XX OIL PALM International Conference

THE TRANSFORMATIVE POWER OF OIL PALM

Oportunidades de las tecnologías de base microbiana para los sistemas de cultivo de la palma de aceite.

Fabio Lopes Olivares

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nudiba
Núcleo de Desenvolvimento
de Insumos Agrícolas de Base Biológica

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Microbial-based technological opportunities for oil palm cultivation systems.

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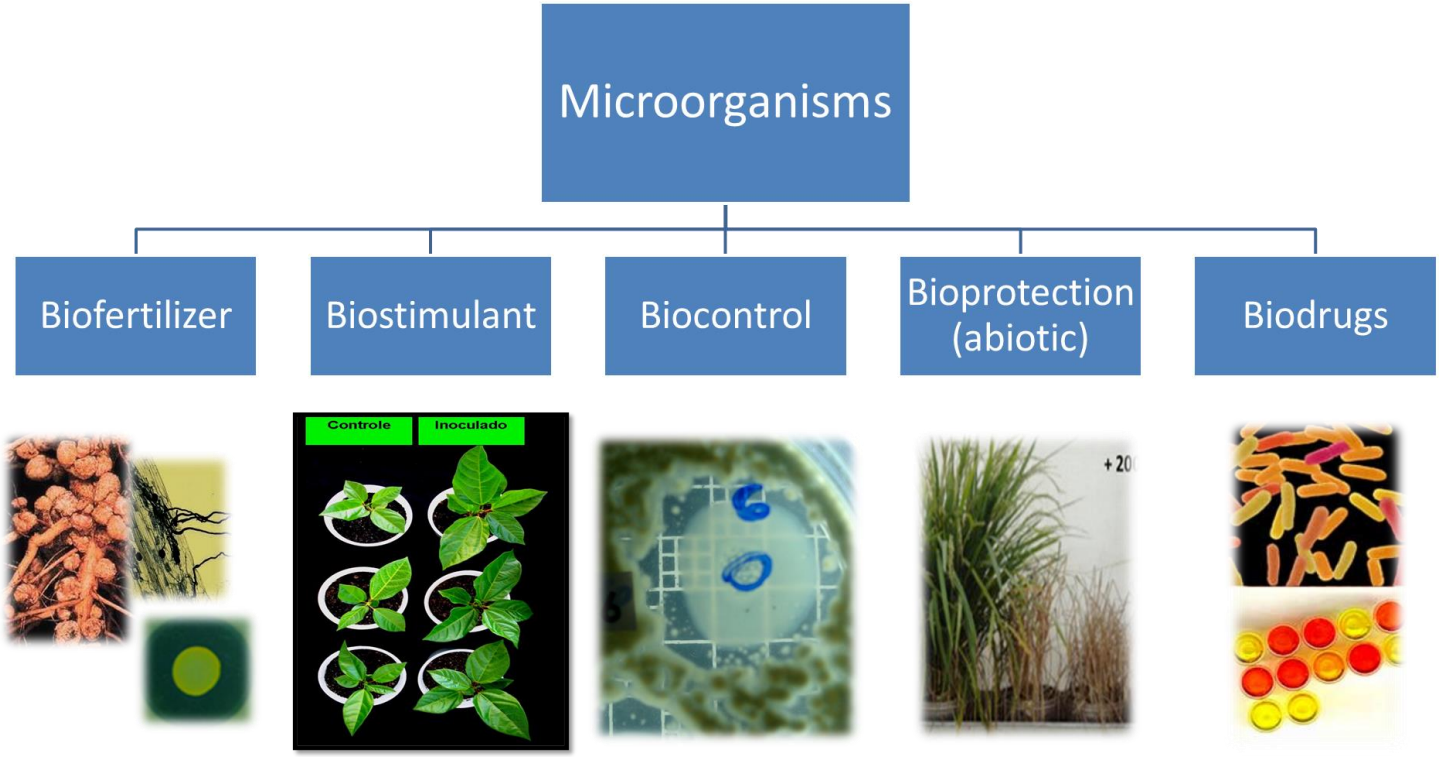
Outline

- ✓ Microbial Inoculants (operational definition and potential mechanisms of action groups).
- ✓ Roadmap to design bioinoculants (from Research to Market).
- ✓ Microbial-based technologies as rising stars in the agroecosystem (Why?).
- ✓ A research case study in a nursery open field for oil palm.
- ✓ Microbial-based technologies opportunities for oil palm crop chain (R&T&I).
- ✓ Conclusion remarks

What are Microbial Inoculants?

(bioinoculants for agroecosystems)

Live microorganisms, formulated in different ways (vehicles and additives) that act as biofertilizers, biostimulants, biocontrol and bioprotection agents through different mechanisms, promoting plant growth and protection.



