



Recent Dynamics and Future Drivers in the Crop Biostimulants Market.

Prepared by AgbioInvestor

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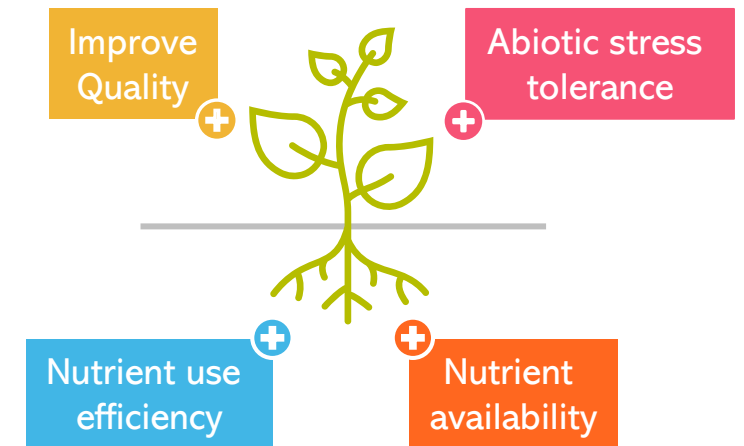
Biostimulant Definitions and Market.

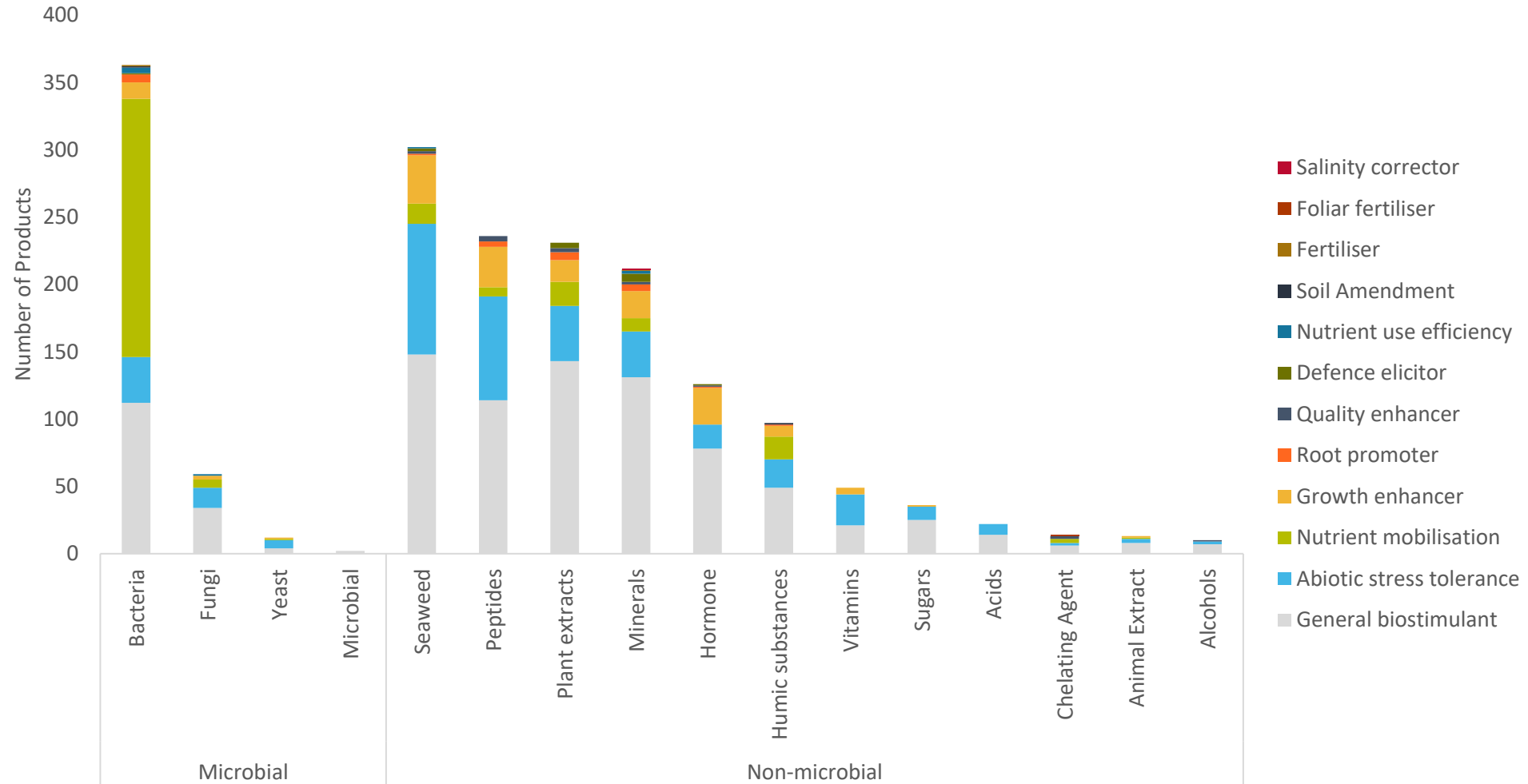
“A ‘plant biostimulant’ is a product that stimulates the nutritional processes of plants independently of the nutrients it contains, with the sole aim of improving one or more of the following characteristics of plants or their rhizosphere:

1. the efficiency of nutrient use; 2. tolerance to abiotic stress; 3. qualitative characteristics; 4. The availability of nutrients confined in the soil or rhizosphere”

- Regulation (EU) n°2019/1009

- Derived from a biological/natural source
- Act only on the plant’s vigour and do not have direct efficacy against pests:
 - Differentiated from **pest control** products
- Enhance the use/retention of nutrients:
 - but are not just **fertilisers**
- Complimentary and/or competitive to pest control and fertilisers depending on situation

