

# Biologicals for Sustainable Agriculture & Syngenta's Solutions

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Syngenta Biologicals Research

## Content

- Agricultural Biologicals introduction
- Overview of current biologicals industry and technology
- Syngenta Biological R&D
- Biologicals Application In China
  - RootEco - Syngenta Integrated Solution of Rhizosphere Ecosystem

Farmers need more sustainable ways to grow their crops to meet consumers’ increasing demands about the way food is produced



By 2050, farmers will need to grow 50% more crops, in a sustainable way, to ensure enough safe and affordable food for everyone.

Farmers face numbers of challenges in a bid to achieve this goal

- 1 Limited crop protection tools due to a stringent regulatory environment and a policy drive for sustainable agriculture
- 2 Food chain and public pressure towards low or no residues in food, further limits farmer options
- 3 Reduced solution efficacy due to resistance and pest shifts, demanding new modes of action
- 4 Lower yield attributable to climate change (drought, heat and cold stress, soil health challenges)
- 5 Poor economics, with increasing cost of farm input, such as fertilizers

# What do we mean with biologicals ?

## Biocontrols

Products based on naturally-occurring materials that are used for biotic stress management in **controlling** fungal and bacterial diseases, arthropod pests, nematodes and weeds.

## Biostimulants

Any substance, that is applied to plants, seeds or the root environment with the intention to **enhance** natural processes of plants. Benefiting nutrient use efficiency, tolerance to abiotic stress or crop quality.

## Nutrient Use Efficiency\*

Microbial based products that are used for **fixing Nitrogen**, Phosphorus solubilization, improving nutrient availability and uptake, and promoting plant growth and soil health.

\*considered as Biostimulants in some markets

**Agriculture Biologicals** are a diverse groups of products derived from natural **microorganisms** (bacteria ,fungi and virus); **plant extracts**, **beneficial insects**(e.g. predatory mites) or **organic matter/ Biochemicals**; **semiochemicals** (e.g. pheromones).

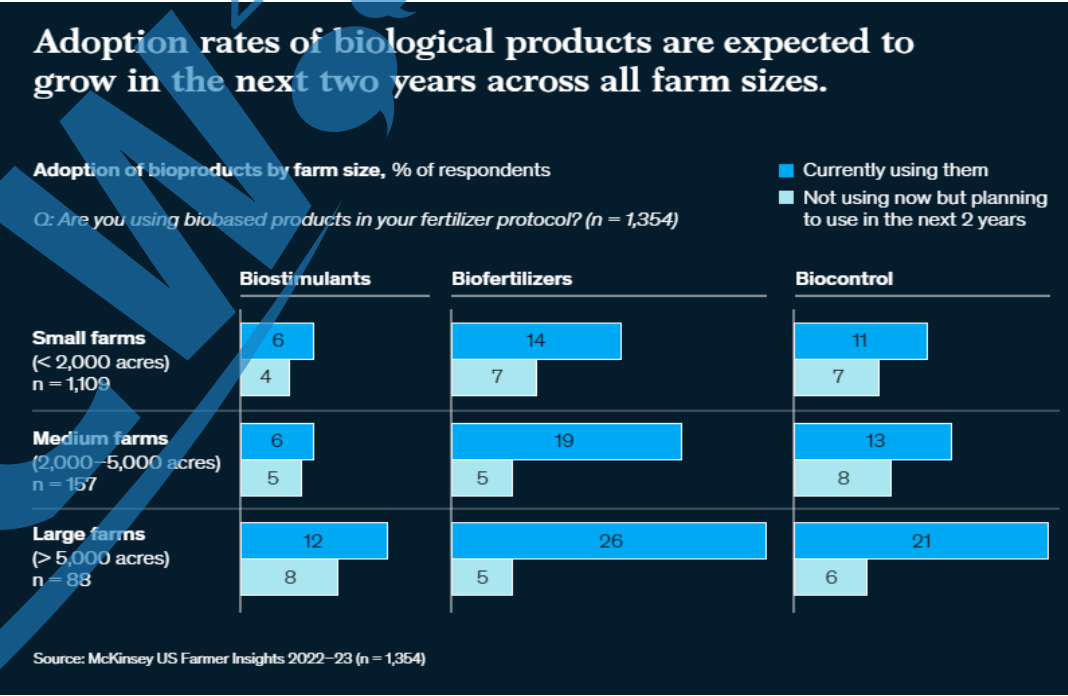
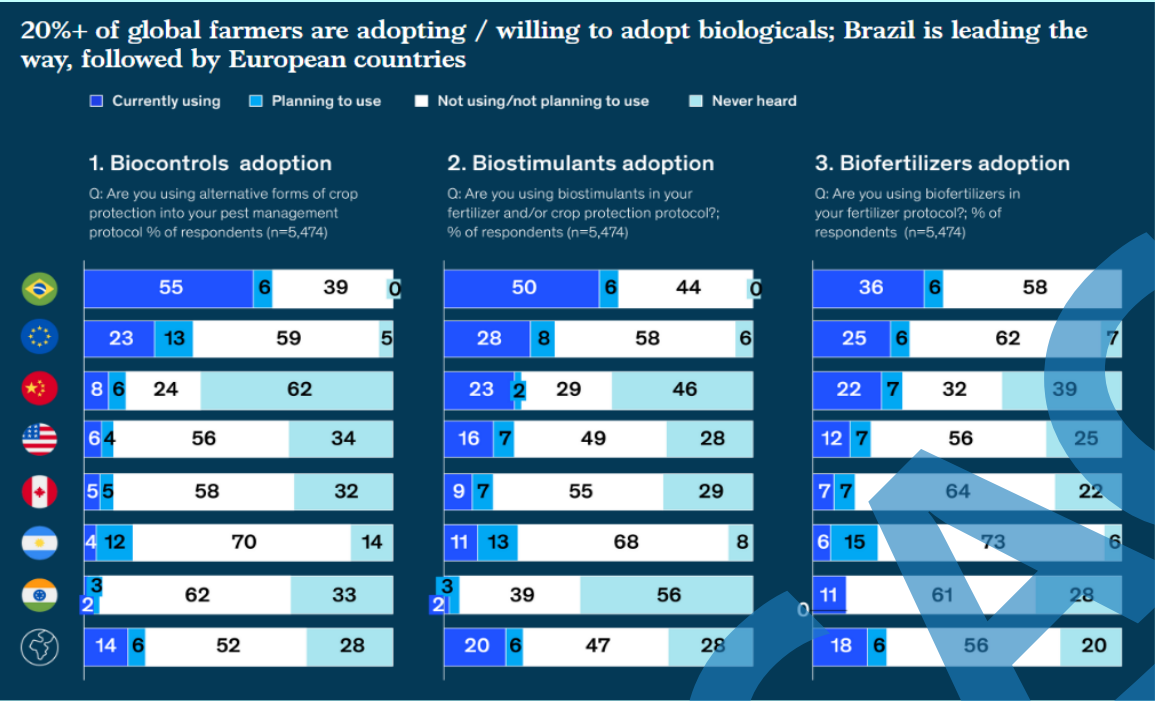
\* NUE includes biofertilizers (estimates from D&T report on biofertilizers)

Biostimulants includes water optimization

Despite size and growth rate, Syngenta does not consider micronutrients in scope due to highly commoditized market and limited opportunity for innovation and differentiation

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# Global Trends – Biologicals Adoption



