The Future of Liquid Fertilizers

Dr. Karl Wyant
Director of Agronomy
Nutrien

March 16, 2023

About Me

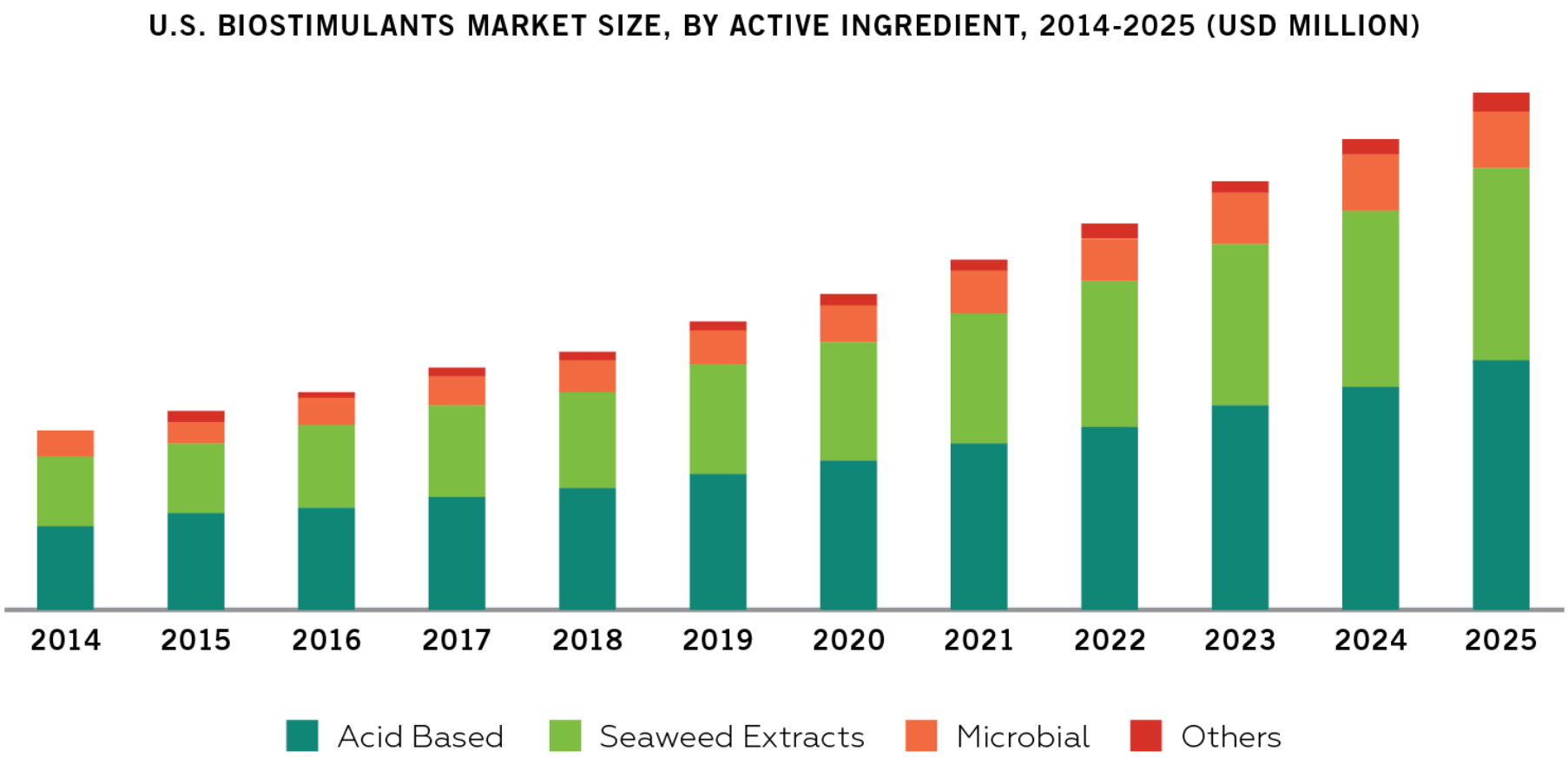
Main Statement

Current Liquid Fertilizers

“New” Novel Ingredients

Fertilizers 2.0/3.0

Biostimulants Market Growth



https://www.grandviewresearch.com/industry-analysis/biostimulants-market

What are Biostimulants?

