Plant Biostimulants: Current State and Future Directions

Dave Lanciault, Board Member
Biostimulants: Working Definition*

As stated in draft for USDA

“Substance(s), microorganism(s), or mixtures thereof, when applied to seeds, plants, the rhizosphere, soil or other growth media, act to support a plant’s natural nutrition processes independently of the biostimulant’s nutrient content, thereby, improving nutrient availability, uptake or use efficiency, tolerance to abiotic stress; and consequent growth, development, quality or yield.”

* Currently, no agreed definition exists for legal / regulatory purposes. Proposed to USDA in industry draft input for Report to Congress.
Biostimulants: A True “Niche” Market

The numbers that excite us:

• A $2.2b global market ¹
• CAGR 13.0% through 2025 ¹
  - Row crop CAGR of nearly 14% ¹
• Surge in AgTech investing ²:
  - ~$2b invested in 2018; >$170m in plant science
  - >$6.5b invested past five years
  - Over 200 deals closed
  - Average deal size up, to $10m
  - Headline deals in hundreds of millions

But, put in perspective:

• Less than 1% of $300b crop inputs market ³
• Over 40% of sales go to 8% of acres (fruits and vegetables) ¹
  - Estimate 20 to 25% penetration? ³
• Row crops dramatically underserved
  - Estimate ~3% penetration? ³
• Overall – 3 to 5% penetration
  (> 95% non-adoptive)
• Period of adoption is closer to 70 years than 10

¹ Dunham Trimmer estimates, © 2019
² Finistere Ventures, 2018 Agtech Investment Review.
³ Agricen analysis of market fundamentals
Biostimulants Market: $3B Globally?

**Percent of Sales (est., 2020)**

- Acids: 51%
- Extracts: 38%
- Other: 11%

**Sources:** Dunham Trimmer Analysis 2019; P. du Jardin analysis of Plant Biostimulants 2015
A Complex Picture for the Grower

How to move from this…

Landscape of Biostimulant Technologies

...to answering grower’s critical questions?

• What problem are we trying to solve?
• What are the best technologies to solve it?
• How do I fit them into my practices?
• How will I know it’s working?
• How do I get full value from all my inputs?
• How does this make me money?

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1 Source: Agricen analysis of market analysts, survey papers on Biostimulants, © 2017
Regulatory Question: Where Do They Fit?

What is a “plant regulator”? According to FIFRA 2(v):

“The term ‘plant regulator’ means any substance or mixture of substances intended, through physiological action, for accelerating or retarding the rate of growth or rate of maturation, or for otherwise altering the behavior of plants or the produce thereof, but shall not include substances to the extent that they are intended as plant nutrients, trace elements, nutritional chemicals, inoculants, and soil amendments.”
Industry Focus Has Been on Two Initiatives

**Industry Goals**: Ability to use the term “biostimulant”
- Make biostimulant claims
- Credibility for the industry
- Clear, consistent, and predictable process to market
- One label for all states
- Safety assessment
- Dual uses for active ingredients
- Global consistency

**EPA**
“Draft Guidance for Plant Regulator Label Claims, Including Plant Biostimulants”

**USDA**
Report to Congress on Plant Biostimulants (required by 2018 Farm Bill)
USDA-led Biostimulant Work Group

*As articulated by Biostimulant Industry Workgroup (BIW), a collaboration led by BPIA and US Biostimulant Coalition*
Industry’s Consolidated Comments to EPA Include…

• Clarify the term “naturally occurring” – does it include synthetic analogs?
• Some PGR claims listed are also true for fertilizers, soil amendments inoculants and biostimulants
• Allow PBS to make plant growth and development promotion claims (e.g. enhanced germination, seedling vigor, root and shoot growth, yield, yield quality, etc.):
  – As logical, natural consequences of primary benefits
• Recognize and clarify “multi-function products”
• Eliminate Table 4 (list of “plant regulator active ingredients”) from the Guidance, as FIFRA is a claims, knowledge and intent based approach…not substance-based
  – Some items referenced are well-known, well-regulated, AAPFCO-defined fertilizers and soil amendments (e.g. seaweed extracts, humic and fulvic acids)
  – Consistent with global initiatives on PBS – specifically the EU
• Define “Nutritional Chemicals” under FIFRA as a category excluded from regulation
• Coordinate with USDA on PBS legal definition as part of Report to Congress (EPA Administrator consulted)
Economic Impact of EPA Guidance*

- Annualized cost of \textit{up to $449m}:
  - Up to $2B over the first five years
- Estimated impact includes such items as:
  - Data package development (for submission as PGR’s)
  - Federal registration
  - State registration
  - Approvals for use as organic pesticides
  - Manufacturing, labeling, branding and supply chain costs
- This economic impact does \textit{not} encompass:
  - Adverse impacts on growers (e.g., product withdrawals or delays)
  - Future requirements (e.g., new formulations with registered actives)

* If implemented as presently drafted
Source: Compliance Services International; BPIA ? USBC analysis
# Composition of USDA Biostimulant Workgroup

*Participants in workgroup convened and facilitated by USDA-APHIS (March 2018)*

## FEDERAL
- USDA Animal Plant Health Inspection Service
- USDA Agricultural Marketing Service
- EPA Biopesticides and Pollution Prevention Division
- FDA Consumer Safety

## INDUSTRY
- American Seed Trade Association
- Biotechnology Innovation Organization
- Biological Products Industry Alliance
- Humic Products Trade Association
- The Fertilizer Institute
- United States Biostimulant Coalition

