Promises, promises: Can biostimulants deliver?

Numerous product ingredients are called biostimulants, and they all promise to promote turfgrass growth and health.

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Over the past several years "biostimulants" have proliferated in the turfgrass industry. Though not marketed as fertilizers or pesticides, these products purportedly improve turfgrass health, vigor and overall quality, especially in turf that is under environmental or cultural stress.

The unique blends ostensibly supply the turf with necessary substances that are, for some reason, deficient in the plants or soil.

Biostimulants hold great potential in turfgrass management. Plant hormones in particular can have a positive effect. Unfortunately, the term "biostimulant" is so broad and ill-defined that it does little to help us understand these products' ingredients or purpose. In the

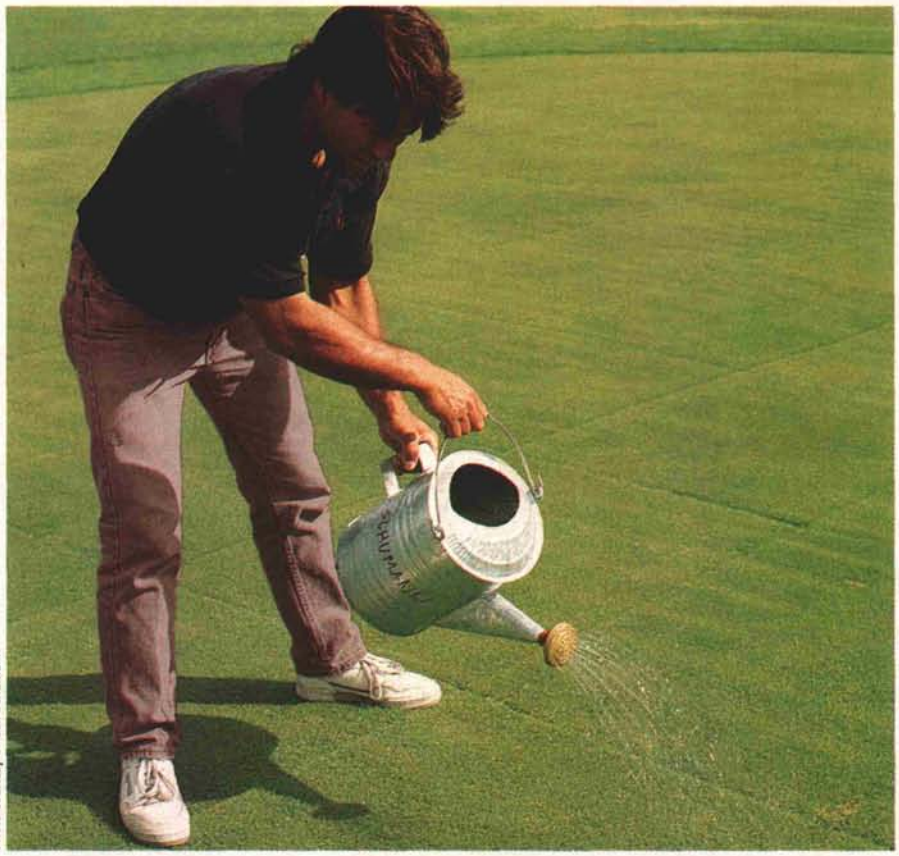

Photo courtesy of Gail Schumann

Small, experimental plots in larger, untreated areas can help you evaluate how biostimulants perform.

KEY POINTS

- Because "biostimulant" mixes can contain so many different substances, scientists often can't prove that any particular substance helps turfgrass.
- Nutrients such as nitrogen and iron are found in some biostimulants, but they are also available in less-expensive formulations.
- Plant hormones can help a plant overcome stress, if applied under the right conditions.