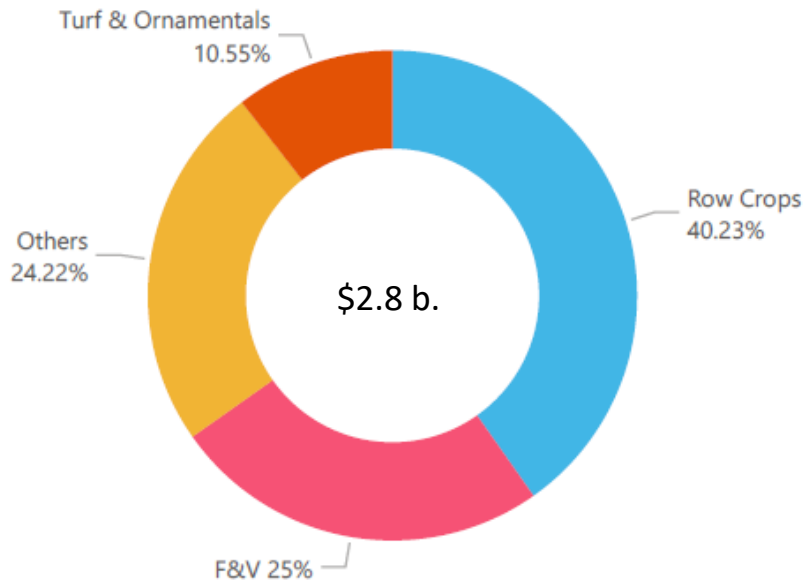




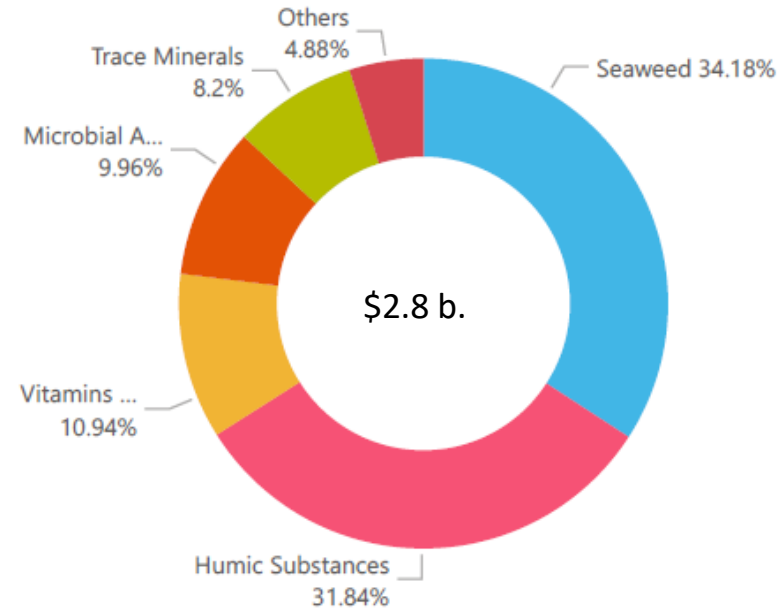
Note: Based on >2500 Biostimulant products identified by AgbioInvestor.

Source: AgbioInvestor Biological Product Database

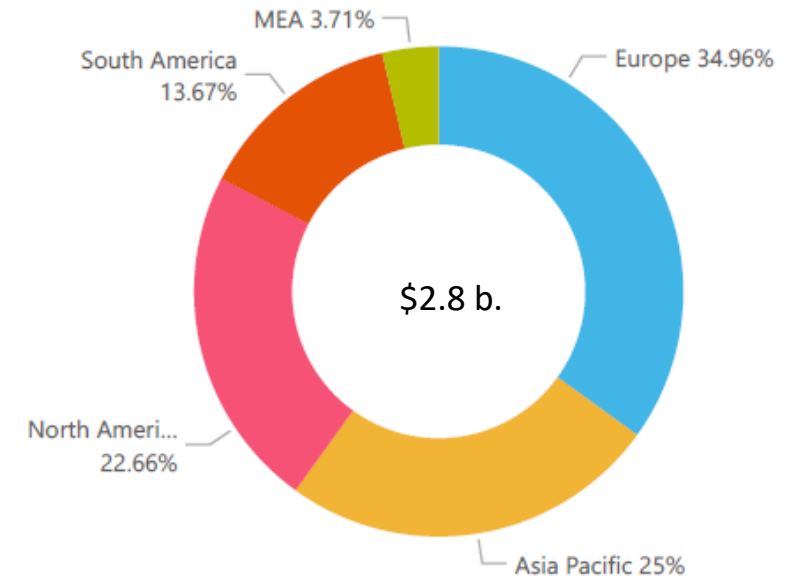
Crops



Product Type



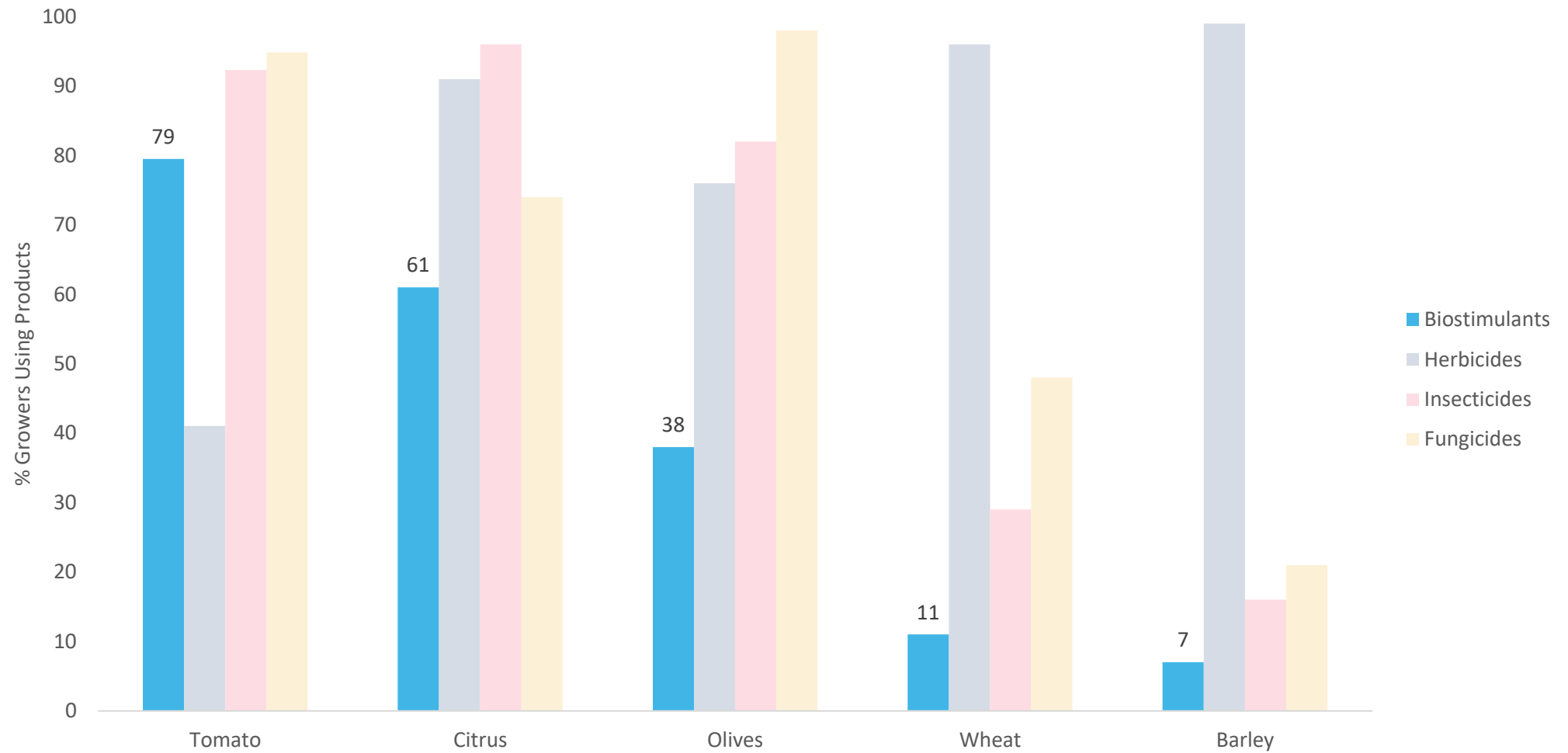
Regions



Total market ~\$2.8 b. in 2020, grown >10% p.a. over recent years.