McKinsey Farmers Insight 2022

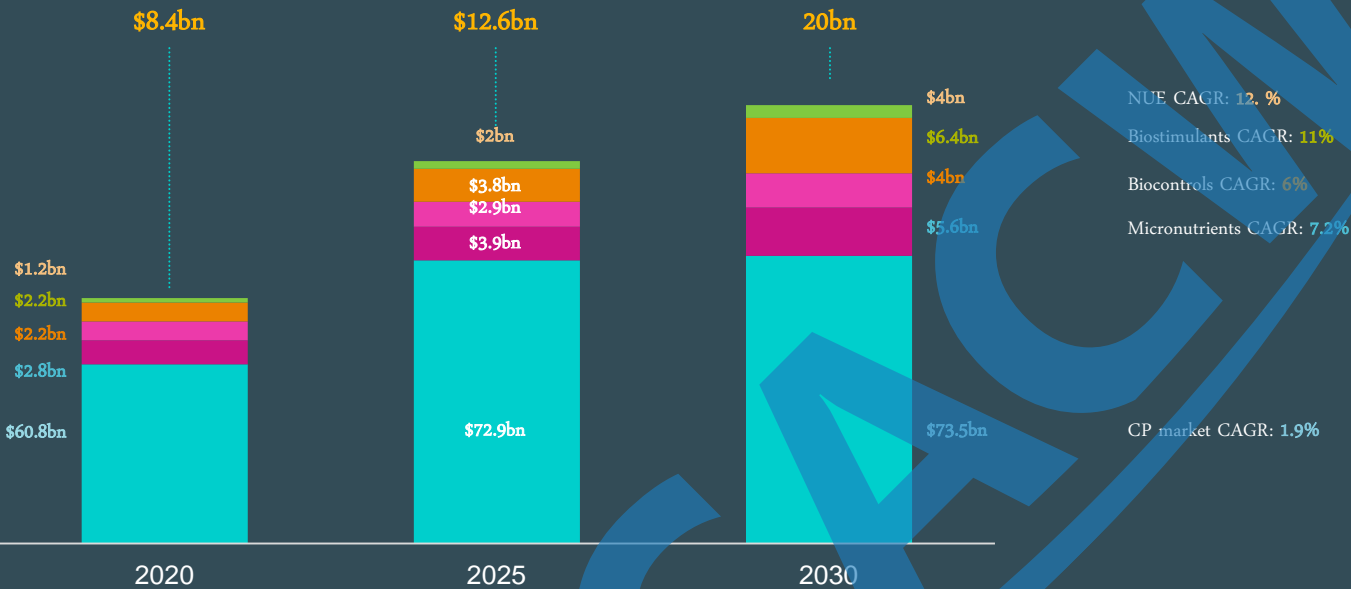


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# Biologicals expected to grow to \$20b

- 4.5x faster growth than conventional CP
- From ca 10% of CP market in 2020 to > 20% in 2030
- Fastest growth driven by nutrient use efficiency (NUE) and biostimulants



General Note: Biologicals market excluding copper and sulfur, fermentation products and seed treatment  
Sources: Agbioinvestor and Syngenta estimates for biocontrol and biostimulant market. 2. NUE is based on internal estimates and D&T report on biofertilizers, micronutrients based on Mordor Intelligence report

## Growth drivers



### Biocontrols

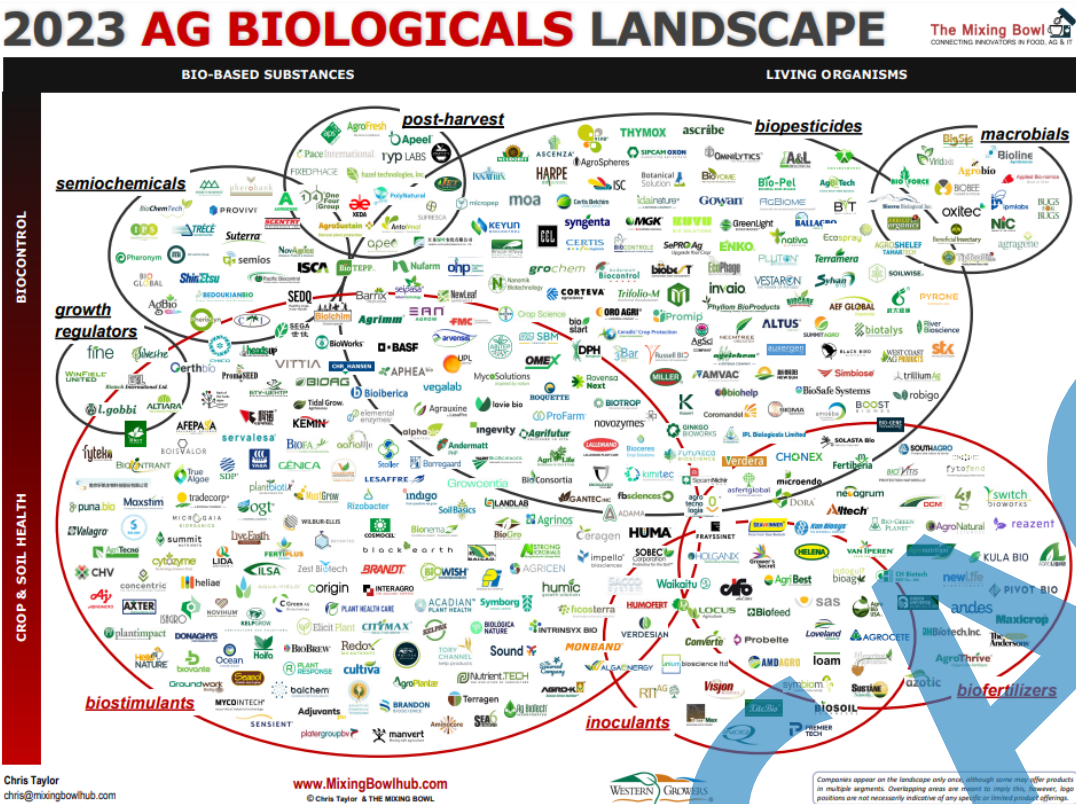
- Food chain pressure
- EU Green Deal
- Resistance and pest shifts