## STATE
- National Association of State Departments of Agriculture
- Association of American Plant Food Control Officials
- Association of American Pesticide Control Officials
Actions Recommended to USDA by Industry

Proposed for the Report to Congress:

1. Enact short-term legislation to:
   - Define plant biostimulants (PBS)
   - Direct EPA Administrator to clarify PBS as excluded under FIFRA

2. USDA-facilitated initiative for more uniform approach to state-level registration of PBS
   - Common label, consistency of claims
   - Safety and efficacy certification standards and processes

3. USDA establish / facilitate Task Force to define regulatory and non-regulatory requirements for a uniform framework

4. Longer-term legislation supporting a Uniform National Framework
What’s Next?

EPA Guidance:
• Public comment period closed July 28, 2019
• EPA review / respond to comments - by ?
• OMB review of revised guidance - ?
• *EPA target to issue is not later than Q1 2020*

USDA Report to Congress - Due December 2019
• Requires extensive validation up the chain of command, and
• Requires coordination with EPA / Administrator
• Industry, other stakeholders standing by to support USDA requests for more info
• Timetable beyond 2019, including legislative action, is unclear

* Target date per Russ Jones of EPA in May 2019 PPDA Meeting
The R&D Pipeline – Driven by “Natural Product Discovery”

- Aspirin, quinine, morphine, digitoxin
- Penicillin isolated in 1928, other antibiotics in 50’s
- Treatments for AIDs, breast cancer, Alzheimer’s
- 80% of people in world still rely on plant-based medicines

The “Omics Revolution” in 90’s Pharma: A Game Changer

- The arrival of high-throughput screening of potential bioactives
  - Enabled by sequencing efficiencies, computational biology / bioinformatics
  - Increased speed, dramatic reductions in processing cost
  - An explosion of information and the ability to use it to guide discovery
Omics Capabilities is Opening Up R&D

Plantomics™
The integrated disciplines for studying complex agricultural systems and the factors that influence them

Genomics
- Functional Genomics
- Metagenomics

Phenomics
- Phenotyping

Transcriptomics

Proteomics
- Metaproteomics
- Proteogenomics

Metabolomics

What genetic capabilities do organisms possess?
What are the structure and functions of the microbial community?

What metabolites are present / produced?
What do they do?

What genes are expressed?
What do they tell us about metabolic activity?

What are the effects on plant response?
How do we enhance them?

What metabolites are present / produced?
What do they do?

What are the effects on plant response?
How do we enhance them?
Driving Deep R&D into Novel Actives and Effects

**Complex organic extracts**
- e.g., SWE, organic acids

**Microbial products**
- Single strain or consortia

**Broad generic claims:**
- Soil structure, function
- Nutrient processing, uptake
- Soil microbial activity
- Plant growth promotion

**Specific compounds**
- Clear, focused Modes of Action
- Optimized strains
  - Potentially improved?

**Claims sound more like:**
- “Improved ATP hydrolysis”
- “Stimulate enzyme production”
- “Regulate stress response pathway”
- “Improves transpiration”

Sources: P. du Jardin analysis of Plant Biostimulants 2015; Agricen Sciences analysis
How Might PBS / PGR Technologies Impact Adjuvants?

**HISTORIC**

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<th>Incorporation of PBS / PGR</th>
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**“BLUE SKY”**

- **Synergists**
  - Enhance A.I.’s
    - Performance
    - Deliverability
  - New molecule discovery contributes to formulation, adjuvants?

- **Safeners**
  - Reduce negative effects (e.g., phyto)

- **Supplements**
  - Promote plant growth / health
  - Abiotic stress tolerance

**Today**

**New Chemistry (A.I.’s)**

**Inerts**

**Tank Mix Adjuvants**

**Plant Biostimulants (PBS)**

**Plant Regulators (PGR)**
What is Needed to Grow Adoption?

- Prove the value to growers
- Demonstrate technology reliability
  - 80% success rate?
- Educate for informed choice
- Win over the influencers
- Price for ubiquitous adoption
- Improve overall farm economics
- Make it seamless to use
- Make it “sticky”

*Need to overcome the stigma of a “luxury” technology*

*Market penetration of 3% - ~ the size of KY*
Growing the Market Calls for New Forms of Collaboration

“Open Innovation”\(^1\) means:

- Tapping the best knowledge and skills – wherever they reside
- Creating value from internal and *external* R&D
- *Monetizing* innovation (not just “papering” it)
- Effective, repeatable innovation business models
- Efficiently translating concepts to practice

Collaboration Opportunities Exist Across the Value Chain

**TECHNOLOGY**

Sourcing the best content to meet solutions needs

**VALUE CHAIN COMPETENCIES**

Leveraging capabilities and know-how

**MARKET FOCUS**

Segment-specific focus, expertise and resources
A New Business Model for Disruptive Innovation?

Traditional | Collaboration Element | Disruptive
Summing Up: Key Messages

• The plant biostimulant market is attractive and growing
• The supply side may be growing faster still
  – Is a shakeout, rationalization inevitable?
• Winning strategies will require:
  – Growing the breadth, pace of adoption (mainstream relevance)
  – Fully leveraging finite resources
• Solutions innovation excellence is cradle-to-grave
  – Selecting targets – developing innovations – delivering the value
• New models for collaboration are inevitable
  – With partners equitably sharing the value they jointly create