

**Bio-Stimulant Positive Results along with a Wealth of Conflicting Info and the Real and Not So Real Benefits**

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**Biologicals (AKA – Biostimulants)**

- Most major dictionaries and encyclopedic references do not define “biostimulant.”
- The USDA National Agricultural Library does not list it in their glossary of terms.
- Current farm bill “a substance or micro-organism that, when applied to seeds, plants, or the rhizosphere, stimulates natural processes to enhance or benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, or crop quality and yield.”
- Biostimulant, in its simplest definition, is anything that stimulates life. For turf managers we will define a biostimulant as anything that helps grass growth, exclusive of nutrients.

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Plant biostimulants: Establishing standards  
<https://www.gconline.com/course/environment/news/biostimulants-turfgrass>  
 Mike Fidanza, Ph.D.; Stan Kostka, Ph.D.; Erik Ervin, Ph.D.; and Cale Bigelow, Ph.D.

- “Some products make claims that are substantiated with scientific research in turfgrass systems, while many others lack direct evidence that they actually work within a turf management program”
- “European Union has proposed policies and regulations to support and enforce what it calls a claims-based definition of plant biostimulants. In other words, plant biostimulant products should be defined by their function, not by the ingredients inside the container”
- “The EU also proposed that plant biostimulant products should be required to have credible demonstrated effects to support the product claims — that is, documented research to support product label statements for the crops and markets targeted”

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**Photosynthesis**                      **Respiration**

- Growth
- Carbohydrate accumulation

- Maintenance
- Carbohydrate depletion

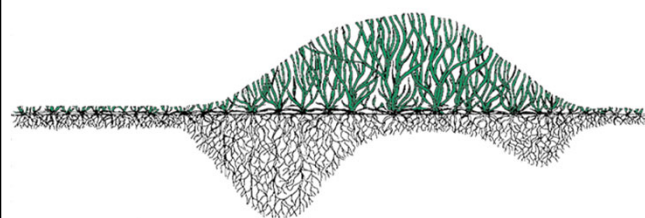
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When respiration exceeds photosynthesis from biotic or abiotic stress turf growth is severely compromised



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Cool-Season Grass Growth



Winter Spring Summer Fall  
 Summer stresses- weeds, diseases insects, heat, drought

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**Manufacturer Reported Benefits of "Biostimulants"**

- Stimulate plant responses and work in all weather conditions
- Increase profits, cut operating costs, lead to 50% reduction in fertilizer
- Increase natural plant toxins, repelling pests
- Increase microbial root protection from soil pathogens
- Increase soil nutrient reserve up to 3000%
- Improve root development
- Build yields
- Improve taste and shelf-life
- Improve drought tolerance
- Increases nutrient uptake
- Stimulate plants' immune system
- Produce better color
- Result in better performance
- Produce deeper roots
- Improve stress tolerance
- Accelerate establishment
- Increases Cation Exchange Capacity
- Enhances fertilization and reduces leaching
- Detoxify chemical residues and heavy metals
- Make urea a long-life nitrogen
- Improve seed germination rates
- Increase stomata opening and plant transpiration

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Products are:

- Frequently a mixture of several components
- Often contain nutrient(s)
- Costs range from \$ to \$\$\$
- Many manufacturers or distributors are smaller entities with lower operating budgets, especially research funds
- Heavily marketed

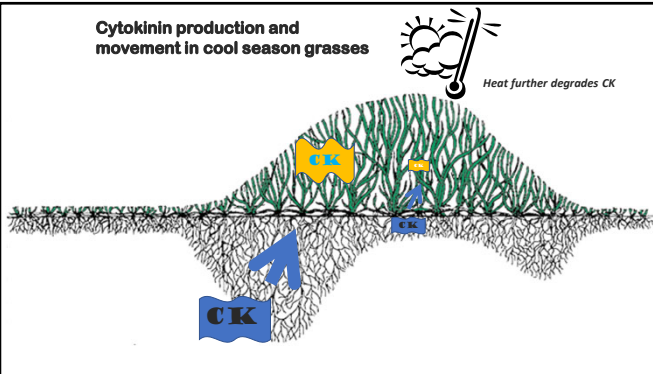
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Cytokinins (CK) are a class of plant growth substances (plant hormones) that promote cell division. They are primarily involved in cell growth, differentiation, and other physiological processes. Their effects were first discovered through the use of coconut milk in the 1940s by a scientist at the University of Wisconsin–Madison named Folke Skoog.