Test the biostimulants

Before purchasing large quantities of a biostimulant, you should test the product at your site. Follow these steps to help ensure a fair and unbiased evaluation:

1. Test the product on small areas first.
2. Always leave a control, or untreated area, immediately beside or within the treated area. Simply place a piece of plywood on part of the area before applying the product.
3. When applying materials that contain nutrients such as iron or nitrogen, it's important to apply an equivalent amount of those nutrients as a control. This will help determine whether the turf response was from the nutrients or from the stated active ingredients of the product.
4. Test on as many similar locations (with the same grass species, soil type and environmental and cultural conditions) on the golf course as possible. Anything can happen with a single treatment of a product. The science-minded superintendent can lay out small plots (5-by-5 feet) with string on a practice green or nursery area. The product being tested and the control can then be replicated three to four times.
5. Observe the treated areas as often as possible. Keep accurate and detailed notes of observations. Pay particular attention to increased or decreased disease and insect activity.
6. Establish a rating scale for turfgrass color and quality where 1 indicates poor and 9 is excellent. This should make the test more objective.
7. If roots are to be measured, take more than a single sample from each testing site. Root length and apparent density can vary significantly within a relatively small area. Record the findings.
8. Usually, it is advisable to make more than a single application. This helps reduce the odds that a resulting effect is simply due to chance. Whenever possible, continue the testing for at least two seasons.
9. If shoot color and quality and root-length data are recorded for each site, be sure to average the numbers, paying close attention to the degree of variation that occurs between each testing location. The larger the variation, the greater the chance the product's performance was simply chance and not a real treatment effect.

truest sense of the word, any material that stimulates life ("bio" means life) would be a biostimulant. Fertilizers and water certainly would be considered the most valuable biostimulants to the golf course superintendent.

Understanding the active ingredients

What is the active ingredient in the typical biostimulant? There is no simple answer. Labels show a wide range of ingredients, from "seaweed" to "cultured living microorganisms" to various "natural" chemicals and compounds. A minimum of 20 to 25 products on the market can legitimately be placed in the biostimulant category.

It's easy to get confused by this category of products. It would be almost impossible to discuss each biostimulant ingredient in terms of potential effectiveness. Yet many of the ingredients found on different labels (seaweed and sea kelp, for example) are essentially the same but are simply called by different names.

In addition to the wide array of ingredients, the claims made by many of the products also can be confusing. Promises range from increased seed germination rates to deeper roots, to improved soil structure, to reduced soil compaction. Because most of the products incorporate several ingredients, it's virtually impossible for the turfgrass researcher to achieve an objective evaluation.

In fact, in recent years, it has become common practice for many biostimulant products to contain one or more nutrients. Iron or nitrogen can often be found on the list of ingredients. This makes it even more difficult for the researcher or superintendent to evaluate the true effect of the product. Couldn't similar results be obtained by applying the nutrient alone without the added ingredients of the biostimulant?

The right conditions

Are biostimulants nothing more than snake oils or magic potions? Not at all. Good research on many ingredients

found in biostimulants shows a definite positive effect on growth and health of plants. In most cases in which research has borne out the claims, the compounds were studied singly so it was possible to monitor precise responses. In most of the positive research projects, environmental and cultural conditions were also closely monitored.

Abundant and excellent research information is available on the effect of certain hormones on plant growth. One could argue that the biostimulant industry today is the result of research into the hormones' roles in the normal growth and development of plants.

Plant hormones

A plant hormone is a compound synthesized in one part of a plant and translocated to another part where, in very low concentrations, it causes a physiological response. The five groups of hormones are auxins (indoleacetic acid or IAA), gibberellins, cytokinin, abscisic acid and ethylene. Each hormone plays a very specific role in the health and growth of plants.

Without question, each hormone can promote certain plant responses that would be deemed very favorable by the turfgrass manager, such as the promotion of adventitious rooting, seed germination and leaf expansion. However, it is well documented that each hormone also has the potential to inhibit the same growth responses.

The key to whether a hormone promotes or inhibits growth depends primarily on its level, or concentration, in the plant. At natural or "normal" levels in the plant, most of these substances have a promoting effect. However, if levels increase significantly above those normally found in the plant, an inhibitory effect may result.

What's in a biostimulant?