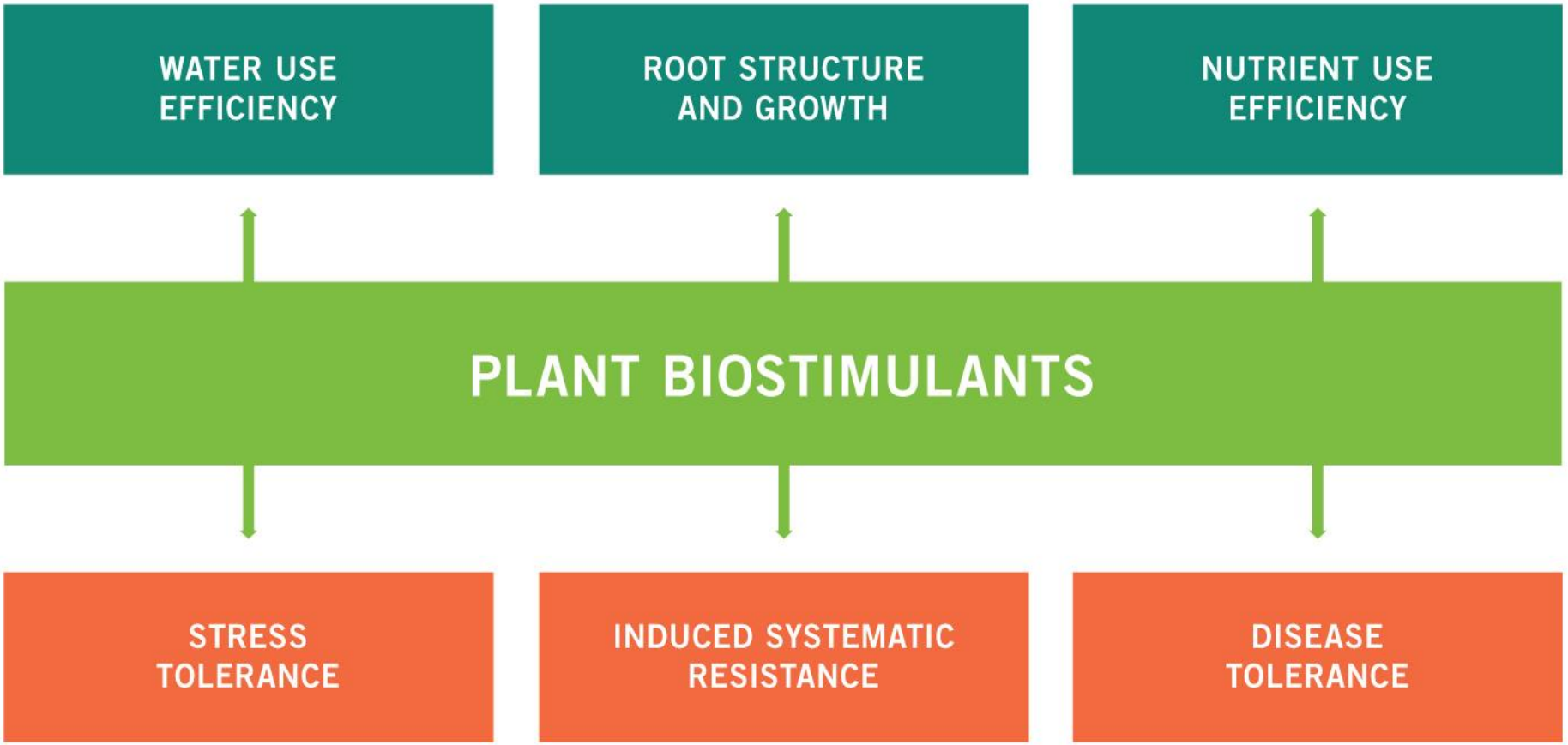