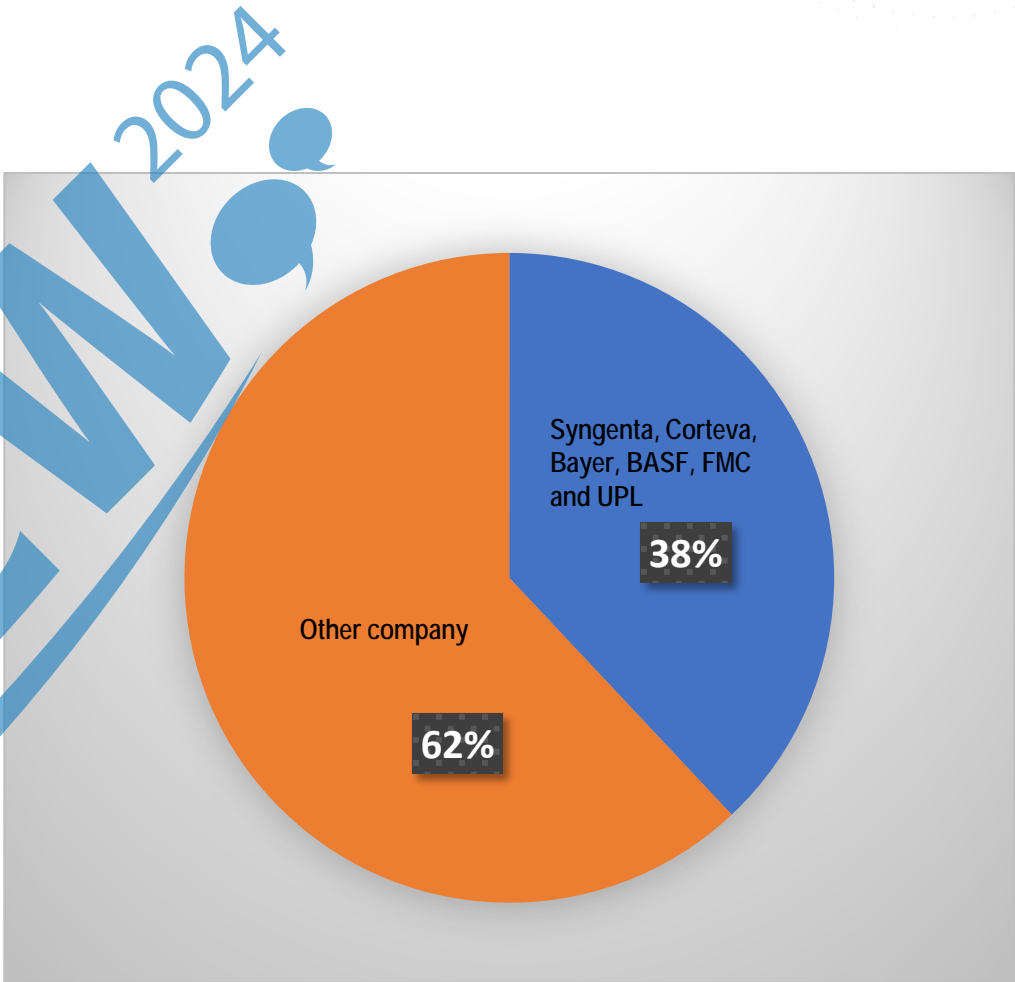
### Biostimulants, NUE

- Climate change
- Increased farmer awareness
- Growing input costs

# Biologicals Company Diversity



2023, <https://www.mixingbowlhub.com/>



In 2020 **Syngenta CP** acquired **Valagro**, accelerating our position in Biologicals. Combined with Syngenta capabilities, we have become the market leading Biologicals R&D and commercializaion platform



- Acquired in 2020
- Growing biologicals business under Syngenta Group



More than 1,000 employees



- Science based innovation
- New research center in Atesa in 2021 (€5.2m)

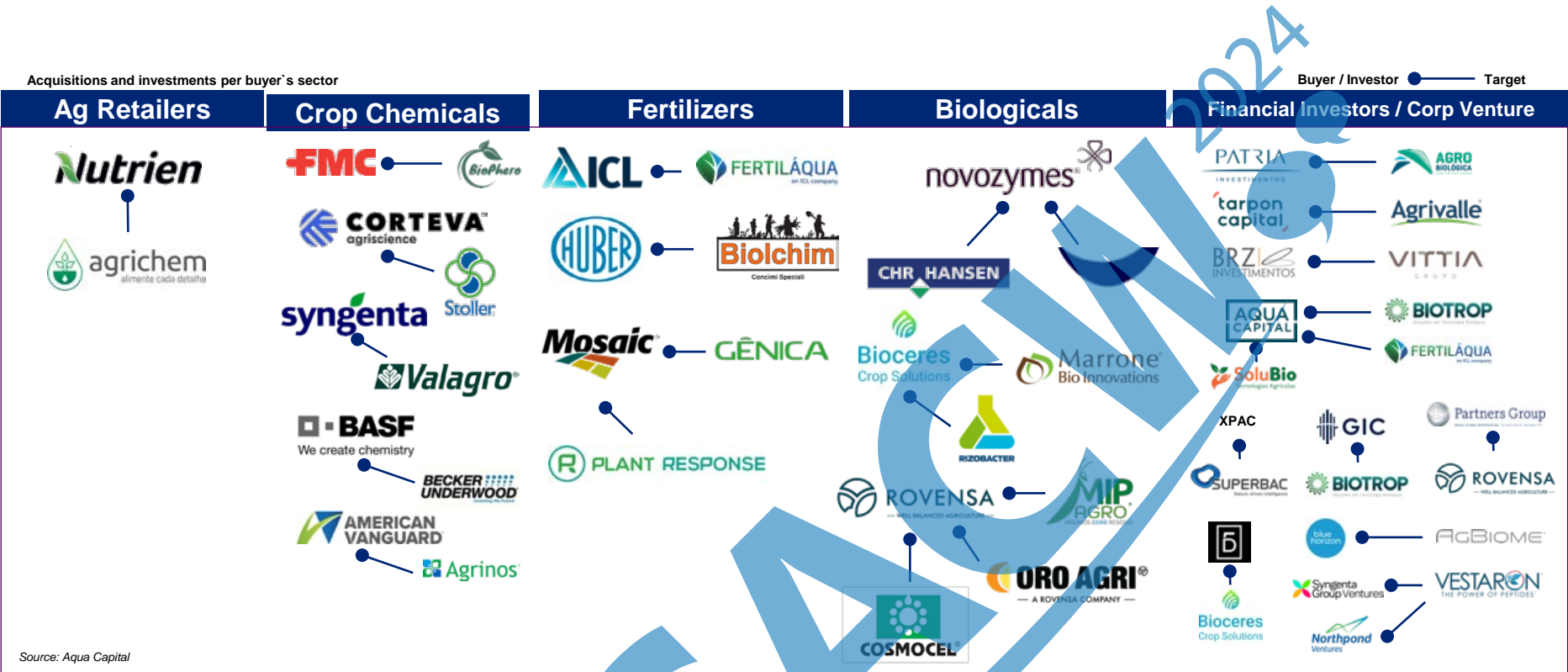


Global reach and unique commercial model through Biosquad





# Speedup Biologicals through Integration and Collaboration



Aqua Capital, 2023

145 million RMB  
Liaoning Weike 100%  
Tetramycin

479 Million RMB Fujian KaiLi 85.12%  
Zhongshengmycin

830 M RMB Shannxi makeboluo 100%  
Kasugamycin

CHINA GRAND ENTERPRISES  
中国远大集团



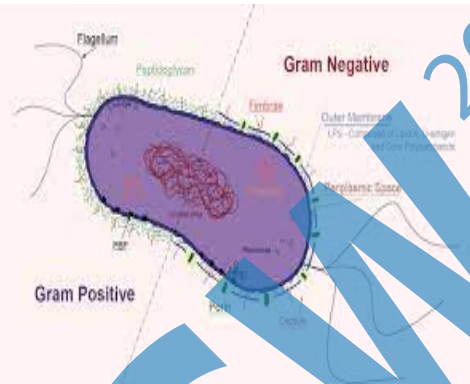
# Current Biologicals Technologies

2019~2023 Biologicals in China

中国2019-2023 登记的生物农药活性成分	
赤霉素	5
28-高芸苔素内酯	4
吲哚丁酸	4
24-表芸苔素内酯	2
28-表芸苔素内酯	2
氨基葡萄糖	2
卞氨基嘌呤	2
14-羟基芸苔素甾醇	1
24-表芸三表芸	1
d-柠檬烯	1
S-诱抗素	1
白藜芦醇	1
贝莱斯芽孢杆菌 CGMCC No.	1
博落回提取物	1
补骨脂种子提取物	1
草地贪夜蛾核型多角体病毒	1
侧孢短芽孢杆菌A60	1
除虫菊提取物	1
反-7, 顺-9-十二碳二烯乙酸酯	1
反-8-十二碳烯乙酸酯	1
谷维素	1
冠菌素	1
哈茨木霉菌DS-10	1
互生叶白千层提取物	1
几丁寡糖素酯酸盐	1
解淀粉芽孢杆菌 SN16-1	1
解淀粉芽孢杆菌HT2003	1
解淀粉芽孢杆菌ZY-9-13	1
糠氨基嘌呤	1
枯草芽孢杆菌	1
尿囊素	1
羟烯腺嘌呤	1
芹菜夜蛾核型多角体病毒 K	1
球孢白僵菌ZJU435	1
三十烷醇	1
杀线虫芽孢杆菌 B16	1
顺-8-十二碳烯醇	1
顺-8-十二碳烯乙酸酯	1
撕裂蜡孔菌GXMS1	1
酰氨基葡萄糖酯酸盐	1
异硫氰酸烯丙酯	1
银杏果提取物	1
诱虫烯	1
爪哇虫草菌J01	1
爪哇虫草菌JS001	1
总计	59



