

Enabling Global Sustainable Farming

Soil Microbial Composition Allows Assessment of
Biological Product Effectiveness

Alberto Acedo PhD
CSO & Co founder

 **BIOME MAKERS**
Better Soil. Better Food. Better Life.

 **ABIM**
Annual Biocontrol Industry Meeting®



Our Vision

To recover

Soil Health worldwide



“Only living things can have health”

Soil health, also referred to as soil quality
capacity of soil to function as a vital living ecosystem that sustains life.

Soil as symbiotic ecosystem that can be
managed to provide nutrients for plant
growth.



Modeling soil functionality

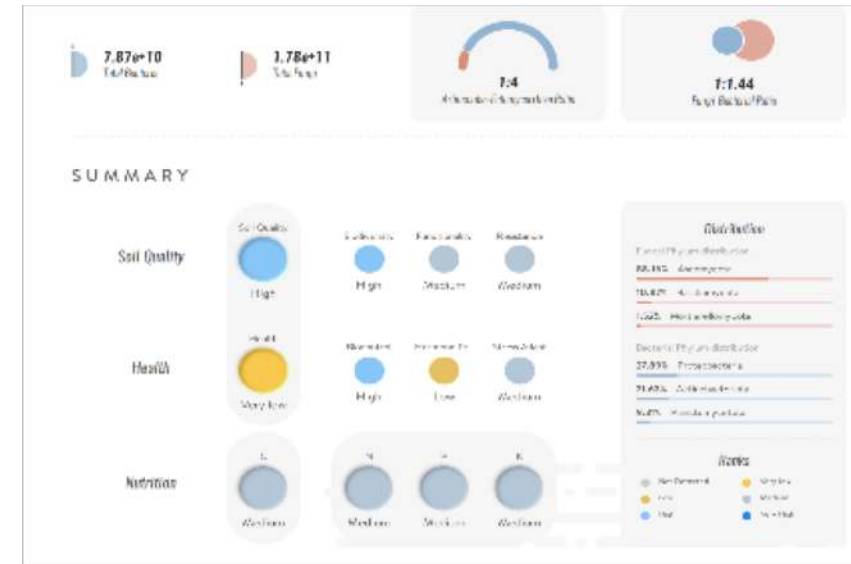
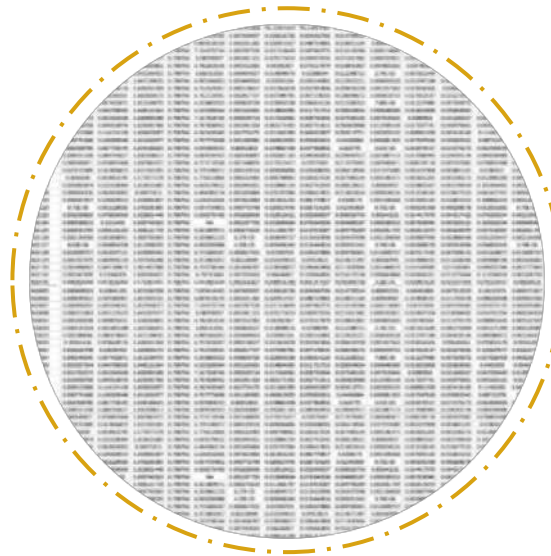
A new way to look underground



From soil

to bio-data

into a functional analysis report



Obtaining soil microbiology insights leads to better-informed decision making. We combine the latest technology in **DNA sequencing and microbiome genomics with AgData**, and intelligent computing to decode soil microbiome functions.