How to achieve a Commercial Product? – The Liturgy

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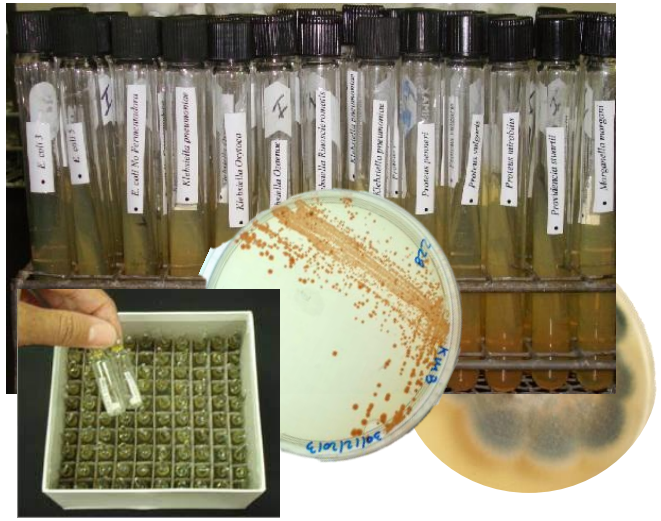
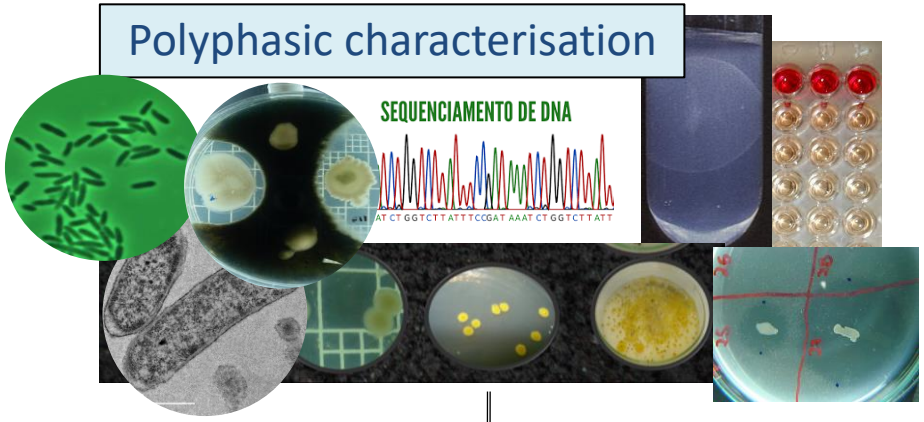
Bioprospection



Polyphasic characterisation



Plant-Growth Promotion Mechanisms

Proof of concept Greenhouse/field

Formulation (needs)

- ❑ Growth media
- ❑ Multiplication Phase
- ❑ Vehicles: Wettable powder, suspension, granules, liquids, gel...
- ❑ Additives, nutrients, stabilizers, others!!!
- ❑ Quality control
- ❑ Shelf Life

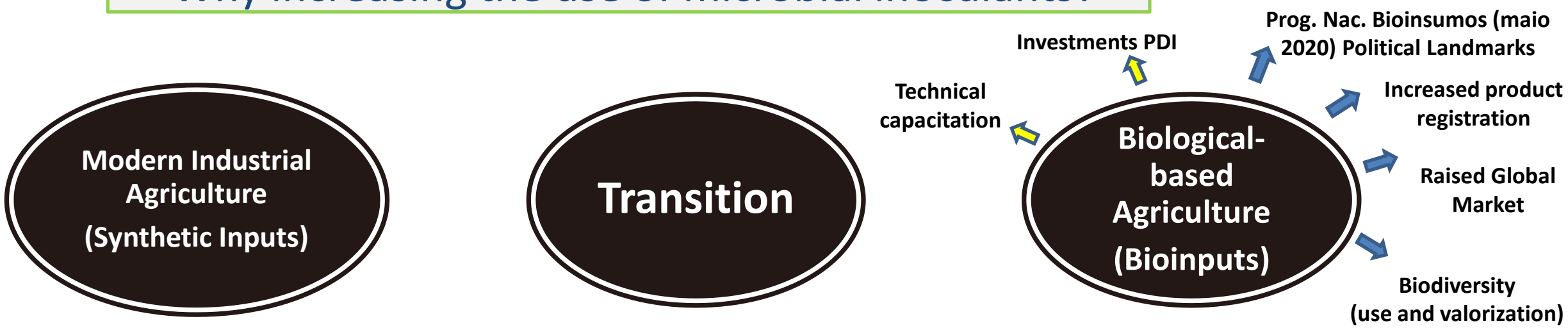
Product Commercialization

- ❑ Product Registration
- ❑ Relationship with Companies
- ❑ Product scaling
- ❑ Market Differentials
- ❑ Adoption
- ❑ Improvement

Microbial “Delivery”

- ❑ How, When and Where to apply?
- ❑ Compatibility with agricultural practices

Why increasing the use of microbial inoculants?



