Microbial Soil Amendments:

NEW INFORMATION AND NEW GENERATION TECHNOLOGIES

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In public forums or educational events, I am often asked to describe the various groups of soil microorganisms, and explain how they could be encouraged in the soil. In the landscape industry, however, few superintendents manage their soils with the specific objective of encouraging soil microorganisms. This is not to say that they dismiss them as being unimportant, it's just that the tools are not available to manage soil microbiology along with maintaining plant growth, disease control and soil fertility.

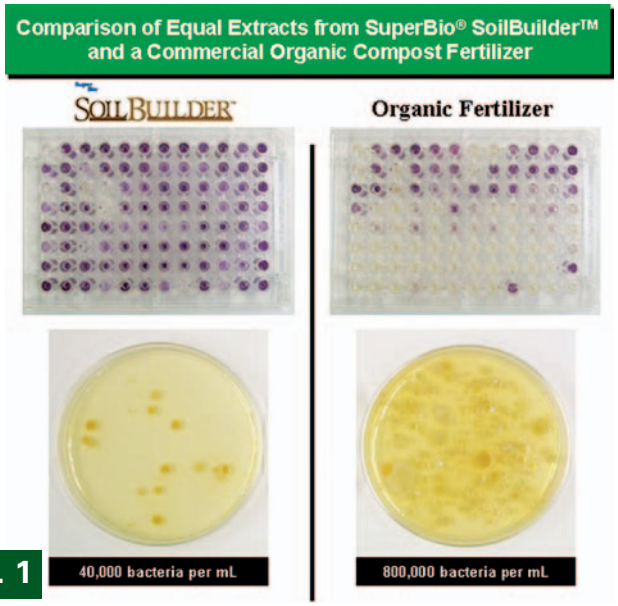


Fig. 1 "High bacterial counts do not necessarily translate to high metabolic diversity. Each well in the upper plates contains a different bacterial food source. Color development indicates the ability of the bacteria to use that particular food base. Lower plates show the bacterial populations being compared in the metabolic testing plates above.

In public forums or educational events, I am often asked to describe various soil microorganisms and explain how they can be encouraged in the soil. Few superintendents manage their soils with the specific objective of encouraging soil microorganisms.

Landscape superintendents are aware that microbial products can be a helpful management tool, however, they encounter a bewildering and often conflicting array of opinions, perspectives and experiences on the subject, from rampant skepticism to gross exaggeration of the benefits.

I thought it would be helpful to share my views about the state of applied microbial products and some of the advances in microbiological research driving a new generation of microbial products.

New Generation Microbial Products at a Glance

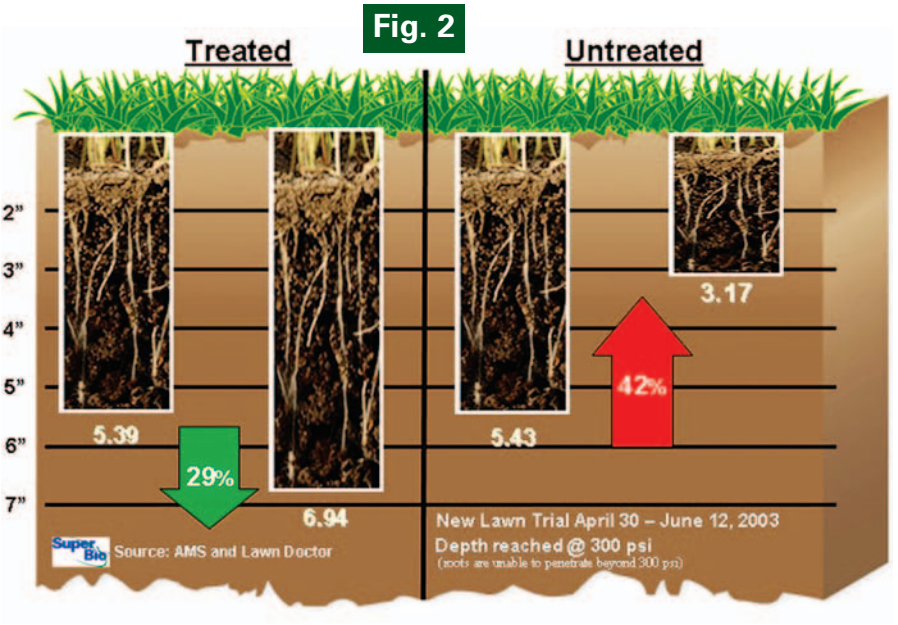
- Microbial products can be a helpful management tool, however, landscape superintendents will encounter a bewildering and often conflicting array of opinions.
- Microbial products with a greater number of species or "counts" of microorganisms are perceived better than products with lower diversity and counts. New technologies and product approaches challenge this view.