Disease risk



Soil sample 1



Pathogen abundance 2000 cells

Soil sample 2

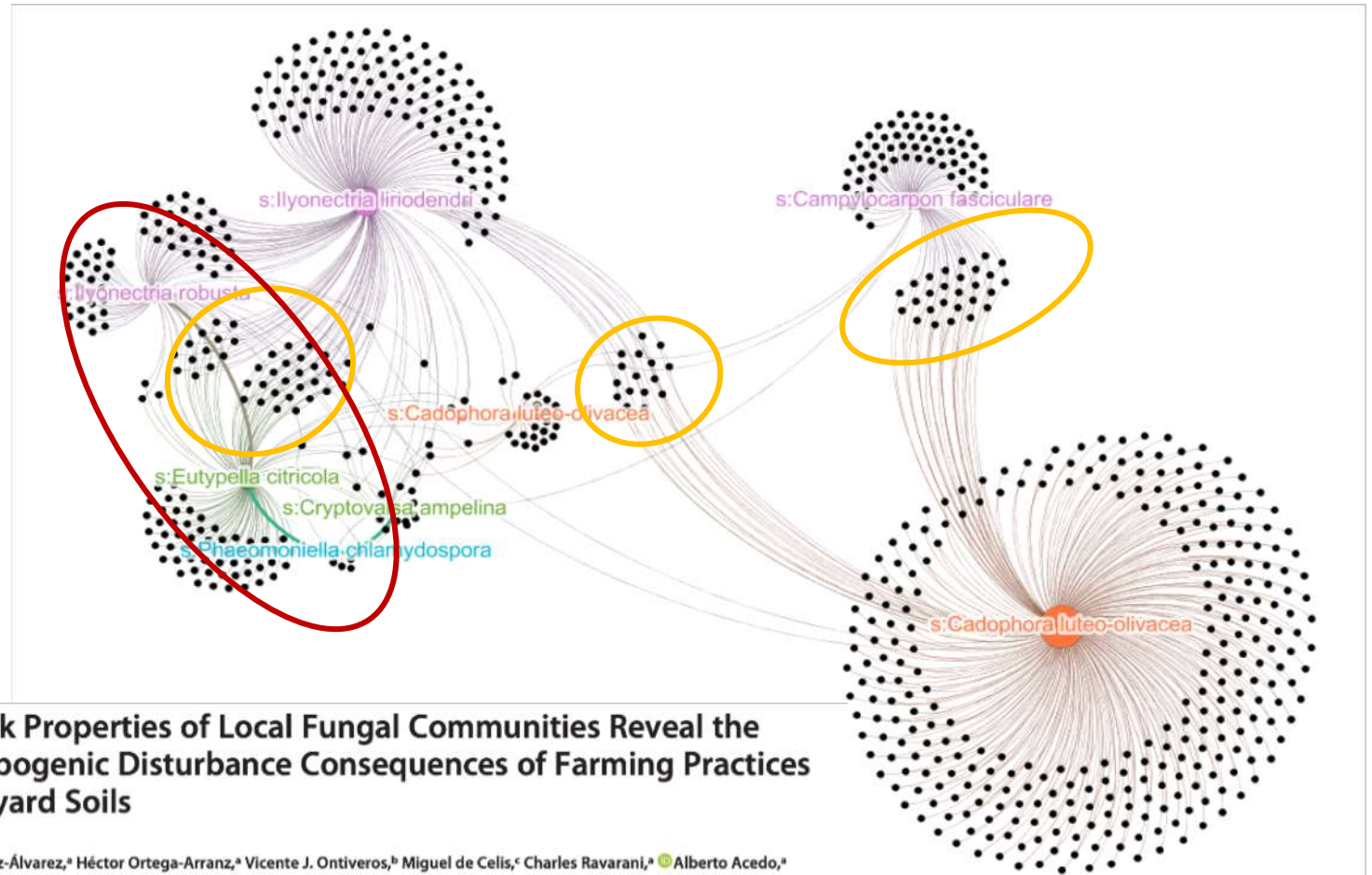
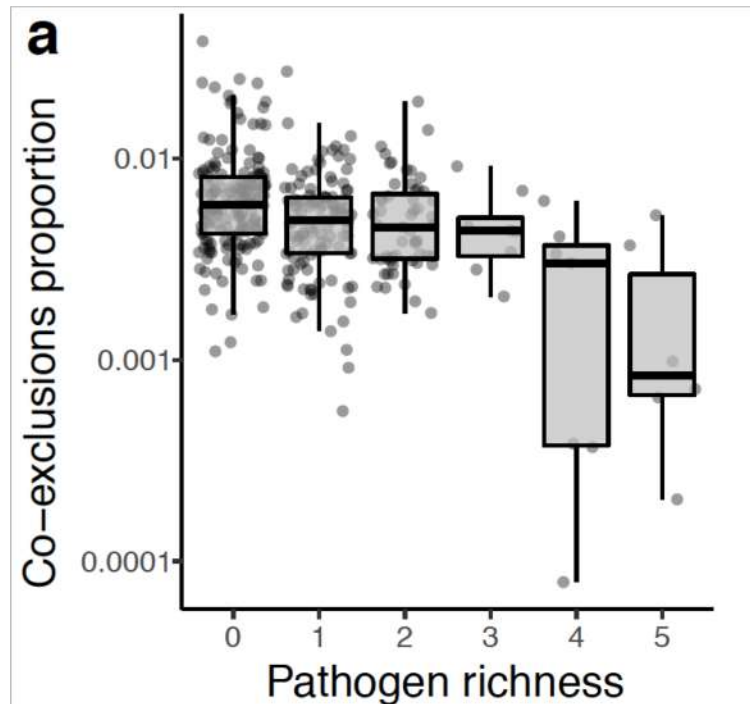