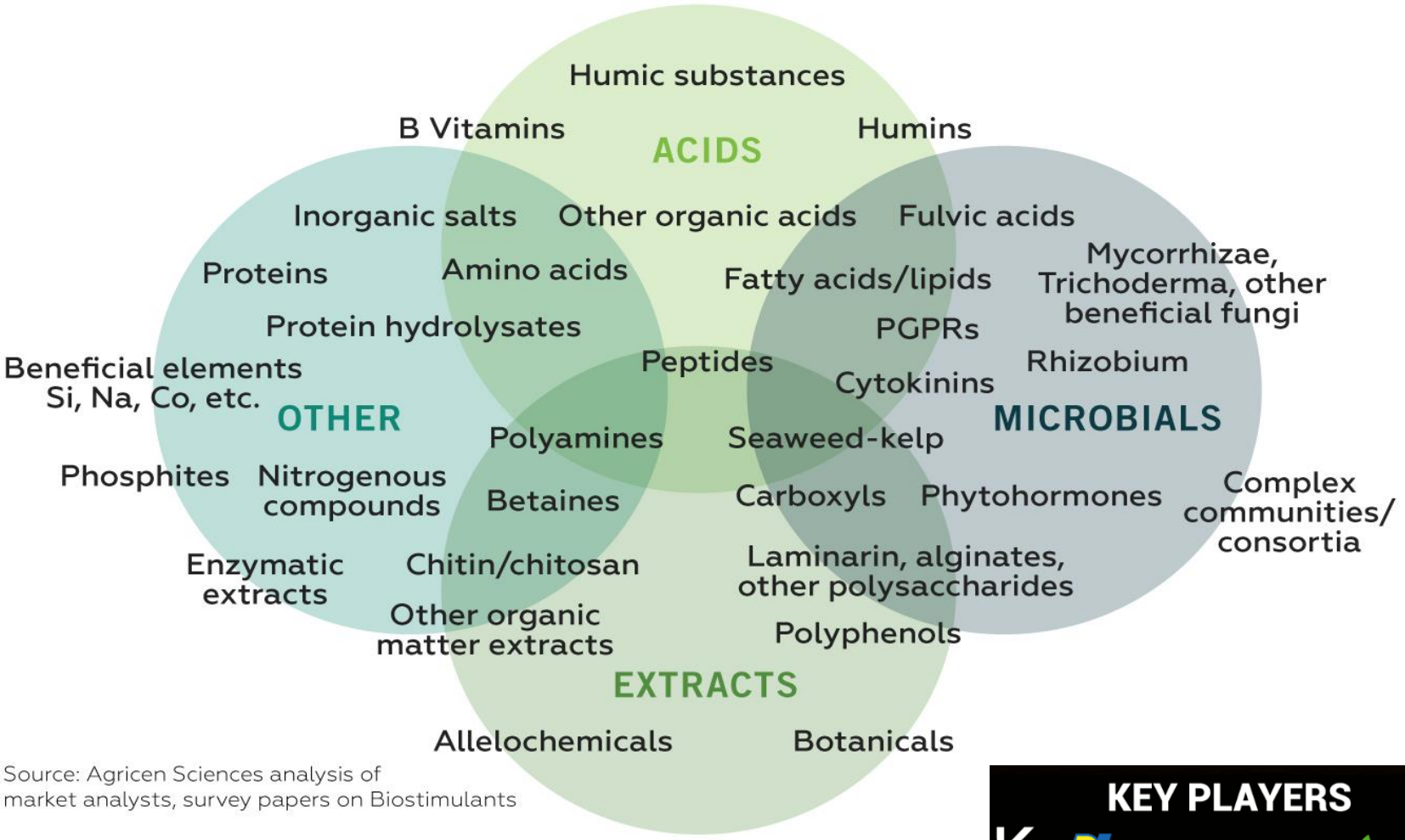


