

Soil Health: The Next Big Trend



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It's almost impossible to turn on the TV or read an article without hearing about the positive effects of probiotics on human health. Many associations are being found between the types of microbes found in human and animal digestive systems and diabetes, obesity, Crohn's disease and other human maladies. Even mental health issues such as depression can be positively affected by treatments with certain types of bacteria.

Plants have a "stomach," too; it's the soil. And, unlike their animal counterparts, plants, trees and turf don't have mechanical digestion or organs with an acidic environment to break down their "food" and are therefore even more dependent on microbes to meet their nutritional demands.

Common treatment programs used for turf and plant care are focused mainly on nutrients, water, weeds and pest or disease control. This does not address the living or organic part of the soil at all; in fact, many common practices are detrimental to the living component of the soil (also known as the Soil Food Web) that's so important for many facets of turf and plant growth and health.

Although not often covered by popular media, soil, plant and turf science is also exploding with new scientific discoveries that are increasing our appreciation of the importance of beneficial microbes. New technologies are making biological treatments cheaper and more accessible. Laws in many states that completely ban or require the reduction of fertilizers and pesticides have passed or are being considered. Consumer demand is constantly increasing for greener lawn care options. Using beneficial microbes is an excellent way to reduce inputs and costs, comply with treatment laws and meet the rapidly growing market demand for greener turf and plant care options.

Fertilizer and water reduction

From a turf care professional or landscaper's perspective the need for

alternatives to synthetic fertilizers is increasing. Some of this demand is due to the above mentioned state bans and growing natural or organic lawn care markets. There's also increasing awareness of environmental damage caused by fertilizer runoff.

A more important concern for professionals in turf care is simply the bottom line; that is the rising costs of nitrogen and phosphorous fertilizers. If you can reduce input costs you can keep prices down for your customers and increase your margins. Integrating beneficial microbes into standard treatment plans is a great way to achieve lower fertilizer use and costs while still retaining the same, or even better, quality of care for your clients.

Beneficial microbes can be thought of as the processing, retention and delivery system of the soil.

Processing: Microbes in the soil are the machinery that break down organic matter into forms that are usable by a plant. They also do the same for nitrogen, converting higher forms of nitrogen (ammonia and urea) into nitrates, which is the form of nitrogen used by turf and plants. Some types of soil bacteria can take nitrogen gas from the air and fix it into the soil to be used as a source of fertilizer. Beneficial bacteria and fungi can solubilize phosphate, that is, free up phosphate that is locked up in salts and rocks to make it available as a nutrient.

Retention: Microbes will grow to the level of resources present in their environment. When you do add nutrients, the bacteria and fungi rapidly divide and incorporate these compounds into their cell bodies. Along with the organic matter in the soil (which is present due to microbial activity), this combination of living organisms and organic matter help to retain nutrients in the soil and keeps them from washing out of the soil or volatilizing.

Delivery: Complex systems of fungal hyphae move nutrients through the soil like a living plumbing system. Bacteria and fungi associate with the roots and/or are also endophytic (that is they live on and in the plant) – thus delivering vital compounds from the soil to turf, trees and plants. Healthy soil biology works in the same manner by aiding water retention in the soil and improving plant drought resistance. With a healthy and diverse soil food web, input use and irrigation costs can be reduced and the value of your added nutrients will be increased with less leaching. Additionally, as excess fertilizer use has been demonstrated to cause an increase in pest and pathogen levels, a secondary effect of fertilizer reduction is decreased disease pressure.



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Even if turf professionals employ best practices, the activity of beneficial microbes in most soils can be stimulated by adding organic or natural products. Note the increased root mass on the turf on the right from a treated soil.

Multiple benefits

“The Enemy of My Enemy is My Friend.” This ancient proverb (resurrected with a vengeance during the First Gulf War) summarizes how biological disease control works – by exploiting natural predators or enemies of a pest or pathogen and using them to your advantage. Whether it’s due to chemical pesticides being pulled off the market for safety reasons, to bans by state or local governments, or to market demands for greener services, there’s a growing need for better green solutions for disease and pest control.

Biological Controls in IPM

There are three main mechanisms in which biological control works as alternatives to chemical pesticides as part of an integrated pest management (IPM) or organic or natural treatment plan:

1. Biological control agents can directly kill or produce compounds that kill or repel pests or pathogens. This is the most direct form of exploiting natural relationships. For example, beneficial bacteria (such as certain strains of *Bacillus*) produce natural compounds that kill a host of pathogenic fungi of plants and turf. Beneficial nematodes can be used to directly kill a host of grubs or other type of insect larvae. Praying mantises are voracious predators of a variety of insect pests such as aphids.

2. Building a healthy population of beneficial soil organisms that can out-compete pathogens. This is called The Competitive Exclusion Principle (or Gause’s Law), which states “two species competing for the same resources cannot stably coexist if other ecological factors are constant.”

In other words, this principle states that healthy soil is a numbers game: you build up your troops (beneficials) in much greater numbers than the enemy’s troops (the disease-causing pathogen) to tilt the balance in your favor to suppress pathogens.

3. Like humans that eat balanced diets and stay in good shape, healthy plants, trees and turf are less susceptible to disease causing pests. This is referred to as the trophobiosis theory, which states “a pest starves on a healthy plant.”

