Microbes

Next to the Grounds Crew,
Microbes May Be the Hardest Workers on the Golf Course.
Would Adding to Their Numbers Be Advantageous?

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Microbes have been around the earth much longer than man, and by most accounts, will be around much longer after man is gone. The complexity of organisms within the soil environment is so wide that even the experts can only speculate at their numbers. By some estimates, no more than 5% have been identified. They have grown and evolved for millions of years. Microbes can survive or repopulate in almost any environment, it seems the only setbacks in the last couple millenniums were the winters of '96 and '97.

To better understand this little guy, let's go over some of the basics of soil microorganisms in a golf course environment. We will simplify some of the information to try to get the important facts out.

Soil Contains 5 Major Groups Of Microorganisms

- Bacteria
- Actinomycetes
- Fungi
- Algae
- Protozoa

We will focus on the bacteria groups (I will call microbes) as they are the workhorse and the most abundant group in the soil (usually more than the other four groups combined). Research indicates that select bacteria strains, either alone or in combination, can accomplish the same tasks in the soil as the other groups.

Three Major Categories Of Microbes

1) **Aerobes.** Aerobes must have oxygen. The good guys in nutrient conversion for plants.

2) **Anaerobes.** Anaerobes flourish only in the absence of oxygen. The bad guys that help in the black layer formation.

3) **Facultative Anaerobes.** Can thrive either in the presence or absence of oxygen.

Microbes Can Have Two Distinct Stages in Life

1) **Vegetative.** Vegetative microbes are alive and reproducing. They are susceptible to dying due to large changes in their environment, i.e., lack of food/oxygen, low/high temp or no moisture. Sunlight exposure can be deadly.

2) **Spore.** The microbes are enclosed in a protective sac in a hibernating state. The sac protects them from large extremes in their environment and can last for extremely long periods of time. When the environmental conditions

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are right, the microbes will emerge from their sacs and become vegetative, (i.e. functional).

Many Factors Affect Microbial Growth, Proliferation and Functional Activity

- Carbon Source (organics)
- Mineral Nutrients
- Soil Base Saturation
- Moisture
- Temperature
- Atmospheric Composition (gas)
- Sunlight
- pH
- Genetics of the Microorganisms
- Interactions between Different Species

To this we add a human/golf factor:

- Application of Fungicides and Synthetic Fertilizers
- Compaction
- Low Cut Turf
- Sandy Soils

Knowing how to deal with these factors is critical for effective green management. Grass and microbes help each other thrive. Through photosynthtesis, the plant produces carboydrates to feed itself and then can use up to a 1/4 of those produced carbs to be exuded out the roots and into the root zone to attract microbes. These carbs are a source of food for the microbes. The microbes then break down the organic matter dropped by the plant and convert it over to proteins and amino acids. They also convert elements in the root zone that the plant uses as a food source. Under a healthy microbial population environment the plant would not have to expend energy to entice more microbes to the root zone. It can then store those extra carbs for stressful times.

This natural relationship works very good until, as with a putting green, environmental factors become inbalanced. Note that almost all of the primary factors that affect microbial growth (as listed) have been altered in a golf course green. Once the beneficial microbes diminish, the root zone can repopulate with organisms that can be detrimental to plant growth and health. Many of these new organisms can cause disease. We than apply a fungicide to kill the disease pathogen. Unfortunately, even more beneficial microbes are also killed during this process. At its worst, we are setting up for a vicious cycle of fungicide applications. This cycle, over a period of time, is what enables the disease pathogens to build up a tolerance to certain fungicides.

Like all technologically-driven industries, the advancement of new products is moving at a fast pace. As you may know, microbial products are the golf course maintenance "HOT" new product.

Universities and commercial microbiologists have learned and developed technology on how to **isolate and culture natural occurring select strains of the beneficial microbes.** Their biggest challenge was getting the microbes from the laboratory and into real world field applications and having the new microbes survive in their new environment in the soil. To overcome this obstacle, scientists basically would take these select strains and submit them to different extremes. They would then remove the microbes that survived. These microbes of course were the strongest and had a very good chance of surviving in a soil profile over a wide variety of conditions.

One of the reasons early field applications of the *microbial only* products didn't work well was because there was little if any food source and a poor environment for the new microbes. Not surprisingly, since it was this fact that made the original micros diminish in the first place. Funny how Mother Nature keeps pointing us back to the basics.

Microbial treatments for turf are packaged and delivered in two ways: Some companies manufacture the microbes on site and dispense them through the irrigation system mainly at night. This had to be done during darkness due to the fact the bacteria were injected in a vegetative state (active) and sunlight would damage them. A great deal of care is required to keep the system free of contaminants. This type of delivery requires a somewhat constant input of the microbes to the target areas.

Finding the right solutions and carriers were the breakthrough for being able to apply and deliver microbes at any time. In this manner the selective microbes are aseptically (desired microbe only) grown and the majority are held in a spore (hibernative) condition. They are applied with a food source (available carbon) and nutrients to help them sustain life and grow into the root zone after they enter the turfgrass soil profile and transform to the vegetative state. Because these microbes are surrounded by a food source going into the new soil environment, they have a very good chance for survival.

There is so much more to be learned and proven in soil microbiology in the years to come. There are many different kinds of bacteria that a manufacturer could use in its microbial product. If the painstakingly steps of growing aseptically cultured bacteria are not taken, there is the possibility of having that many unwanted guests.

Microbiologists have long known the specific functions of different bacteria strains. Couldn't we be highly selective and isolate and cultivate bacteria to perform very specific functions? For example, sulfide reduction for blacklayer, algae control or disease control. Though the science is still young, products that can contribute to such beneficial results are available today. And the possibilities beyond this are enormous.

We have only touched what goes on under our feet and how and why these new microbial products have emerged. Can these new microbial products be a cure-all? Absolutely not. Can they be another tool in your box to work together with your other proven cultural practices to help you in your turfgrass management? It would seem so, but only you can truly answer that. However, if these little creatures could lessen the stress on your turfgrass, wouldn't they, in fact, be doing the same for you?