



Bayer **SeedGrowth**<sup>™</sup>

## Biological Seed applied Technology an increasing trend

César Roberto Lamonega

**5<sup>th</sup> Seed  
Congress  
of the Americas**

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**Definition of Biologicals**

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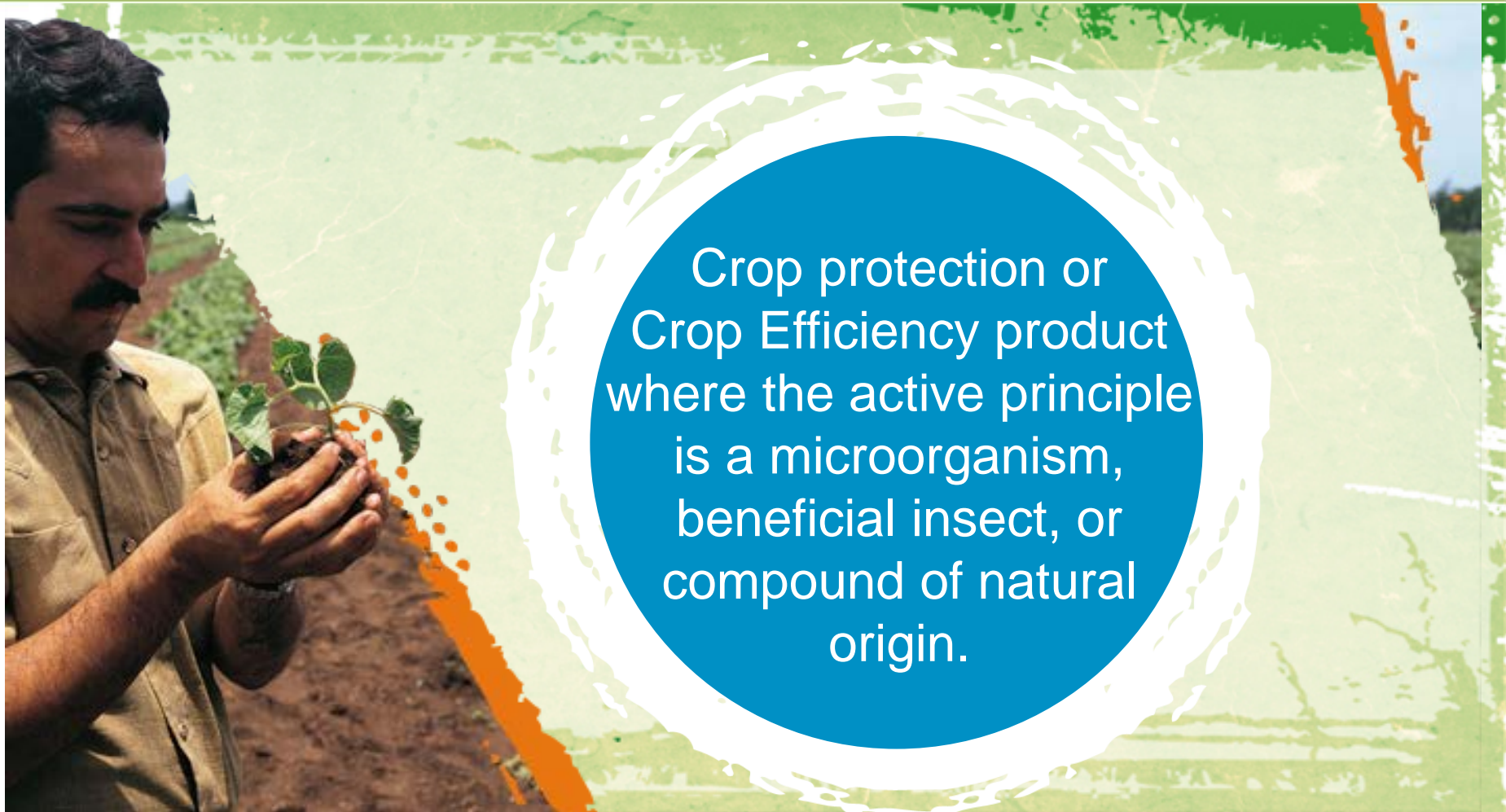
Biologicals and integrated crop solutions

**3**

Sustainable seed technology



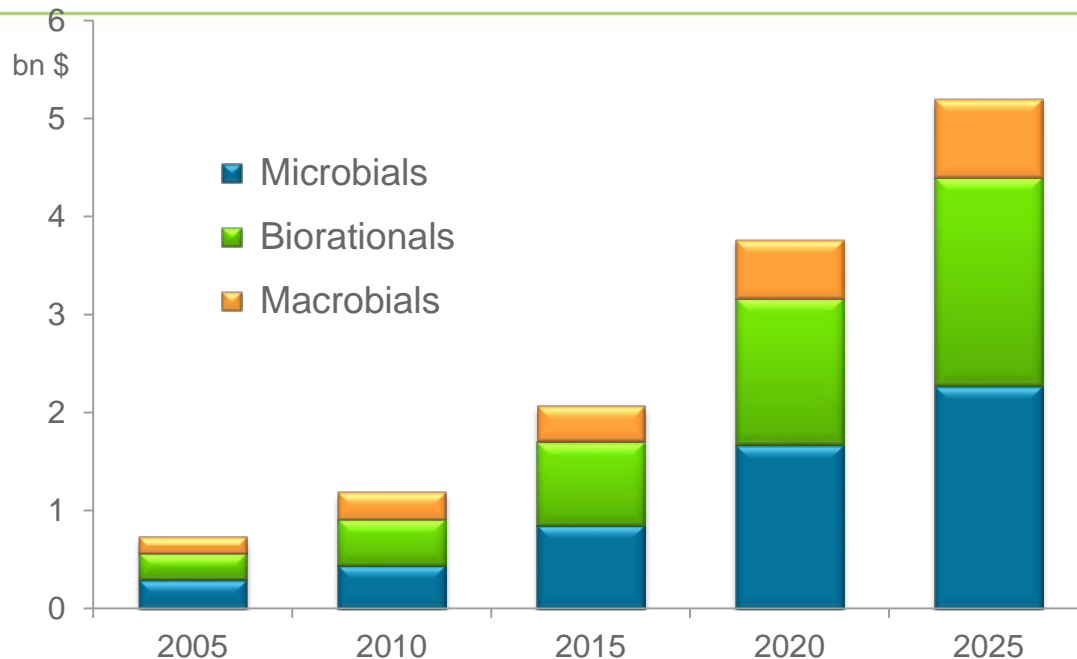
# What are Biologicals in Agriculture?