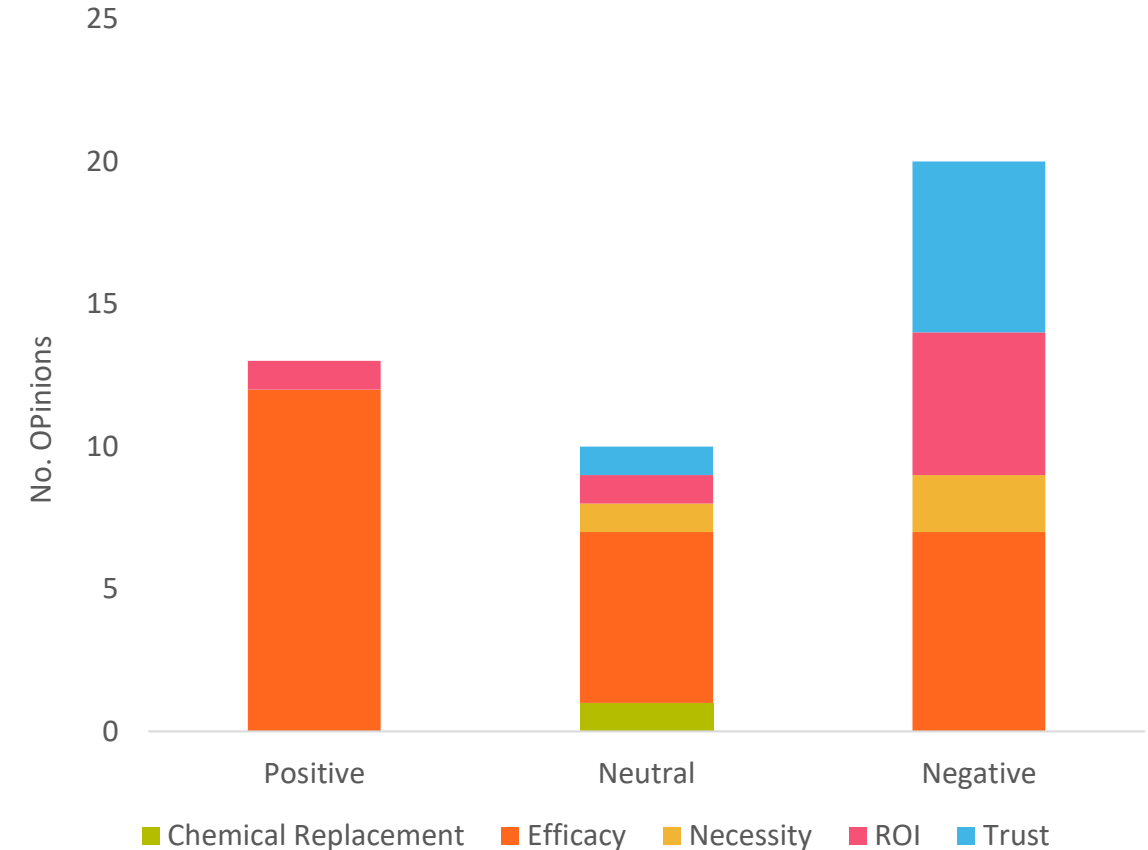


Market Drivers and Barriers.



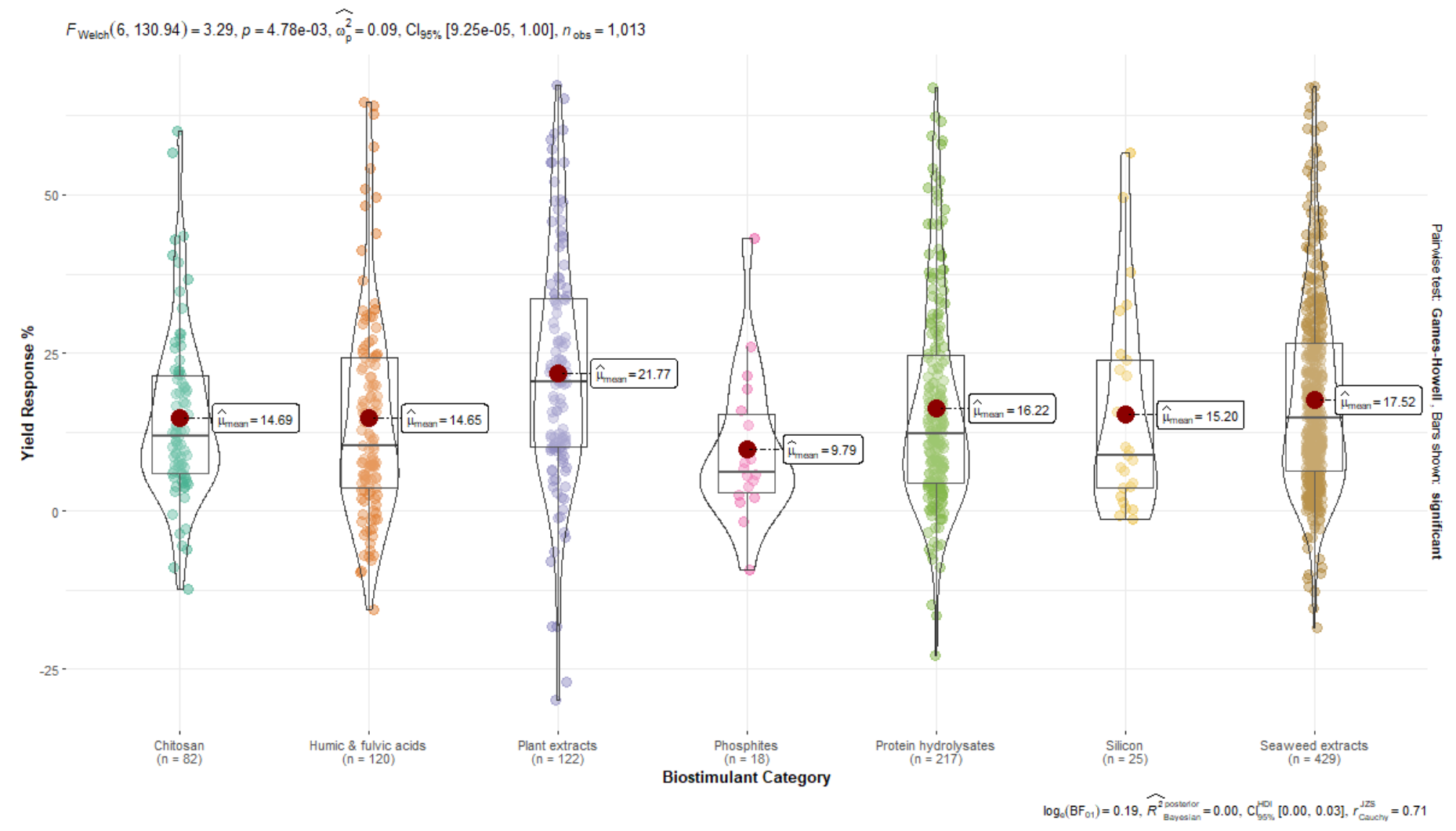
- Grower sentiment has been an issue for grower acceptance, and 'Snake oil' perception remains with some growers
- Regulation and education could be key to realigning expectations of what biostimulants are and can do:
 - Testing can enforce grower confidence
 - Biostimulants placed on market have been demonstrated as having defined properties
- Digital agriculture could enable better understanding:
 - Sensors/data loggers to see impacts
- Newer products with greater efficacy