Bacillus



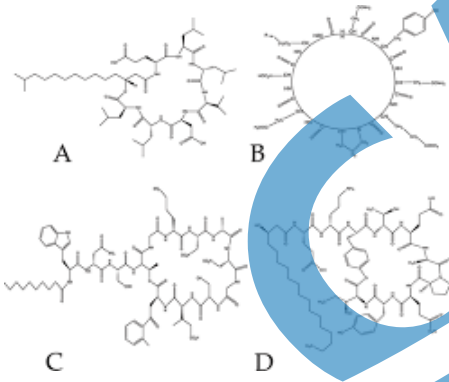
Gram -



Fungi



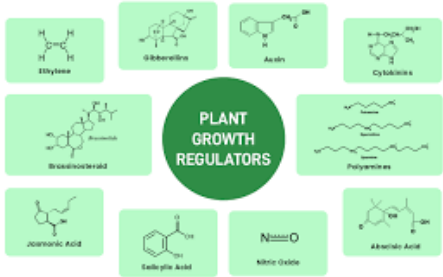
Baculovirus



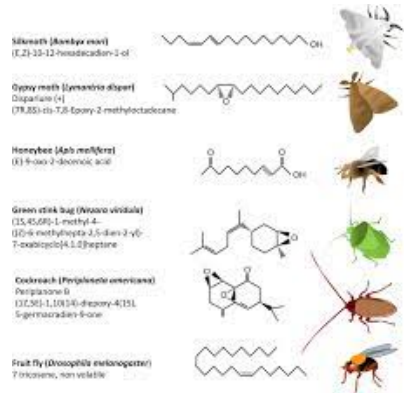
Metabolites



Plant extracts



Plant growth regulators



Insect Pheromones



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Classification: External

Web sourcing 2023



## Pivot Bio (联合固氮)

Active ingredient: *Kosakonia sacchari* 6-5687,  $\geq 1 \times 10^8$  CFU/ml  
*Klebsiella variicola* 137-2253,  $\geq 1 \times 10^8$  CFU/ml



### Mode of Action

Pivot Bio optimizes microbes' natural ability to produce nitrogen for corn crops. In multi-year research studies, corn planted with Pivot Bio PROVEN<sup>™</sup> microbes show improved growth when compared to the control.

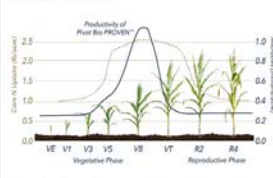


### Studies for Root Colonization



The data from this fluorescent scan validates how Pivot Bio delivers sufficient and viable microbes to ensure robust colonization. Pivot Bio microbes feed off the exudates of the corn plant and deliver nitrogen to the plant daily and throughout its growth cycle.

### Nitrogen Utilization

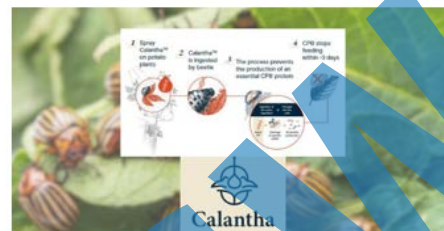


The corn plants demand for nitrogen over the growth cycle is in correlation to the nitrogen production of Pivot Bio PROVEN<sup>™</sup>.



## GreenLight's new biopesticide fights invasive Colorado potato beetle

January 9, 2024 / Agriculture Latest News / By Bio News Staff

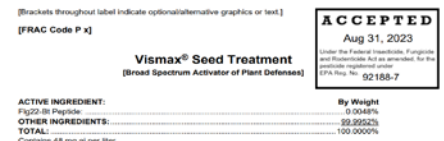
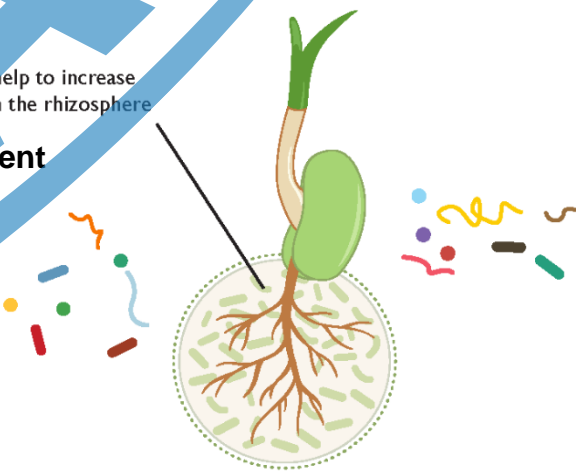


Works best against small larvae



Beneficial microbes help to increase nutrient availability in the rhizosphere

### Seed Treatment



Flg22 induces defense gene expression to trigger both local and systemic immune responses and is thus widely used in plant defense studies.

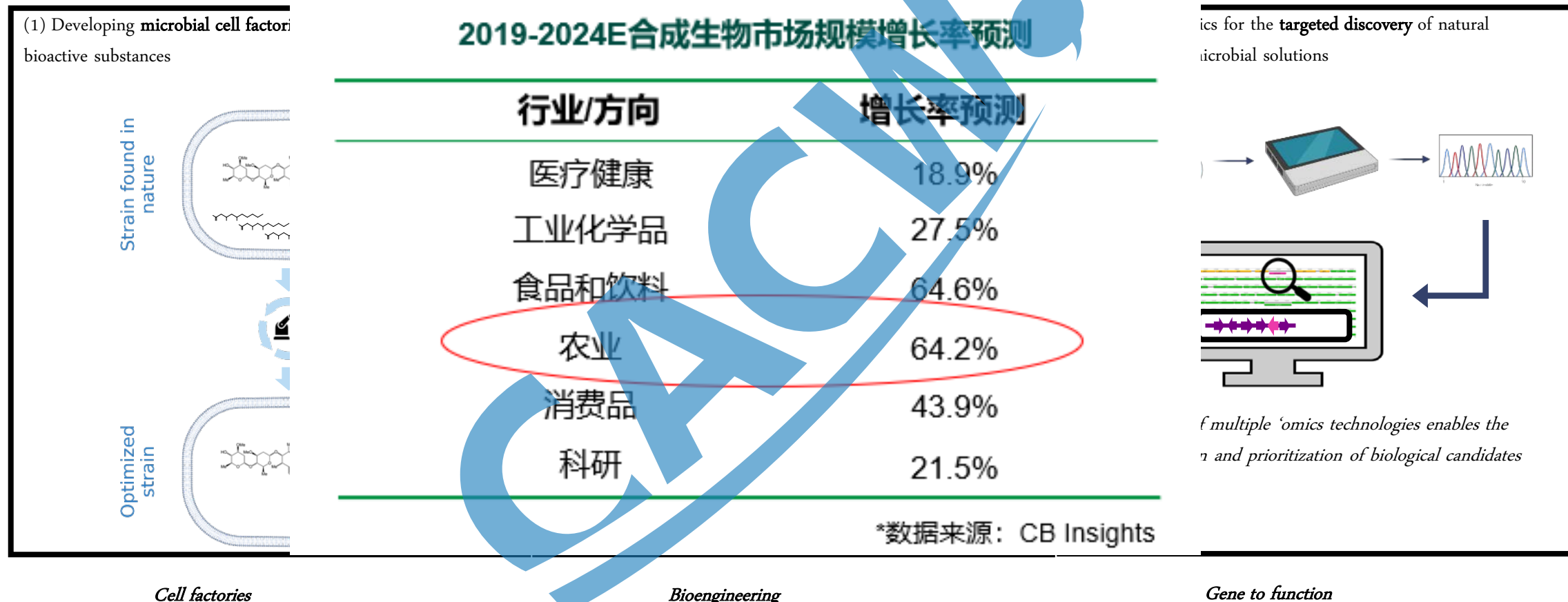


AMP (anti-Microbes-Peptides)