Bioinput and Sustainability of Agroecosystems

> Synthetic Fertilizers	Local, GGE, Country sovereignty and Economic Impacts	< Synthetic Fertilizers
> Pesticides	Human Health, GHG, Food Safety and Economics	< Pesticides
> Non-renewable sources (imported)	Autonomy over the means of production, circular economy	> Renewable Sources
< Agroecosystem diversity	Resilience of microbial processes, accelerates the transition	> Agroecosystem diversity
> GGE	Greenhouse Gases Emission (carbon footprint)	**< GGE**
Genetic erosion and loss of diversity	Use and Monetization of Soil Microbial Diversity	New products and processes

Economic, social, health and cultural impacts

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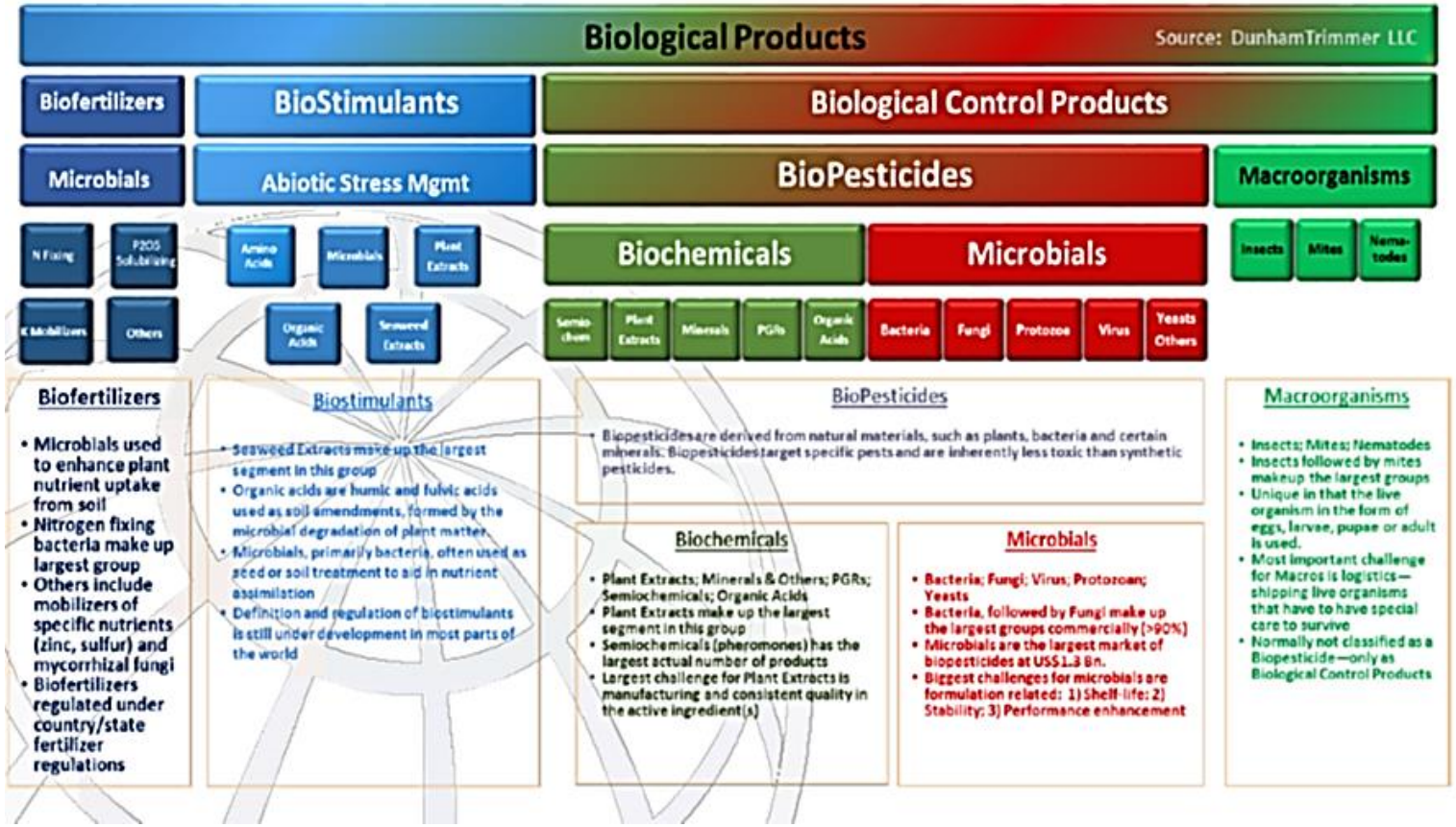
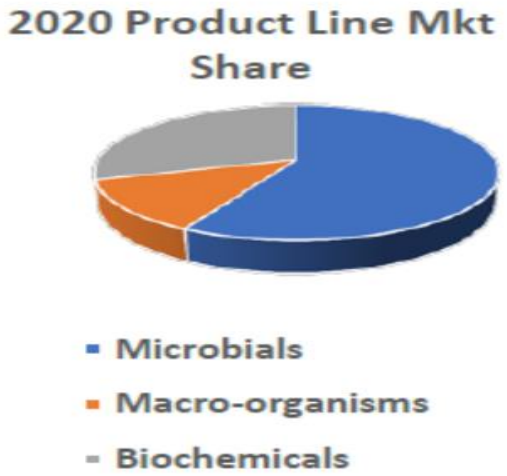
Microbial-based technologies as a rising star in Global Market

