





Pivotal Moments in Biocontrol

*Taking stock of where we are and where we need to go
to advance innovation and adoption*

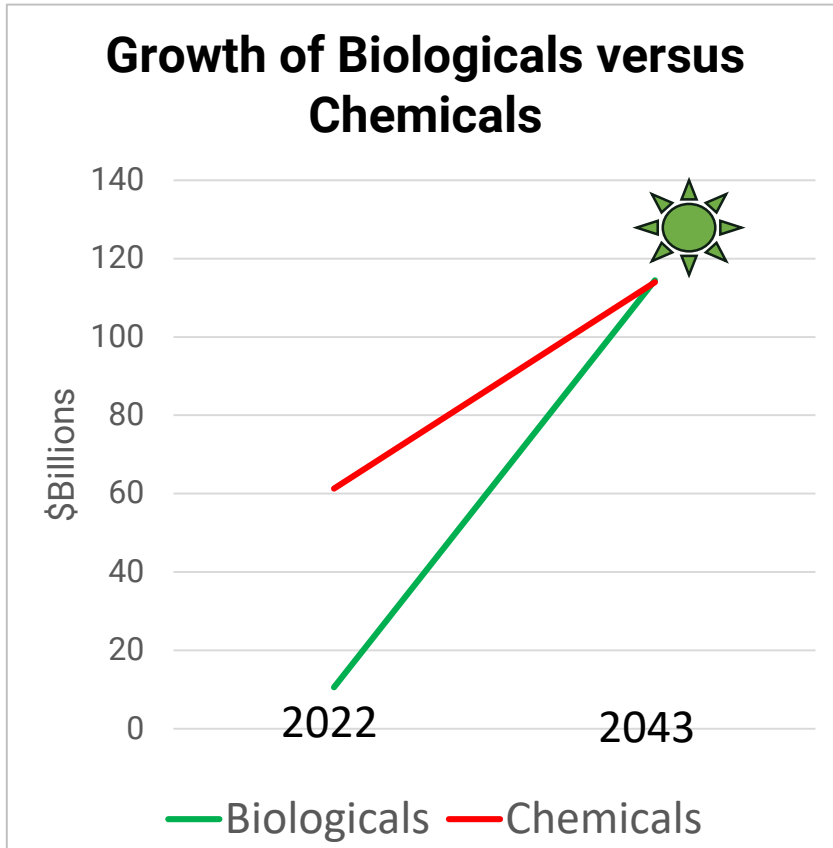
Pam Marrone, Ph.D.

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Biologicals Market Equal to Chemicals in ~20 Years!



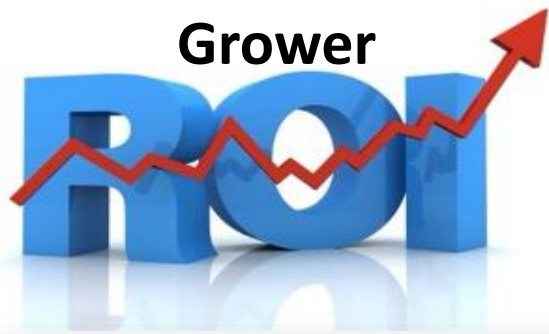
Growth rate (CAGR)		12 %
Number of periods	Biologicals	21
Initial value		10,600,000,000 \$
Final value		114,520,791,603.36 \$

Growth rate (CAGR)		3 %
Number of periods	Synthetics	21
Initial value		61,300,000,000 \$
Final value		114,036,057,245.79 \$