Pathogen abundance 4000 cells

Disease risk factors



- Pathogen abundance
- Total microbiome abundace
- Total bicontrol abundase
- Human pressure



Network Properties of Local Fungal Communities Reveal the Anthropogenic Disturbance Consequences of Farming Practices in Vineyard Soils

Rüdiger Ortiz-Álvarez,^a Héctor Ortega-Arranz,^a Vicente J. Ontiveros,^b Miguel de Celis,^c Charles Ravarani,^a Alberto Acedo,^a Ignacio Belda^{a*}

^aBiome Makers Inc., West Sacramento, California, USA



Biocontrol - mode of action



Mode of action	Method for screening	Pathogen specificity	Risk of resistance ¹	Dependency on environmental conditions	Dependency on plant physiology	Use by distributors and end user
Induced resistance	Complex bioassay on plants	Specific to broad	Low	Low	High	Knowledge transfer needed
Competition	Simplified bioassays	Broad	Low	High	Low	Knowledge transfer needed
Hyperparasitism	Simplified bioassays	Pathogen specific interactions	Low	High	Low	Knowledge transfer needed
Antimicrobial metabolites produced <i>in situ</i>	Simplified bioassays	Specific to broad	Low	Moderate	Low	Knowledge transfer needed
Antimicrobial metabolites in product	<i>In vitro</i> assays	Broad	Moderate	Low	Low	Similar to use of fungicides
Helper strains ²	Complex bioassays	Depends on MBCA	Low	Reduced	Reduced	Knowledge transfer needed
Assembled consortia combining different modes of action	<i>In silico</i> design followed by complex bioassays	Broad	Low	Low	Low	Knowledge transfer needed
Modulation of indigenous microbiota	Complex site-specific bioassays	Broad	Low	Medium	Low	Site-specific knowledge needed

¹ Also depending on the specific evolutionary potential of targeted pathogen. ² Applied in combination with MBCAs.



Decoding Ag-input biological effects

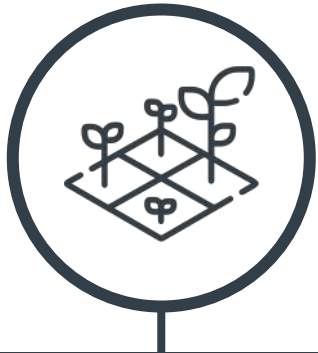
Functional microbiome assessment of your inputs

**What is the Impact/Effect of your product in the “Plant Second Genome”?
How choice a biocontrol solution without this information?**