Pathogens evolved eating dead or weakened plant material with simple forms of nitrogen (amino acids) and sugars. Healthy plants contain more complex forms of nitrogen (proteins) and sugars that cannot be digested by pests. Building healthy soil with a diverse array of beneficial microorganisms increases plant, turf and tree and health, quality and yield and directly and indirectly leads to less disease pressure.

Ultimately, you want to deliver a better quality product to your customers to gain a market advantage; whether that is greener turf, more beautiful flowers or healthier trees. Using beneficial organisms is a powerful tool to help you

achieve this important goal. The first thing that is usually most apparent after application of bacterial or fungal inoculants is better root growth. Better root growth allows for better nutrient uptake and deeper access to water. This obviously leads to better and healthier top growth, increased drought resistance and lower stress and disease.



[Click image to enlarge.](#)

Products that are used to build soil biology may contain various species of bacteria (*Bacillus* species, for example) or fungi, including Mycorrhizal or *Trichoderma*, which are the most common.

In addition to their nutrient and water retention and delivery capabilities, bacteria and fungi produce phytohormones (plant hormones) of all three major classes: auxins, gibberellic acids and cytokinins. Unlike using synthetic plant hormones, microbes deliver a more steady and even level of these beneficial growth factors (growth defects such as epinasty or stalk brittleness in grass can result from synthetic hormone use). Using beneficial bacteria or fungi for their growth promoting abilities will allow you to deliver a better product or service and make your customers happy. The best part: this approach is easy and cost-effective to implement.

Stimulation or supplementation?

To increase the beneficial biology in your soils and obtain the many benefits of doing so, there are two approaches: bio-stimulation and bio-supplementation. Bio-stimulation is maintaining and increasing the microorganisms that are already in the soil. Bio-supplementation is adding beneficial microorganisms.

The easiest and cheapest approach to bio-stimulation is actually an addition by subtraction tactic: eliminating practices that destroy soil biology. Fungicides, nematicides, insecticides and anti-bacterial compounds are all non-specific. That is, they destroy the good along with the bad organisms that are being targeted. Using these compounds in an “as-needed” manner as opposed to using them routinely or preventatively is the best way to avoid the residual damage these substances can cause to beneficial soil organisms.

Some herbicides used in excess can destroy beneficial organisms while stimulating pathogens. For example, excess glyphosate use kills beneficial bacteria and will stimulate *Fusarium* growth. Excess fertilizer, especially phosphate, can be toxic to beneficial microbes in high concentrations. The other way to approach bio-stimulation is the incorporation of products that add organic matter and micronutrients, in addition to standard N-P-K mixes, to stimulate microbial growth and help build a strong soil food web: fish, seaweed (kelp) and manure are excellent fertilizers for achieving this goal. Humates or molasses will add organic matter and micronutrients to soil.

Whether used in addition to standard fertilizers or alone, incorporating

these substances into your nutrient programs will go a long way to help build better soil. Bio-supplementation can speed up the general process of building soil microbiology. As a direct inoculant, biologicals are also a powerful tool for disease and pest control. Products that add microorganisms, or soil probiotics, are available in several forms: compost, compost teas or controlled biological inoculants are the most common and practical for most turf, plant and tree applications. Compost can be used as a topdressing on turf or in potting mixes to plant trees or plants. The drawback on turf is that compost is labor-intensive to spread. For that reason, compost can be "brewed" like a tea to extract nutrients, organic matter and microorganisms. The advantage of teas is an easier application that can be used with most standard liquid application equipment.

Controlled biologicals are more consistent and controlled than compost teas and in addition are more shelf stable (for years in many cases). This makes controlled inoculants easier to use and more amenable to bulk purchases and storage. Controlled biological products are available in both liquid forms and dry forms, so they can be applied by liquid application equipment (drench or foliar) or with dry spreaders.

Products that are used to build soil biology may contain various species of bacteria (*Bacillus* species, for example) or fungi (various Mycorrhizal species or *Trichoderma* are common). There are multiple products on the market that can be used directly as biological control agents, or biological pesticides, when diseases or pests are present.

For treatment of fungal or bacterial infections, the most common biological controls contain bacteria (many contain various *Bacillus* species) that can be directly applied to infected areas. For insect control, ladybugs, predatory wasps and praying mantises are effective, although these are better used in a greenhouse or indoor setting. For biological grub control in turf, products that contain dry forms of the bacterium *Paenibacillus popillae* cause milky spore disease – specifically in Oriental beetle grubs. These products are generally most effective in the South or in warmer, wetter climates. For more broad-spectrum control of grubs and other insect larvae in turf and plants, beneficial nematodes are a very effective biological control agent. Applied as a liquid it is important to know the specific type of insect larvae you're targeting in order to apply the right species of nematode and at the right time of year; this greatly increases the chance for success.

Integrating biologicals into your treatments programs is smart, simple and cost-effective. You can grow better plants, trees and turf; naturally fight diseases; reduce fertilizer use, costs and runoff; expand business in the rapidly growing organic or natural lawn care markets; and increase customer satisfaction while complying with laws on fertilizers and pesticides and helping the environment at the same time.

Joe Magazzi is the president and co-founder of Green Earth Ag and Turf LLC (www.greeneearthagandturf.com). He researches and develops microbial-based probiotic products for use in turf care, horticulture and agriculture, and also promotes and teaches about the use of greener products as alternatives for pesticides. He has a master's degree in genetics (with a microbiology

focus) from the University of Connecticut-Storrs. Contact him at joe@greeneearthagandturf.com.