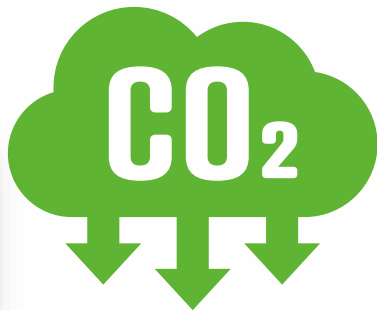
Source: Shane Thomas, Upstream Insights

New and Old Drivers Continue to Spark Growth

Biologicals are ClimateTech



The data continue to support their value

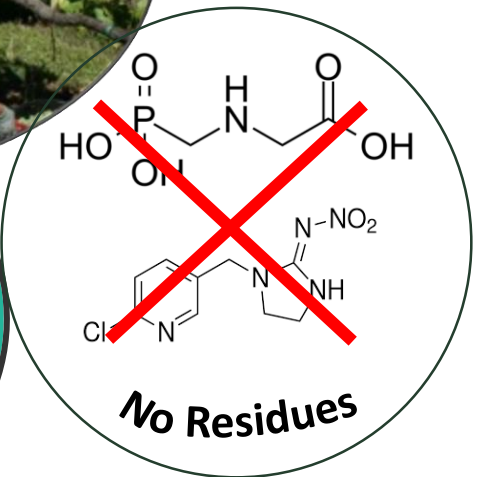


New Science Tools Drive Efficacy & Scale

The Fundamentals



<\$6 million
<5 years to develop



Biologicals Companies are Getting Funded

Despite Tough Funding Environment; Peptides are Hot!

