THE MICROBIOLOGY OF NONPATHOGENS AND MINOR ROOT PATHOGENS IN HIGH-SAND CONTENT GREENS

Golf greens constructed with high-sand content mixes have become the standard for the golf course industry. the high-sand content green is physically superior to older sandy-loam greens because plants with larger, deeper root systems can be produced. The majority of these greens function well, but they are often susceptible to biological problems in the root zone that are difficult to identify and result in loss of turf. The problems are unpredictable; difficult to control and involve both nonpathogenic microbes and minor root pathogens. Because of the stressful conditions under which today's greens are maintained, both nonpathogenic microbes and minor root pathogens are increasingly involved in disease problems. The physical characteristics of sand, and the cultural practices used, may inadvertently contribute to the microbiological problems.

CHARACTERISTICS OF SAND

Characteristics of sand that may contribute to micro-biological problems include the inherent microbiology of sand, sand-induced root abrasion and the chemistry of sand. Microbial populations of sand are believed to be less diverse or lush than that found in soul. thus, the sand placed in a green may be more susceptible to colonization by organisms in the surrounding soil, especially greens reconstructed with sand on old golf courses where the soil is well-infested with turf pathogens and other organisms associated with grasses.

Roots growing in sand have sharp twists and turns accompanied by unilaterally swollen cortical regions. The inner side of most twists and turns show cuts due to the root growing around and between sharp edges of sand particles. This abrasive action may be worsened by the shifting and grinding of sand particles under foot and machinery traffic, and by the addition of sand topdressing. this abrasion provides sites for nutrient leakage that may attract the motile spores of pathogens, or for infection by other soil-borne pathogens.

The chemistry of the sand used in the construction of greens may affect the microbiology of the sand. Many sand sources are calcareous with pH values of 7.5 to 8.5 or higher. These alkaline sands are especially supportive of cyanobacteria (blue-green algae) and may also promote growth of some fungi and sulfate-reducing bacteria in anaerobic microsites within the green.

CULTURAL PRACTICES

The physical characteristics of sand alone would cause only minor problems if it were not for cultural practices that compliment and enhance the physical problems. Cultural practices suspected of contributing to micro-biological problems in sand include mowing, irrigation and the application of some nutrient substances. Close mowing (1/8 inch) subjects plants to severe stress during high temperatures and opens the surface for greater light penetration and colonization by cyanobacteria. The minimal formation of thatch under close mowing contributes to sand abrasion of leaves, stems and roots under foot and machinery traffic. Close mowing and sand abrasion predispose the plant to attack by microorganisms normally of little consequence to healthy turf.

The microbiological problems associated with the excessive irrigation are cyanobacteria and black layer. Cyanobacteria reduce drainage and induce anaerobic conditions that support growth of sulfate-reducing bacteria and b[redacted] layer. Water from ponds and rivers may contain numerous species of algae, bacteria and fungi that become dominant species on sand greens. These problems may be further complicated by alkaline water.

High-sand content greens often need frequent fertilization and application of specialty nutrient products to maintain vigor and color. Excessive use of iron and sulfur may promote cyanobacteria and can be utilized by sulfate-reducing bacteria in black-layer development. It is probable that interactions between other nutrient substances, pesticides and microbial populations also will be found.

Nonpathogens

Nonpathogenic microbial problems of high-sand content greens include cyanobacteria (blue-green algae), sulfate-reducing bacteria and fungal mycelium responsible for localized dry spots. Cyanobacteria deposit hydrophilic mucilaginous substances in the sand and create a perched-water table at the surface of the green. This condition slows water movement and produces anaerobic microsites that are colonized by sulfate-reducing bacteria that form black layer. These conditions are promoted by close mowing, heavy irrigation, calcareous sands and excessive use of iron and sulfur containing products.

Localized dry spots result from hydrophobic by-products of nonpathogenic fungi that bind sand particles together to the exclusion of water. Development probably results from the inability of the microbial population of sand to prevent colonization by the fungi responsible for dry spot.

Minor Root Pathogens

Four genera of fungi are consistently associated with loss of turf on high-sand content greens. These include Pythium, Curvularia, Microdochium and Acremonium. Preliminary studies suggest that each of these organisms is capable of reducing the growth of creeping bentgrass grown in sand. P. arrhenomanes and P. aristosporum are minor pathogens of young roots in sand mixes during establishment. They persist and damage turf the first two years after construction and then usually cease to be a problem. They show a preference for very young roots or aging roots.

Curvulari lunata and C. geniculata are associated with brown to golden-orange colored spots, about one-quarter inch in diameter, that occur with a density that produces a measles-like appearance on the green. The spots do not increase in size, occur only during periods of high temperature, rarely kill any substantial quantity of turf and do not respond to fungicides. The Curvularia species are found only in the roots. Dry weight of root-inoculated plants ranges from 42 percent to 79 percent noninoculated plants.

Microdochium bolleyi is associated with irregular chlorotic to necrotic areas of the green and collar that occur primarily in cool, wet periods of the spring and fall. Development slows with high temperature and recovery is slow with lower temperatures. The disease may reappear in the same area in subsequent years. Inoculation of roots decreases the dry weight of plants 56 percent to 93 percent of healthy controls.

Acremonium is associated with symptoms that range from general thinning to thinning in relatively confined areas of the green and collar that persist from year-to-year and gradually increase in diameter. The affected areas are most active with heat stress and do not respond to fungicides. Dry weight of root-inoculated plants is 41 percent to 95 percent of healthy controls.

The organisms discussed in this paper are part of the normal microflora of grass root systems and should not present major problems for survival of creeping bentgrass. The fact remains, however, that the incidence of these organisms (and others) in the roots of low vigor or dying plants has increased with the increasing use of high-sand content mixes.

Knowledge of imbalances in populations of nonpathogenic microorganisms and of the activity of minor root pathogens in sand mixes is inadequate to conclude that these microorganisms are inherently more active in sand than soil. However, potential interactions of physical and biological characteristics of sand; cultural practices; and growth and development of the root system with nonpathogenic microbes and/or minor readily predisposed to these microbes than those in soil. Sand abrasion, pH and 1/8 inch mowing, in combination with periods of high temperature, may be the primary stress factors predisposing roots to infection by minor pathogens, or in aiding the colonization of sand by nonpathogens.

The problems and questions relative to root disorders in sand mixes are numerous and the solutions and answers are few. The turf pathology of the next decade relative to high-sand content greens will be more complex than simply indentifying clear-cut pathogens; the sand environment will necessitate an approach to the study of disease that encompasses nonpathogenic microbes, minor pathogens, physiochemical stress and all aspect of culture.

ACKNOWLEDGEMENT

The preliminary research presented in this abstract was supported in part by the O.J. Noer Research Foundation, the Iowa Golf Course Superintendents Association and the Iowa Turfgrass Institute.

This article was taken from the 1991 GCSAA Conference Proceedings