Crop protection or  
Crop Efficiency product  
where the active principle  
is a microorganism,  
beneficial insect, or  
compound of natural  
origin.



# Biologicals are in demand!



Source: Frost & Sullivan, Nov. 2009; BCC Research Survey 2010;  
CPL Business Consultants 2010

## Short term (<3 years)

- Food Chain demands
- Sustainable Use Directive EU
- New Biological product introductions
- Country low chem programs (e.g. France)

## Mid term (>5 years)

- Increasing demand for Biological solutions in emerging markets (*Brazil, China and India*)
- Sustainable growth of Biological solutions in the US and EU
- Investments BASF, Syngenta, Bayer, Monsanto & other

## Long term (>10)

- Introduction of new Biological technologies

- Average Market Growth (2005-2025): **> 10 %** Biologicals vs. Chemical < 3% CAGR
- Biologicals Market (2010-2020): 1.2 – 3.7 bn. US\$





# Biologicals are an area of increasing investment

## Syngenta launches breakthrough seed treatment nematicide



Basel, Switzerland, May 27, 2012

- Novel innovation against damage caused by nematodes
- First commercial product from Syngenta's new seed treatment technology
- Initial launch in USA for use on corn and soybeans

## Bayer CropScience acquires US-based biological company AgraQuest for close to US\$ 500 million

Further milestone to strengthen the fruits and vegetables business: Unique technology platform and promising biological pipeline; wide range of established green product brands; purchase includes R&D and manufacturing facilities

Monheim (PRWEB) July 11, 2012

Bayer CropScience announced today that it has signed an agreement to purchase AgraQuest, Inc. for a total of approximately EUR 500 million.

**CHR HANSEN**

improving food & health

## FMC Builds World-Class Platform for Biological Crop Protection with Global Strategic Alliance and Key Acquisition

FMC Corporation has built a world-class platform to serve the fast-growing biological crop protection market through two strategic transactions. On October 7, 2013, FMC announced it signed an exclusive and global collaboration agreement with Chr. Hansen, a leading biosciences company specializing in cultures, enzymes, fermentation, to develop and commercialize biological crop protection products.

FMC also announced the acquisition of the Center for Agricultural and Environmental Biosolutions (CAEB), a division of North Carolina-based RTI International, specializing in sustainable agriculture research. With these two transactions, FMC Agricultural Solutions has created an end-to-end biological crop protection technologies platform that complements its traditional strengths in synthetic crop protection chemicals.

Click [here](#) for more

**BASF**  
The Chemical Company

## BASF completes acquisition of Becker Underwood

2012-11-28

- New global business unit Functional Crop Care established
- Integration plans will be developed jointly
- Biological seed treatment solutions complement BASF's crop protection portfolio

Ludwigshafen, Germany – November 28, 2012 – BASF has completed the acquisition of Becker Underwood from Norwest Equity Partners, a U.S.-based private equity investment company, for a purchase price of 2 billion (€785 million). With the acquisition, BASF is now a leading global provider of technologies for seed treatment as well as seed treatment colorants and polymers. BASF has also expanded its product portfolio in the areas of biological crop protection, turf and horticulture, animal nutrition and landscape treatments and coatings.

The acquisition fits very well with our long-term growth strategy. It will provide our customers with an even wider range of innovative solutions for agriculture. And it also provides our new colleagues with access to BASF's global R&D platform as well as new markets and customers," said Dr. Andreas Kreimeyer, member of BASF's Board of Executive Directors responsible for the Agricultural Solutions segment and Research and Development.



## Novozymes acquires TJ Technologies Inc., further strengthens position in bioagriculture

The acquisition complements Novozymes' leading position within the growing market for sustainable bioagriculture solutions.

25. June 2013

Novozymes, has signed a definitive agreement to acquire TJ Technologies Inc. based in Watertown, South Dakota. The acquisition marks yet another milestone in Novozymes' business within sustainable bioagriculture.



May 30, 2012

## BioDirect™ Technology

An Agricultural Biological Platform

The latest addition to our research and development efforts is our agricultural biological platform, featuring BioDirect™ technology. Leveraging our genomics expertise, BioDirect technology uses molecules found in nature that we expect to develop for use in topically applied crop protection and other products. BioDirect technology may enable specific and effective products with a wide range of applications – including weed, insect and virus control.