Peptides



SOLASTA Bio
Nature Inspired
\$14 million



biotallys
reinventing food protection
\$16.3 million




micropep
\$40 million


Biofungicides



AgroSpheres
\$37 million



BioConsortia
\$15 million



BotanicalSolution
\$23 million

Phytosterols for water stress



Elicit Plant
\$40+ million announcing soon

Engineered microbes for N fixation



switch
BIOWORKS
\$17 million

M&A Continues

Emergence of Sizeable Pure-play Biological Companies



biobest
SUSTAINABLE CROP MANAGEMENT

BIOTROP

BioWorks

\$570 milion



VALENT BIOSCIENCES

fbciences

\$400 milion



Rovensa Next

AGRO-K



invaio

peptyde



PAINE SCHWARTZ PARTNERS

elemental enzymes



CORTEVA
agriscience

Stoller

Symborg
NATURAL GROWTH

\$1.2 bil



CERTIS
Biologicals

AgBIOME



GINKGO BIOWORKS

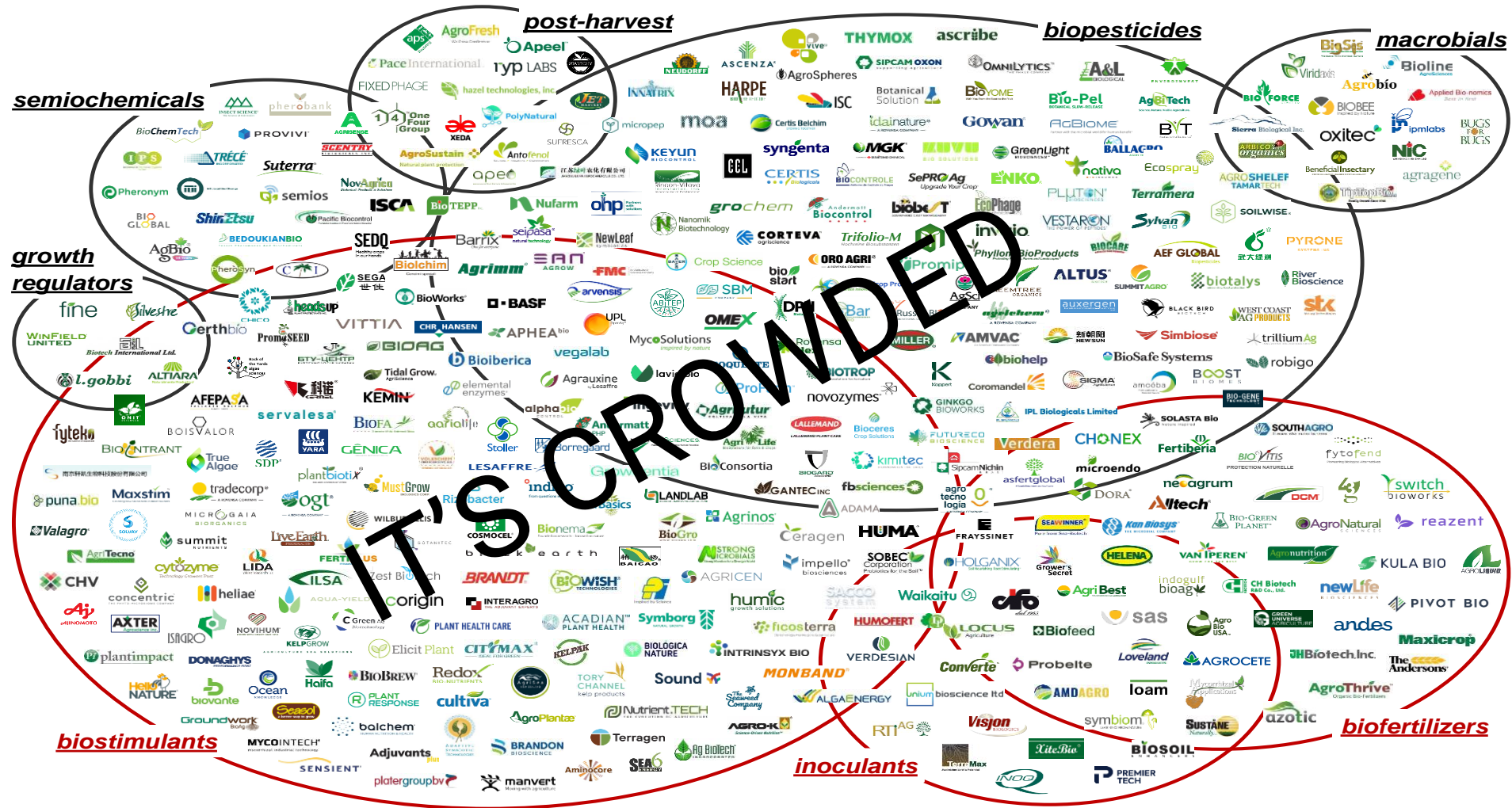
AgBIOME

With many product licensing deals between large & small cos.

2023 AG BIOLOGICALS LANDSCAPE

BIO-BASED SUBSTANCES

LIVING ORGANISMS



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Companies appear on the landscape only once, although some may offer products in multiple segments. Overlapping areas are meant to imply this, however, logo positions are not necessarily indicative of any specific or limited product offerings.

New Entrants Need to Have Differentiated Technology With Clearly Articulated Competitive Advantages



Fill an Unmet Need!

Mistakes Being Made

- “**Deep tech**” will quickly transform biologicals & create unicorns
- Misjudging the complexity of the **commercial development process**
- “**My technology is better,**” when it’s only incrementally better
- Going after the **technically easiest** products, but the **most crowded market**
- **Business model confusion** – platform vs product
- Not realizing the goalpost has changed: from 3-7% yield increase and 70% win-rate to **≥10%** and **90%**
- **Carbon sequestration** and **ghg reduction** are going to drive farmer adoption
- Losing sight of the need for **capital efficiency**

Success Factors Become Obvious

There is a nice cohort of young companies reaching \$100 million revenues and another startup group with rapid sales growth

- **Innovative, differentiated, value-added** products
- **Scalable** manufacturing/**competitive COGS**/pricing
- **Portfolio** across full range of grower needs OR **one** product/technology that is **first** to fill a large unmet need
- **Partner with growers to test** early versions; **incorporate feedback**
- **Grower-focused pull-through** marketing and sales. Articulate **details** of **how to use** the product and **why it works**
- **Profitable for distribution/retail** channel; Provide good channel support
- **Global** expansion (some)