Cytokinins are involved in many plant processes, including cell division, shoot and root morphogenesis, chloroplast maturation, cell enlargement, auxiliary bud release and senescence. The ratio of auxin to cytokinin is crucial during cell division and the differentiation of plant tissues

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Cytokinin production and movement in cool season grasses



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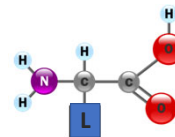
### Cytokinin Summary

- Research inconsistent and plentiful
- When environmental conditions are optimal the plant produces more than adequate CK's
- Seaweed is very high in CK, hence seaweed extract products are widespread
- *Synthetic cytokinin does not result in same response as seaweed extract*

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**Amino acids** are molecules containing an amine group, a carboxylic acid group and a side chain that varies between different amino acids.

These molecules are particularly important in biochemistry, and have many functions in metabolism. One particularly important function is as the building blocks of proteins. Amino acids are also important in many other biological molecules, such as forming parts of coenzymes, and in N transport

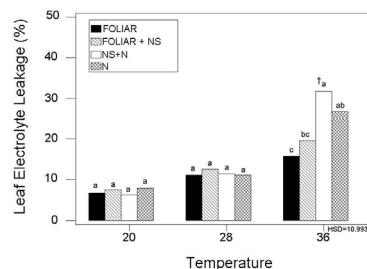


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### Activity of Foliar Macro-Sorb Amino Acids

- Gordon Kauffman, Ph.D. (Penn State)
- perennial ryegrass
- "ramped" temperature stress (68-97° F)
- **Treatments:**
  - FOLIAR
  - FOLIAR plus nutrient solution (NS)
  - NS + an equivalent amount of N contained in FOLIAR
  - NS + N
  - N

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36° C (97° F)



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### Amino Acids

- When environmental conditions are optimal the plant produces more than adequate AA's
- Under heat and drought stress, production is severely limited
- Much like CK, topical applications during stress may be beneficial; research results are inconsistent
- *Also, like CK, pure AA's do not elicit the same response as extracts*

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### Soil Inoculants

- Beneficial organisms frequently packaged with other ingredients (biostimulants, fertilizer)
- Sensitive to UV light
- Heat instable
- Sometimes packaged as spores
- Do they work?

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### Theoretical Example

- Products may contain up to  $10^9$  organisms per ml
- Applied at 1-6 oz/M
- Soil contains  $10^8$  bacteria/gm of soil
  - 100X less actinomycetes; 100X less fungi

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### Assuming:

All applied microorganisms survive and maximum use rates, the ratio of applied vs. native bacteria is approximately:

*6000 native : 1 applied*

or the applied represent *0.02 %* of the total population

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### Further:

Boehm's work at OSU showed that at approximately 2 years post construction in a soil/sand/compost vs sand/peat green microbial diversity was relatively the same even though the former green was significantly higher at establishment

*Similar work at UNL in the late 1990's confirmed response*

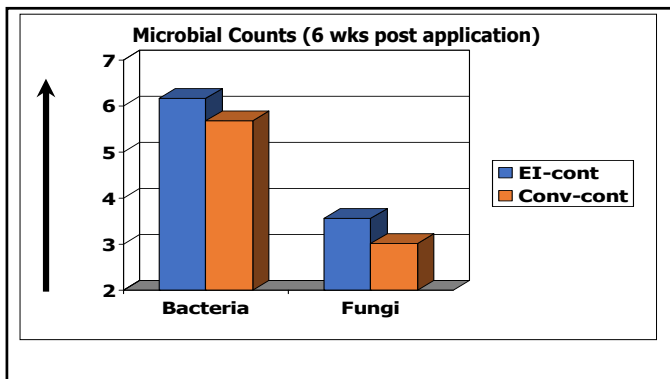
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### Do microbial inoculants have merit?

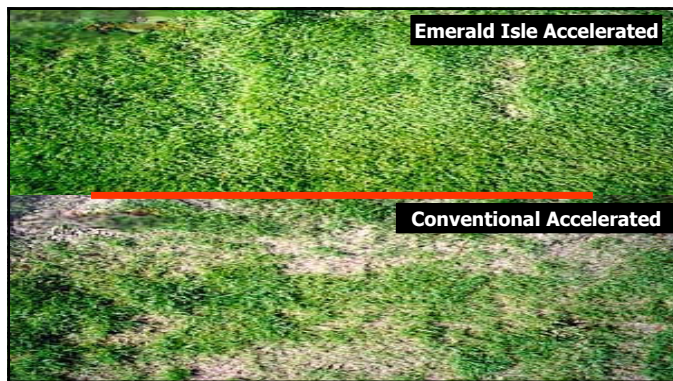
- Some have shown pest suppression potential
- Structured research is limited, but work in this area is increasing
- When soils are limited in microbial diversity there may be merit to there use

*Emerald Isle Inoculum Study on a Sand Based Rootzone*

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### Summary of Emerald Isle Work

- The EI grow-in resulted in faster establishment than the Conventional grow-in
- Fungi and bacteria levels were higher in EI plots *short term*
- EI treatments had less *Pythium* injury than the Conventional grow-in

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### A Problem with Soil Inoculants

- Andrew McGuire, Washington State University
  - “Native microbes eat invaders”
  - “The environment, which you determine through management, selects what will thrive.”