Experiences with Early Microbial Products

Many of the first commercial microbial products consisted of one bacterial (or fungal) species selected to stimulate plant growth or help with disease control. The difficulty was that some of these products relied on successful establishment of high numbers of the microorganism in the soil. Products improved by combining a food source for the desired organism, combining different microorganism species, and/or incorporating other plant-growth ingredients. The evolution of microbial soil amendments was like going from a "rifle shot" (single-target) to a double-barreled shotgun (broad spectrum of microorganisms, nutrient base and plant stimulants). Product complexity increased, but was primarily directed at improving plant growth rather than the critical underlying soil problems. Also, microorganism counts seemed to be a key concern.

The failure of many microbial products was attributed to not increasing the population of soil organisms above

levels in untreated soil. A related view was that, even in highly managed systems like turf, all the microorganisms required for a healthy soil environment were already present, based on performing counts of microorganisms growing on Petri plates using a limited selection of nutrient media. Plate counts are still in wide use, but modern genetic research has shown only about one percent of the total numbers of bacteria in the soil are detected using this method. In that sense, conclusions about how microbial products affected soil microorganism populations were based on evaluating less than one percent of the total population—arguably not a good representation.



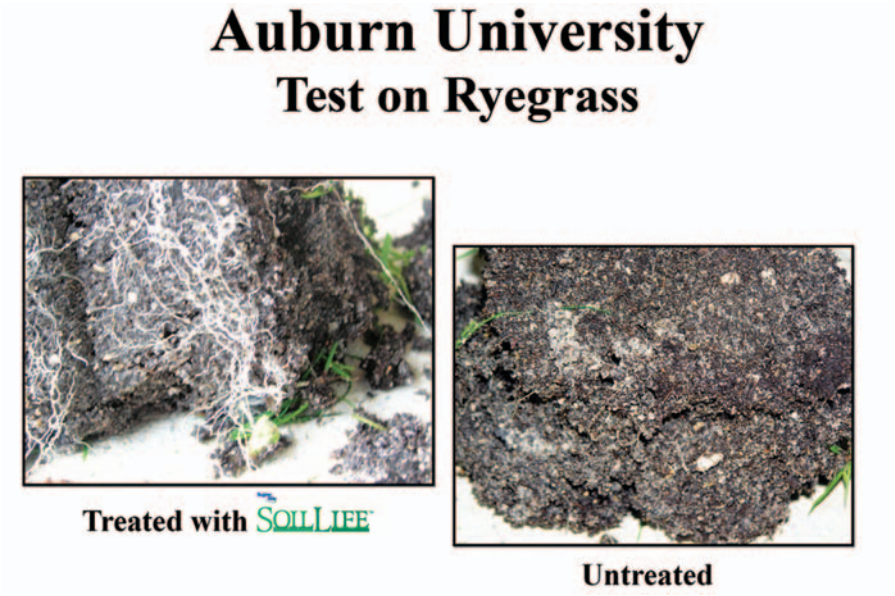
Reducing compaction with microbial products. The data shows a reduction in soil compaction in only six weeks using a microbial fermentation product. Note that the untreated lawn at the same site actually increased in compaction over the same time period.

New Generation Microbial Products

Microbial products with a greater number of species or "counts" of microorganisms are perceived better than products with lower diversity and counts. New technologies and product approaches challenge this view. Consider the analysis techniques of what the microbes do, rather than counts alone. The principles of metabolic function are fairly simple. Microorganisms able to consume (or metabolize) a greater diversity of food sources in the soil should have an advantage for surviving and performing the required soil functions. A helpful analogy is the microbial community as a city. Envision two cities, one with a population of 100,000 who, oddly, share only one or two job skills; the second city has only 1,000 people, but with job skills to cover all required services for a large city. Now, envision you urgently need double by-pass heart surgery. The large city has only plumbers and electricians; the small city has those skills, but also heart specialists. Microbial products with high-metabolic diversity ("skill sets"), but fewer total microorganism (population) counts, just might provide better performance than very high numbers of a less metabolically diverse product.

An example of this can be seen in **Figure 1**. This figure shows evaluations of extracts obtained from a microbial soil amendment and a composted poultry manure product. Petri plate counts show the compost, on the right, had a greater diversity and number of microorganisms. However, based on the diversity of food sources used—as shown by the top row of plates—the microbial soil amendment product had a much larger degree of microorganism metabolic functioning.

Advances in fermentation technologies allow development of large, interactive microbial communities—a major step forward from synthetic blends of a few strains of cultured species. Microorganisms continuously communicate with their environment and each other via chemical and biochemical signals. These signals communicate whether conditions are favorable for growth



Auburn also tested turf, here ryegrass. Whether it's turf or ornamentals, your plants will benefit from microbal soil amendments.

Fig. 3

Left: Similar grow-in sites at the Kennsington Golf Club, Canfield, Ohio, comparing a turf treat with a microbial-based soil amendment (right) and untreated tees. The grow-in, root development and turf coverage on the new course has been dramatic, according to Sean Novotny, superintendent at Kennsington. "It has enabled us to get our turf ready much earlier than expected, about a month ahead of schedule. There is a 100 percent difference between the turf treated compared to the turf that was not treated."

and food is available, or if the microbes should shift into a survival mode. Certain nonculturable bacteria require one or more different species of bacteria to grow, and fermentation technologies take advantage of the biological and biochemical interactive nature of microorganisms and direct these resources to benefit plant and turf growth.