Agricultural products based on the microbiota are one of the fastest growing sectors in agronomy, with a Compound Annual Growth Rate (CAGR) of 15–18% and a predicted value of over 11 billion US dollars by 2025.

DunhamTrimmer
International Bio Intelligence

Source





Microbials will continue to make up 60% of the market.

Brazilian Market (2021)

- 80 millions doses (90% soybean and 10% grasses)

Microbial-based technologies as a rising star (Agricultural Brazil Case)

- Brazil is an agro-food potency **versus** the most prominent fertilizer importer on the planet, with almost 40 million tons imported (about 85% of our demand).

- Reduce Environmental Impact
- Increase Food Quality
- More sustainable production

- Increased production costs
- International consumer market requirements

- Legal Frameworks
  - Brazilian National Fertilizer Plan (aim to reduce dependency on Brazil's external supply)
  - Brazilian National Bio-inputs Program (launched in May 2021)

The Brazilian market for agriculture bioproducts has had significant growth of 37% (2021), with projections to grow by 74% by 2026.

Case study for Rhizobacteria Inoculation at Oil Palm Seedling Production Systems

Josue Lima
PhD. student

Dr Gisele Barata
Leader Research

Scientia Horticulturae 264 (2020) 109161

Contents lists available at ScienceDirect

Scientia Horticulturae

journal homepage: www.elsevier.com/locate/scihorti

Hormonal imbalance triggered by rhizobacteria enhance nutrient use efficiency and biomass in oil palm

Josué Valente Lima[c], Ricardo Salles Tinôco[a], Fabio Lopes Olivares[b], Alessandra Jackeline Guedes de Moraes[c], Gilson Sanchez Chia[d], Gisele Barata da Silva[c,*]

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Case study for Rhizobacteria Inoculation at Oil Palm Seedling Production Systems

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Rhizosphere 19 (2021) 100420

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Rhizosphere

journal homepage: www.elsevier.com/locate/rhisph

Rhizobacteria modify root architecture and improve nutrient uptake in oil palm seedlings despite reduced fertilizer

Josué Valente Lima [a,e], Ricardo Salles Tinôco [b], Fabio Lopes Olivares [c], Gilson Sanchez Chia [d], José Ailton Gomes de Melo Júnior [e], Gisele Barata da Silva [e,*]

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The study was carried out in the field in the seedling nursery of the company Agropalma Group S/A.

Case study for Rhizobacteria Inoculation at Oil Palm Seedling Production Systems

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Dr Gisele Barata
Leader Research

ARCHIVES OF PHYTOPATHOLOGY AND PLANT PROTECTION
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Oil palm production with reduced economic costs and environmental impacts through the use of rhizobacteria

Josué Valente Lima[a,b], Marcos Antonio Souza dos Santos[a], Ricardo Salles Tinoco[c], Gilson Sanchez Chia[d], Fabio Lopes Olivares[e], João Paulo Morais da Silva[b] and Gisele Barata da Silva[a,b]

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Rhizobacteria Inoculation at Oil Palm Seedling Production Systems (a Summary)

