Can you impact your soil microbiology?

BY **ROCH GAUSSOIN, PHD**

Turfgrass managers, especially sports turf managers, are inundated with products that are marketed to improve turf and increase stress tolerance. Often the claims of these products are based on testimonials from end-users or manufacturers marketing departments. Academic institutions across the US and internationally unfortunately do not have the resources to scientifically test the merits of all products available.

One group of products available are designed and marketed to enhance turf "health" of both the plant and the soil through the addition of beneficial microorganisms. In theory these products are applied and the beneficial microorganisms colonize the rootzone increasing the plants capacity to combat disease, take up nutrients and tolerate stresses like drought, heat etc. Until recently little scientific information was available which provided even a rudimentary understanding of turfgrass soil microbiology and the possibility of introducing microbes into the turfgrass environment to enhance turf health.

Work completed at numerous university turfgrass research programs has resulted in information that is helpful in determining the merits of microbial applications. This research has created new and academically interesting challenges for future research, fundamental questions have been answered and common perceptions been found to be untrue or at least, suspect. This article will attempt to summarize these studies and indicate implications relevant to sports turf operations.

Here are common perceptions about microbial relationships in turfgrass soils: Excessive pesticide applications adversely affect soil microbiology; sand-based rootzones are relatively sterile; soil inoculums/additives can alter soil microbiology; and turfgrass soils are lower in microbial biomass and diversity than other soils.

From 1996-1998, sand-based rootzones located on 16 golf courses in eastern Nebraska were sampled for microbial properties in a project funded by the USGA and the O.J. Noer Turfgrass research program. The courses were separated into three distinctly different management groups based on pesticide and fertility inputs. Rootzones ranged in age from 1-28 years. Results indicated that age of rootzone was the most significant factor in microbial biomass/diversity. Management level did not influence microbiology, indicating that higher levels of management, including relatively high pesticide inputs, did not adversely affect soil microbiology.

These findings are similar to data reported from Florida and New York. Microbial biomass of sand-based turfgrass soils 18-24 months after establishment was less than native undisturbed soils, but greater than traditional row crop soils. Similar results concerning microbial levels and stability were reported in work conducted in North Carolina. These data indicated that sand-based turfgrass rootzones reached significant microorganism levels and stability relatively quickly (within 12-18 months), and levels were equal to native soils.

They also reported the temporal effects of microbial populations, with the largest populations being associated with the periods of greatest plant growth, i.e., spring and fall, which also agrees with work conducted in Nebraska. It is interesting to note that the period associated with the lowest microbial numbers also coincides with the period of greatest root pathogen activity and other stresses, i.e., summer. Obviously, these other stresses such as heat and drought are contributing to the grass decline during the summer, but the soils microbial "health" should not be overlooked.

In a relatively short time, sand-based turfgrass rootzones reach microbial levels comparable to other "native" soils. This information can be used to develop a theoretical scenario for the use of microbial inoculants. These are products that are packaged and marketed to turfgrass managers to improve the microbiology of the soil. These are often beneficial organisms packaged with other ingredients such as iron or biostimulants, or in some cases packaged as spores of the desired microbe.

These products may contain up to 109 organisms per milliliter of product, and application rates range from 1 to 6 ounces per 1000 sq. ft. Soil contains 108 bacteria per gram of soil. The relative quantity of actinomycetes is approximately 100 times less than the bacteria and fungi 100 times less than the actinomycetes, but for our theoretical example, we will disregard both.

Realizing that many soil microorganisms are sensitive to UV light and/or heat instable, and survival from purchase to application is decreased when the packaged organisms are exposed to light and/or heat, assume that all applied microorganisms survive and that the maximum use rates of the product are applied - the ratio of applied vs. native bacteria is approximately 6000 native: 1 applied, or the applied represent 0.02 percent of the total bacterial population.

When one considers the total microbial population (i.e. actinimycetes and fungi), this ratio is even more unbalanced. The applied microbes are being introduced into a hostile environment at levels considerably lower than the indigenous microbial population. It appears that the applied microorganisms have little or no chance of effectively competing with the already established population. Further, work at Ohio State showed that at approximately 2 years post-construction in a soil/sand/compost vs. sand/peat rootzone, microbial diversity was not different, even though the former rootzone was significantly higher at establishment. While the compost increased microbial taxa initially, a natural equilibrium ultimately occurred in 1-3 years.

Research has shown the benefits of biological pest control products, where the goal is pest control as opposed to increasing microorganisms in the soil. Structured research is limited, but work is increasing. Since it appears that new sand-based rootzones take 1-2 years to reach equilibrium, the use of microbial-based products may have merit during establishment. Work in this area continues, and perhaps future research will shed more light on the use of microbial inoculants in turfgrass management. In summary:

* Relatively high pesticide applications do not appear to adversely affect soil microbiology.

* Sand-based greens are not sterile, but in fact, reach levels of native soils in a short time.

* Soil inoculums/additives may alter soil microbiology in the short term, but their use on established turfgrass soils is questionable. ST

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