Bioherbicides are coming

They kill weeds that chemicals can't but still face big challenges

P.26

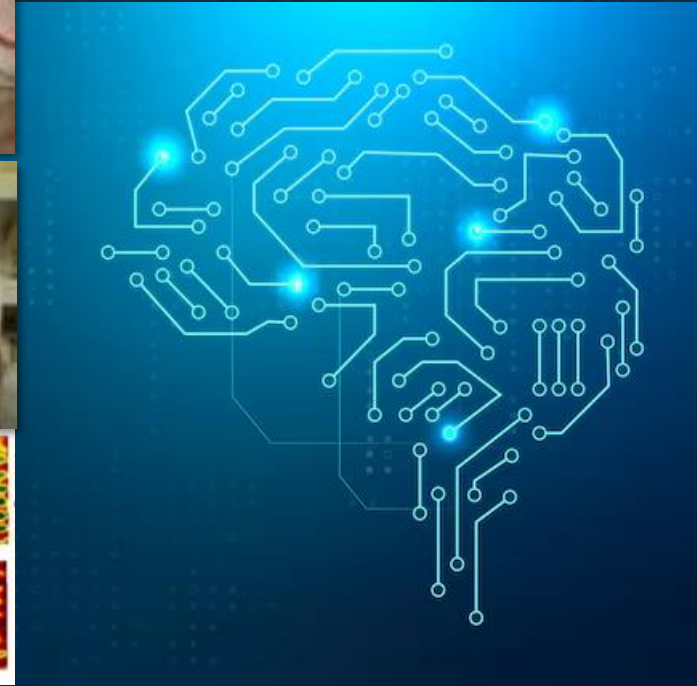
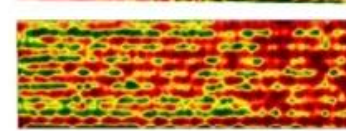
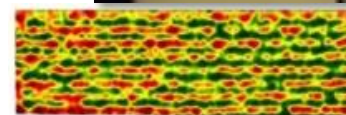
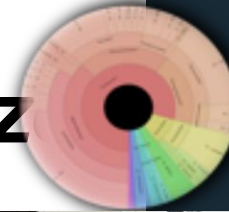


- Novel microbes/strains
- Novel compounds
- Directed & high throughput screening
- Synthetic biology
- Herbicide mixtures
- AI/ML tools

What About AI and ML?

Large potential to speed up & optimize discovery and development

- New **compound discovery** and **protein/peptide** design & improvement
- Drive **genomics-led microbial discovery**; more datasets are needed connecting genes, efficacy/function and fermentation conditions
- **Understanding mixtures: Molecule-molecule** interactions
- Can aid **fermentation process** improvement: **performance prediction, optimization, monitoring, and control** of bioprocesses
- **Formulation development**: forecasting their **solubility, stability, and bioavailability**
- Mining/assessing **field trial** images



EPA and USDA Collaborating on GM Microbes

On May 8, 2024, the the EPA, FDA, and the USDA released a plan to update, streamline, and clarify their regulations and oversight mechanisms for products of biotechnology

EPA and USDA will clarify, and as possible harmonize, regulatory roles, processes, and information, data, and authorization requirements for **environmental release of modified microbes**. The agencies will undertake this effort to reduce regulatory duplication where possible, harmonize risk-based processes and requirements, and increase interagency communication, particularly regarding small-scale field trials.