**MONSANTO**



**BioDIRECT**



Bayer SeedGrowth™



Bayer CropScience

# Some examples of successful Biological Technologies in global Seed/Soil solutions today

Rhizobium  
Inoculants

Bacillus  
Firmus

Bacillus  
subtilis

Penicillium  
bilaai

Trichoderma

Signal  
Technology

Humic acid



VAULT<sup>HP</sup>

BIAGRO

RIZOBACTER

VOTIVO

SERENADE

Jumpstart®

QuickRoots®

TORQUE<sup>IF</sup>

fb<sup>sciences</sup>



# Biological Product Categories

## 1. Microorganism

- Bacteria (e.g. *B. thuringiensis*, *Bradyrhizobium*, *B. firmus*, *B. subtilis*, *Pseudomonas*)
- Fungi (e.g. *Beauveria bassiana*, *Verticillium lecani*)
- Virus (e.g. *granulosis virus*)



## 1. Biorationals

- Plant extracts & essential oils (e.g. neem, citrus, tea tree)
- Pheromones (*semiochemicals*) (e.g. mating disruption, mass pheromone trapping)



## 2. Macrobiotics

- Beneficial insects including predatory nematodes



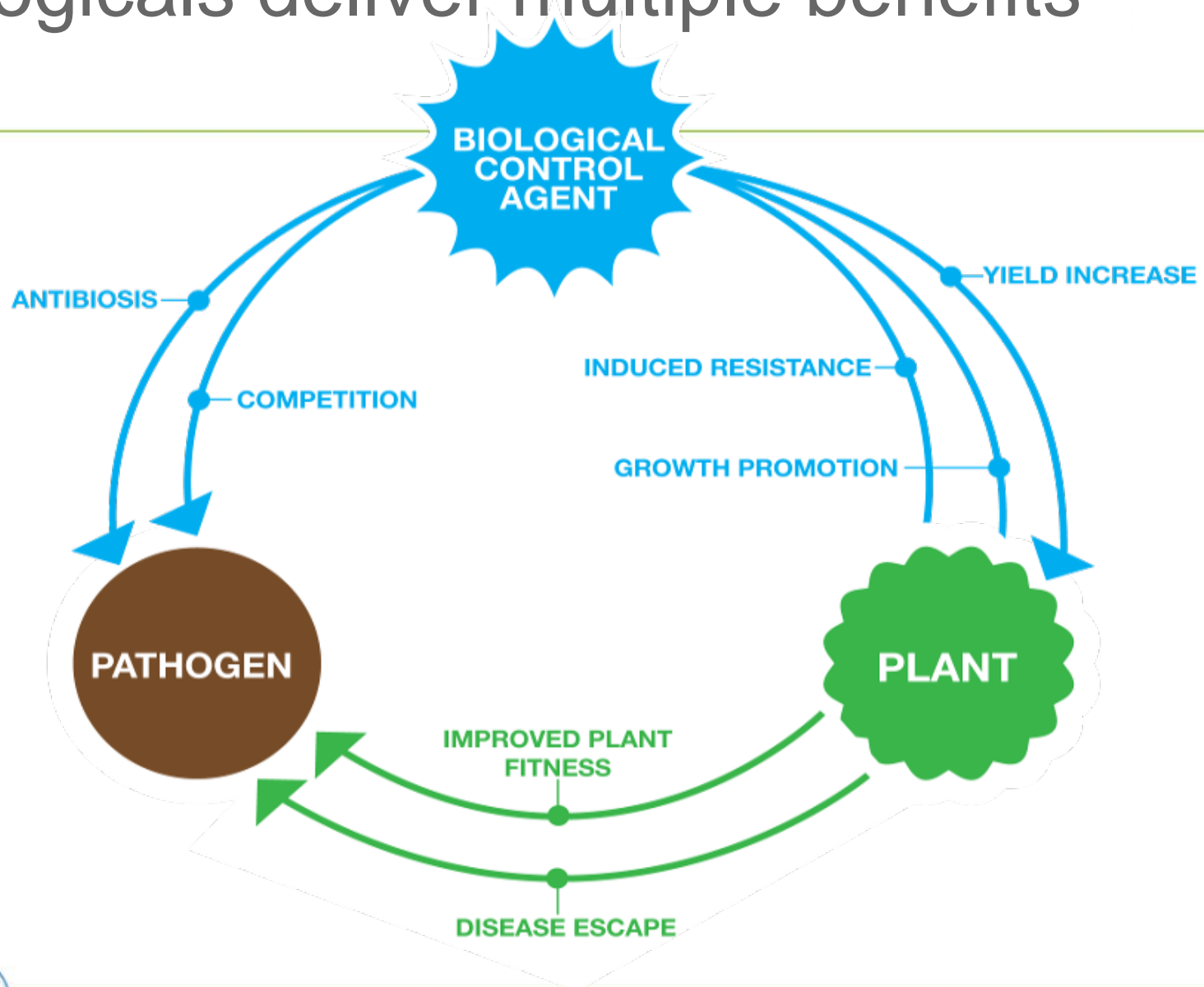
## 3. Other

- Cyclic peptides
- RNAi *RNA interference: Biological process of RNA molecules inhibit gene expression (potentially using microbes as inducer/carrier)*
- Gene delivery