Grower biostimulant sentiment by type based on farm forum posts (n=43).



Note: Based on small sample size (n=43) of opinions from farmer forums!

Field Trials for Yield Benefits

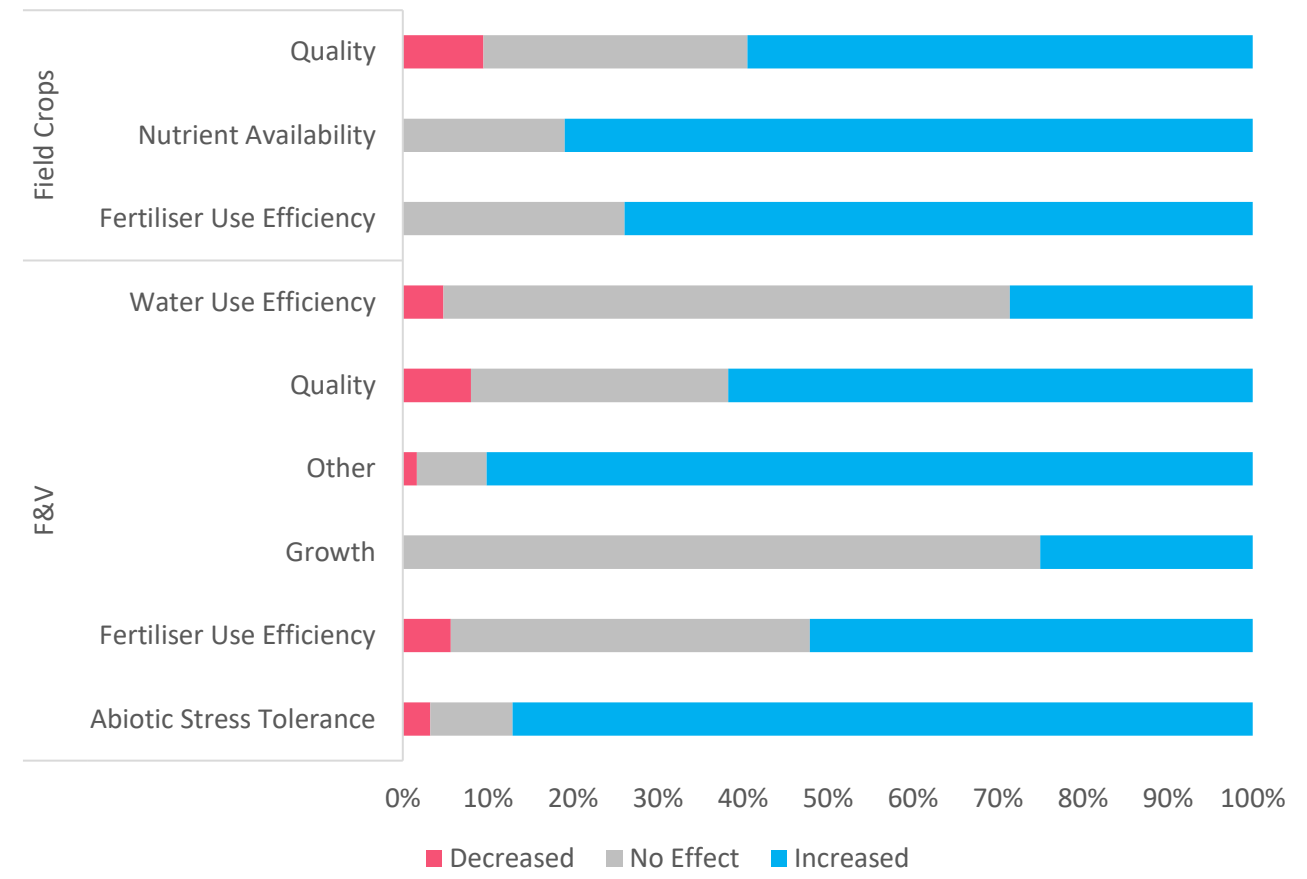


Source - Internal meta-analysis of data from: Li J, Van Gerrewey T and Geelen D (2022) A Meta-Analysis of Biostimulant Yield Effectiveness in Field Trials. Front. Plant Sci. 13:836702. doi: 10.3389/fpls.2022.836702

Field Trials for Effects

- Field-testing shows variability in effects of biostimulants
- Generally a majority of tests showing positive impacts
- Evidence products work best in soil applications, notably:
 - low OM content, non-neutral, saline, nutrient deficient and/or sandy soils
- Growers with high quality soils may have less need and see less benefit:
 - Key to communicate such issues to avoid disappointment?

Percentage of Field Tests by Crop Group, Effect Type and Impact in Bio4Safe Database (Jan 2023).



Source: Internal analysis of data from Bio4Safe biostimulant testing database accessed Jan 2023 - <https://bio4safe.eu/>

Published in May 2020 and voted in during October 2021 as a major component of the European Green Deal.