This list was compiled from the labels and promotional materials of about 15 "biostimulants."

activated nutrients
active humic acid
amides
amino acids
antioxidants
bacteria
carbohydrates
carbon-rich organics
cellulose fiber
chelated micronutrients
chelates
chemical activators
complex sugars
cultured living microorganisms
cyanobacteria
cytokinin
disaccarides
enzymes
fermentation materials
fungi
gibberellic acid
growth simulators
humic substances
humic/fulvic acids
hydrated organic proteins
intermediate metabolites
invert sugars
kelp extract
lignin
manure extract
metabolites
micronutrients
minerals
monosaccarides
mycorrhizae
natural wetting agents
N-fixing bacteria
non-ionic wetting agents
nutrient broth
organic chelates
peptides
PGRs
plant extracts
plant hormones
plant nutrients
polysaccharides
proteins
scientifically balanced formulation (no ingredients mentioned)
sea kelp
seaweed
secondary nutrients
simple sugars
soil conditioners
sugar acid chelates
vitamins
wetting agents
yeast
yucca extract wetting agent

The inhibition may have the direct effect of an increased hormone level on a specific plant function, or an indirect effect on concentrations of other hormones in the plant that, in turn, affect normal growth and development.

Plant hormones on turfgrass

Can applications of certain biostimulants containing plant hormones improve turfgrass quality or stress resistance? The answer has to be a very guarded "yes." The effectiveness of such materials would depend on many factors.

First, it should be understood that under normal conditions, a plant has adequate levels of all hormones to ensure normal growth and development. Additional hormones sprayed on the plant won't affect growth. In fact, the addition of certain hormones beyond the normal levels already present in the plant may inhibit normal growth.

On the other hand, research has shown that certain environmental and cultural stresses can limit the natural production of specific plant hormones. For example, the production of cytokinin in roots and movement to shoots may be inhibited by flooding, drought and high temperatures.

Under these conditions, if other hormones in the plant are at proper levels, applications of a properly formulated cytokinin product could result in plant stimulation. It should be remembered that most physiological processes require interaction among several hormones and that a single hormone has several functions.

Furthermore, the function of hormones depends not only on specific cells and organs but also on the turfgrass species. Different species apparently use different hormones or rely on different interactions among them to accomplish various functions.

A study conducted several years ago

It's important to keep track of results when using untested turf products.

by the author showed that the application of gibberellic acid to bermudagrass (*Cynodon* species) to delay the onset of winter dormancy had a very positive effect on growth and color. However, the same treatment applied to St. Augustinegrass (*Stenotaphrum secundatum*) under the exact same conditions had a very negative, or phytotoxic, effect.

Perhaps another rate or another hormone would have resulted in a favorable response on St. Augustinegrass. The point is, although there is great similarity among turfgrasses, each is an individual species that has specific characteristics and environmental and cultural requirements. If turfgrasses differ in nutritional and irrigation needs, why wouldn't they differ in their responses to applied plant hormones or similar-acting materials found in biostimulants?

Biostimulants in management

Biostimulants hold great potential in turfgrass management. Within the huge range of active ingredients currently being used, plant hormones in particular can have a positive effect on turfgrass growth.

However, it's evident that the right conditions must be present to obtain a positive response. What are the right conditions? In the case of plant hormones, a hormone deficiency or imbalance must be present.

There is no easy way for this to be determined. Research has shown that most imbalances — and therefore the greatest positive response to biostimulants — appear to occur when the plant is undergoing some environmental or culturally imposed stress.

It has been suggested that application of the biostimulant should begin before the plant is stressed (summer stress, for instance). Our current knowledge and understanding suggest that the use of these materials is, at best, hit or miss. The lack of research in the area of biostimulants is the primary reason why more definitive recommendations cannot be made.

Because biostimulants work sometimes and don't at other times, turfgrass managers understand that turfgrass growth, physiology and biochemistry are very complex. Management is not a simple matter of applying a mixture of materials that have theoretically been shown to have a positive effect on plant growth.

A delicate balance exists within the plant. Until we understand exactly what imbalances are present under what conditions with specific turfgrass species, we will always be using the "shotgun" approach in the use of biostimulants.

It is recommended that, before purchasing large amounts of any biostimulant, you first request university test results. It's also important to talk to fellow superintendents to find out what products have worked for them. Finally, conduct your own on-site testing.

Be wary of products whose manufacturers make far-reaching claims that go beyond the realm of common sense. And, above all, always practice sound agronomic practices that have years of scientific research behind them. The use of any biostimulant should only be a supplemental practice — never a replacement for proven turfgrass management practices. ■

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