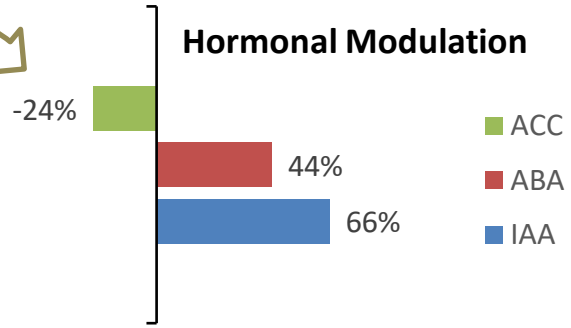
Josue Lima
PhD. student

Dr Gisele Barata
Leader Research

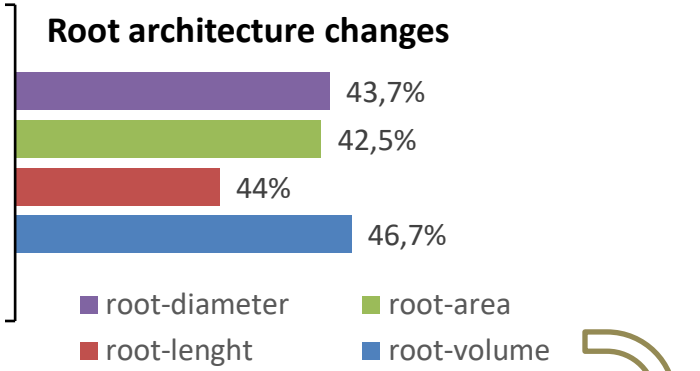
***Bacillus amyloliquefaciens* strain UFRAB01**
***Burkholderia pyrrocinia* strain BRM 32113**
***Bacillus subtilis* strain UFRA 92**

- 100 mL (10^8 cells. mL)
- 3 applications at 15, 45 and 75 d.a.p.
- Treatments:
  - **C- (IN -, 50% NPK)**
  - **C+ (IN -, 100% NPK)**
  - **T (IN+, 50% NPK)**

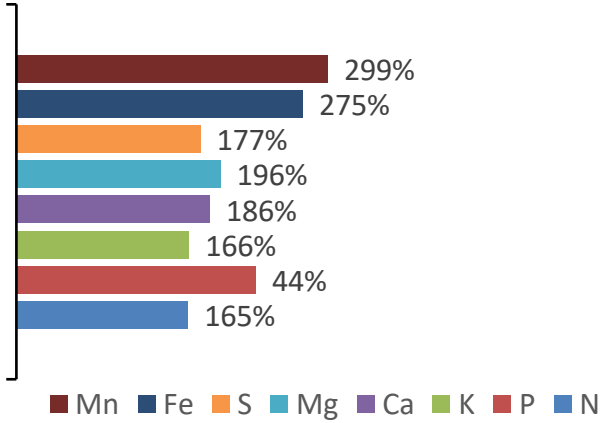
Hormonal Modulation



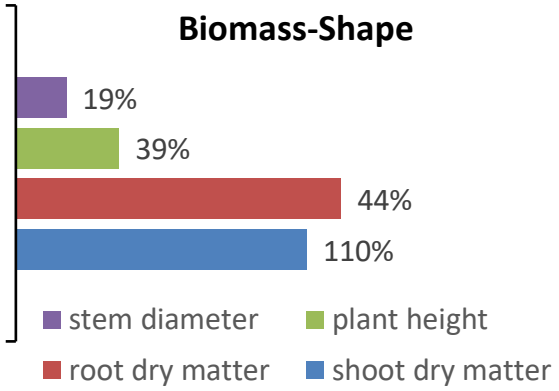
Root architecture changes

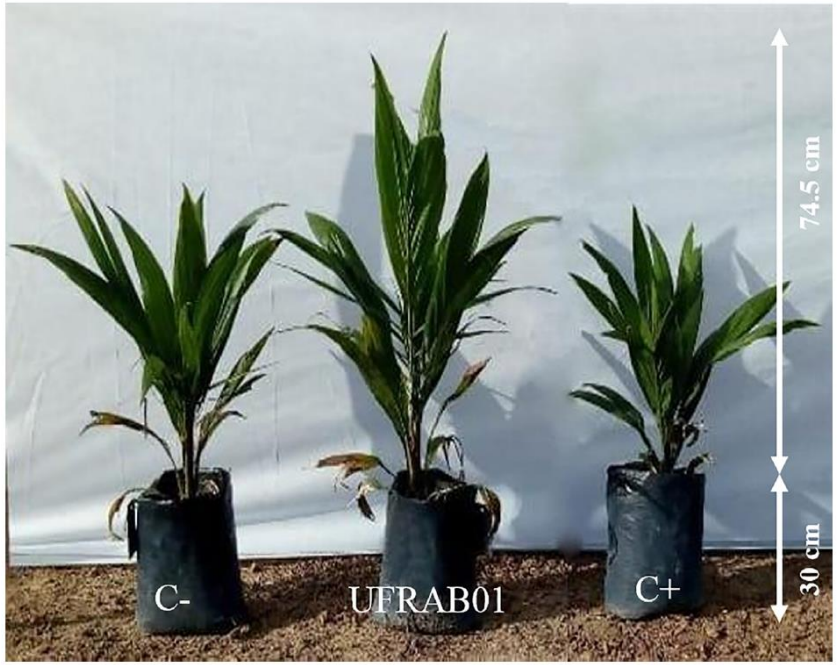


Nutrient accumulation



Biomass-Shape





Effects of *Bacillus amyloliquefaciens* UFRAB01 on *Elaeis guineensis* Jacq. seedlings six months after planting.