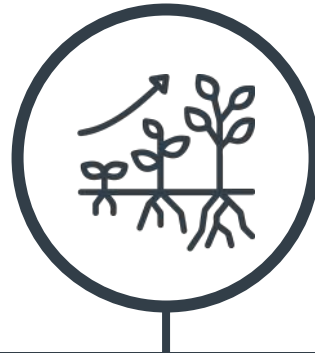


Gheom: Revealing Ag-input Effects

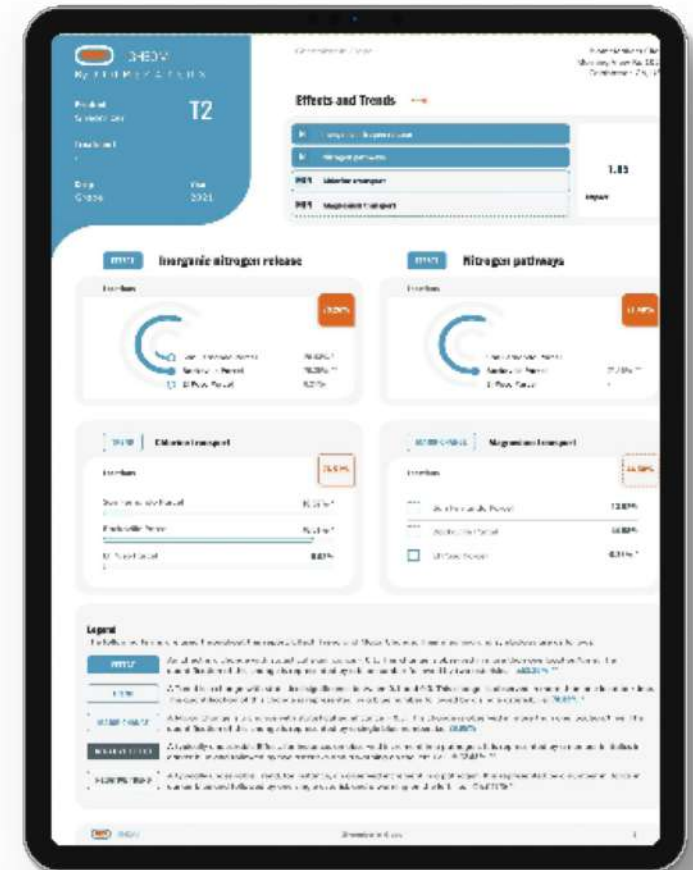
Gheom is a service designed to track the effects of ag-inputs in control and treated



Gheom is recommended for anyone needing to monitor biological effects over several time periods, as a result of a specific treatment or management practice.



It is extremely important for ag-manufacturers to evaluate and verify the real effects of their products, make science-based improvements and verify product claims based on third party company data.



"It is a unique approach to utilize soil biology and optimize the use of crop inputs moving forward towards a real personalized agriculture" - project leader at Bayer Crop Science.

Sampling Collection

in different times and plots with different treatments

GHEOM LIKE

