Biostimulants:
A State Fertilizer Regulatory Program Perspective

AAPCO
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Framing the question: Fertilizer Regulation

- No national regulatory program
- Regulated by individual states
- Regulations and requirements vary between states
Elements of State Fertilizer Regulation

• May, or may not, include:
  – fertilizers (plant nutrients),
  – soil amendments,
  – plant amendments,
  – horticultural growing media (e.g. potting soil),
  – compost, and
  – “beneficial substances (e.g. silicon, fulvic acid)
Elements of State Fertilizer Regulation

• State programs may, or may not, regulate:
  – product registration,
  – labels (format, terms)
  – labeling (promotional materials),
  – ingredients,
  – heavy metals (limits),
  – inspection, sampling, and analysis.
The Role of the Association of American Plant Food Control Officials (AAPFCO)

• Promote uniformity through consensus

• Uniform:
  – Definitions
  – Model bills for legislation
  – Labels and labeling
  – Inspection methods
  – Sampling and analysis
The Role of AAPFCO

• Not regulatory
• Participation is voluntary
• Conformity trumped by state laws
• Definitions - one of the most commonly used, and useful, functions
"Define your terms. . . or we shall never understand one another."

- Voltaire, *Dictionnaire philosophique*, 1764
Regulatory Definitions

• Fair and equitable regulation requires accurate and complete definitions.
• Regulatory definitions must have clear boundaries. (What’s in? What’s out?)
The Definition of Biostimulant?
It depends on who you ask.
European Biostimulant Industry Council (EBIC)

“Plant biostimulants contain substance(s) and/or micro-organisms whose function when applied to plants or the rhizosphere is to stimulate natural processes to enhance/benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, and crop quality.”

—From du Jardin, et al., 2012
To date, the European Commission (executive arm of the EU) has been unable to agree on a regulatory definition of “biostimulant.”
Biostimulant Coalition (US)

“Substances, including micro-organisms, that are applied to plant, seed, soil or other growing media that may enhance the plant’s ability to assimilate applied nutrients, or provide benefits to plant development. Biostimulants are not plant nutrients and therefore may not make nutrient claims or guarantees.”
Association of American Plant Food Control Officials (AAPFCO)

• The Biostimulant Coalition definition was submitted to AAPFCO, but considered too vague for a regulatory definition.

• Currently, AAPFCO does not accept the use of the term “biostimulant” on labels or in labeling.
Relevant AAPFCO Terms

*Soil Amendment*

“. . . any substance or mixture of substances which is intended to improve the physical, chemical, biochemical, biological or other characteristics of soil, except fertilizers . . .”
Relevant AAPFCO Terms

*Plant Amendment*

“... any substance applied to plants or seeds which are intended to improve growth, yield, product quality, reproduction, flavor, or other favorable characteristics of plants, except fertilizers ...”
Relevant AAPFCO Terms

*Beneficial Substance or Compound*

“... any substance or compound other than primary, secondary, and micro plant nutrients that can be demonstrated by scientific research to be beneficial to one or more species of plants, when applied exogenously.”

(To date, only silicon and hydrophobic fulvic acid.)
Relevant EPA Term

*Plant Regulator (PGR)*

“A plant growth regulator, through physiological action, is intended to accelerate or retard growth, or alter plant behavior or the produce of the plant.”

- EPA Label Review Manual (2014), page 2-6
“Whether a product is considered to be a plant growth regulator depends on whether the plant response or mode of action being claimed would go beyond what would be expected from simple nutrition.”

- EPA Label Review Manual (2014), page 2-6
What materials are Biostimulants?

Reference frequently cited by industry:

*The Science of Plant Biostimulants – A bibliographic analysis* by Prof. Patrick du Jardin (prepared for EBIC)
What materials are Biostimulants?
(From Jardin et al.)

• Humic substances
  – Released from organic matter by decomposition – humins, humic acid, fulvic acid, etc.
  – Soil: help formation of soil aggregates, may chelate or complex nutrients.
  – Plants: hormonal effects, increase enzyme activity, stimulate mitochondrial respiration, and more.
What materials are Biostimulants?
(From Jardin et al.)

• Humic substances,
• Complex organic materials
What materials are Biostimulants?  
(From Jardin et al.)

Complex organic materials

– “complex organic materials are obtained from composts, manure, sewage sludge extracts, agro-industrial and urban waste products.” Include humic substances.

– Provide organic matter, nutrients, promote bacterial activity, control soil-borne pathogens, “enhance degradation of pesticide residues and xenobiotics.”
What materials are Biostimulants?
(From Jardin et al.)

• Humic substances,
• Complex organic materials,
• Beneficial chemical elements,
What materials are Biostimulants?
(From Jardin et al.)

• Beneficial chemical elements
  – Five main “beneficial elements” — Aluminum (Al), Cobalt (Co), Sodium (Na), Selenium (Se) and Silicon (Si)
  – Effects include “cell wall rigidification, herbivore deterring, osmoregulation, reduced transpiration by crystal deposits, thermal regulation via radiation reflection, enzyme activity by co-factors, plant nutrition via interactions with other elements during uptake and mobility, antioxydant protection, interactions with symbionts, pathogen and herbivore response, protection against heavy metals toxicity, plant hormone synthesis and signalling.”
What materials are Biostimulants?
(From Jardin et al.)