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Microbial Inoculation Opportunities in Nursery Practices in Oil Palm

Motivation

- ❖ Stage with the highest production cost due to the long nursery period and the high use of chemical fertilizers.

Achievements

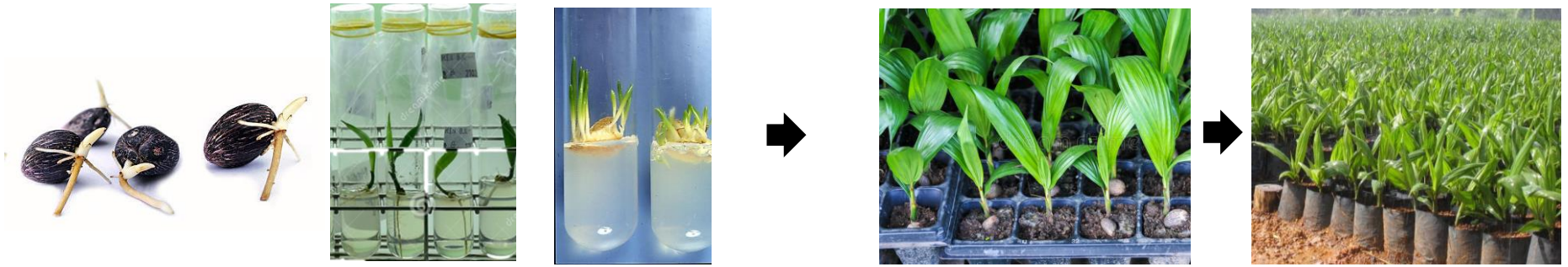
- ➢ Production of high-quality seedlings in 2 months less in nursery time, with a reduction in synthetic fertilizers by half and an 11% reduction in average cost compared to conventional management.

Derivative Opportunities

- ✓ Plant breeding process conducted under bioinoculant selective pressure – clone selection for plant responsiveness to microbial inoculation.
- ✓ Microbial community remodelling in vitro tissue culture plantlets.
- ✓ Plant media substrate using crop and agro-industrial residues (feasible?)
- ✓ Biological fortification of plant media substrate
- ✓ Combine strategies for

Research and Technological Opportunities in Nursery Practices for Oil Palm (OP) to increase nutrient availability based on microbial processes.

At Pre- and main nursery processes from germinated seeds or tissue-culture-produced ramets



	Seed-seedling phase/micropropagated-MOP	Seedlings in trays/bags
Fundamental Research	✓ Seed-borne microbial prospection ✓ Green-house screening for Plant-growth promotion ✓ Metagenomics (taxon and functional genes) ✓ Seed-borne microbial core (Vertical transmitted) ✓ MOP (microbial-free) -> Engineer Beneficial community ✓ Germination assays under biotic and abiotic selective pressures (ex. Ganoderma challenger assay)	✓ Rhizosphere/endophytic prospection ✓ Green-house screening for Plant-growth promotion ✓ Metagenomics (taxon and functional genes) ✓ Seed-borne microbial core (Horizontal transmitted) ✓ MOP (microbial-free) -> Trap for soil bacteria ✓ **Screening for a compatible mutualistic interaction between beneficial bacteria-fungi**
Technological Derivatives	✓ Microbial candidates selected ✓ Define microbial community (≠ purposes) ✓ Define “microbial inoculant formulation.” ✓ Define “microbial inoculant delivering” for nursing steps ✓ Evaluation of compatibility with the ordinary management practices (ex. Agrochemicals)	✓ Microbial candidates selected ✓ Composting agro-industrial product ✓ Biological enrichment of plant substrate (N, P, K increased contents, Biocontrol) ✓ Define “microbial inoculant delivering” for nursing steps (foliar spray combined with humic acids)

