Golf Turf Management

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Bacteria

Bacteria are the most abundant of the soil organisms. For example, a single gram of soil (about the size of a raisin), contains more than 10 billion bacteria representing 10,000 different species. Most bacteria are very small (<1/1,000,000 inch, <2.5 x 10^{-5} mm), single-call microorganisms without a nucleus or chlorophyll. These exist as mats, clumps, and filaments on and around soil particles and roots. Their shape ranges from spheres (cocci), ovals (spirals), or rods (bacilli) to branching filaments (actinomycetes). They are responsible for many biochemical reactions necessary to support higher plants including nitrification, N fixation and S oxidation, which provide these nutrients to plants. Due to the abundance of roots and organic matter, bacteria are found in the highest numbers in grasslands. Heterotrophic bacteria decompose organic materials, as their primary function in ecosystems is to release nutrients for recycling to higher plants. Bacteria populations, like most soil organisms, fluctuate with the season. Numbers are generally highest in temperature regions in early summer and in fall. Bacteria are rapid multipliers, doubling in population in as little as 20 minutes. Cyanobacteria, also known as blue-green algae, contain chlorophyll and fix limited amounts of N under damp wet conditions.

. . . Gram-positive bacteria, in general, have stress-tolerating, rigid cell walls and often dominate in extreme soil conditions (hot, cold, dry, etc.). Gram-negative bacteria are involved in N cycling, have relatively weak cell walls, and usually are dominant bacteria under normal growing conditions.

On golf course greens, two main bacteria genera occur; Bacillus and Pseudomonas. Other genera in lower occurrence include Clavibacter, Flavobacterium, Microbacterium, Arthrobacter, and Xanthomonas. Soil aeriation largely determines the type of bacteria in the soil. Where gaseous O_2 is available (e.g., aerated, oxidized soils), aerobic bacteria exist and use O_2 to oxidize and decompose organic matter. Bacteria also help decompose turf thatch by breaking down simple organic compounds such as plant exudates and other compounds. **In the absence of gaseous O_2, anaerobic Thiobacillus bacteria dominate, utilizing compounds such as nitrates, sulfates, and iron (ferric) oxides in metabolism**. As mentioned, the reduced forms of some elements, such as Fe and Mn, may be present in sufficiently high quantities to be toxic to higher plants. When sulfate is use rather than O_2, hydrogen sulfide (H_2S) is produced that can be toxic and smells like rotten eggs, possibly leading to “black layer’ formation.

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