Aims by 2030

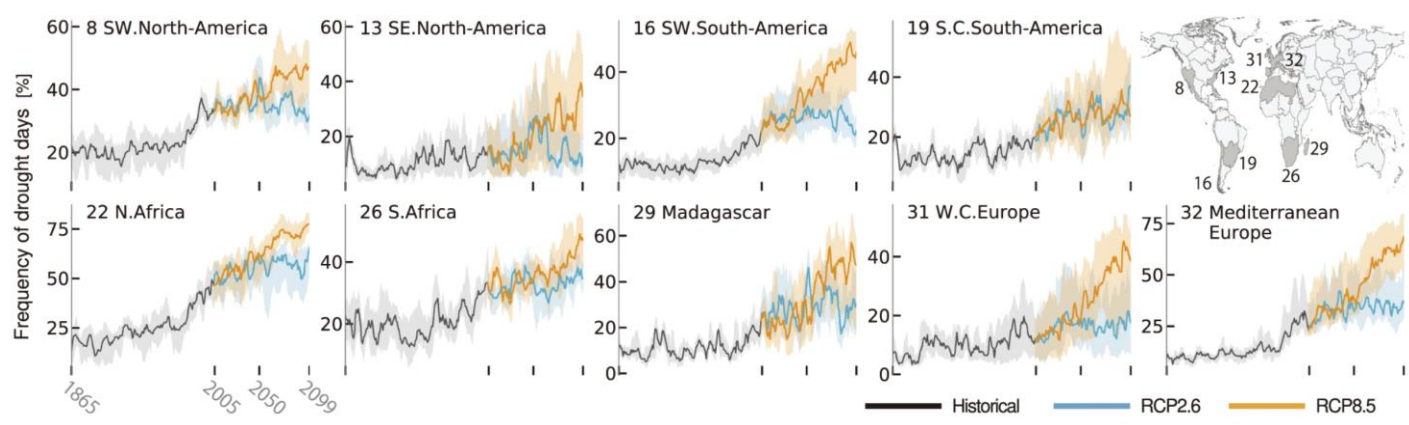
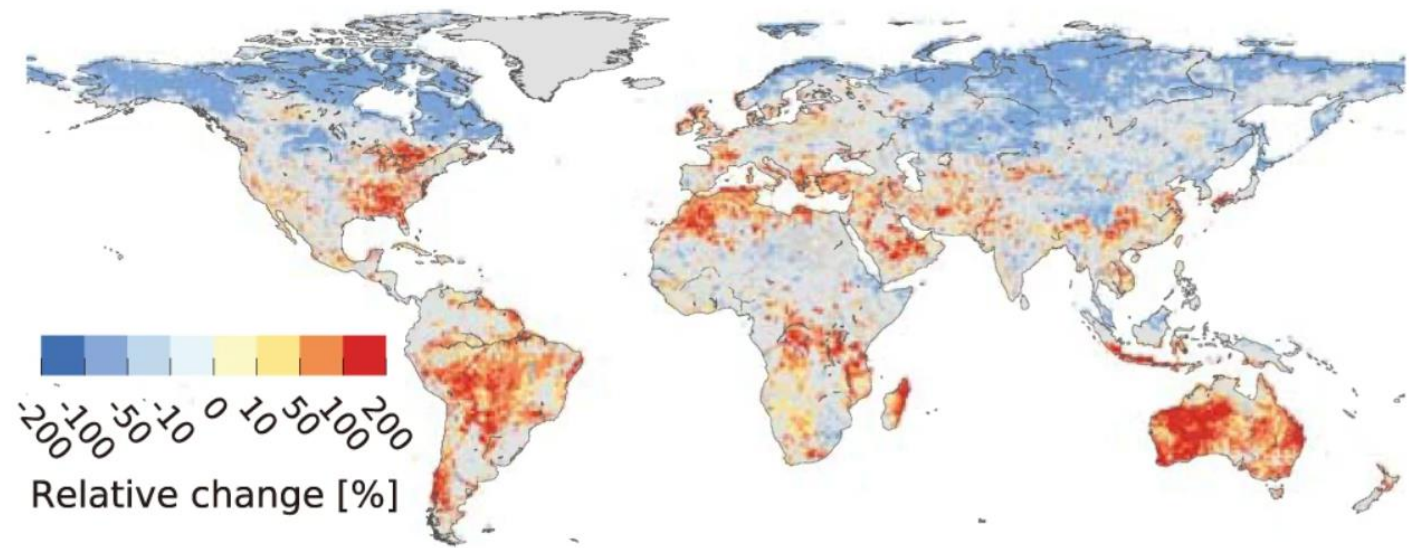
- Accelerate transition to a sustainable food system
- Preserve food security and affordability of food
- Generate fairer economic returns

Factor	Risks	Opportunities
Reduce Fertiliser Use 20%	Chemical fertilisers	Biostimulants Organic fertilisers
Reduce Nutrient Loss 50%	Chemical fertilisers Organic fertilisers	Nitrification inhibitors Biostimulants
Organic Farming to 25% Area	Chemical pesticides Chemical fertilisers	Biopesticides/Biofertilisers 'Organic' inputs

Environmental Change

- Drivers of environmental change create uncertainty for growers, and can have substantial yield impacts:
 - E.g. climatic change expected to increase frequency of droughts even under low temperature growth scenarios (see chart)
- Biostimulants can act as an “insurance policy” for growers facing increasingly volatile climate impacts
- Help protect against extremes of heat, drought, salt etc.

Change in Frequency of Drought Days Under RCP2.6 Scenario (Low emissions, limited temperature growth).



Source: Adapted from Satoh, Y., Yoshimura, K., Pokhrel, Y. *et al.* The timing of unprecedented hydrological drought under climate change. *Nat Commun* **13**, 3287 (2022). <https://doi.org/10.1038/s41467-022-30729-2>



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Regulation.

Trend	Positives	Negatives
Adopting regulatory processes	Certainty for users that products will work	Smaller companies may struggle with costs
Defining “biostimulants”	Creates clarity for regulatory purposes and a “level playing field”	Could stifle innovation of substances not deemed ‘biostimulants’ by regulators
Harmonisation	Ease of understanding and easier routes to market	Regulations may not suit specific local market needs
Regulation alongside plant nutrition	Provides single framework for products which can have fertilising and stimulating effects	Could create confusion over requirements for biostimulant vs. fertiliser testing
Regulation outside of pesticides	Separates very different use cases and intended effects of CP vs BS products Allows BS companies to avoid sometimes strict and costly pesticide legislation	Potential issue where products are biostimulants AND pesticides

- EU enforced the Fertilising Products Regulation (EU n°2019/1009) since July 2022
- Defines and sets process for Biostimulant (BS) approvals
- Requires efficacy testing to show product has Biostimulant effects – cannot just be just a fertiliser!
- Biostimulants regulated for whole EU market alongside national regulations
- Two routes for placing BS on market in EU:
 - **National:** Gain national registration then seek mutual recognition with other member states
 - **EU:** Gain EU-wide registration and ‘CE’ mark for sale across whole of EU