*Excludes inorganic compounds (i.e. copper, sulphur)*



# Biologicals deliver multiple benefits

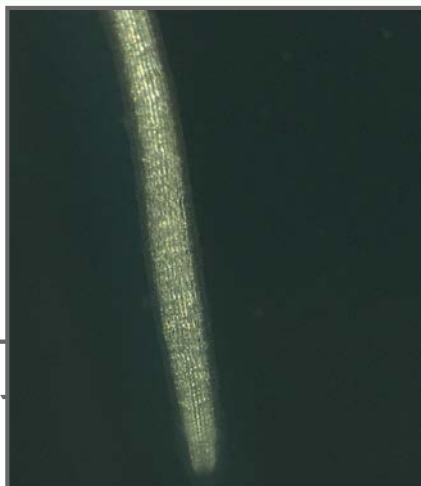




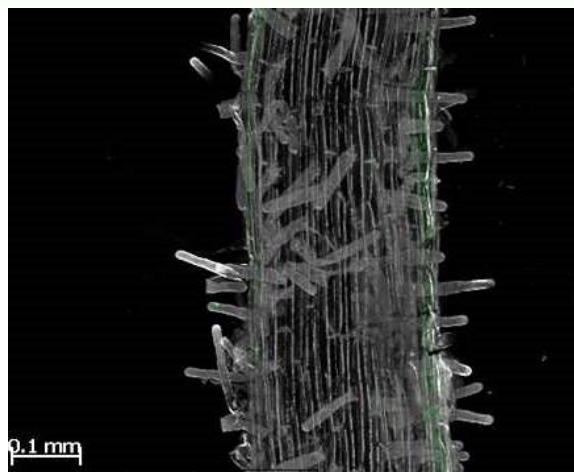
# Biological root colonization

Germinated tomato seeds dipped into a QST713 suspension and placed into ½ strength MS medium. After 5 days, the roots were visualized under microscopy in order to observe colonization.

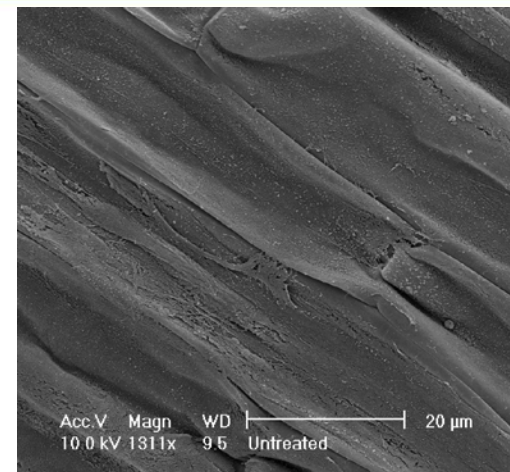
Untreated water



Digital Microscopy

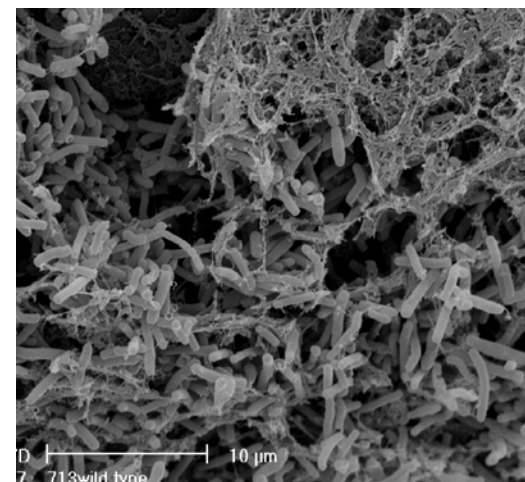
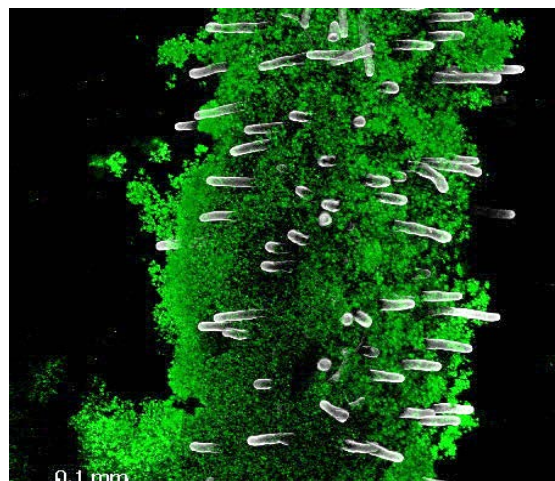