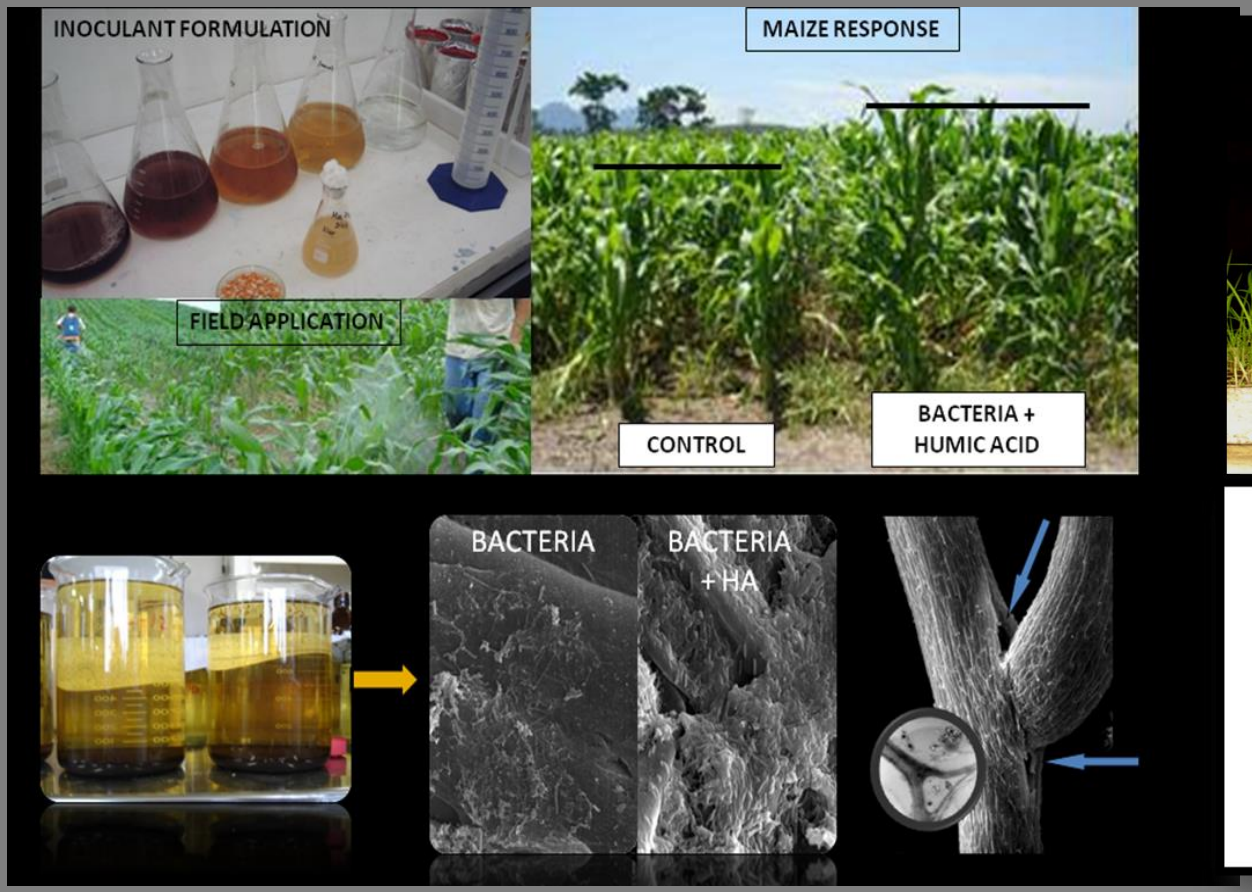
Target: high-quality field-ready plants

Target: Cost and time reduction

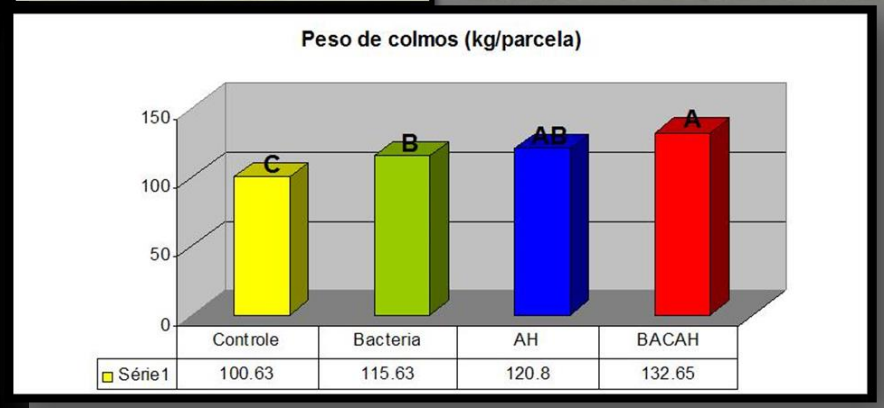
Target: bio-primed seedlings

OP Field Performance?