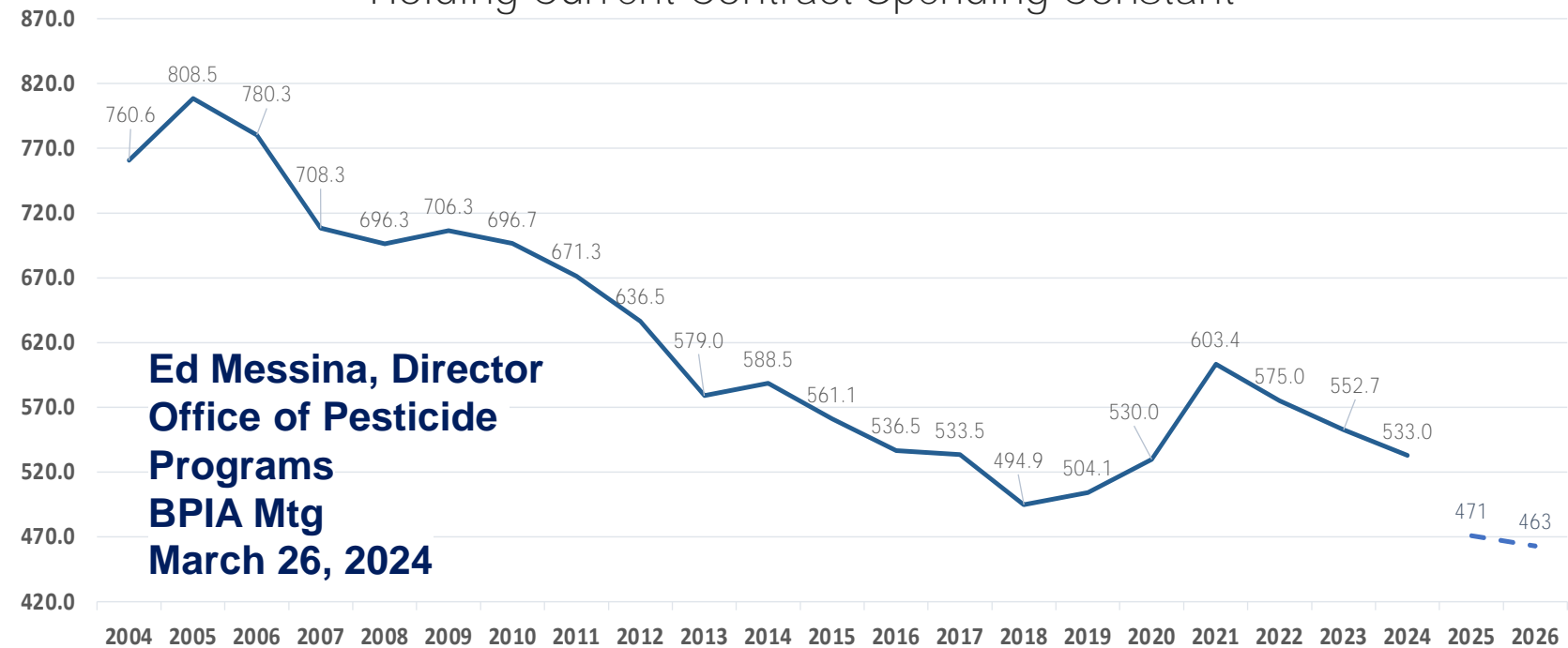
Bottleneck at the EPA, especially BPPD

Brazil Becomes the Leader in New Active Ingredient Approvals



- **Currently, ~80 new AI submissions in Biopesticide Pollution Prevention Division (BPPD)**
- **Only 9 new chemical AIs in Reg. Div.**
- **BPPD has staff to handle about 30/year**

EOY Total FTE Usage Assuming FTE Cuts & Holding Current Contract Spending Constant



**Ed Messina, Director
Office of Pesticide
Programs
BPIA Mtg
March 26, 2024**

95 FTE deducted from the OCSPP Program funding levels to normalize the data to reflect OCSPP Reorganization and those FTE being moved to OPS.

