Understanding and minimizing soil compaction

Soil compaction is becoming an ever more prevalent problem within the turf world. With the surge of athletic events and practice on a limited number of fields, unhealthy turf and playing conditions are emerging. Facilities wishing to attract additional revenue are facing the situation where the more customers they attract, the greater the traffic on the turf and thus, the greater the amount of soil compaction.

Soil compaction is the pressing together of soil particles, resulting in a more dense soil mass with less pore space. When the soil particles push together, they occupy a smaller space, thus, are considered compact. Compaction occurs in areas receiving the most traffic. Athletic training fields are a high compaction risk due to the near daily usage and the evolution of larger and stronger participants. Other areas at risk are recreational fields open to almost unlimited play and practice. It is not just foot traffic causing compaction, but also vehicular traffic. Daily mowing, periodic topdressing, and fertilizing require heavy machinery to perform, thus, additional sources of compaction.

Soil compaction can occur at any time, however it is most acute when the soil is wet. This is from the water in the soil acting as a lubricant, more easily allowing the soil particles to slide past each other with less resistance than when they are dry. This is amplified when soil high in silt or clay is used during construction. These soils remain wet longer following rain and the smaller size of these soil particles allows them to press closer together.

Problems caused

Compaction can also cause a number of soil problems, including an increase in bulk density, an increase in soil strength or firmness, a reduced aeration porosity, and an altered pore size distribution when soils are highly pressed together.

Bulk density is a measure of mass or weight per unit area. In compacted situations, due to the increase in number of soil particles in the area, the mass will increase. This also contributes to the reduction in aeration porosity, as the closer soil particles are to one another, less pore space exists. Sufficient pore space allows air, water, and other nutrients to enter the soil, a reduction in this eventually leads to poor turf. Non-uniform pore size distribution also can contribute to this, causing soil particles to move closer to one another, reducing pore space.

These physical changes can have detrimental effects on turfgrass growth such as decreased root growth, decreased shoot growth, reduced carbohydrate reserves, and decline in overall quality. Destruction of the soil structure also may occur. The resulting soil often becomes "hard as a brick" when dry and a "mud hole" when wet. The turf eventually thins, potholes develop, and the resulting hard surfaces can cause player injury.

Prevention

Constructing fields with sands that do not compact is the first step in preventing soil compaction. This involves replacing the existing soil with a pre-approved sand-based rootzone mix that balances good water management and compaction prevention. Unfortunately sand-based athletic fields are more expensive to build.

The most common way of reducing compaction is through the use of soil cultivation techniques. Most of these techniques operate by physically altering the soil profile in some way, be it by removing parts of the soil or by altering the structure of the soil. A great deal of diversity exists among the cultivation techniques available.

The most popular method of reducing existing soil compaction is hollow tine aeration. Hollow tine aerifiers are hollow tubes 1/2 to 3/4-inch in diameter and 3 to 12-inches long, designed to pull plugs out of the soil, thus, reduce the amount of soil per unit area. They operate on the principle that if less soil is present then a lower mass per unit area (or bulk density) results. Note that hollow tine aeration can disrupt the surface considerably, the equipment can be expensive, and generally requires a medium sized tractor.

The disruption cause by hollow tines has increased the popularity of solid tine aeration. Hollow tine aerifiers are hollow tubes 1/2 to 3/4-inch in diameter and
or a series of teeth set on a rotating blade. Similar to slicing, grooming operates in a similar manner but the blades are attached to a walk-behind mower. The blades used in grooming are much smaller and thinner than those used in slicing as the technique is generally used in the prevention of mat and grain formation on turfgrass. The blades are powered to revolve against the direction of machine movement. Due to the shallow blades, grooming is unlikely to have a great deal of effect on deep compact areas but helps in alleviating or preventing compaction in the upper soil profile.

Supplements to the use of machinery include reducing or altering the traffic pattern on the turf, especially when the soil is excessively wet. On football and soccer fields concentrated practices should be performed or rotated on different parts of the field. Using only lightweight machinery and minimizing its use and practice when soils are saturated also help prevent soil compaction.

Soil compaction is a serious issue among the turfgrass community and one that has possible legal ramifications. It can cause the deterioration of turf quality and be a danger to participants. Take steps to relieve this problem or eventually undesirable turf and soil conditions will develop.

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