Figure 1. Biostimulant effects on plants.

Albrecht 2019

Marketplace Noise



Source: Agricen Sciences analysis of market analysts, survey papers on Biostimulants

https://www.bpia.org/solutions-provided-by-biological-products-biostimulants/#acid-based-biostimulants

Biostimulant Market Size, Growth, Share | 2022 - 27 (mordorintelligence.com)

Infographics - Biostimulants Market (fortunebusinessinsights.com)

Marketplace Maturity

Market Concentration

BAU

Consolidated- Market dominated by 1-5 major players

Source: Mordor Intelligence

Biostimulant Market Size, Growth, Share | 2022 - 27 (mordorintelligence.**com**)

Legislative Positioning – 2018 Farm Bill

SEC. 10111. REPORT ON PLANT BIOSTIMULANTS.

(a) REPORT.—Not later than 1 year after the date of the enactment of this Act, the Secretary shall submit a report to the President and Congress that identifies any potential regulatory, non-regulatory, and legislative recommendations, including the appropriateness of any definitions for plant biostimulant, to ensure the efficient and appropriate review, approval, uniform national labeling, and availability of plant biostimulant products to agricultural producers.

(b) CONSULTATION.—The Secretary shall prepare the report required by subsection (a) in consultation with the Administrator of the Environmental Protection Agency, the several States, industry stakeholders, and such other stakeholders as the Secretary determines necessary.

(c) PLANT BIOSTIMULANT.—For the purposes of the report under subsection (a), the Secretary—

(1) shall consider "plant biostimulant" to be 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; and

(2) may modify the description of plant biostimulant, as appropriate.

https://www.congress.gov/115/bills/hr2/BILLS-115hr2enr.pdf

Making Progress

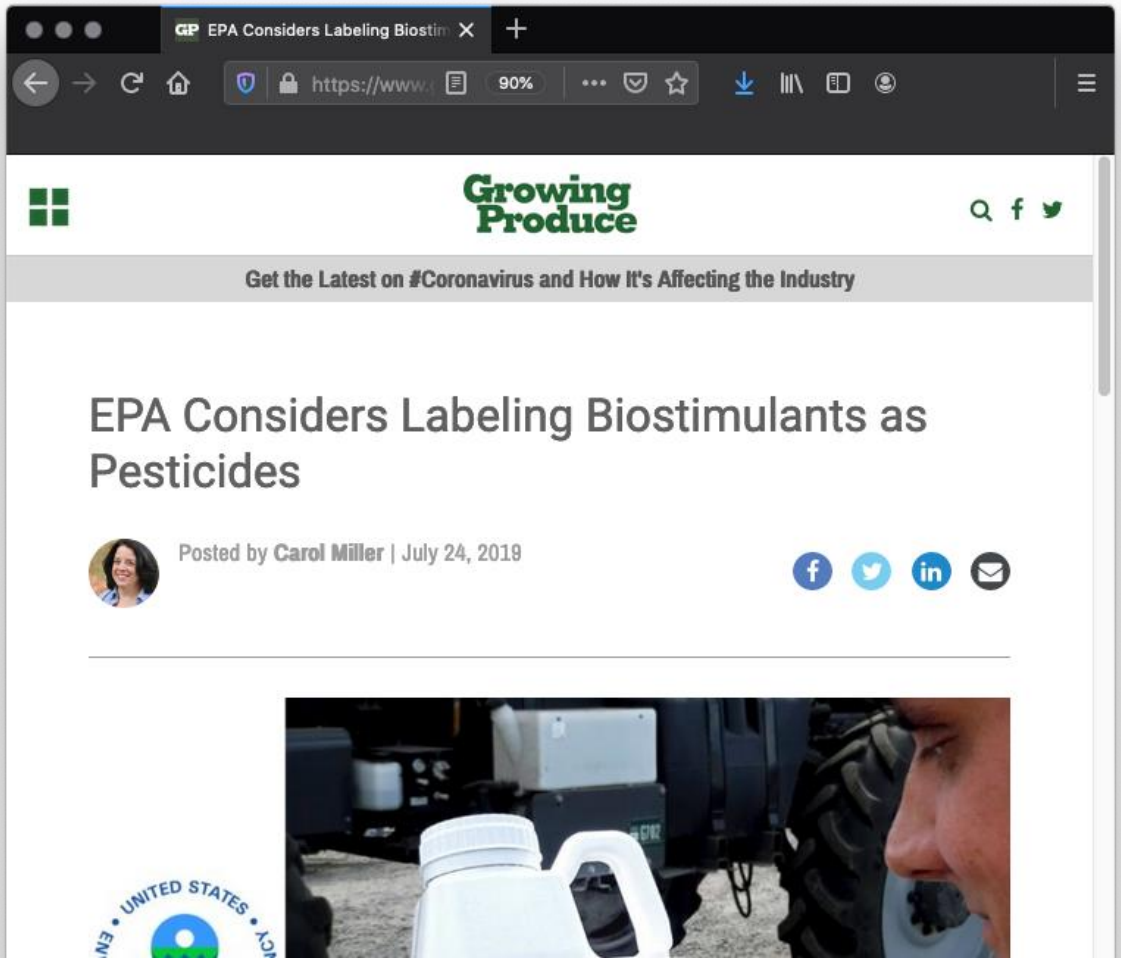
117TH CONGRESS
2D SESSION

H. R. 7752

Date	All Actions
06/08/2022	Referred to the Subcommittee on Biotechnology, Horticulture, and Research. Action By: Committee on Agriculture
05/12/2022	Referred to the House Committee on Agriculture. Action By: House of Representatives
05/12/2022	Introduced in House Action By: House of Representatives