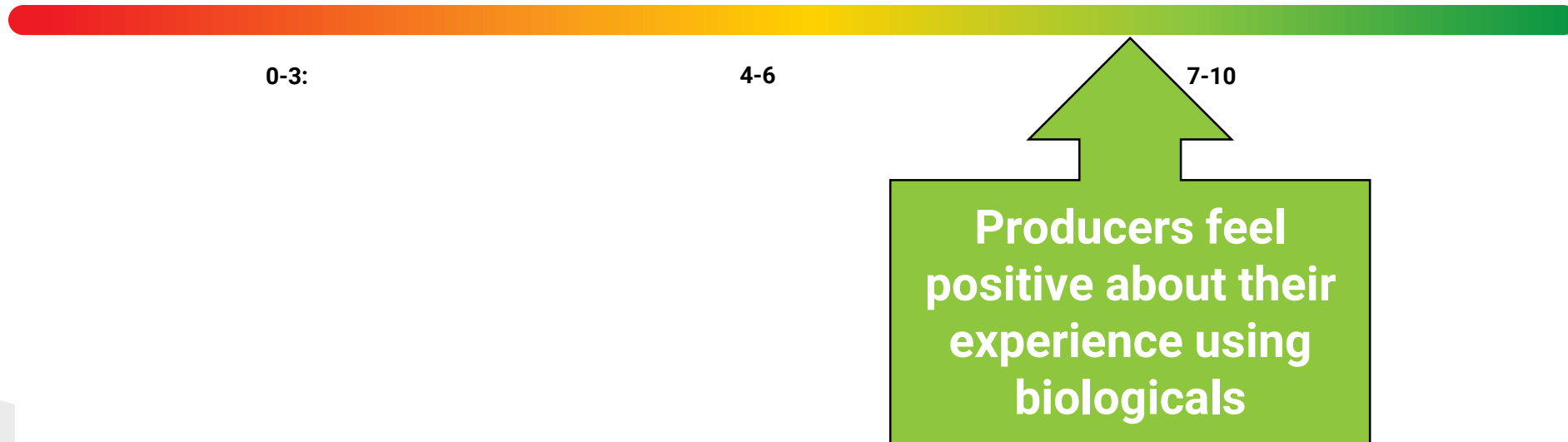
When Farmers Learn How to Use Biologicals, They Score Them Highly

Biological user-farmers rate their experience with biologicals a 7.14/10, showing a positive perception



*CURRENTLY
USE*

On a scale of 0-10, with 0 being “terrible” and 10 being “fantastic” how would you rate your experience with biological products? N=185



NON-USERS: Why Have you Chosen Not to Use any of These Product Types? N=270

Producers who have never used biologicals believe they are not proven, or have a lack of knowledge on the subject



NEVER
USED

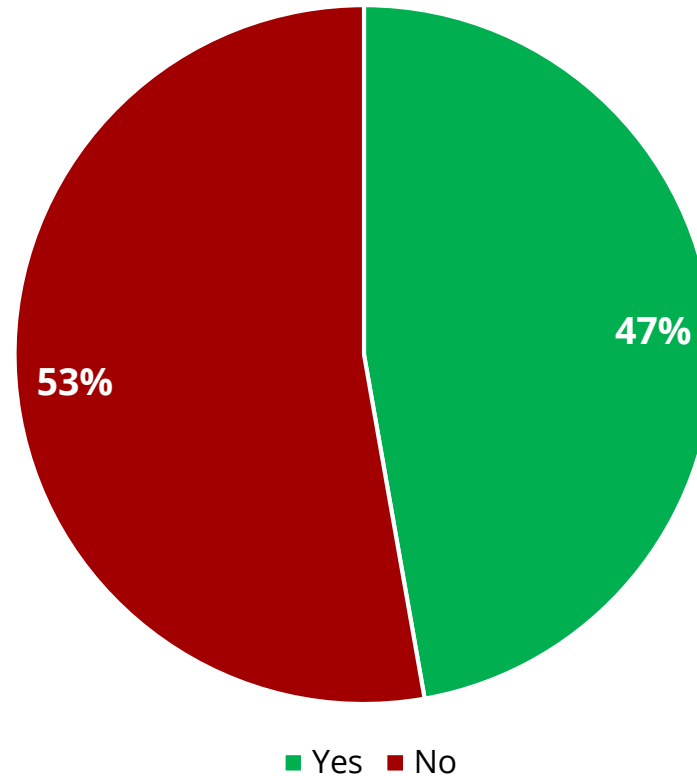


Have you been educated about biologicals? Such as the benefits, limitations, or available options?