- Humic substances,
- Complex organic materials,
- Beneficial chemical elements,
- Inorganic salts, including phosphite,
What materials are Biostimulants?
(From Jardin et al.)

• Inorganic salts, including phosphite
  – “. . . phosphites and phosphates, but also
    bicarbonates, sulphates, nitrates . . .”
  – . . . provide protection against fungi, which may
    involve direct fungicidal action or indirect
    protection by stimulating plant defenses . . .”
What materials are Biostimulants?
(From Jardin et al.)

• Humic substances,
• Complex organic materials,
• Beneficial chemical elements,
• Inorganic salts, including phosphite,
• Seaweed extracts,
What materials are Biostimulants?
(From Jardin et al.)

• Seaweed extracts
  – “. . . biofertilisers, soil conditioners and biostimulants . . .”
  – “Micro- and macronutrients, special polysaccharides (like alginates, laminarin and carragheenans), sterols, N-containing compounds like betaines, and hormones . . .”
What materials are Biostimulants?
(From Jardin et al.)

• Humic substances,
• Complex organic materials,
• Beneficial chemical elements,
• Inorganic salts, including phosphite,
• Seaweed extracts,
• Chitin and chitosan derivatives,
What materials are Biostimulants?
(From Jardin et al.)

• Chitin and chitosan derivatives
  – “. . . bioactive biopolymers from which many derivatives are produced by hydrolysis and chemical modification . . .”
  – “The main function is in plant protection against viruses, bacteria, fungi and insects, via the activation of host defense genes and the development of so-called immune response.”
What materials are Biostimulants?
(From Jardin et al.)

• Humic substances,
• Complex organic materials,
• Beneficial chemical elements,
• Inorganic salts, including phosphite,
• Seaweed extracts,
• Chitin and chitosan derivatives,
• Antitranspirants,
What materials are Biostimulants?  
(From Jardin et al.)

- Antitranspirants
  - A) Physical barriers on the leaf surface – kaolin, latex, wax, polyacrylamide
  - B) Physiologically regulate opening of stomata – abscisic acid, acetylsalicylic acid
  - Lower leaf temperature, reduce evaporation within leaf and to atmosphere
What materials are Biostimulants?
(From Jardin et al.)

- Humic substances,
- Complex organic materials,
- Beneficial chemical elements,
- Inorganic salts, including phosphite,
- Seaweed extracts,
- Chitin and chitosan derivatives,
- Antitranspirants,
- Free amino acids and other N-containing substances.
What materials are Biostimulants?
(From Jardin et al.)

- Free amino acids and other N-containing substances.
  - Stimulate enzymes regulating nitrate assimilation, Krebs cycle, and enhance nitrogen use efficiency, increasing photosynthesis and plant growth.
  - “...stimulate plant defenses to biotic and abiotic stress...”
What materials are Biostimulants?
Jardin didn’t include microbial inoculants

– Mycorrhizal fungi
  • Form symbiotic relationship with plant roots
  • Effectively increases plant rooting area by joining root and hyphae
  • Plant provides sugars
  • Fungi provides nutrients, water, enzymes, hormones
What materials are Biostimulants?

– Mycorrhizal fungi

– Trichoderma fungi

  • Bio-pesticide – parasitize other fungi and plant-parasitic nematodes
  • Increase secondary root formation
  • Solubilize phosphates and iron
  • Infect plants to induce systemic resistance
What materials are Biostimulants?

– Mycorrhizal fungi
– Trichoderma fungi
– Plant-growth-promoting rhizobacteria
  • Fix atmospheric nitrogen
  • Solubilize phosphates
  • Chelate iron
  • Increase mineral uptake
  • Synthesize phytohormones (e.g. auxins, cytokinins)
Three Big Questions for Regulators

1) Does the product work?
   • As claimed, when applied according to directed rates?
   • Lab vs. Field?
   • Limiting conditions? (e.g. temp, soil pH)
Three Big Questions for Regulators

2) How does the active work?
   • Pesticidal vs. non-pesticidal
     – Biostimulant, or release from pest pressure?
Three Big Questions for Regulators

2) How does the active work?
   • Pesticidal vs. non-pesticidal
   • Microbial vs. non-microbial
     – Combo product – Inoculant, or nutrients?
Three Big Questions for Regulators

2) How does the active work?

- Pesticidal vs. non-pesticidal
- Microbial vs. non-microbial
- Direct vs. indirect
  - Affect plant cell, or alter nutrients in soil?
Three Big Questions for Regulators

2) How does the active work?
   • Pesticidal vs. non-pesticidal
   • Microbial vs. non-microbial
   • Direct vs. indirect
   • Biological vs. biochemical
     – Fungal hyphae providing nutrients, or hormones?
Three Big Questions for Regulators

3) How is it regulated?

• A biostimulant soil amendment, plant amendment, or beneficial substance; or a PGR?
Status of Biostimulant as a Term

- Vague definitions
- Action poorly understood
- Not an AAPFCO-defined term
- Most states will not accept it in labeling
Future of Biostimulant as a Term

• To build a definition –
  1. Submit definitions to AAPFCO for individual materials
  2. Use those materials to build categories (e.g. PGPR)
  3. Use the categories to build a definition for “biostimulant”
Exception

• Most state fertilizer programs will accept the term biostimulant if it is used as part of the name of an EPA-registered product.
Thank You