Analyze the trending effects
of an input

Localizations

Less than 3

Replicates

Less than 3

Parcels

Control + Treated

Times

Before or after

Results delivery

Statistical data analysis

GHEOM STANDARD

Scientifically validated
impact assessment

Localizations

3 to 14

Replicates

3

Parcels

Control + Treated

Times

Before + after

Results delivery

Statistical data analysis
Gheom Report

GHEOM ADVANCED

Large essay to identify
variables impacting effectivity

Localizations

Minimum 15

Replicates

3 or more

Parcels

Control + Treated

Times

Before + after + more

Results delivery

Statistical data analysis
Gheom Report

Soil Analysis

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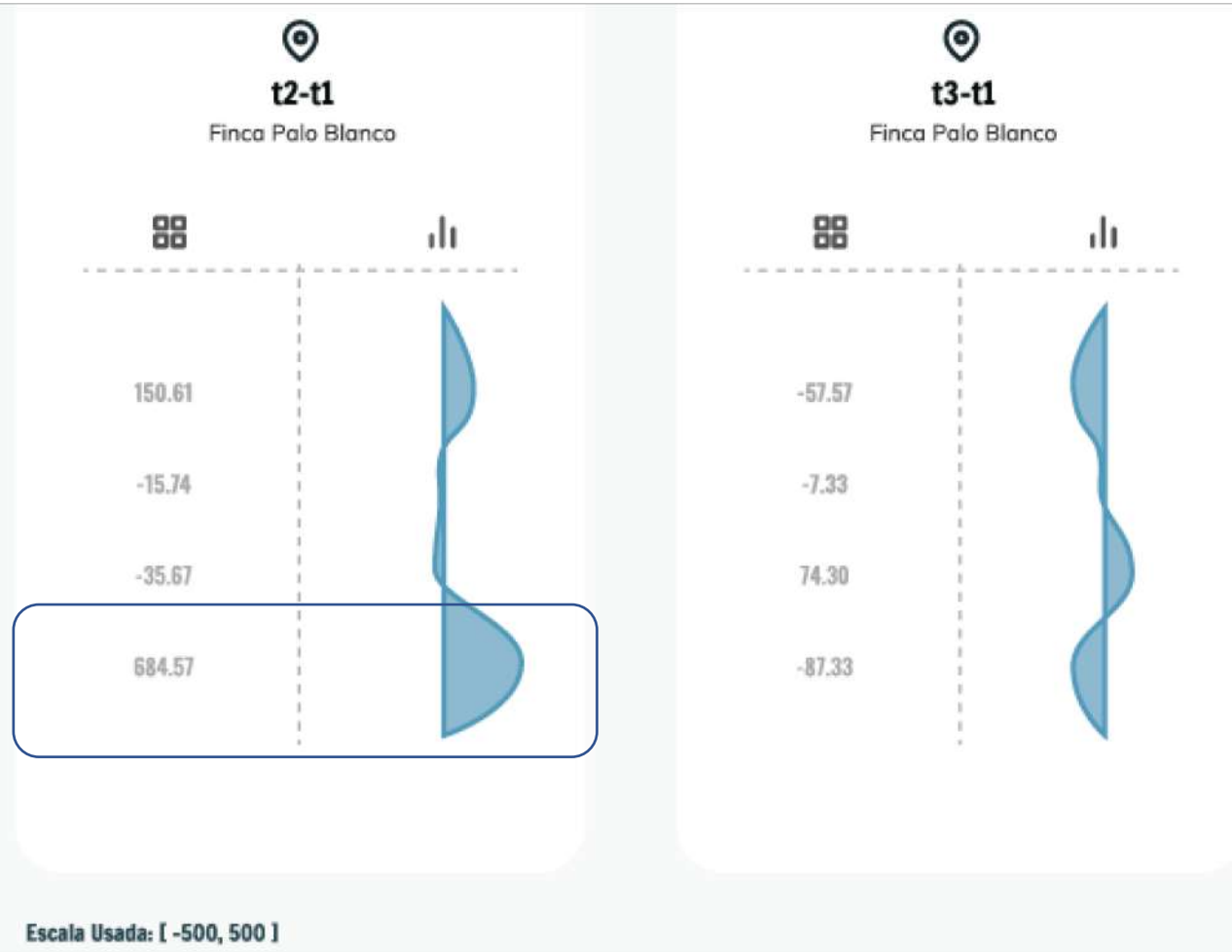
Objective: 30% reduction of Maconceb
Gheom *Bacillus pumilus* qst 2808
Foliar application
Soil microbiome analysis