# Synthetic Biology in Biologicals Research and Application

Application of engineering principles to biology





# The science behind biologicals-

Syngenta Global Biological Research and Development

CACW 2024

Our Innovation playground

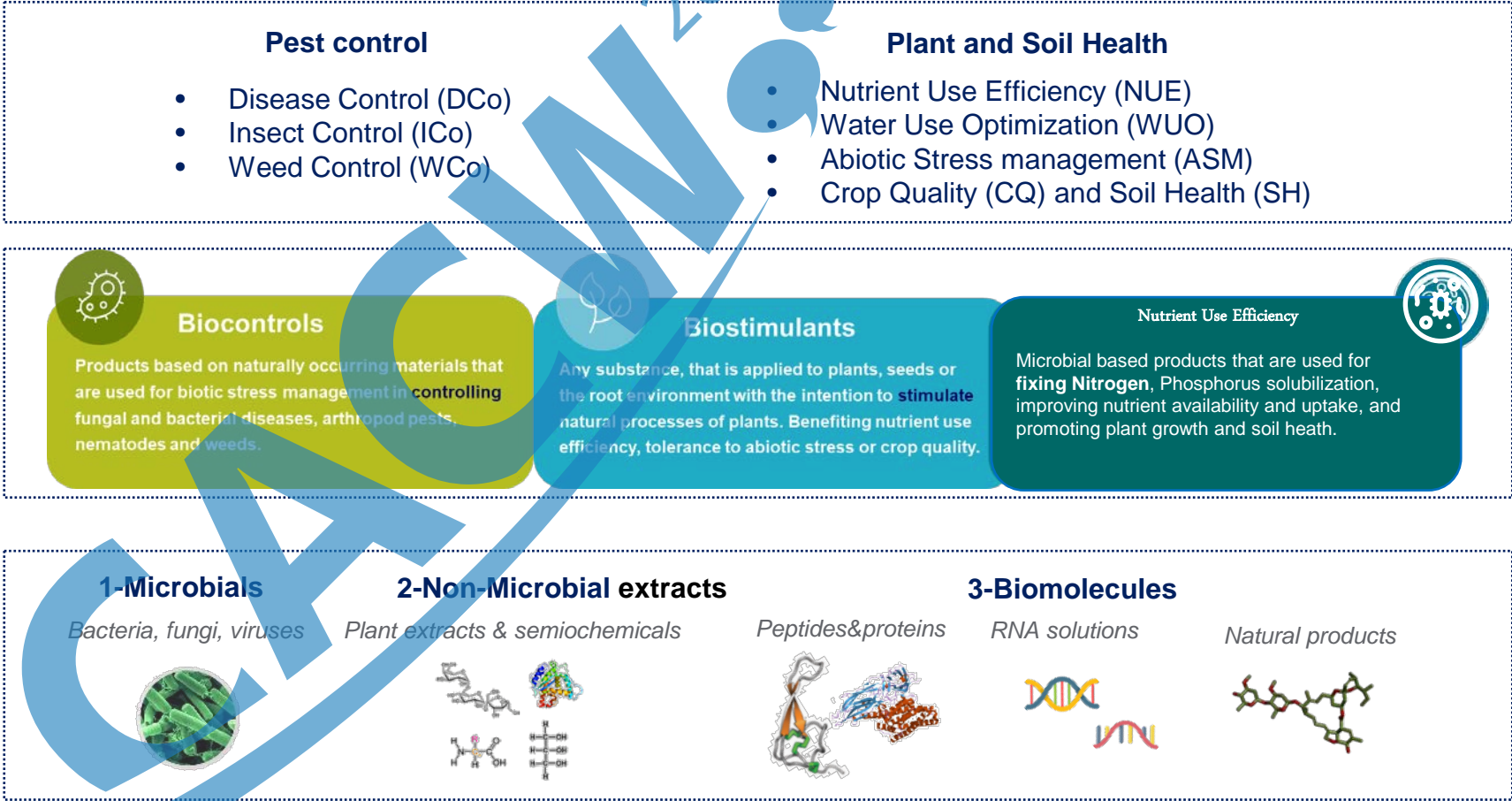
CUSTOMER  
NEED

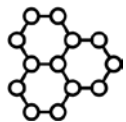


MARKET  
SEGMENTS



TECHNOLOGY  
CATEGORY





## What technologies?



### MICROBIALS



### NON-MICROBIAL EXTRACTS



### BIOMOLECULES



## What are they?

**Microorganisms** (living cells or extracts) such as bacteria and fungi that can be produced by scalable technologies such as fermentation

**A mixture of components** achieved from a biological source (plant, seaweed, and others). Composition depends on extraction process.

**Isolated biopolymer** or **secondary metabolite** identical to nature, modified or *de novo* produced by fermentation from native host or through recombinant techniques



## What can they offer ?

- ✓ Wealth of untapped potential vast **biodiversity** in global collections
- ✓ Meeting societal and regulatory pull for **zero residues**
- ✓ Potential for **novel modes of action**
- ✓ Proven technologies for **cost effective production**
- ✓ Broad range of **natural substances** from different biological matrices
- ✓ **Selected/customized mixtures** of components for specific targets
- ✓ Sustainable solutions through raw materials from **circular economy**
- ✓ **Streamlined regulatory approval** primary targeting biostimulants
- ✓ Simplicity of a defined **single active ingredient** as for chemicals
- ✓ **Unique modes of action** - High selectivity combined with no/low residues
- ✓ **Optimization** or **de novo discovery** enabled by synthetic biology
- ✓ **Low carbon footprint**



FOLIAR



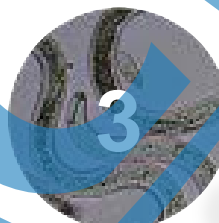
SEED CARE



DISEASE CONTROL



INSECT  
CONTROL



NEMATODE  
CONTROL



WEED CONTROL



**TAEGR0®** is a biofungicide based on *Bacillus amyloliquefaciens* that can be used as part of an integrated disease management program to ensure high value crops, such as fruits and vegetables, are protected against diseases.



A first for Indonesian rice farmers, **NELVIUM™** is an innovative sprayable pheromone-based technology that controls rice stemborer. It is a mating disruption solution, and the result of our collaboration with Provivi.



A bionematicide and biofungicide product based on the exclusive *Bacillus velezensis* strain. **ARVATICO™** is specially developed for soybean and corn seed treatment. Under a convenient low rate of application, it delivers strong compatibility with conventional chemistry and a broad spectrum of control.





PLANT HEALTH

SOIL HEALTH



NUTRIENT USE  
EFFICIENCY



TOLERANCE  
TO ABIOTIC  
STRESS



WATER  
EFFICIENCY



QUALITY  
TRAITS



ISABION® is a product of natural origin obtained from collagen hydrolysis, a raw material very rich in amino acids and peptides. Biostimulant for crop quality and abiotic stress management (Fruits and Vegetables)



VIXERAN® is a resilient biostimulant based on the bacteria *Azotobacter salinestris* that frees up nitrogen-to-crop on demand, improving the yield in a more sustainable way. It works across a wide range of crops (most notably corn and cereals)

