



There was a time when bionutrition, or biofertility as some prefer, was a misunderstood and under-appreciated approach to plant health. But as the scientific community continues to find more evidence of the efficacy of biologically based products, so too are end-users becoming believers.

A report presented by  
LebanonTurf

**There is still a lot that scientists, the academic community and turf managers *don't* understand about microorganisms and their interaction with soil and turf. But a number of respected members of those groups *are* convinced of one thing: bionutrition is now an accepted – and proven – form of fertility.**

“They’re misunderstood and often misrepresented by both the academic community and the industry,” Dr. Roch Gaussoin, a professor of agronomy and horticulture at the University of Nebraska-Lincoln, says of the microorganisms that make up the emerging category of bionutrition, or as some prefer, biofertility. “But recent studies are beginning to clarify and substantiate their importance in the soil ecosystem.”

In its simplest form, bionutrition is the enhancement of beneficial microorganisms in the soil to facilitate nutrient availability and uptake. Exactly how that process works through the many different forms of microbial activity has mystified even those who have devoted their careers to plant science.

### *‘Bugs in Jugs’*

“We can’t see microorganisms without powerful microscopes, and they are extremely difficult to identify and characterize,” Dr. Gaussoin says. “It’s an extremely complex and intricate system that is not widely understood.”

Because of the complexity – and maybe even owing to academic myopia, as the academicians themselves acknowledge – early biologically based products promoted to golf course superintendents and turf managers were largely dismissed by the scientific community. Some in academe and the fertility and turf industries even took to calling the products “bugs in jugs” and labeled the practice “witchcraft.” Their attitude may have been shortsighted, Gaussoin admits. “We’re taught in academics that we’re supposed to be open to new ideas and look at things as problem solvers. But we should have been more open to the potential of these microorganisms.”

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### *Bionutrition Believers*

Gaussoin’s “awakening,” as he calls it, came two years ago when he conducted a study of LebanonTurf’s GREENSMART Enhanced Efficiency Fertilizer™, which is promoted as a product that enhances and extends nutrient performance. “The data (from the study) clearly indicated an equivalent response with reduced rates of fertility,” Gaussoin says. “We found that we could put down 30 percent less nitrogen and get an equivalent response in terms of color quality and digital analysis.”

Other scientists, whose research has opened up a broader discussion of various forms of biofertility, also are becoming believers. Dr. Robert Ames, senior staff scientist at Advanced Microbial Solutions in Pilot Point, Texas; Dr. Mike Amaranthus, associate professor at Oregon State University (adjunct) and the

president of Mycorrhizal Applications, Inc, in Grants Pass, Oregon; and Robin Ross, market development scientist, Plant Science Division, at Acadian Seaplants Limited in Dartmouth, Nova Scotia; joined Dr. Gaussoin at a bionutrition conference hosted by LebanonTurf at Cooperstown, New York. Individually and collectively, the scientists vouched for the credibility of the bionutrition category.

“Ten years ago, the mention of ‘mycorrhizal fungi’ to a turf manager might have been met with a blank stare,” says Dr. Amaranthus, whose work has focused on the beneficial associations most grass species form with soil organisms, including mycorrhizal fungi, which evolved over some 400 million years. “Today’s turf managers are much more knowledgeable regarding the benefits of mycorrhizae because research studies have shown us all how these specialized fungi can improve turf health.”

### Multiple Benefits

Scientists at the LebanonTurf conference cited benefits of biological products in three categories: plant health, cost-reduction and environmental sustainability.

#### Plant Health

- Disease suppression and thatch decomposition
- Root growth/grow-in
- Nutrient uptake & turf quality
- Fertilizer use efficiency
- Reduced nutrient loss