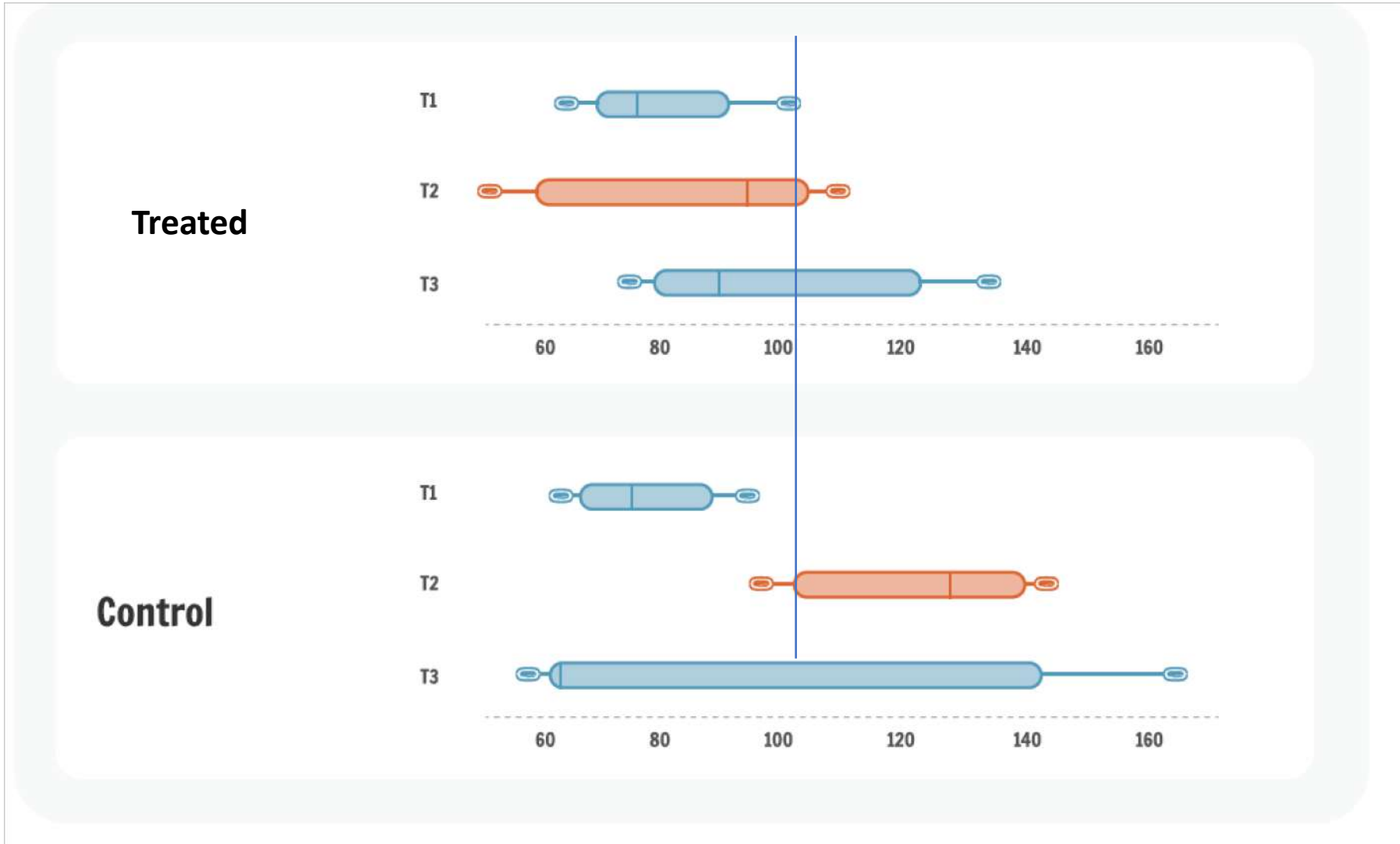
Gheom result: 7X increase on microbiome fungicide activity T2