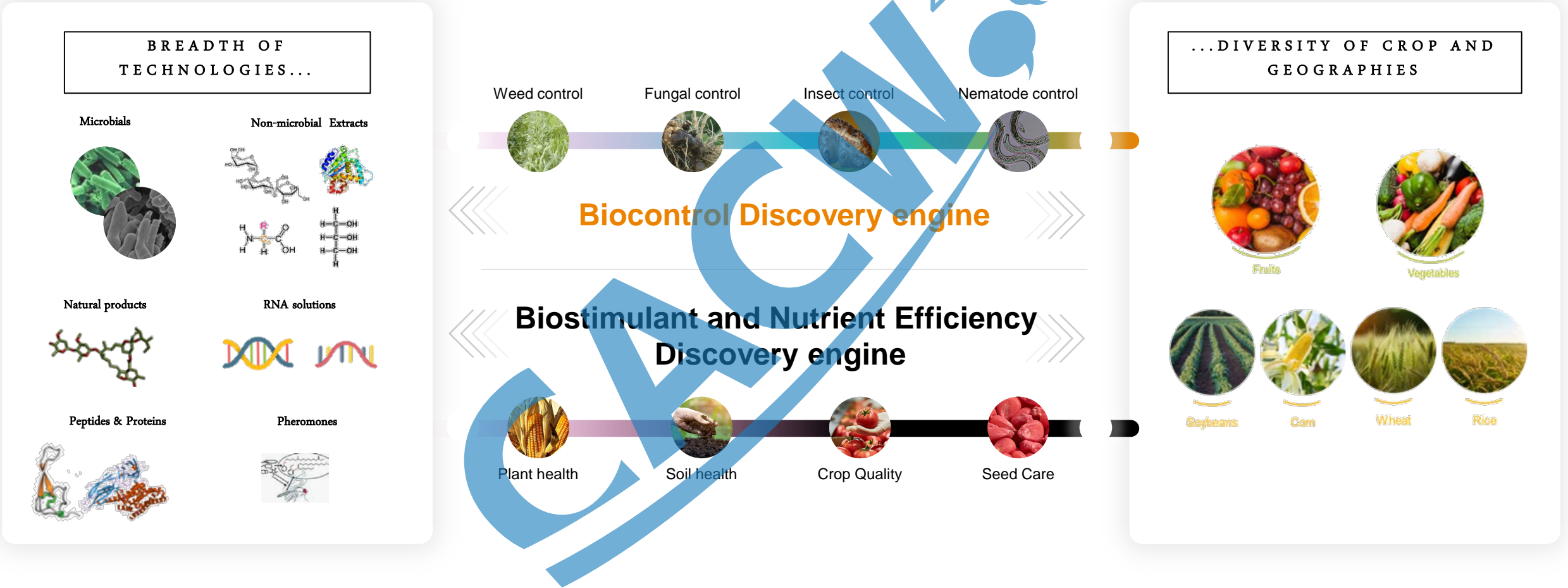
MEGAFOL

MEGAFOL™ is 100% vegetal origin, including extracts from the brown alga *Ascophyllum nodosum*. Biostimulant allowing the plants to tolerate and quickly overcome the stress, preserving yield.

TALETE

TALETE™ is a new biostimulant, originating from the exclusive GeaPower® platform, to increase Crop Water Productivity under adequate or reduced water availability

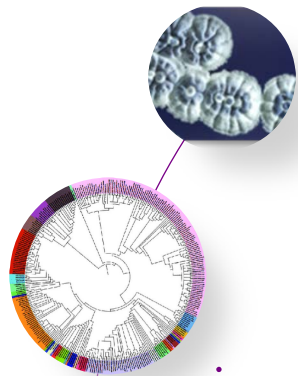
# Biologicals Discovery: complementary engines



# Microbial-based biological discovery

## Unique microbial strain collections

Bioprospection, characterization



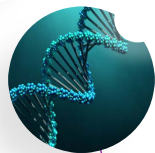
## Automated cultivation

Advanced robotics for sample preparation and multi-parallel fermentation



## Microbial omics

Genome sequencing, metabolite analysis and mode of action studies



## Extract and living cells bioassays

Microprofiling and whole plant screening



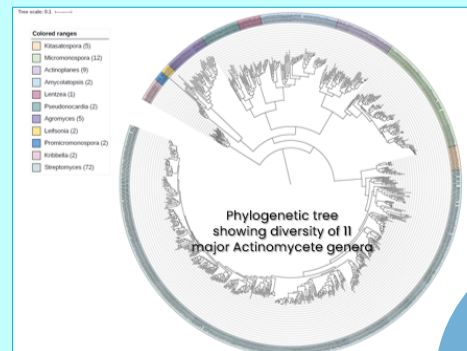


# Discovery Working Flow

## Taxonomy & Diversity of Strain Collections



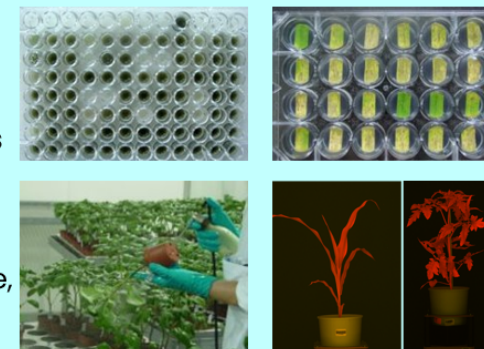
- Screened collection of strains are which are known to produce a wide variety of active compounds including novel ones, as well as *Bacillus* species,
- In addition, new strains from other orders are regularly added to screen the full diversity of the microbial world.
- Partnership on bioprospection is essential to access microbial biodiversity relevant for agriculture



## Microbial extract and living cells bioassays



- First level testing of microbial extract samples on whole organisms can be performed by simultaneously screening on weeds, insects and fungi as well as on crops for biostimulant effect
- Next level testing includes extract and live cells bioassays on leaf disc and whole plant assays to characterize activity: performance, spectrum, symptomology



## Robotics for microbial culture & sample preparation



- Liquid handling robots in microbiological safety cabinets enable the high-throughput cultivation of diverse microbes
- Microbes are cultivated in a selection of media and screened as living cells and solvent extracts to mine their full metabolic diversity

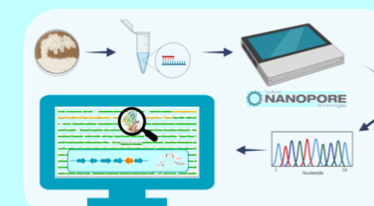


## Genomics & Bioinformatics

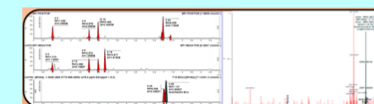
Enabling technology for strain characterisation & targeted discovery of biologicals



- Cost of sequencing whole bacteria and fungi genomes dropped from \$50k in early 2000's to less than 100\$ today
- Metabolite analysis using High Resolution -Liquid Chromatograph/Mass Spectrometer (MS) essential to characterize activity and early safety assessment



Whole genome sequencing



Metabolite analysis using High Resolution



# Geapower: A unique R&D platform to deliver efficient extract-based solutions

Geapower is a systematic approach to the research and development of new products, leveraging on a combination of **science, technology and know-how** to transform the most varied raw materials into effective products that meet the needs of the farmers.



## WHAT MAKES BIOSTIMULANT SOLUTIONS SO COMPLEX?

For biostimulants, the “active ingredient” is not a single molecule, but a combination of substances, that can be equally extracted from biological sources and nature-identical. The composition of these extracts depends both on the raw material from which it is extracted and on the extraction processes and this, in turn, influences the biological activity of the product.