National Approval



EU-Wide Approval



- USA Introduced Plant Biostimulant Act in 2022
- Defines biostimulants as:
 - *“...a substance, microorganism, or mixture thereof, that, when applied to seeds, plants, the rhizosphere, soil, or other growth media, act to support a plant’s natural processes independently of the biostimulant’s nutrient content, including by improving nutrient availability, uptake or use efficiency, tolerance to abiotic stress, and consequent growth, development, quality, or yield.”*
 - Harmonized with EU definition
- Set national framework to register biostimulants and describe benefits on product labels
- Aims to develop model bill for use across states to streamline registration process
- Educate and highlight benefits of biostimulants for soil health, sustainability, and climate smart agriculture opportunities
- Achieve regulatory clarity from EPA regarding existing regulations, including the definition of plant growth regulators within FIFRA

Plant Biostimulant Act Objectives

1. Define plant biostimulant

2. Exempt plant biostimulants from regulation under pesticide regulation process (FIFRA)

3. Allow Secretary of Agriculture to conduct soil health studies to assess and recommend management practices to promote soil health and other environmental/agronomic benefits

Source: <https://www.bpia.org/2022/08/plant-biostimulant-act/>

Biostimulants Regulated Through Fertiliser Control Order (FCO)

Regulators

Nutrient Management Division of Agriculture Ministries at Central and State levels

Order Aims

Controls quality and specifications of biostimulant approvals

Key Listings

Schedule IV, which outlines specification and tolerance limits under key categories:

- Botanical extracts, inc seaweeds
- Bio-chemicals
- Protein hydrolysates and amino acids
- Vitamins
- Microbials
- Antioxidants
- Antitranspirants
- Humic and fulvic acids

Requirements

- Testing data (chemistry, bio-efficacy trials, toxicology/ecotoxicology, heavy metal analysis)
- Affidavit that product is not laced with pesticides within detectable limit
- Sample provided to inspector for analysis at approved laboratories

Permissions Granted

License to import / manufacture biostimulant product for use in agriculture

Biostimulant Definition

"...a substance or micro-organism or a combination of both whose primary function when applied to plants, seeds or rhizosphere is to stimulate physiological processes in plants and to enhance its nutrient uptake, growth, yield, nutrition efficiency, crop quality and tolerance to stress, regardless of its nutrient content, but does not include pesticides or plant growth regulators which are regulated under the Insecticide Act, 1968."

- India Fertilizer (Inorganic, Organic or Mixed) (Control) Amendment Order, 2021

Biostimulants Regulated Through NY/T 3831-2021 Organic Water-Soluble Fertilizers-General Regulations

Regulators

China Ministry of Agriculture and Rural Affairs

Order Aims

- Provides definition, resolving ambiguous legal status
- Offers pre-marketing procedures for biostimulants
- Outlines classification, general rules on raw materials, nutrient/harmful contents and label requirements
- Sets methods for testing and standards

Key Listings

Inoculants, Rhizobia etc. registered under **Microbial Fertilizers**. Other biostimulants listed under “**Water-soluble fertilizers (WSF)**” in following categories:

- WSF containing amino acid
- WSF containing humic acid
- Organic WSF containing alginic acid
- Organic WSF containing chitosan
- Organic WSF containing polyglutamic acid
- Organic WSF containing polyaspartic acid
- Other WSF containing molasses, low-value fish and its fermented products, as well as other organic materials

Requirements

Overseas applicants must use Chinese agent for application

Supply main ingredient used, pH value, water content (liquid fertilizer only), insoluble and limits of harmful contents

Toxicity test and efficacy trials required depending on raw materials, manufacturing process and end uses

Lesser requirements compared to e.g. Urea, Ammonium Nitrate and other fundamental nutrition products – do not require technical review for registration.