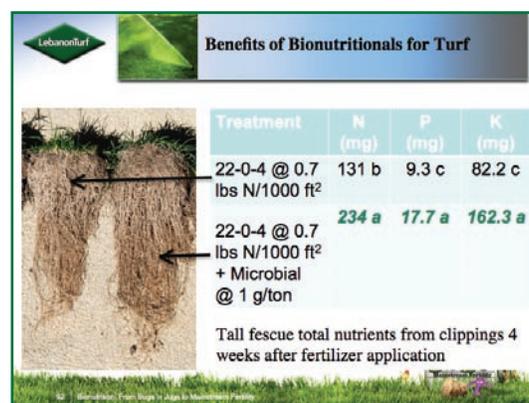
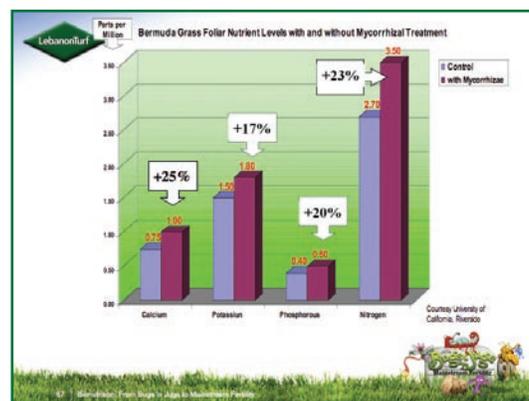
#### Cost Reduction

- Faster grow-in rates
- Reduced maintenance costs
- Effective use of lower analysis fertilizers
- Reduced application rates or frequency
- Reduction in nutrient loss

#### Environmental Sustainability

- Improved quality of water runoff
- Reduced groundwater, lake, stream and ocean pollution

In addition to their below-ground benefits to plant nutrition, biological fertilizers increasingly are being recognized for their contributions to the air and water above ground. But it’s their potential to sequester carbon gases that really have environmentalists excited, Dr. Amaranthus says. “Grasses are great for



building carbon in the soil, which has implications for global warming. In studies, we've seen that these products can increase the carbon content of treated soil 1 percent per year, which is huge. Multiply that over millions of acres and there is the potential to reduce 27 percent of U.S. carbon emissions.

"I see at some point, turf managers are going to receive credits for taking carbon out of the air, where it does damage, and putting it into the soil, where it does all sorts of good things," Dr. Amaranthus adds.

*"This was probably the hottest, driest summer I've ever encountered, and these biologicals saved our cookies."*

### *Saved Our Cookies'*

But the true test for any product or technology, of course, comes from those who use it to solve real-world problems. Bernie Banas, superintendent at the Leatherstocking Golf Course in Cooperstown, New York, has been using biological products on his 101-year-old course for 17 years.

"This was probably the hottest, driest summer I've ever encountered, and these biologicals saved our cookies. Our turf just thrived this summer," Banas said, adding that he battled a tough case of anthracnose when he came to the course that adjoins the venerable Otesaga Resort Hotel on the shores of Lake Otsego, the famed "Glimmerglass" of James Fenimore Cooper's novels. "I haven't seen any anthracnose in a long time. This stuff works – it really does."

### *Better Understanding*

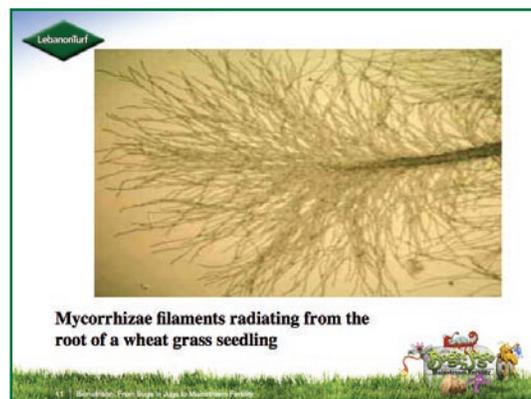
As they devote more attention to biologicals, scientists are discovering more reasons for their efficacy.

"Most of these microbial soil amendments started out many years ago as individual organisms, or maybe just a couple of organisms that were cultured artificially and then put into a product," Dr. Ames says. "Many of the early products had very specific functions: enhancement of organic matter decomposition, for example. But as technologies evolved, products with multiple microorganisms were introduced. Later humic acids, plant hormones and other plant stimulants were added to help the organisms survive in the soil."

The "major evolutionary step," Dr. Ames says, has been scientists' willingness to look more at products obtained from natural communities of organisms and their biochemical byproducts. "This has been the big step, to identify these tools to gain a better understanding of how organisms function within the soil and interact with the plant through biochemical processes."