# The Talete discovery story

Crop Water Productivity: a sustainable development goal

**TALETE**

## RATIONALE

Agriculture accounts for 70% of global freshwater consumption

Increased water demand will lead to water scarcity

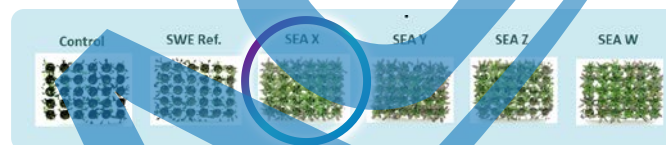


Yield (kg)  
Water (m³)

## TARGETED DISCOVERY

- › *Ascophyllum nodosum* selected as the main source
- › *In vivo* bioassays conducted by inducing water depletion with different extracts obtained by varying extraction processes

### Oriented extraction processes



**SEA X extract showed the best efficiency:**  
It acclimates plants to the incoming water deficit

## PROTOTYPING



### Physiological assessments

Stomatal conductance



### Phenomics assessments

Via high-throughput, multi-spectrum image analysis



# Syngenta Biologicals research

Innovation powered by nature



Unrivalled science platforms across all relevant biological technologies



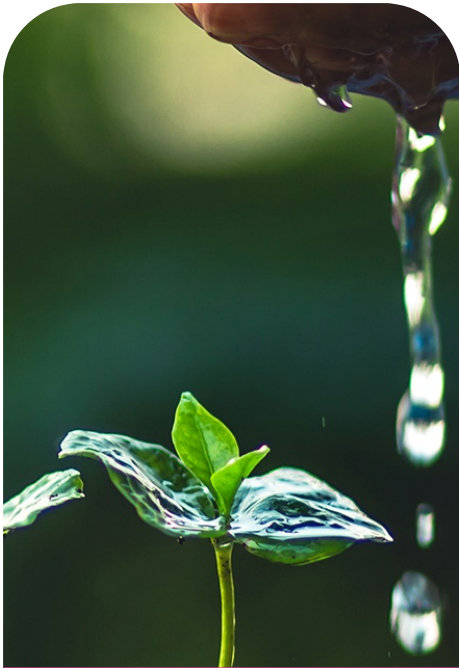
Complementary discovery engines for biocontrols, biostimulants and biofertilizers