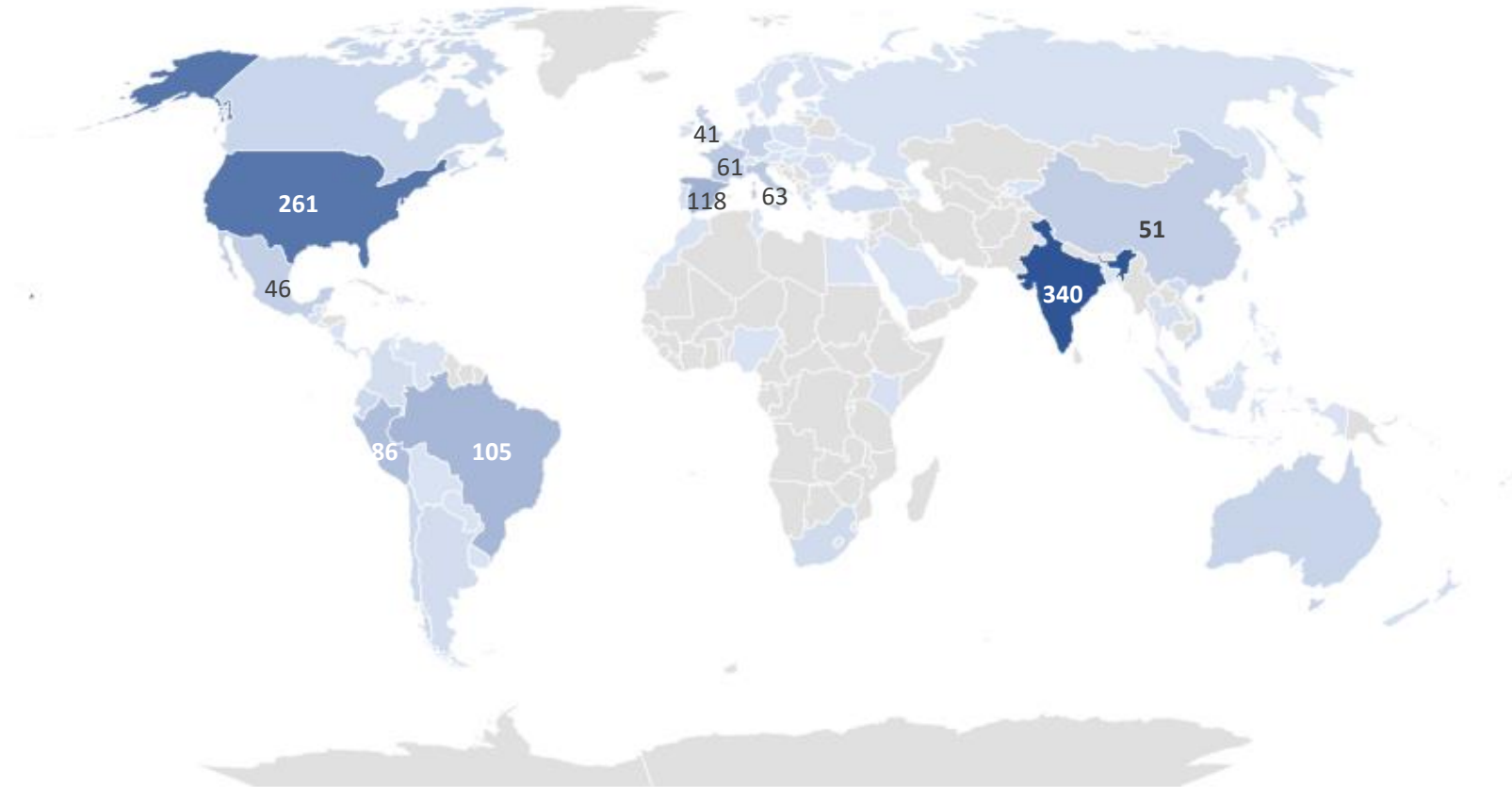
Permissions Granted

Permit for commercialisation



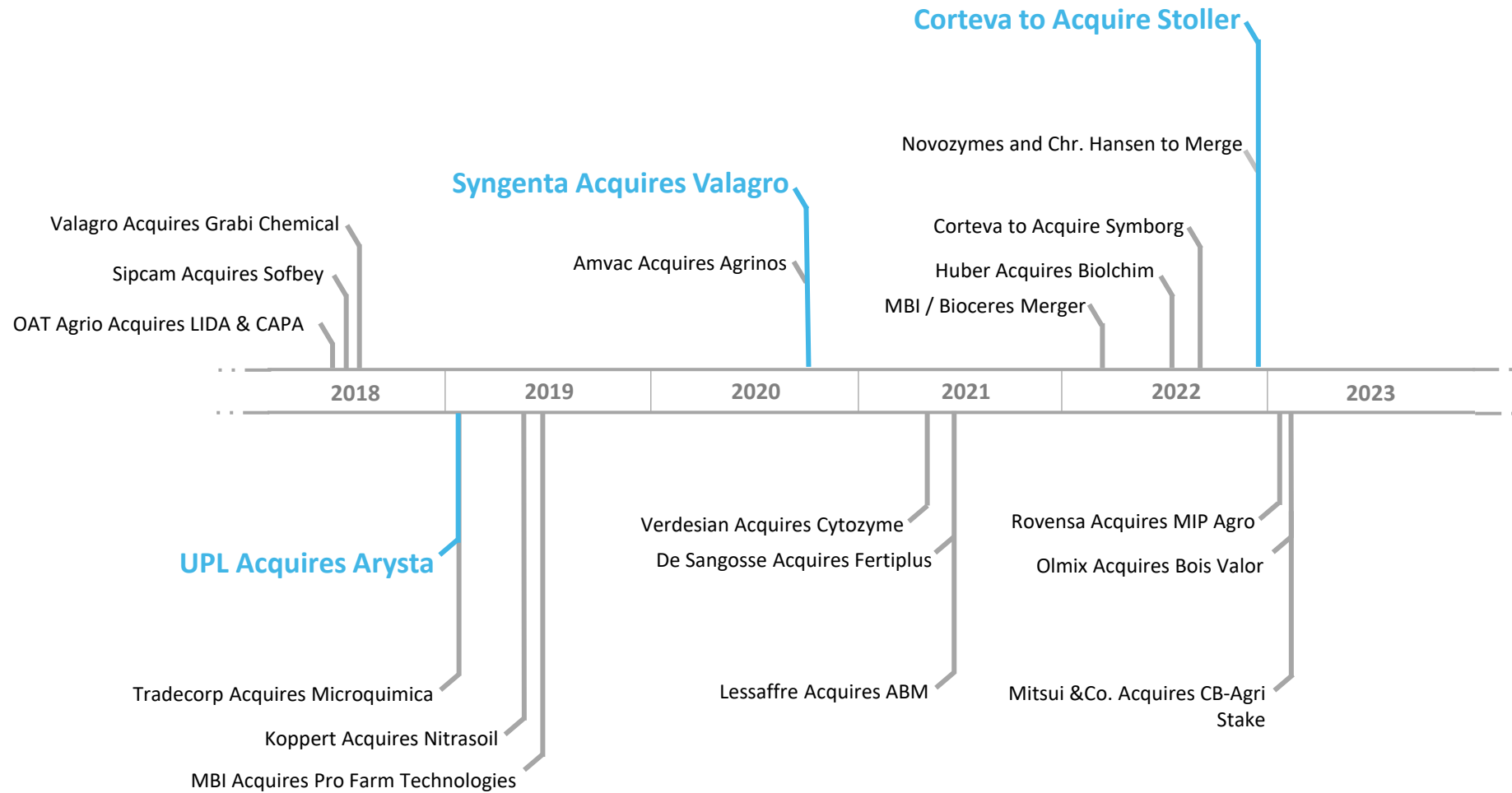
Company Landscape

Number of Biopesticides or Biostimulants Companies by Country.



- Very fractured market – ABI found 1,671 companies active in the space
- Relatively few basic manufacturers – many licensing and supply agreements and resellers
- Most have minor biostimulant turnover (\$1-5 m.) with a focus on specific product line, type, region etc.
- Majority sell biologicals as part of wider fertiliser/chemical pesticide lineup
- Market is expected to continue to consolidate in the coming years

Note: Companies active in selling, manufacturing and/or distribution.
Source: AgbioInvestor Biological Company Database