BILLS-117hr7752ih.pdf (govinfo.gov)

Challenges for Category



https://www.growingproduce.com/vegetables/epa-considers-labeling-biostimulants-as-pesticide/

Unanswered Questions

- **Problem**: *What exactly is a biosimulant?*
- Unclear definition - pg. 419 pf 2018 Farm Bill
- EPA Draft Guidance – 2019 - **Table 4** list of ingredients (pg. 11)
- Clear up what product label language claims and FIFRA categories
- **Conflation of ingredients** - PGRs, ag chem, and fertilizers
- **Alignment issues** - USDA, EPA, and a variety of state regulators
- Clarify international standards and pathways to market

Question for Audience

How do we **innovate** liquid fertilizers with **new and novel** ingredients?

Some Ground Rules

- New active ingredients have **utility**
- **Species identity** determines role in soil:
  - Living inoculants
- **Carbon chemistry** determines function in soil:
  - Size
  - Charge
  - C:N ratio
  - Macromolecule diversity - *food sources*

Inoculant Cheat Sheet - Fungi

Yeasts/protein mixes – nutrient delivery source for plants (amino acids, NPK, etc.)

***Trichoderma* species** – a beneficial **fungus** that helps protect the plants against pathogens

Mycorrhizae – a beneficial plant/**fungal** symbiosis that help trees get more water and phosphate

Plant Production and Protection Division: Soil biological management with beneficial microorganisms (fao.org)

Inoculant Cheat Sheet - Bacteria

Bradyrhizobia – nodule forming, living **bacteria** that helps with N fixation on legumes.

Azospirillium/Klebsiella – free-living **bacteria** that helps with N fixation on *non-legumes*

Bacillus species – **bacteria** that helps with pathogen control and nutrient availability

Pseudomonas species – **bacteria** that helps with pathogen control and nutrient availability

Aspergillus species **- bacteria** that produce enzymes that break down hard-to-digest plant fibers

Plant Production and Protection Division: Soil biological management with beneficial microorganisms (fao.org)

Challenges with Inoculants

- **Viability and species ID** is a concern
- **Living vs. spore form**
- Sensitive to fluctuations in environment – **moisture, temperature, UV, competition**
- Some labs can help **confirm label CFU** count
- Challenges with **mixing and compatibility** in the field

- **Key question: how alive is your product?**

Some Ground Rules

- New active ingredients have **utility**
- **Species identity** determines role in soil:
  - Living inoculants
- **Carbon chemistry** determines function in soil:
  - Size
  - Charge
  - C:N ratio
  - Macromolecule diversity - *food sources*

Feed the Microbiome

From: Kallenbach et al. 2016 Nature Comm.

Images of sugar-treated model soils over time (a); the far-left panel is an uninoculated sterile kaolinite and sand mixture, and the far-right panel is the same mixture, inoculated and treated with **weekly glucose additions for 15 months.**

Lots of sources: molasses, sugars, microalgae, etc.

Specific Enzymes = Specific Action

- Protease
- β glucosidase
- Amidase & Urease
- Phosphatase & Sulfatase

- **Protein breakdown**
- **Cellulose breakdown**
- **N cycle**
- **P and S release**

Yang et al. 2012 – Soil Enzyme Activities and Soil Fertility Dynamics

Challenges with Non-living Products

- **Variance** in quality and efficacy
- **Will it blend?**
- Laundry list of label claims – **what does it do best?**
- Logistics at all levels – *need for agitation?*

- **Future: Liquid Biostimulant/fertilizer mixtures**

Moving Forward

- Consultants/advisers are crucial **for translating MOA** into product selection
- **Nuanced functionality/crowded marketplace**
- **Watch out for wild claims**
- Start with the **end goal** in mind
- Focus on blending and in-can options
- Proposed regulatory changes are sure to **shake things up**

Crucial Questions for Suppliers and Growers

Robust Trial Data?

Clear MOA?

Probability of +ROI?

Patents and IP?

Regulatory Future?

Portfolio Fit?

VC $ Source?

Thank You!

Nutrien™
Feeding the Future™

March 16, 2023