Elementos de Biocontrol

- Bactericide Agents
- Insecticide Agents
- Nematicide Agents
- Fungicide Agents



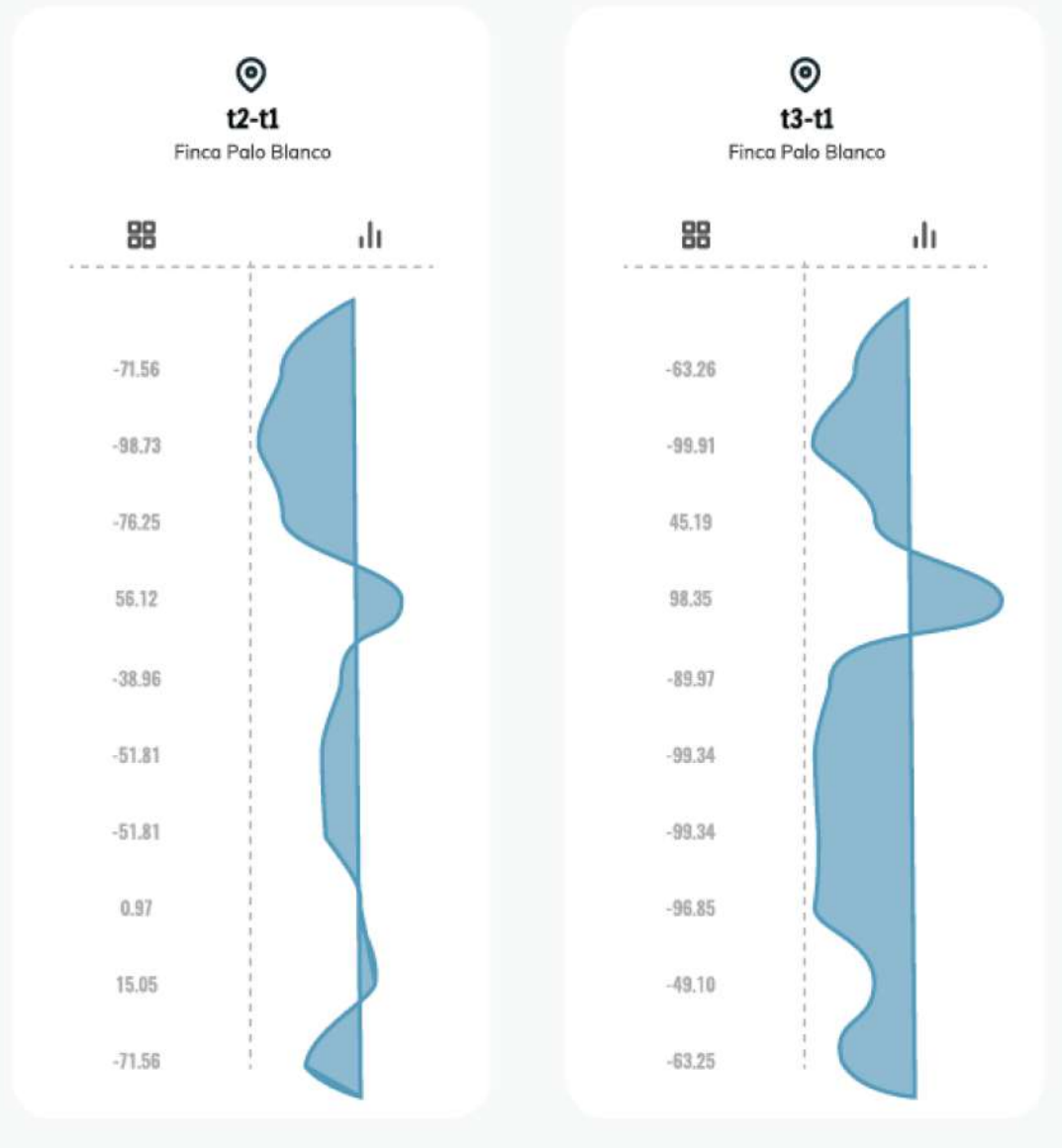
Gheom: decrease of biodiversity at T2



Gheom: decrease of fungal disease risk

Riesgos de Enfermedad

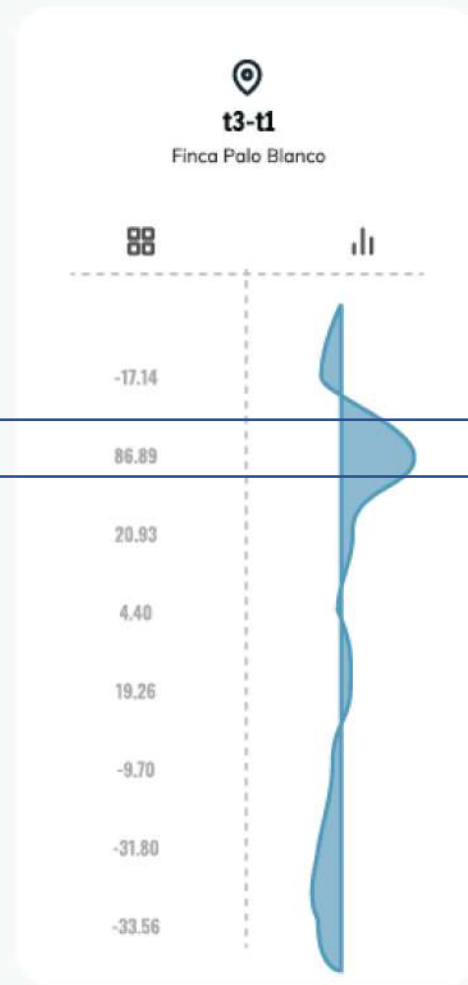
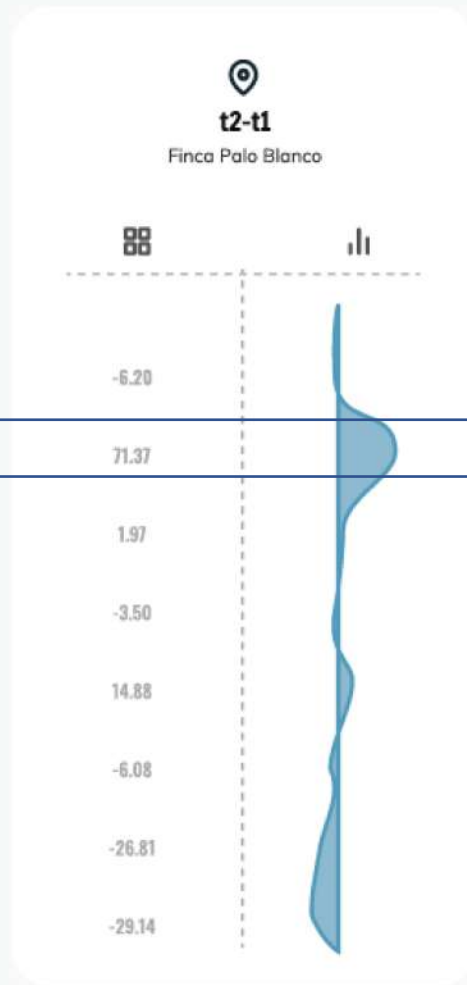
- Cigar-end rot
- Cordana leaf spot
- Crown rot
- Diamond spot
- Finger tip rot (gumming)
- Fungal root-rot
- Fusariosis
- Leaf spot
- Peduncle rot
- Verticillium tip rot