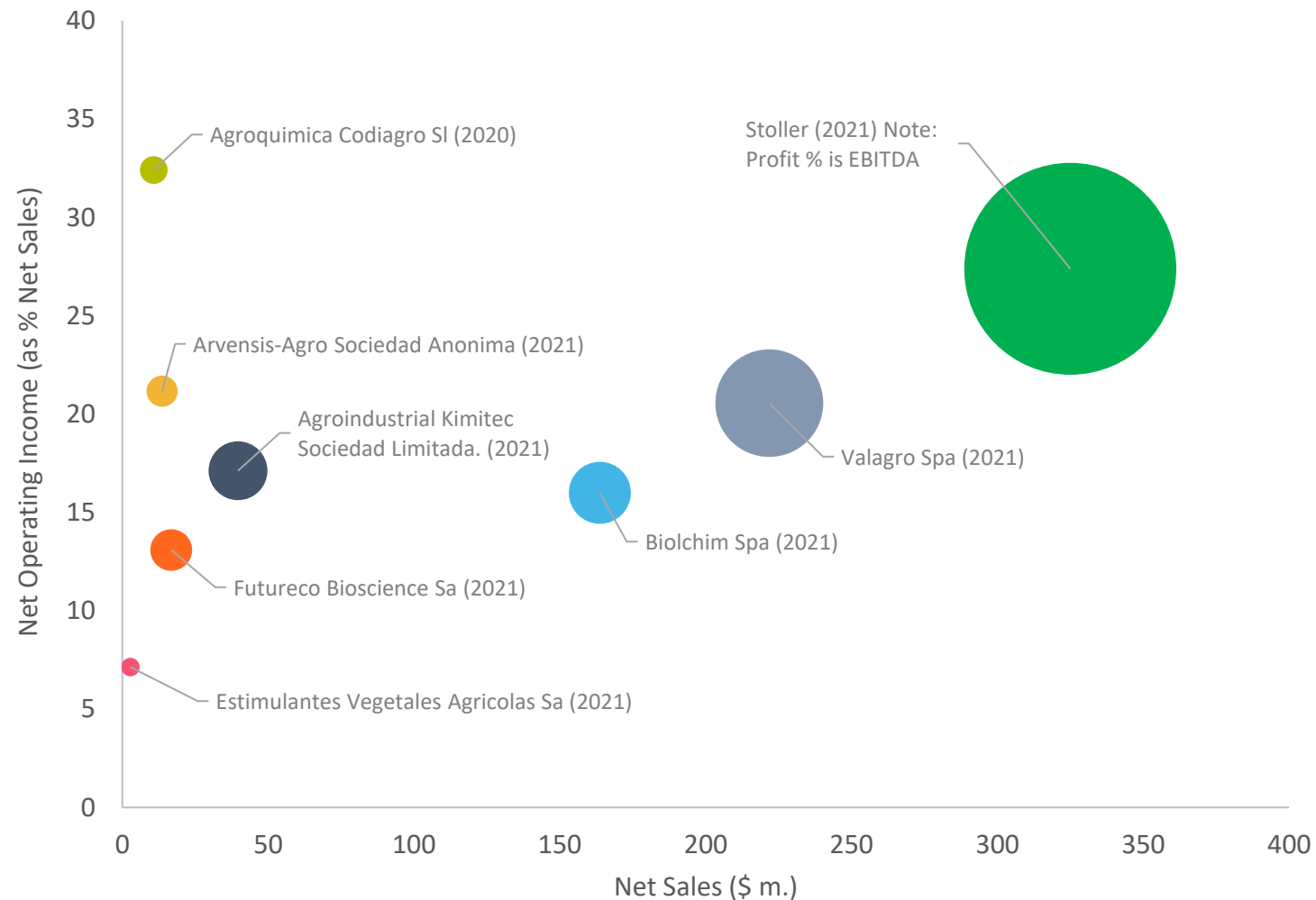
Note: Not comprehensive, some key deals highlighted.

- Profitability specifically from biostimulants difficult to assess:
 - many companies not pure-play
 - also offer e.g. biopesticides, nutrition etc.

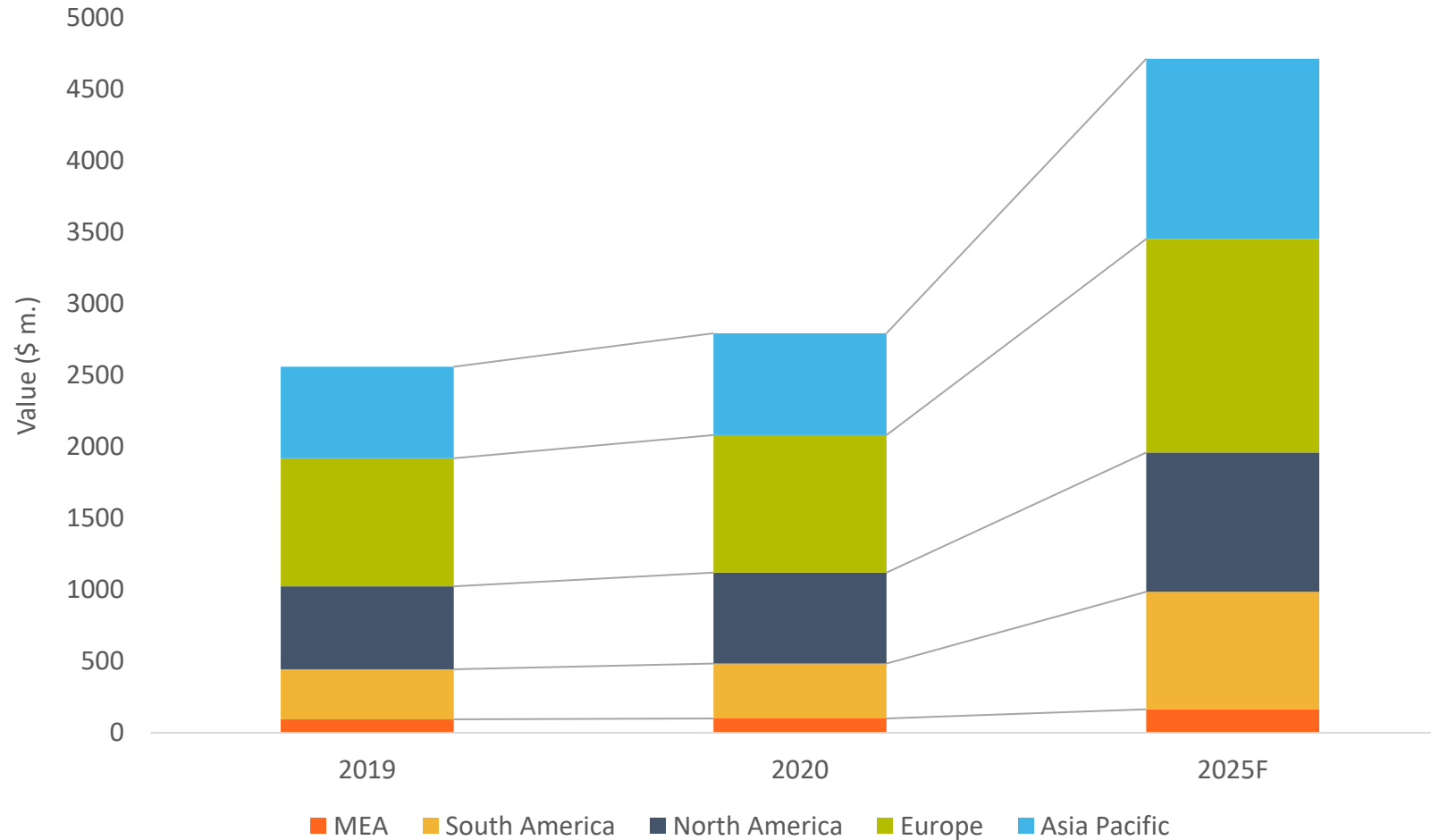
Companies in chart average 19.4% profitability

Note: (based on NOI as % Net Sales terms, Stoller as EBITDA)

- Large variability!
- Similar levels to agrochemical majors and biopesticide companies



Note: Bubble size reflects number of employees.
Source: Company financials.



Expected to grow **11.0%** p.a. in real 2020 USD terms to **>\$4.7 b.** in 2025.

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