Fluorescence Microscopy



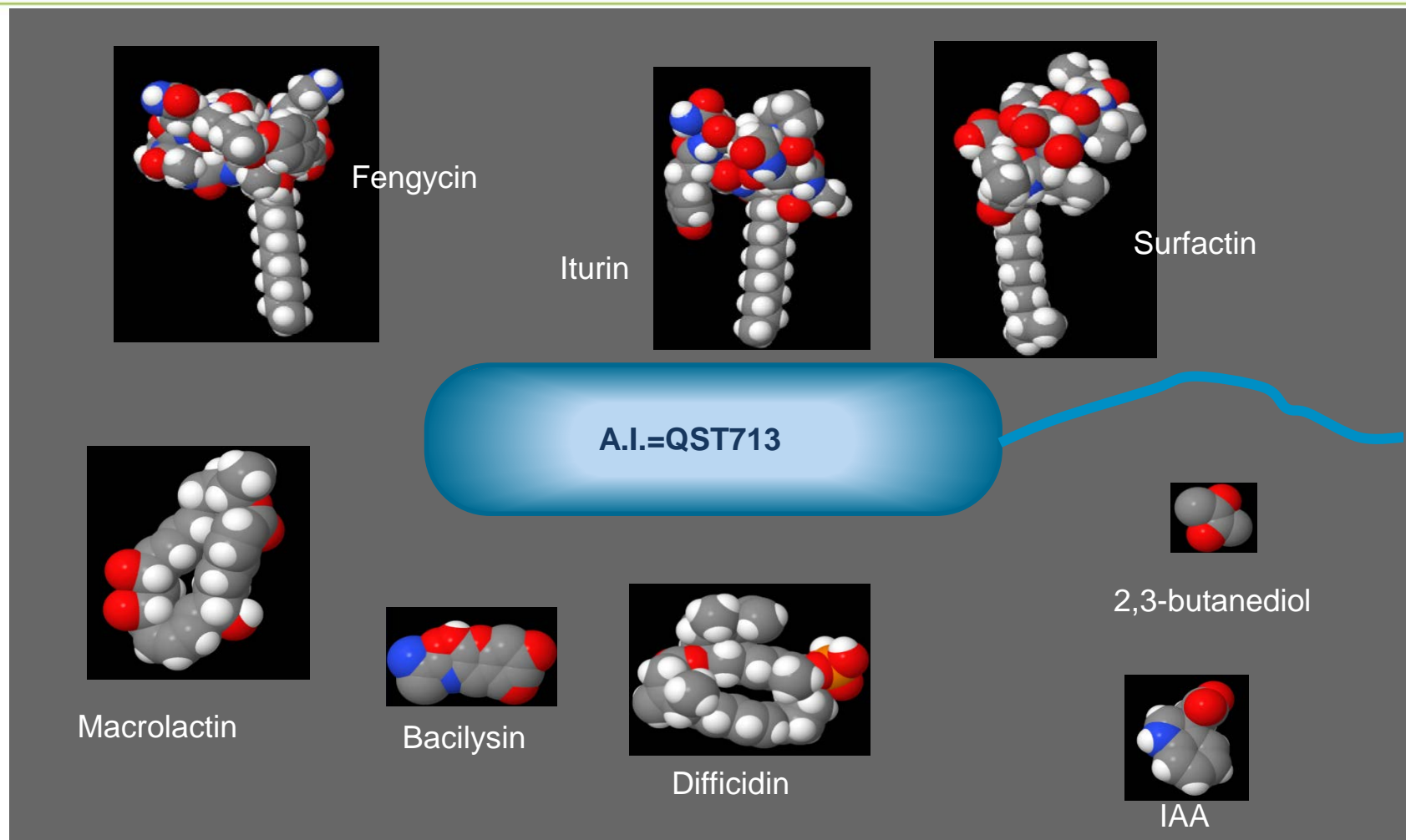
Scanning Electron Microscopy

B. Subtilis QST713



# Biologicals produce natural chemicals

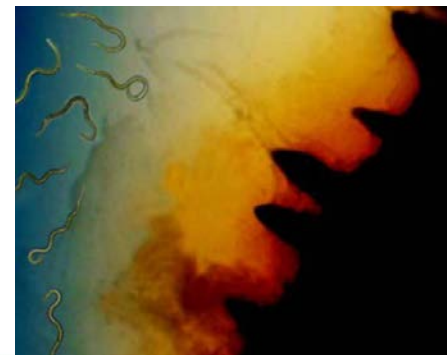
Single microbe can yield multiple products