Overall

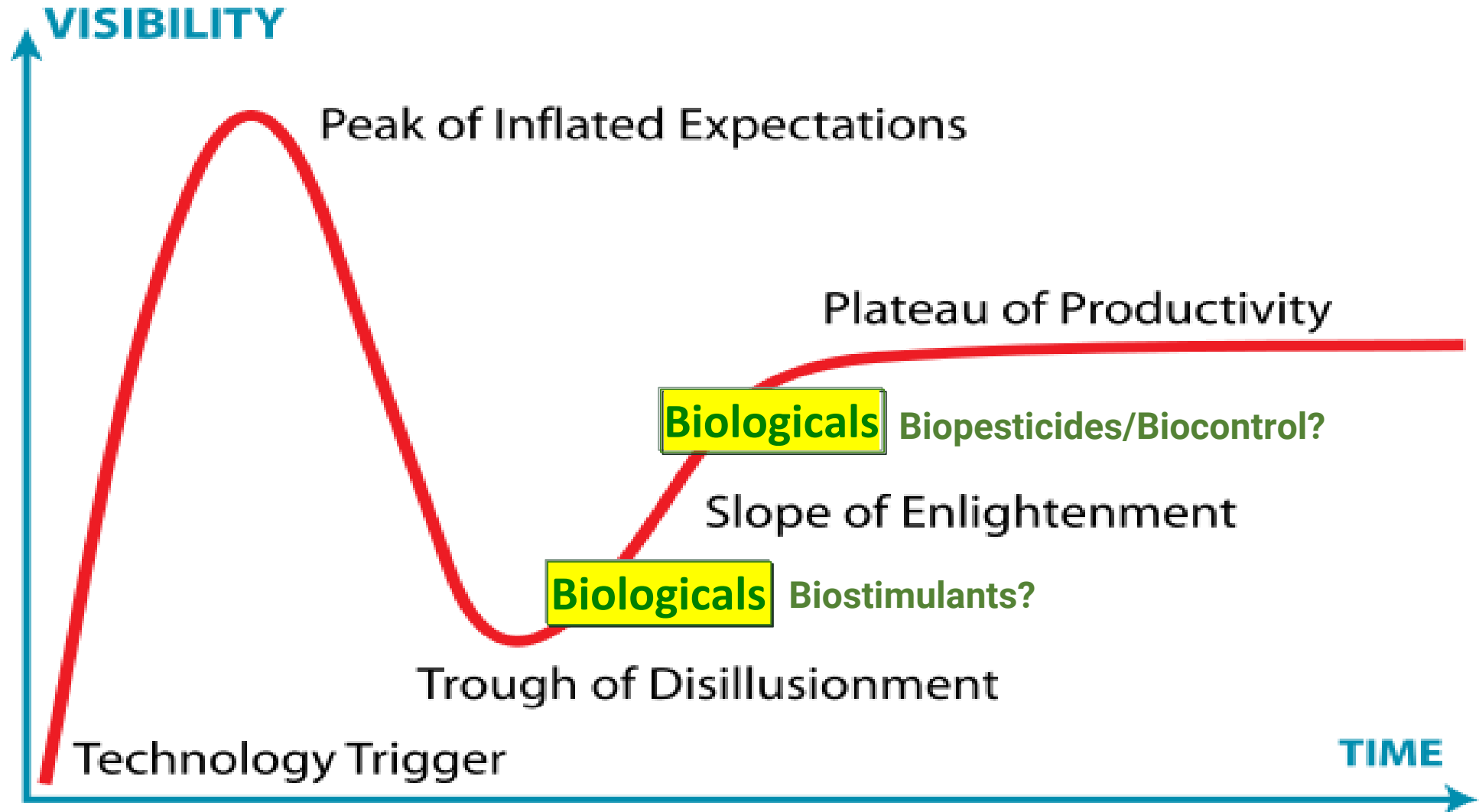
Education on biologicals is still lacking and is one of the major things holding acceptance back

**EDUCATION
EDUCATION
EDUCATION**



In any survey, the percentage of farmers who say they they are not educated about biologicals has remained at ~50% **for the past 5 years**

Gartner Hype Cycle (as Applied to Biologicals) 2024





ISC

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