Unique R&D footprint combining the best of Syngenta and Valagro



Collaborator of choice across the external innovation ecosystem



Fast science and technology evolution promises great future

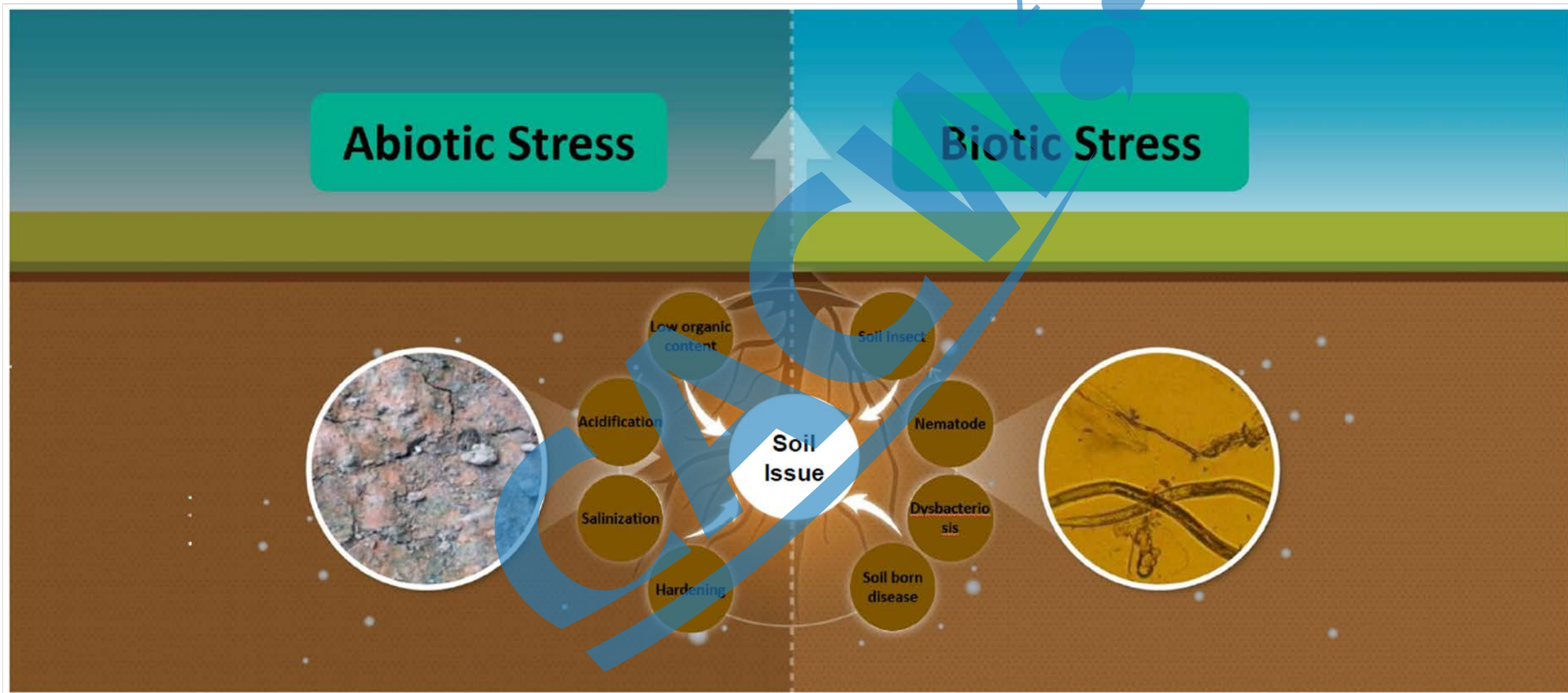


# Biological Application In China

RootEco – Syngenta Integrated Solution of Rhizosphere Ecosystem

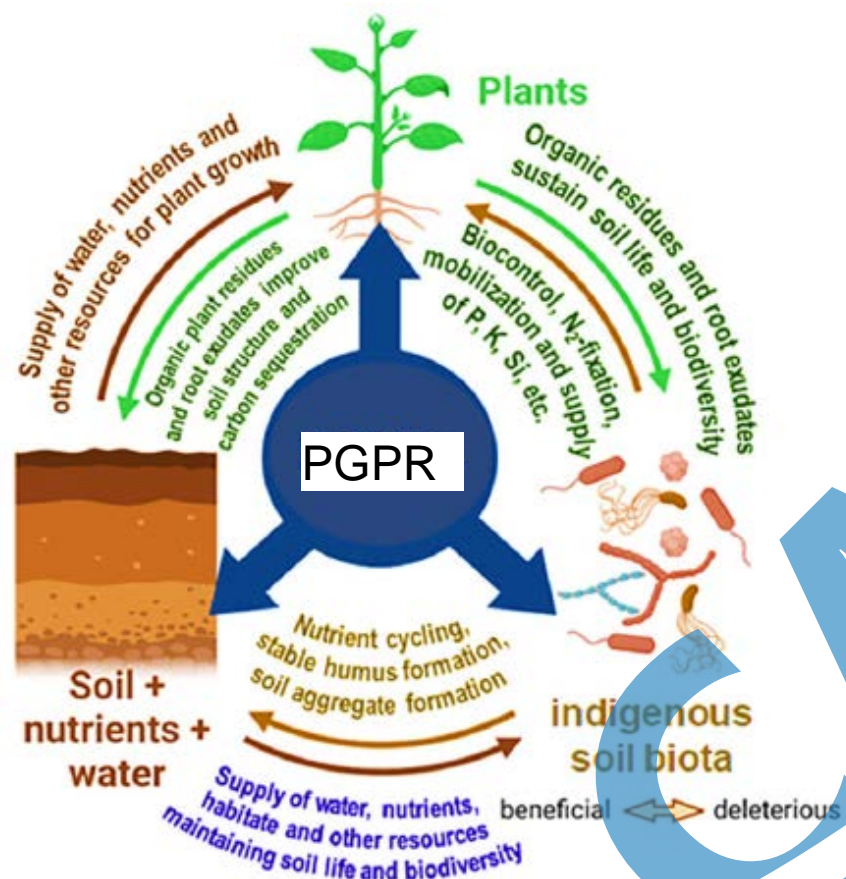
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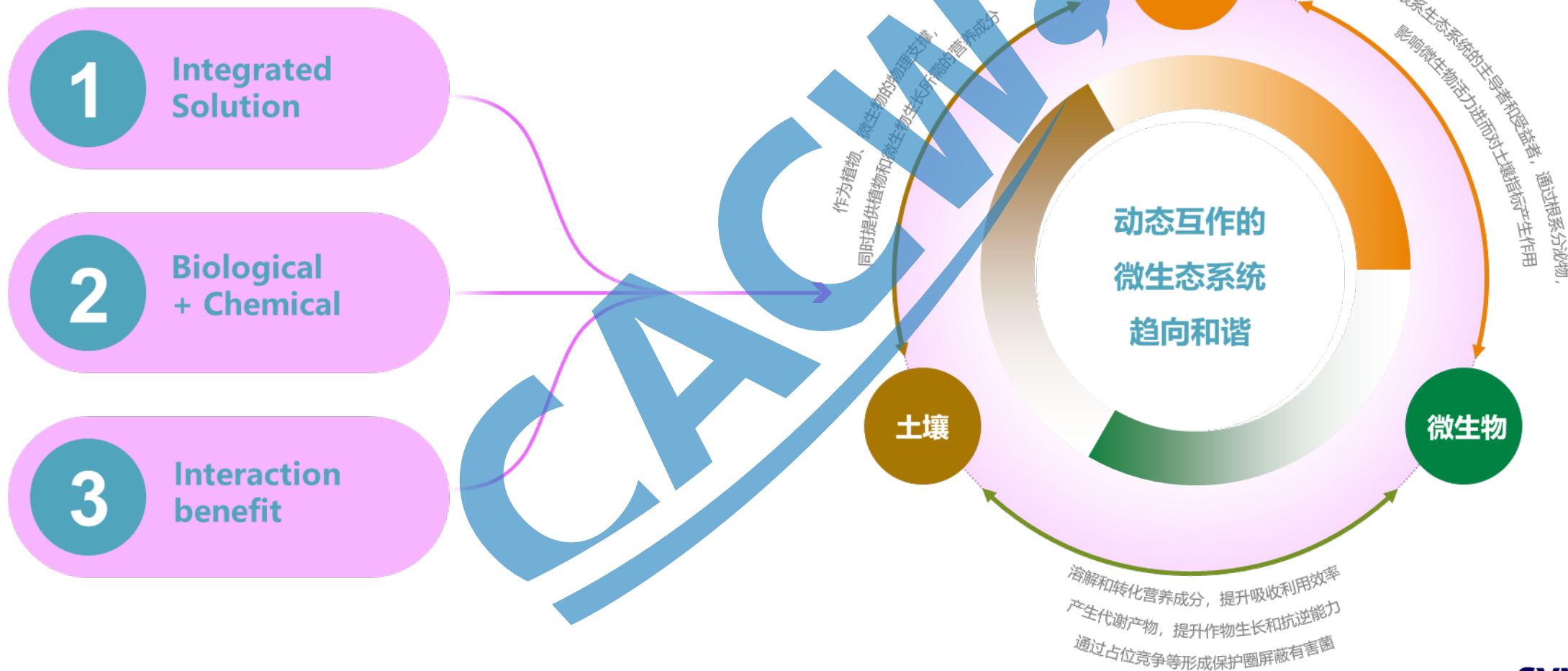
## The Theory of RootECO



(Graphic design: C. Godinho, F4S)



## The Crop Solution with combination of Biologicals and Chemical





# Syngenta China CP and Biologicals Products Portfolio

CP products	
Fungicides	Insecticides
Herbicides	Seed coating

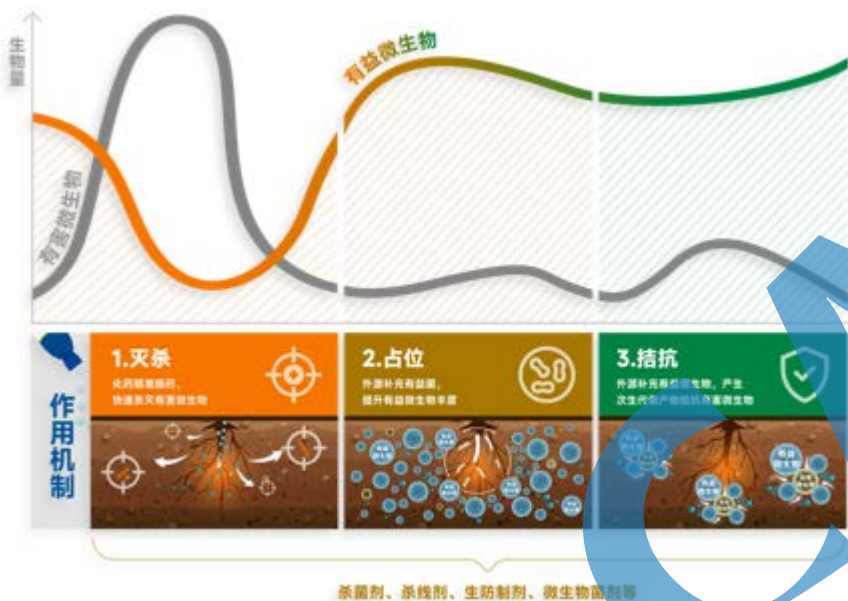
Biologicals	
Biostimulants	Biocontrol
Microbes	Crop Nutrients



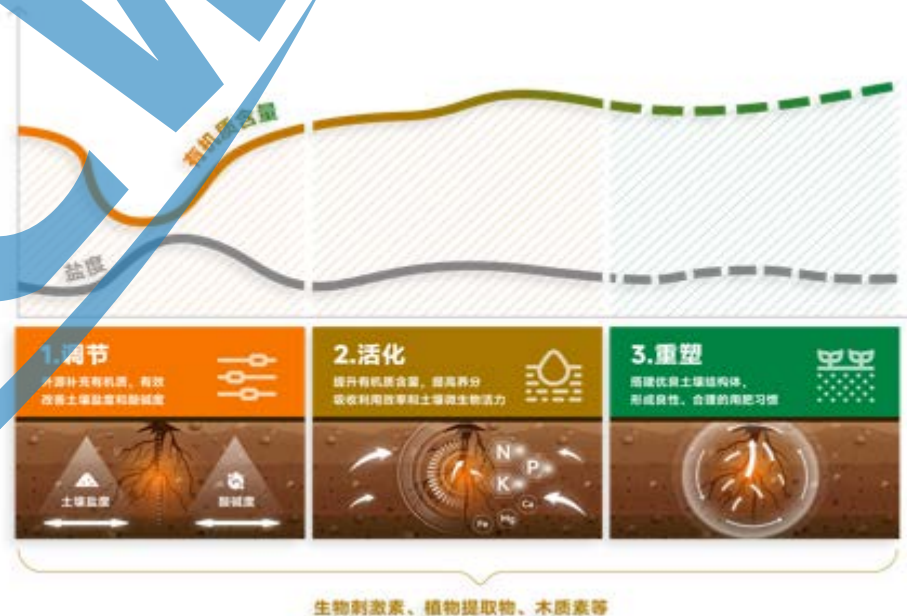


## Benefits of RootEco

### Regulate Rhizosphere Microbial Environment



### Optimize the Physical and Chemical Environment of the Rhizosphere



# Success Stories with RootEco



# Outlook: Biologicals Now, Next and New

**Now**, Biologicals are the right technology for the right time, not mean replace Chemicals, but fast adoption driven by existing technologies

- 
- Integrated with Chemical application
- Biostimulants, NUE, Nitrogen fixation; P solubilization

**Next** generation biologicals to overcome current limitations and expand into row crops

- Science is already there: engineered biology to reduce cost and improve function
- Digital Agriculture technology and evaluation system will increase more biologicals field application and provide integrated program for farms

Biological Industry Alliance collaborated to explore **New** frontiers to increase impact on sustainable agriculture

- Collaboration is key to bring the future closer to our customers



# Thanks

**Contact information:**

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