# Biological Product benefits

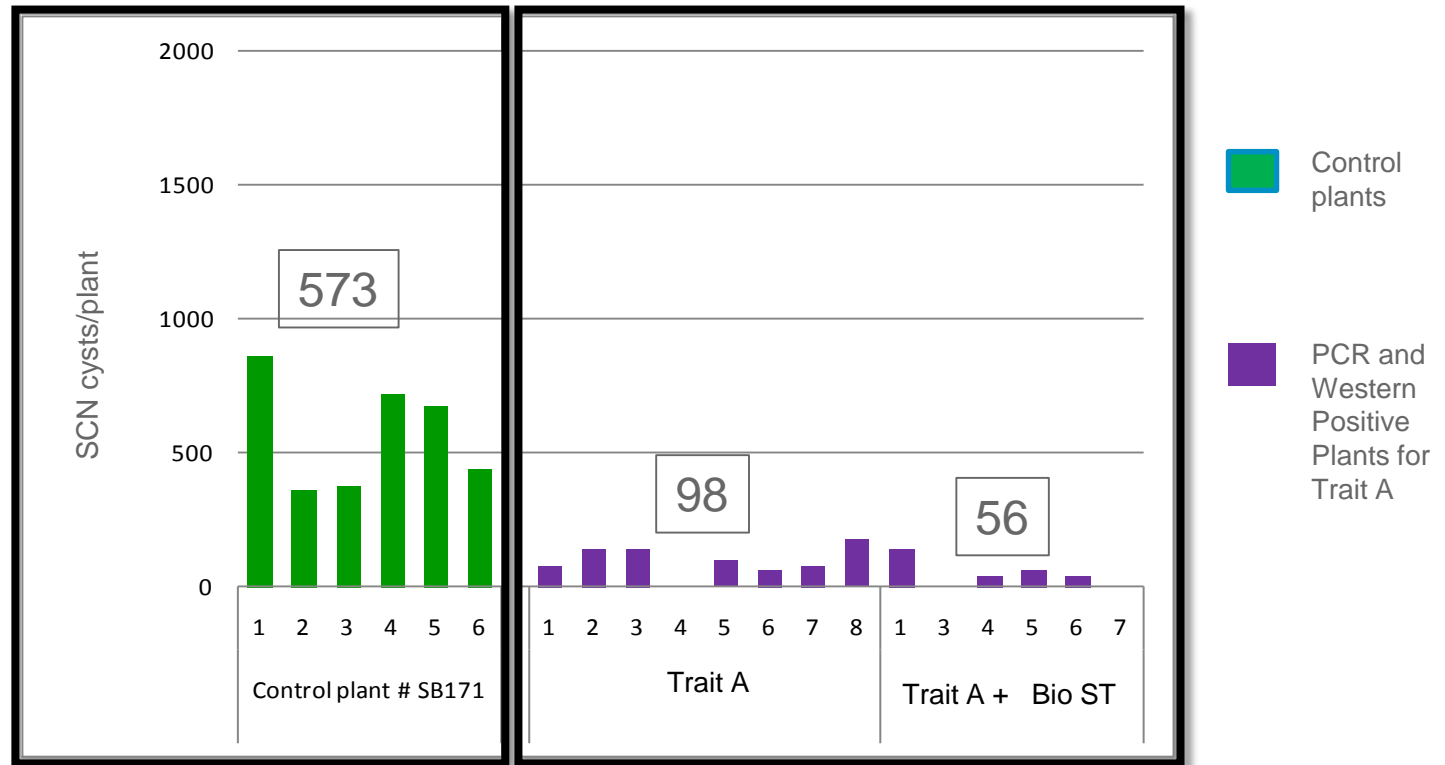
## Control

- **Can be direct control or barrier to penetration of the pest/disease or a plant stimulant to accelerate growth preventing infections**
  - Many companies and institutions developing products in this class
  - Spectrum of control is expanding
  - Application stability and more broadly adaptability to a range of environments
- **Products Example**
  - Bacillus firmus launched in 2010
  - Brought unfamiliar method of pest control for nematodes
  - Widely adaptable across crops and geographies
  - Naturally occurring product
  - Partner to nematode resistant genes
  - Improved applicator safety



# SCN Resistance with Biological Seed Treatment

## Individual plant cyst counts for Trait A soybean



Trait A expression correlates with reduction in SCN cysts counts in transgenic soybean plants & further reduction is available with a biological seed treatment





# Biological Product Benefits

## Plant Health

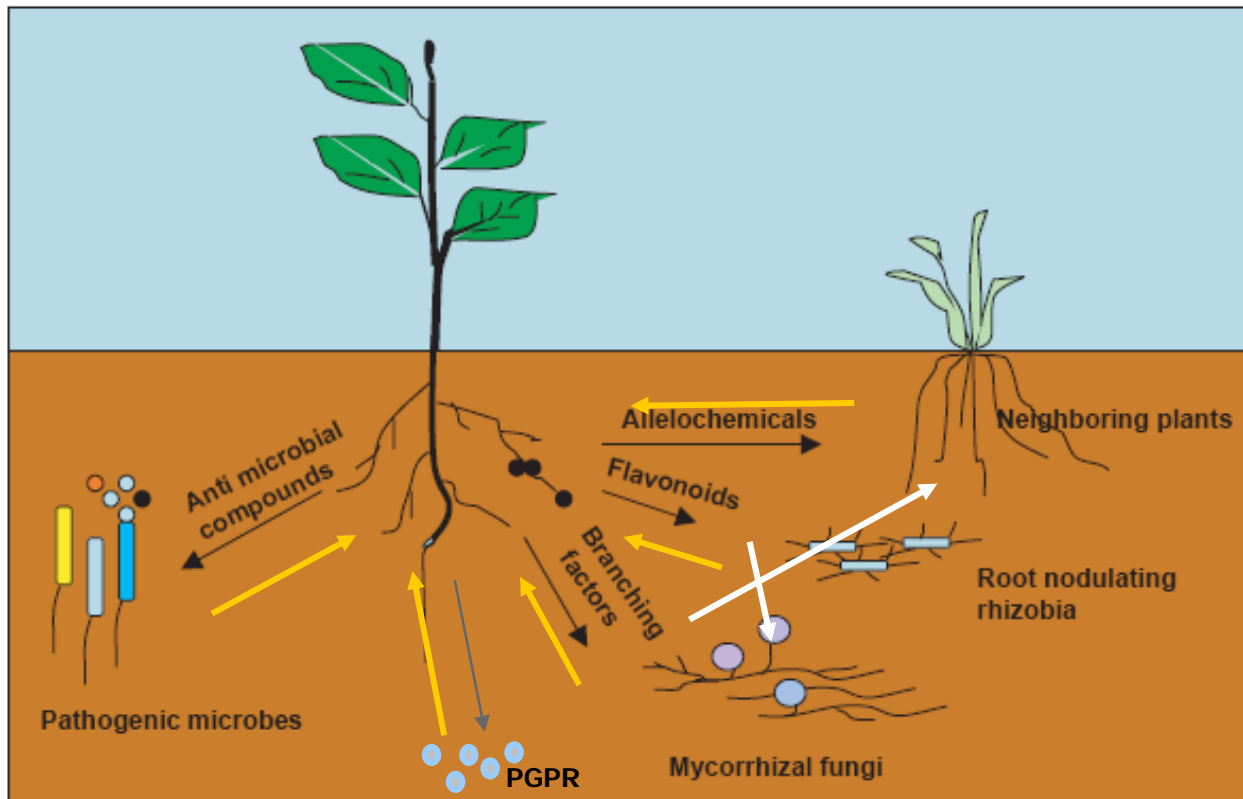
- **Plant defense** - Compounds that trigger direct health responses on the plant and **could complement new traits in seed**
- **Signal technology** – Compounds with effect on rhizobium bacteria or mycorrhizal fungi that **could enable other plant health mechanisms**
- **Anti-mycotoxins** – mycotoxin inhibitors, not necessarily something that kills the fungus with potential for **residual control not achievable with traditional products**





# Underground Communication

Mediated by root exudates and microbial compounds



▶ In the Rhizosphere multiple signaling products or microbes are able to have an effect on plants

