Biostimulants: what they are and how they work

By Adrien Gallant
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GROWING up in Prince Edward Island, I recall how my uncle grew some incredible vegetables in his garden. The secret to his success was the annual incorporation of generous amounts of kelp, a naturally-occurring seaweed. My uncle was on to something, because seaweeds were later found to contain large amounts of micronutrients as well as biostimulants.

In the late 1960s, Dr. T.L. Senn at Clemson University found that high levels of natural plant hormones in seaweed, calledcytokinin, stimulated plants, providing a growth stimulator effect.

Eighty per cent of golf course superintendents surveyed in the United States say they use biostimulants, according to University of Georgia professor of agronomy Dr. Keith Kamok. Hormone-based biostimulants have a great potential but need more research, according to Kamok.

Superintendents should continue to test biostimulants under their own conditions. There's no doubt that that there's a lot of positive testimonies concerning the use of biostimulant produces. One of the complicating factors in evaluating the benefits of biostimulants is the inclusion of fertilizers in some products. The user must determine that the benefits of the product are not just coming from the fertilizer component.

Following are some claims made by manufacturers of biostimulants:

- "A growth miracle for your plants."
- "An all organic growth enhancer."
- "Biostimulants will show a greener, richer, thicker lawn or turf surface."
- "Biostimulants will also help keep disease and stress down to a minimum."
- "Meters out micronutrition and greening for at least two weeks."
- "Produces bigger, deeper roots because it contains a better biostimulant."
- "You can keep your turf healthy, hardy and beautiful during intense stress."
- "Loosens and mellows the soil, promotes larger root systems, increases nutrient and water intake."
- "One kilogram of Powhumus (concentrated powder) is equivalent to about 30 metric tons of manure."
- "It acts as conditioner for the soil and as bio-catalyst and biostimulant for the plant."
- "Neutralize both acid and alkaline soils; regulate the pH value of soil."
- "Acts as natural chelator for metal ions under alkaline conditions and promotes their uptake by the roots."
- "Increase root respiration and root formation."

- "Increase germination and viability of seeds."
- "Enhance plant's natural resistance against disease and pests."

So what are biostimulants?

The term biostimulant is defined as a substance that is neither a plant nutrient nor a pesticide, but has a positive impact on plant health. A biostimulant is an organic material that, when applied in small quantities, enhances plant growth and development such that the response cannot be attributed to application of traditional plant nutrients.

Biostimulants have been shown to influence several metabolic processes such as respiration, photosynthesis, nucleaic acid synthesis and ion uptake.

Biostimulants are not fertilizers meant to correct a severe nutrient deficiency, but are mixtures of one or more things such as microorganisms, trace elements, enzymes, plant hormones, and seaweed extracts.

They may enhance nutrient availability, water-holding capacity, increase antioxidants, enhance metabolism and increase chlorophyll production.

Humus and humic acids

The term "humus" dates back to the times of the Romans, when it was frequently used to designate the soil as a whole. It was later applied to the organic matter portion of soils.

The best sources of humic acids are found in layers of sedimentation of soft brown coal called Leonardite. Leonardite is organic matter that has not yet reached the state of coal and differs from soft brown coal by its degree of oxidation. Both humic and fulvic acids have been shown to have a positive impact on plant growth. One of the ways in which humic acids enhance the soil to provide an effective growing environment for turf is by increasing surface water penetration, infiltration and soil water-holding capacity. They also increase the availability of micronutrients, phosphorus and potassium. Humic acids have been shown to retain nutrient ions thus preventing them from leaching. They also buffer plants from too high concentrations of fertilizer salts. Also, humic acids have been shown to increase germination rates and promote greater fibrous root growth.

Biostimulants act in synergy with plant nutrients. Combinations of humic acid plus nitrogen have helped promote more root growth than with nitrogen alone. The increased metabolism promoted by humic acids also enhances chlorophyll content of plant leaves and improves stand uniformity. Increases in the production of antioxidants in turfgrass leaf tissue have been observed following foliar applications of humic acids.

But perhaps the most significant benefit from using humic acids for the turf industry may be the increased ability of plants to deal with stresses such as drought, excessive moisture, heat and frost damage.

Fulvic acids

Fulvic acids, are humic substances known to be powerful organic electrolytes which help to dissolve minerals and metals. In other words, fulvic acids transform minerals so that they are readily available for absorption by plants. Fulvic acids work more in the plant than in the soil. They enhance nutrient, vitamins, coenzyme, auxin, and metabolism, which contribute significantly to plant growth and health. An indirect way in which fulvic acids help plants to withstand wilting is by increasing the amount of carbohydrates which results in the accumulation of soluble sugars in the cell. This increases the osmotic pressure on the cell walls and makes the plant better able to deal with drought stress.

Lastly, fulvic acids help to sensitize and enhance the permeability of the cell membrane which assist in the nutrient uptake. The following table shows the relative amount of humic and fulvic acids in various organic materials.

Relative amount of humic and fulvic acids in various organic materials

Natural Sources	Content of Humic & Fulvic Acids in % (from-to)
Leonardite/Humate	40-85
Black Peat	10-40
Sapropel Peat	10-20
Brown Coal	10-30
Dung	5-15
Compost	2-5
Soil	2-5
Sludge	1-5
Hard Coal	0-1

Source: Humin Tech

Cytokinins

The main function of cytokinins in plants is to promote cell division. They have been shown to promote cell expansion, increase leaf surface area that results in an increase in photosynthesis and more chlorophyll production. Cytokinins have been used as a seed treatment to promote lateral root development in young seedlings. They also have the ability to promote nutrient translocation within plants which is responsible for increased plant metabolism.

Dr. T.L. Senn at Clemson University spent many years studying the beneficial effect of seaweeds and seaweed extracts on plant growth.

Stabilizing these plant growth hormones was difficult and this resulted in inconsistent and unpredictable results.

In the early 1990s, however, agricultural chemists developed better methods to stabilize these plant hormones.

At the turn of this new century, researchers Z. Hunzhong and R.S. Schmidt, working with the turfgrass industry, were asked to help develop strategies to reduce drought stress on golf courses, putting greens and athletic playing fields. Their work led to studying the effects of cytokinin, humic acid, salicylic acid and other plant growth hormones to reduce plant stress. Cytokinins from brown kelp were found to contain the highest levels of plant growth hormones (PGH). Stable extracts from these sources improved root and shoot growth of turfgrass, improved photosynthesis, delayed senescence in the fall by keeping the turf growing green and healthy longer.

Plant growth hormones extracted from seaweed stimulate the in-plant production of antioxidants and thus behaves like a biostimulant.

Antioxidants in plants are concentrated in the chloroplast of cells and protect the photosynthetic apparatus when a plant is subjected to stress.

It does this by scavenging excessively reacted oxygen species known as free radicals. Antioxidants are defined as enzymes or other organic substances such as vitamin E and beta-carotene, that are capable of counteracting the damaging effects of oxidation in plants and in animal tissues.

Conclusion

Biostimulants are getting a great deal of attention today. We may just be in the infancy in our understanding of biostimulants. They look rather promising in terms of providing the turf industry with a tool that may help us to deal with turf stress.

Biostimulants, however, should not be used instead of good, sound agronomic practices. Still a good way to maintain high levels of soil microorganisms, trace elements and enzymes in the soil is by providing organic matter-rich food for the microbes.

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