Technological Platform: Combined use of beneficial microorganisms (bacteria) and humic substances (humic acids)



Sugarcane sets heat treated

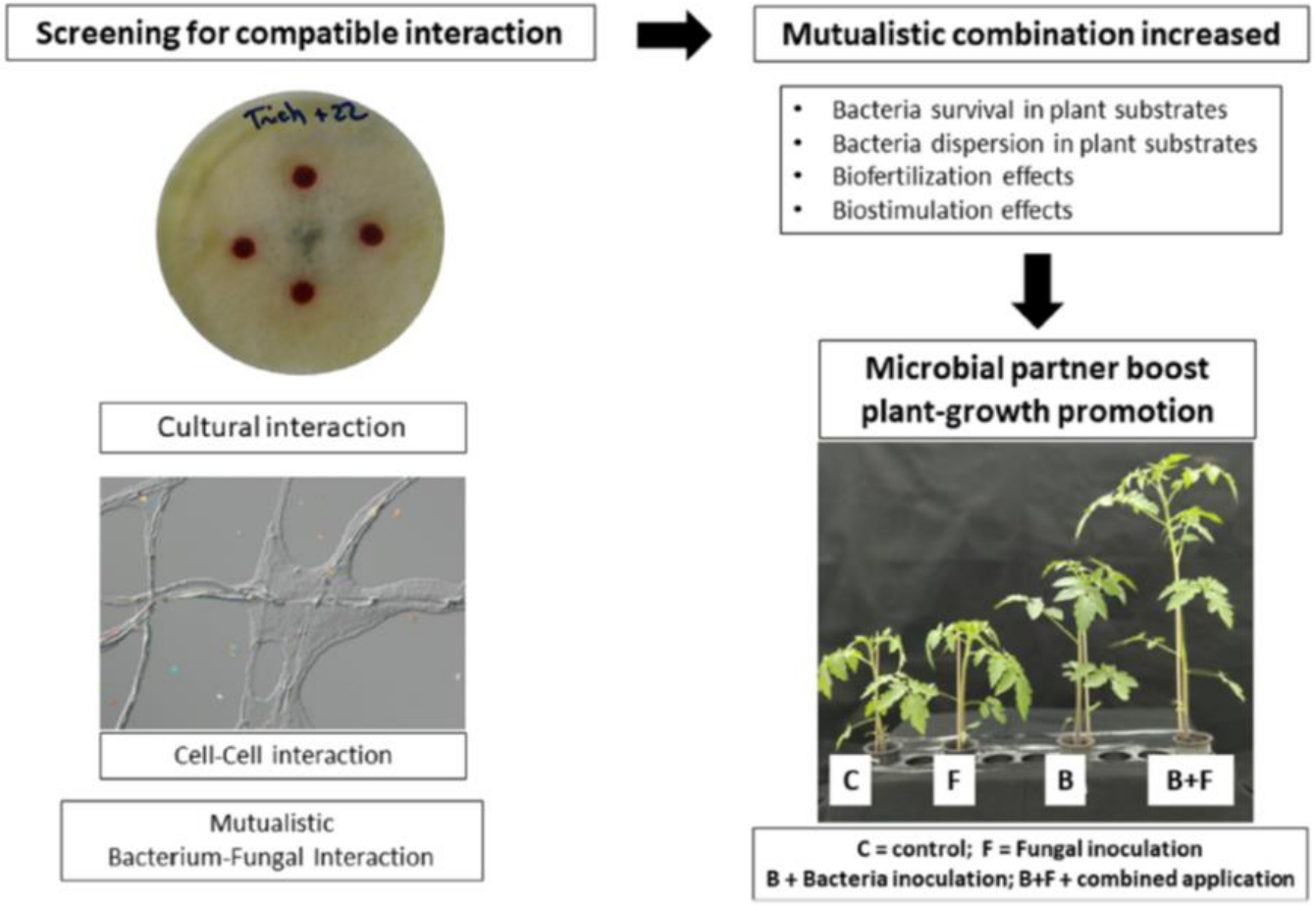


Corn seed coated with BacHA

Basic Research

Technological Research

Mutualistic interaction of native *Serratia marcescens* UENF-22GI with *Trichoderma longibrachiatum* UENF-F476 boosting seedling growth of tomato and papaya



Keywords Substrate biofortification · Beneficial bacteria · Microbial technology · Microbial interaction · Biological input

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https://doi.org/10.1007/s11274-021-03179-z

Conclusion Remarks

- ✓ Comparatively few microbial-based research and technologies developed for oil palm production systems.
- ✓ Plenty of mature technologies can be driven to increase oil palm growth and protection under the nursery stage.
- ✓ Impact of those technologies on plants under open field conditions has been scarcely explored.
- ✓ Wide adoption of microbial technologies in the oil palm production chain involves changes in agricultural dogmas and must be justified by real needs.

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Thanks