# Biological Product Benefits

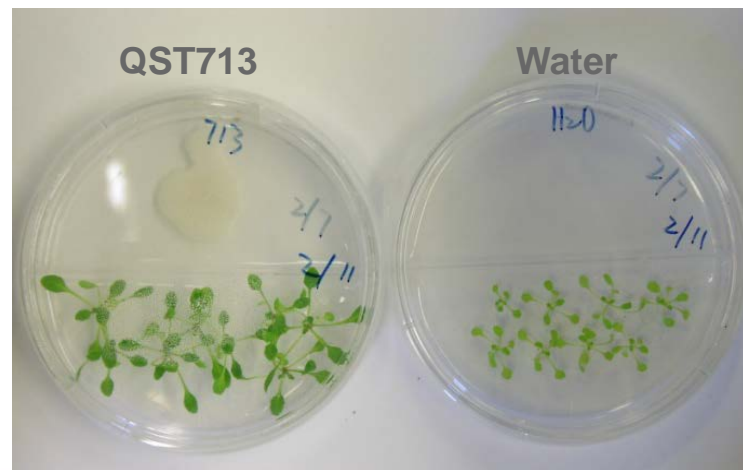
## Abiotic Stress Tolerance

- **Partner to Plants Drought Tolerance Characteristic's**

## Fertility/Yield Enhancement

- **Product improving plant health, promoting growth and yield**
  - Acquired resistance
- **Fertility**
  - Focus on minor elements with positive impact on the seed and seedling

Rice seed treated with QST713 at 64 oz/acre, grown under 60mM of salt for 4 weeks



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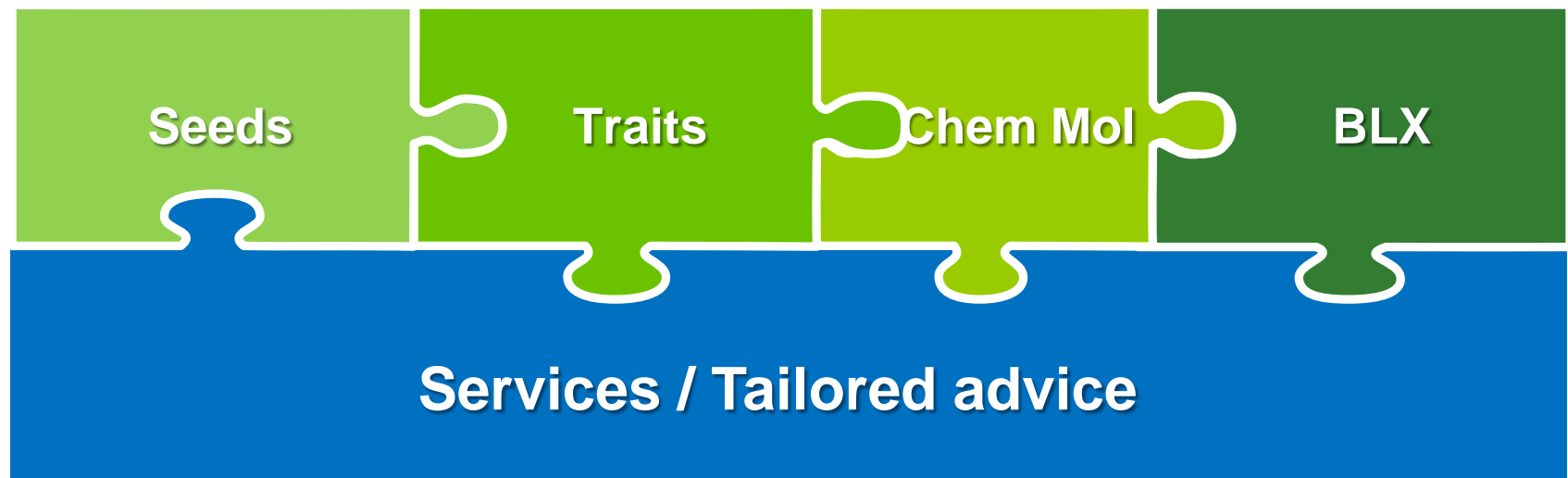
**3**

**Sustainable seed technology**



# Biologicals are a great tool in Integrated Crop Solutions (ICS)

**Integrated Crop Solutions** are offers of any combination of **Seeds, Traits, Traditional Chemical Molecules, Biologicals** and Services that are tailored towards our target customers and **create sustainable value** for them and the value chain



# Integrated Crop Solution will be Essential for Progress into Future Agriculture

Limited arable  
land coupled  
with rising  
demand



Climate change



## Safeguard and increase yields from constant land area

- **Better resource management** (targeted use of crop protection, irrigation technology, fertilizers and resistance management)
- **Increase yields through innovative technologies** (hybridization, plant biotechnology, better crop protection)

## Expand agricultural production in marginal areas

- **New crops with greater tolerance of drought and extreme temperatures**

## Increase tolerance of plants to climatic variability

- Develop **new varieties** using state-of-the-art technologies
- **Improve plant health and nutrient uptake**



Research and innovation are the key to mastering the challenges of agriculture





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# Competencies exist to lead in Sustainable Crop Solutions

Depending on specific market conditions, individual solutions for **customer needs** can be made available through different technology platforms

**Molecular Biology**

**Molecular Biology, Small Molecules and Biologics** can be efficient solution-providers for unmet customer needs - each requiring a different expertise