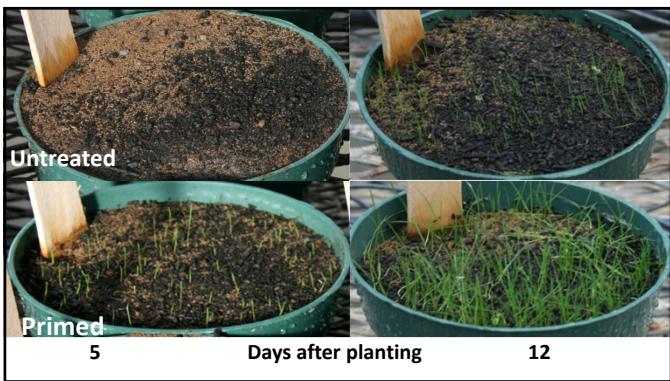
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### Seed priming with water or “biostimulant”

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- UNL research greenhouse
  - Kentucky bluegrass
  - Primed vs. Untreated (control)
    - Days to germination
    - Establishment
    - Cultivar

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**Summary**

- We have consistently seen decreased establishment time with Biostimulants + Priming vs. unprimed or water-only priming.
- Decreased time is between 7-10 days.
- Treated areas 2-3 months after seeding are not different in density.

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**Sports Turf Grow-In Experiment**  
**International Turfgrass Society Research Journal**  
**Volume 12, 2013 R.M. Goss and R.E. Gaussoin**

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**Experimental Process**

- **Solicited cooperators**
  - Follow each company’s recommended protocol
  - Included treatments to separate out each component of each protocol
- Kentucky bluegrass blend
- 90:10 Spec. sand:Dakota Reed Sedge Peat
- Data collected on % cover and root strength

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**From N to Mycorrhiza**

- **Biostimulants**
  - cytokinins, AA’s etc.
- **Mycorrhiza**
  - *“form a mutualistic relationship with the roots of most plant species”*

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**Experimental Process**

- **Two planting dates:**
  - Mid-summer (Suboptimal)
  - Late-summer (Optimal)
- **37 treatments; 111 plots**
- **Analyze**
  - Fertilizer
  - Mycorrhizae
  - Biostimulant
  - Liquid (foliar) fertilizer

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**Top Treatments (for Cover & Root Strength)**

- 1. Any treatment with fertilizer**
  - Mycorrhizae and/or biostimulant did not significantly speed up establishment
  - Foliar fertilizers did not speed up establishment

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### Bottom Treatments

1. Untreated
2. Mycorrhizae and/or biostimulant alone

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### Bottom Line for *Establishment*

- Amount of N and P applied
  - At establishment
  - During first 30 days after germination
- Readily available fertilizers provide best establishment
  - Quick vs. slow release
- Little benefit was realized from mycorrhizae, biostimulants or foliar fertilizers

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From: <https://sportsturfonline.com/2019/06/11/biostimulants-boom-or-bull/>

- *“Biostimulants are an exciting trend with lots of promise. However, don’t abandon proven practices for promises that seem too good to be true. Be optimistically pessimistic. Keep an open mind, but realize that most of these won’t likely work, especially if the turf is well managed and healthy. In the meantime, independent and industry scientists will continue to search for reliable products and ways to manage them. We advise to not be on the cutting edge of the biostimulant world to the point of throwing caution to the wind and chasing every new product with miracle claims.”*



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	Number of Trials	Significant Positive Response	Significant Negative Response	Average, %
Soil & Geological Extracts	87	28	4	1.9*
Animal Hydrolysates & Extracts	26	5	1	0.1
Botanical & Algal Extracts	19	2	1	-0.1
Inorganic & Synthetic Chemicals	15	1	0	-0.3
Microbial Inoculants & Extracts	31	3	1	-0.1

Hopkins research lab has conducted 178 field and greenhouse biostimulant trials, on a variety of plant species, over the past two decades. <https://sportsturfonline.com/2019/06/11/biostimulants-boom-or-bull/>



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### Bottom Line on Biostimulants


- Do they work?
- Will they work for my program/company/facility/clients?
- Do your research!

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### Chapter 15: Considerations with biostimulants in turfgrass

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