Dr. Amaranthus, who says he was "trained very conventionally – everything was N-P-K when I was coming along" – calls the process that delivers beneficial mycorrhizae and nutrients to the root system the "plant's freeway system."

"Once the mycorrhizal association is established, it provides increased root surface area to support the exchange of nutrients between the fungus and the grass," Dr. Amaranthus explains. "These filaments form an extensive system that absorbs water and nutrients, which are transported back to the turf root system."



## Seaweed Benefits Come Ashore

Although used by farmers for hundreds of years to improve crop production, seaweed is a relative newcomer to the discussion of biofertility. *Ascophyllum nodosum* is the most researched and considered the most active of all of the seaweeds. Extracts from this species promote improved root growth that, in turn, can lead to greener, more attractive turf. Ironically, this species of seaweed, which also enhances turf's ability to stand up to extreme heat and drought conditions, is found exclusively in the cold waters of the north Atlantic, mostly in the Bay of Fundy, off the coast of Canada and Maine.

As Ross of Acadian Seaplants Limited explains, the Bay of Fundy exhibits one of the world's largest tidal flexes, meaning that billions of gallons of clean, nutrient-rich water rush into and out of the bay each day. Because the seaweed that grows in the bay is subjected to extreme temperature swings – hot summers, when it sits on dry rocks and bakes in the sun, and cold winters, when it is submerged in extremely cold water and under snow – it developed unique genetic qualities that help it tolerate extreme stress. “When you put extracts from the *Ascophyllum nodosum* species on land plants, they take on some of the same ability as the seaweed to tolerate stress,” Ross says.

In addition to increased stress tolerance, turf treated with seaweed extract exhibits greener color and a more attractive appearance (due to higher amounts of chlorophyll) along with increased root growth, according to Ross.

## Questions Remain

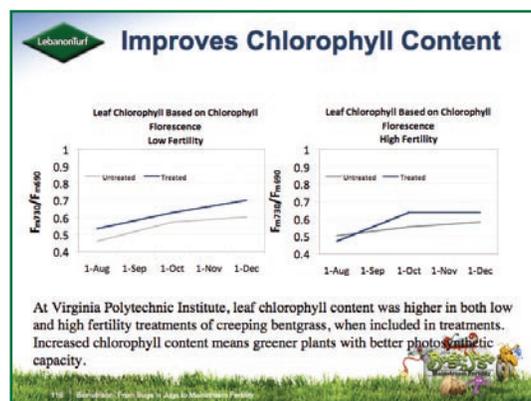
Despite a growing body of scientifically supported knowledge, questions remain concerning biofertility and its role in today's fertility programs:

- What about elements other than nitrogen? Do biologicals also produce enhanced uptake of other essential elements like phosphorous, potassium and micronutrients?
- What is their longevity and what are their residual effects?
- Are they enhancing the availability or uptake of applied N or of the soil organic N?

“We don't know all the answers to all the questions,” Gaussoin says. “From an academic standpoint, we want to know these answers. But we also don't need to know them all to know these products do give equivalent responses with lower N inputs.”

## Synthetic Complement

One answer the scientists do seem comfortable with is to the question: Do biological products support and work in a complementary fashion to traditional synthetic products?



“We use technologies such as slow-release fertilizers, inhibitors and coatings all in an attempt to keep more of the fertilizer available to the plant for longer periods of time,” Dr. Ames says. “Biological additives are another technology to enhance fertilizer efficiency.”

Biological products “enhance the effectiveness of conventional fertilizers and make those fertilizers work better,” according to Ross. “If you’re not using a biological product, you’re completely missing the ability to bolster the plant’s natural defenses, especially to drought and salinity stress.”

### *Still Just on the Edge*

“We’ve come a long way from where we were in our belief process,” Dr. Gaussoin says. “And we’re just on the edge of what we might be doing five to 10 years from now. But as we learn more, and manufacturers apply more of the science, I think we will see highly reputable companies producing appropriate and proven biologically active compounds that turf managers can’t live without.”



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**Presenters Participating in the LebanonTurf  
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