**Customer Needs**

Disease control  
Weed control  
Pest control  
Plant health  
Maximize Yield

**Synthetic Chemistry**

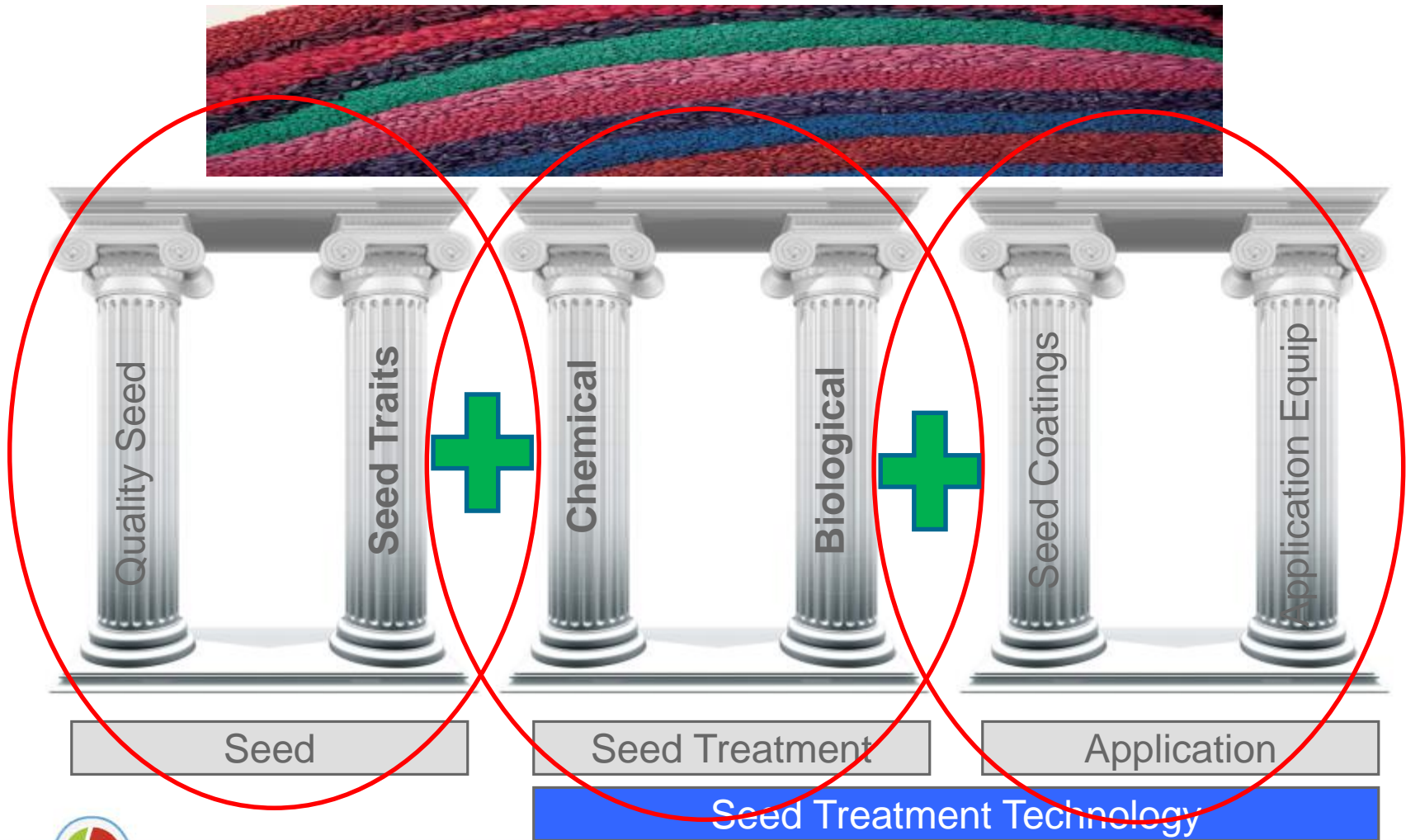
**Biologics\***

**Integrated Solution & offering for growers**

\*Suitable for conventional and organic agriculture



# The Pillars of Seed Technology



# With Biological Innovations the Seed Industry can address unmet needs today & in the future

**Solution Thinking**

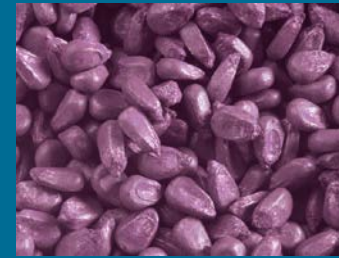
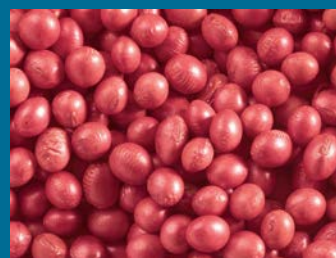
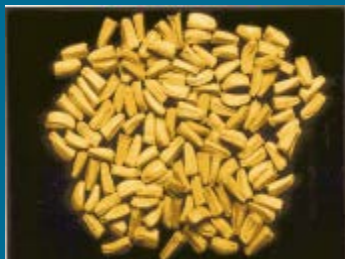
**Product Thinking**

## Potential unmet needs\*

- ✓ Sustainable Cropping
- ✓ IPM / ICM compatible  
(e.g. safe for beneficials)
- ✓ Deal with some difficult pests/diseases (e.g. thrips, bacteria, nematodes, etc.)
- ✓ Yield increase (*quality & quantity*)  
i.e. *plant health/yield enhancement*
- ✓ Resistance Management
- ✓ Lower chemical input
- ✓ Flexibility in use (*low REI or PHI*)
- ✓ Worker safety
- ✓ Enabling Global Trade  
(*residue management*)

\* different unmet needs can also be addressed with chemical





Science For A Better Life

Thank you!

**5<sup>th</sup> Seed Congress  
of the Americas**



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