One problem of early generation microbial products was they contained only one or even a few species of

Selection Criteria

Fig. 4

- Determine soil or plant management problems
- Does the product help with those problems?
- Understand product attributes (stability and handling)
- Ask for data (lab or university) test results
- Ask about quality control measures
- Make sure the product is registered in your state
- Ask for evidence that the company is reputable
- Ask about the company's scientific staff
- Ask about the product's distribution network

Testing Criteria

Fig. 5

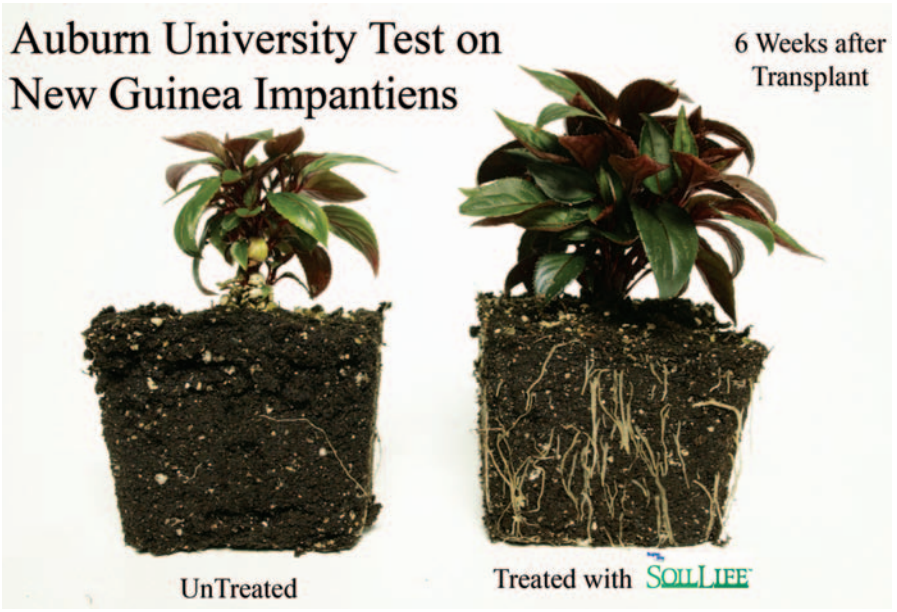
- Follow label instruction
- Ask about compatibility before tank mixing
- Establish a sound test system with controls
- Take relevant measures - not just visuals
- Do statistical comparisons, where possible
- Consult the manufacturer for assistance, if needed

"Microbials products have definitely improved the quality of our St. Augustine grass. Our turf has better color and density, which I can attribute to reduced soil compaction."—Gregg Newcamp, district manager, Busch Gardens, Fla.

laboratory-grown microorganisms. They carried with them the biochemical signals and physical conditioning of their nutrient-rich, ideal growing environment. When placed in soil, the growing conditions were certainly not ideal. Fermenting "in community" represents a way to better prepare microorganisms into the soil. The focus on the soil (and microbial solutions to its problems) aims to improve the environment for healthy and sustained growth, rather than merely targeting direct stimulation of the plant.

An example of this potential, **Figure 2**, shows how a microbial fermentation product worked in soil to reduce compaction in as little as six weeks. **Figure 3** shows how the microbial soil amendment product added to the standard management practice dramatically improved the rate and quality of turf establishment for the grow-in of a new golf course.

Auburn University tested various plants to see the growth results of plants treated with microbal soil amendments. Guess which plant was untreated.



Further Auburn University tests revealed the root development with and without microbal soil amendments. These transplanted New Guinea impantiens are six weeks old.

Current and Future Applications for Microbial Technologies

Microbial fermentation technologies produce a very stable product with an extended shelf life. This stability allows for product combinations that can protect the microbial and biochemical aspects of the newly combined product. For instance, John Deere Golf & Turf One Source™ is selling fertilizers that contain additives derived from microbial fermentation. This product combination improves the fertilizer use efficiency and may help with other soil management problems. Future products will combine microbial community technologies and biochemical mechanisms, bringing new "skills"—some that can be directed at plant protection, nutrition, or curing common soil problems. The possibilities seem limitless.

Getting Started

Landscape superintendents should take a proactive role in selecting microbial amendments, and once the appropriate product is selected, set up testing procedures to help validate the performance. Most importantly, the evaluation should be designed in such a way that the user can gain firsthand insight into what is happening and what results are achieved. To that end, **Figures 4 and 5** outline some useful considerations for selecting and testing microbial soil amendments. Microbial products are not identical in content and performance. Avoid selecting products based only on numbers of organisms. Look at the quality of testing and data on performance. If you are not sure how to apply or test the product, contact the manufacturer directly. Be wary of general statements like "these products don't work" (ask for the basis of that conclusion) or "this product does it all." Microbial products are evolving and may become a useful tool in your plant and soil management practices. Keep an open mind, and learn for yourself just where and how they might fit for you!