### Mowing

For a particular turfgrass species, and even cultivars within a species, mowing height has a direct relationship with root depth and root mass. Each species enjoys and performs well when mowed within a certain height range. Some cultivars within a particular species will tolerate mowing heights outside of their desired range for a short time period. However, for optimum turfgrass performance, always mow within the desired height range.

Mowing often also promotes a tight-knit and thick canopy, while simultaneously keeping the thatch layer drier, which decreases disease potential.

### Irrigation

One of the primary factors affecting optimum turfgrass growth is providing adequate soil moisture. A properly modified rootzone is a tremendous insurance policy for proper soil moisture.

Compaction affects water infiltration and percolation, and since compaction is a continuous process, irrigation must be constantly monitored to coincide with the compaction process. This is true even in modified rootzones.

It's always best to apply water at the same rate as the infiltration and percolation rates. Therefore, it is important to know the field capacity of the rootzone in order to properly schedule irrigation to match the soil's water acceptance rate. Ideally, irrigation should just barely exceed field capacity so unnecessary drainage is prevented.

Factors affecting adequate soil moisture include the precipitation rate of the irrigation system, soil type and percolation rate of the rootzone, and depth of the root system. Knowing these important factors is the first step in properly scheduling irrigation.

### Fertilization

Since modified rootzones enhance the drainage capacity of soils, the availability of soil nutrients is diminished somewhat. This is because of the lack of clay particles that serve as holding areas for the nutritional soil solution made available for root absorption. Clay is made up of the small soil particles that inhibit gravitational water flow, and is generally found in small quantities in modified root zones.

Soil fertility requirements in modified root zones are normally greater, as is the fluctuation of the availability of soil nutrients. The buffer zone between the turf's nutritional needs and availability is narrowed substantially with modified rootzones because of the lack of clay particles.

The effectiveness of any fertility program depends not only on the type, rate, and timing of the fertilizer, but also on the soil reaction. Most nutrients are available to the plant if the pH of the soil is neutral (7.0) or slightly acidic (6.5). Modified root zones need to be near neutral to be nutritionally beneficial.

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### Thatch Control

A certain amount of thatch provides beneficial microbial activity, cushion, and resiliency to turf. Problems arise when an excessive thatch layer begins to adversely affect water infiltration, microbial activity, and desired plant growth.

Keep the thatch layer at a level that provides maximum field safety without interfering with water movement and desired plant growth. This is normally at three-quarters-of-an-inch.

### Aeration

Compaction is inevitable on any heavily used turf area, even those that possess a modified rootzone. The extent of compaction, however, is reduced dramatically in a modified rootzone.

Most of the compaction occurs within the top three to four inches of the rootzone and greatly affects water movement, soil structure and desired plant growth. Soil aeration, therefore, is an effective way to relieve compaction.

Core aeration is probably the most effective way to reopen the soil and relieve compaction on high-traffic areas. Numerous aeration applications may be required throughout a given year.

### Topdressing

The purpose topdressing is to re-level the surface area and provide a desirable growth environment for seed gemination and turfgrass growth. The type of topdressing material used should approximate the rootzone's soil texture, providing it is of an acceptable quality for turf growth. Other, the potential for soil "layering" increases.

### Sodding

As with topdressing, if the sod's growth medium is substantially different from the soil on which it is laid, then layering problems are not far behind. Layering severely decreases water infiltration and percolation, and as long as it prevails it will have an adverse affect on the soil's drainage capacity.

Core aeration can help to alleviate some of the layering problems if the different textured soil is close to the surface. However, if the soil layer lies well beneath the surface, then deep coring or ripping may be necessary.

Modified rootzones aren't a "cure-all," but they do provide a life insurance policy against the detrimental effects of compaction. And compaction is responsible for the failure of a majority of high-traffic fields.

Properly modified rootzones provide adequate water movement through the soil profile. With free water movement, the oxygen and carbon dioxide exchange can function properly. With these two major components in healthy working order, healthy, strong and stable turf is sure to follow. ❑

*Editor's Note: Steve Wightman is stadium manager at San Diego Jack Murphy Stadium. This article was adapted from a session on modified rootzones he gave at the University of California, Riverside, during the Sports Turf Management for Professionals clinic held March 9-10, 1993.*

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