Why Manage the Root Zone Microbes?

IPM Corner

Soil microbial inhabitants generally thrive when given nutrients, organic matter, air circulation, and adequate moisture with good drainage.

In areas with chronic low moisture, the bacteria and fungi that survive best are the ones which form stable dormant structures. This limitation changes the general population diversity and activity cycles with rainfall.

Turf management may look simple to an outsider. Just mow, irrigate, fertilize, and treat occasionally with commercial products for pest control. However, balanced care of the turfgrass ecosystem takes into account the health of the many microorganisms in the root zone, as well as turf appearance. The populations of beneficial fungi and bacteria can change dramatically in both species composition and activity. Key factors that favor healthy soil include the use of organic amendments such as compost, slow release fertilizers, aeration, and irrigation. It is best to avoid the problems that can develop when the root zone is disturbed by compaction, heavy fungicide use, and overfertilization with soluble nitrogen.

Benefits from taking care of the root zone

Soil microbial inhabitants generally thrive when given nutrients, organic matter, air circulation, and adequate moisture with good drainage. Grass plants benefit from the same treatment. And since growing plant roots stimulate the activity of many soil microorganisms, it is easy to see that healthy turf and high microbial activity can complement each other. The benefits of an active microbial population include nutrient cycling and availability, thatch decomposition, and disease suppression. The question is, given real world considerations, how do mowing, aerifying, topdressing, and pest control affect the turfgrass soil ecosystem?

A key component of golf course care is the intensive management necessary to have a grass surface ready for season long play. Heavy traffic can lead to compaction, a problem to plants and microbes alike. High visual quality expectations are difficult to meet at times, especially when microclimates favor disease, or during very hot weather. But sometimes the short term solution to a problem will not be a benefit in the long run. Integrated pest management requires an understanding of the relationships between cultural practices and total plant health.

Mowing

Cutting grass leaves off regularly is a drastic cultural practice. In a natural setting, grass plants flower and set seed without losing their photosynthetic leaves, the source of sugars for new growth of roots and shoots. When grass is cut, there is a temporary cessation of root growth. Taller grass has a deeper root system, giving the plants more drought resistance and surface area for nutrient uptake. Experts think that some grasses, such as bentgrass and annual bluegrass, were adapted to grazing by animals over evolutionary time. As a result, they have become adapted to close mowing height. Since soil microbes thrive on the exudates of growing roots, it follows that higher cutting heights favor a larger, more active microbial population by increasing the root system.

Grass clippings

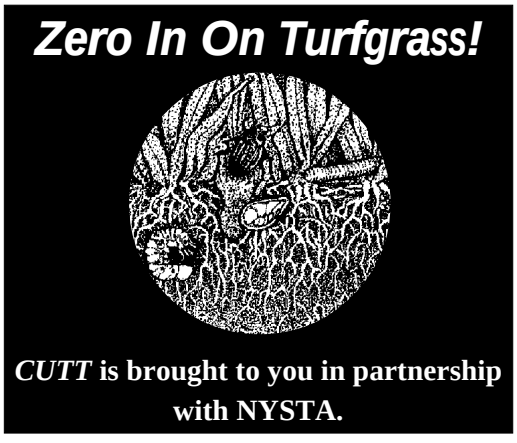
Returning grass clippings to decompose provides an excellent nutrient source: the fertilizer analysis of clippings is 5-3-1. The clippings begin to decompose within a week, if conditions favor microbial activity. The nitrogen from clippings can be found in new grass leaves within two weeks when conditions are right. The organic matter promotes microbial growth, with bacteria and fungi converting complex nutrients to simple, soluble compounds that roots can absorb. Organic matter and nutrient recycling are critical to healthy turfgrass, so don't bag the clippings and take them away!

Cultivation and aerification

Compacted soil layers, poor drainage and bare, dry patches in turf indicate the need for cultivation or aerification. Areas that don't show such serious problems can benefit from cultivation too. Equipment that removes cores, slices the turf, or drills holes will improve the soil environment for microbes. Better air circulation and drainage will enhance microbial activity, possibly encouraging deeper rooting.

Irrigation

When the soil becomes dry, the beneficial microorganisms cannot maintain the same rate of growth and reproduction. In areas with chronic low moisture, the bacteria and fungi that survive best are the ones which form stable dormant structures. This limitation changes the general population diversity and activity cycles with rainfall. If the root zone is deep and the grass is



mowed tall, the turfgrass ecosystem will be more stable during drought.

Fertilization

Too much fertilizer can result in burning, but more subtle problems can also arise. If fertilizers are applied at the wrong time, fast, succulent growth will result that is more susceptible to diseases. A high concentration of soluble nitrogen can reduce the activity of nitrogen fixing bacteria. Judicious use of slow release fertilizers or light, frequent fertility programs lead to healthy turfgrass and a healthy root zone. Natural microbial processes in the soil release nutrients gradually for uptake by the roots. If the carbon to nitrogen ratio is high, such as in dry, brown leaf litter, the microbes need additional nitrogen to continue to decompose the organic matter, degrading cellulose to usable compounds and humus. Without nitrogen fertilizer, the microbes might win the competition with the grass roots for nitrogen, and inadvertently cause yellowing of the turf.

Topdressing

Topdressing of compost, sand, sludges, and/or slow-release fertilizer can make a significant difference in the microbial population. Topdressing provides cover that alters the microclimate in the thatch. In addition, biological control products (derived from suppressive soils) and composts can supply additional microorganisms to enrich the turf grass ecosystem and provide competition with soil pathogens. Combining the application of topdressing with cultivation ensures that materials will penetrate to the soil level.

Application of fungicides

The products available to control fungal diseases can be very effective in stopping the growth of fungi. In studies with applied beneficial inoculants, certain fungicides can completely prevent growth and reproduction.

Soil respiration is considered a sign of the health and fertility of soil. For a short time after fungicides are applied, there is a reduced consumption of oxygen and release of carbon dioxide by the mixed population of soil microorganisms. This reduction in respiration is the result of the chemical toxicity toward the many susceptible species of fungi and bacteria, both target and nontarget. Fortunately, the respiration recovers quickly.

In summary, the turfgrass manager has a powerful set of tools to use in promoting a healthy root zone. Soil microbes are a valuable resource. Nutrient cycling and disease suppression are two very important natural processes. Since the cultural practices that benefit microbes also promote healthy turfgrass, it behooves the manager to make careful investments and decisions.

Jana Lamboy
New York State IPM Program
Cornell University Turfgrass Team

Soil respiration is considered a sign of the health and fertility of soil. For a short time after fungicides are applied, there is a reduced consumption of oxygen and release of carbon dioxide by the mixed population of soil microorganisms.

Since the cultural practices that benefit microbes also promote healthy turfgrass, it behooves the manager to make careful investments and decisions.