# Microbes in Turf

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I was recently asked to review literature that is being distributed to professional turfgrass managers. The more I read, the more perturbed I became, and therein lies the motivation for and the gist of this article.

When you receive literature of this type, the first thing you should do is study the writing style. Ignore the factual material. Establish the motivations of the author and understand where they are coming from and what is their agenda. Here are some things to look for.

**Words or phrases with shock value:** Examples in the literature I reviewed are "soil is a nutritional desert," "microbial vacuum," and "calls for crisis intervention." These are "wow" statements intended to make you believe that this is must-read material. Sit up straight in your chair and pay close attention.

**Weaseling:** You're supposed to overlook words such as "could, may, possibly, helps, and aids." Authors use these word to remain intellectually honest, but as the reader you're supposed to overlook them and think in more positive terms such as "will, does, and results in."

**Bias:** Here's where the author tips you off as to where they're coming from and whether or not the article is intended to inform or persuade. There is a big difference between these two objectives. Beware of statements such as "petroleum-based chemicals kill" or the implication that anything "synthetic" is inherently bad.

**Inferences:** How do you react to the stand-alone statement "Treatment X didn't change the overall microbial population but the type of organisms were very different?" You're supposed to conclude that the product used in treatment X should not be used even though its effects were not what the author anticipated. Unless the author offers evidence that the shift in the populations of different groups of microbes had adverse effects, you've fallen into a trap.

**History vs reality:** There is a strong tendency among authors with certain biases to quote or reference historical events that reflect badly on something. In these cases, you have to ask yourself the question "When and what were the circumstances under which this undesirable event occurred and are they relevant today?" Very often, the answer is "No." The products referenced and how they were used and on what crops may not pertain to turf at all. In many respects, turf is unique and cannot be thought of in the same vein as agronomic or horticultural crops.

**Chicken and egg:** The issue here is what came first and what is a cause versus an effect. Take the statement "Killing off fungi favors bacteria, causing soil to become alkaline." Bacteria do not cause soils to become alkaline. Rather, they tolerate high soil pH better than do fungi. Changing soil pH causes shifts in microbial populations. Shifts in microbial populations do not change soil pH.

**Warm, fuzzy words:** Examples are " balanced and harmonious." To a large extent, these are merely concepts that have eluded clear definition and quantification. They sound good but have little or no util-

ity in turf management.

**Extremes as the norm:** Be on the lookout for words such as "...there can be as much as..."

The author is stating an extreme value that cannot be interpreted as the normal situation. Take as an example a situation in which one researcher has found a 40% increase in something due to a treatment, but several others have found the response to the same treatment to be in the range of 1 to 10%. The 40% figure is not the norm.

Now I'll examine a number of specific claims often made in the type of literature that has me upset. Let's start with quotations of the numbers of microorganisms in thatch, soil, or the rhizosphere (the soil immediately surrounding plant roots). Approach these numbers with great caution. Burgess and Raw (1967) have clearly stated that it would be surprising if more than 1 cell in 10 or even 1 in 100 that is actually in soil is detected given the current methodology by which they are counted. Tate (1995) reinforces this in his book and further points out that the isolation of a particular organism means that it was present in the soil sample but not that it contributed to the microbial activity of the soil at the time of sampling. It sounds impressive to say that application of an organic fertilizer increased bacteria counts by 7 million, but his number may be in error by 300% and may not have relevance in the field.

Even if we place some faith in the numbers of organisms detected, it is very difficult to interpret what they mean. As stated by Sparling (1997), "Current knowledge is such that there are no accepted or reference values." We simply do not know how numbers of microbes relate to turfgrass growth, what , if any, are the optimum populations, and whether or not there are benefits to having a certain balance among the numbers of bacteria, fungi, and actinomycetes in soil. Furthermore, even if we could define optimum populations, these optima would have to be different for different soils, simply because there are inherent soil properties that regulate microbe populations and activity and these properties vary from one soil to another.

How many times have you read that fertilizers and, in particular, the "synthetic" fertilizers kill soil microorganisms? There probably exist instances in the past where inappropriate uses of chemical fertilizers were observed to adversely affect microbe populations in soil. In response to allegations that this continues yet today, let me quote from Couch (1995). He presents in his book data from several experiments and, from this, concludes that "...inorganic, synthetic organic, and natural organic fertilizers used in accordance with the manufacturer's suggested rates and application schedules have the same impact on the incidence and severity of disease and the same effect on micro-

bial activity in the thatch and soil." Need I say more?

Pesticides kill soil microorganisms. Of course they do. If they don't, then we're at a loss as far as control of soil-borne pathogens are concerned. But, is it true that every time a pesticide is applied, there are adverse effects on non-target soil microbe populations? Absolutely not. Such a global statement is irresponsible. Take, for example, the work of Harman et al. (1997). They made multiple applications of seven commonly used fungicides at the maximum legal rates and found that the fungicides had little or no effect on microbe populations. It is not universally true that pesticides reduce soil microbial activity. Some do, but others do not. Some even increase microbial activity (Nelson and Craft, 1997).

There is the assertion that acceptable quality turf can be maintained in an all-natural way. There is some very exciting research being done on biological control of turf diseases and this needs to be very intensively investigated. But, we have not yet arrived at the point where golf turf diseases can be biologically controlled to the extent that use of fungicides is not needed (Nelson and Craft, 1997). Therein lies the current dilemma finding combinations of biological and chemical controls that are compatible and can be used together in an integrated disease control program.

Would you believe the statement that "Plants obtain almost all of their nutrients through the help of beneficial organisms working in and around the plants roots?" I hope not. I'd be foolish to dismiss the importance of microbes in plant nutrition, but the above statement goes too far. The role that soil organisms play in plant nutrition varies substantially from one nutrient to another, and there are instances where microorganisms provide unwanted competition with plants for nutrients. No one disputes the importance of soil organisms when it comes to nutrients such as nitrogen. But, there are numerous instances where the role they play is minuscule. A case in point is phosphorus. It is a generally accepted idea that in temperate climates plants rely very little on organic soil P and its microbial release to plants (Anderson, 1980).

Now for the final issue, that of the role that microbes play regarding soil structure. It has been stated over and over again that soil microorganisms form soil aggregates, thereby alleviating soil compaction, increasing water infiltration and favoring root penetration. The truth of the matter is embodied in the statement made by Elliot (1997). "Production of soil organic matter, including extracellular polysaccharides and other cellular debris, increases the capacity of soil to maintain soil structure once it is formed". How structure forms in soil is a poorly understood phenomenon, primarily because it is such a long term process that is not easy to study. A common perception is that the starting point is the physical rearrangement of soil minerals that brings them in close enough proximity to one another so that gummy microbial and plant produced substances can bind them together. These substances, in and of themselves, do not cause soil structure to form. They stabilize existing structures and do so only temporarily. The binding agents themselves are food for other microbes.

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