Gheom: Increase of Zn transport and ABA production

Movilización y Equilibrio de Nutrientes

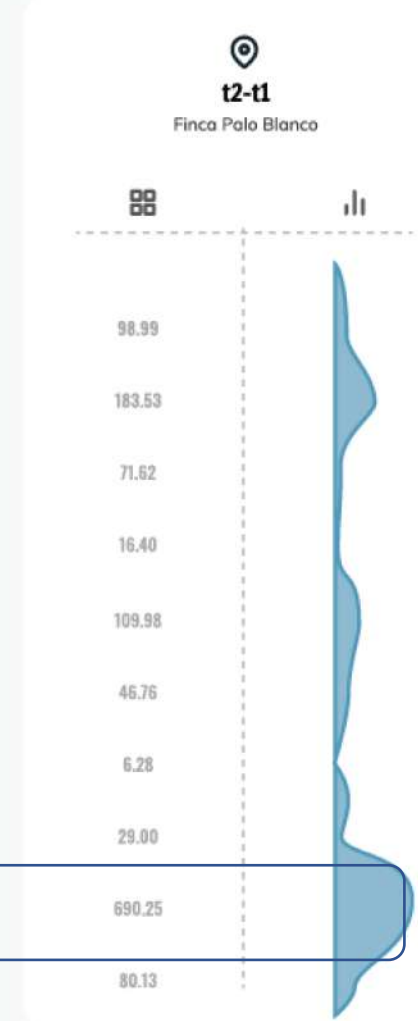
- Iron Assimilation
- **Zinc Transport Equilibrium**
- Manganese Transport Equilibrium
- Sulfur Cycles Equilibrium
- Calcium Transport
- Copper Export
- Magnesium Transport
- Chlorine Transport



Escala Usada: [-100, 100]

Producción de FitoHormonas

- Auxin Production
- Cytokinin Production
- Gibberellin Production
- Exopolysaccharide Production
- ACC Deaminase (ACC-d)
- Heavy Metal Solubilization
- Salicylic acid
- Salt tolerance
- **Abscisic Acid**
- Siderophore Production



B I O M E
M A K E R S



Soil Microbial Composition and Structure Allow Assessment of Biological Product Effectiveness and Crop Yield Prediction

Nabeel Imam,  Ignacio Belda, Adrian J Duehl, James R Doroghazi, Daniel E Almonacid, Varghese P Thomas, Alberto Acedo

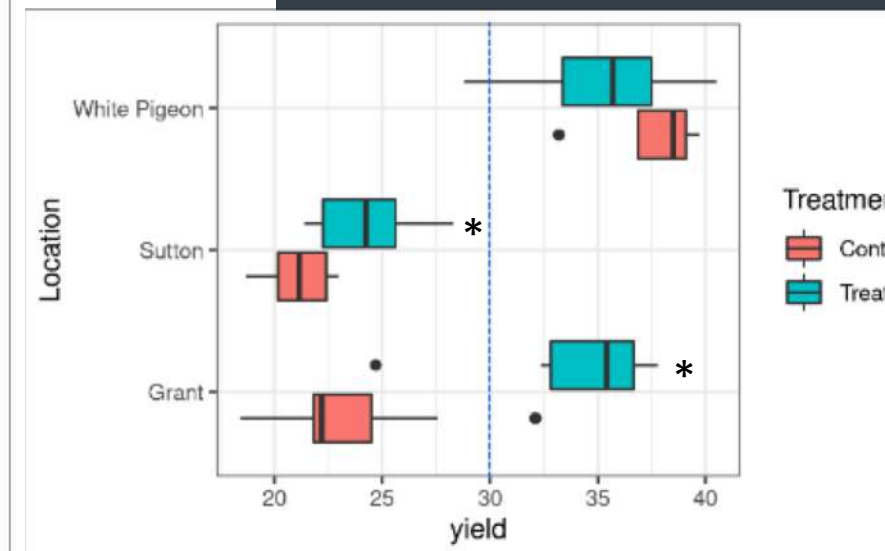
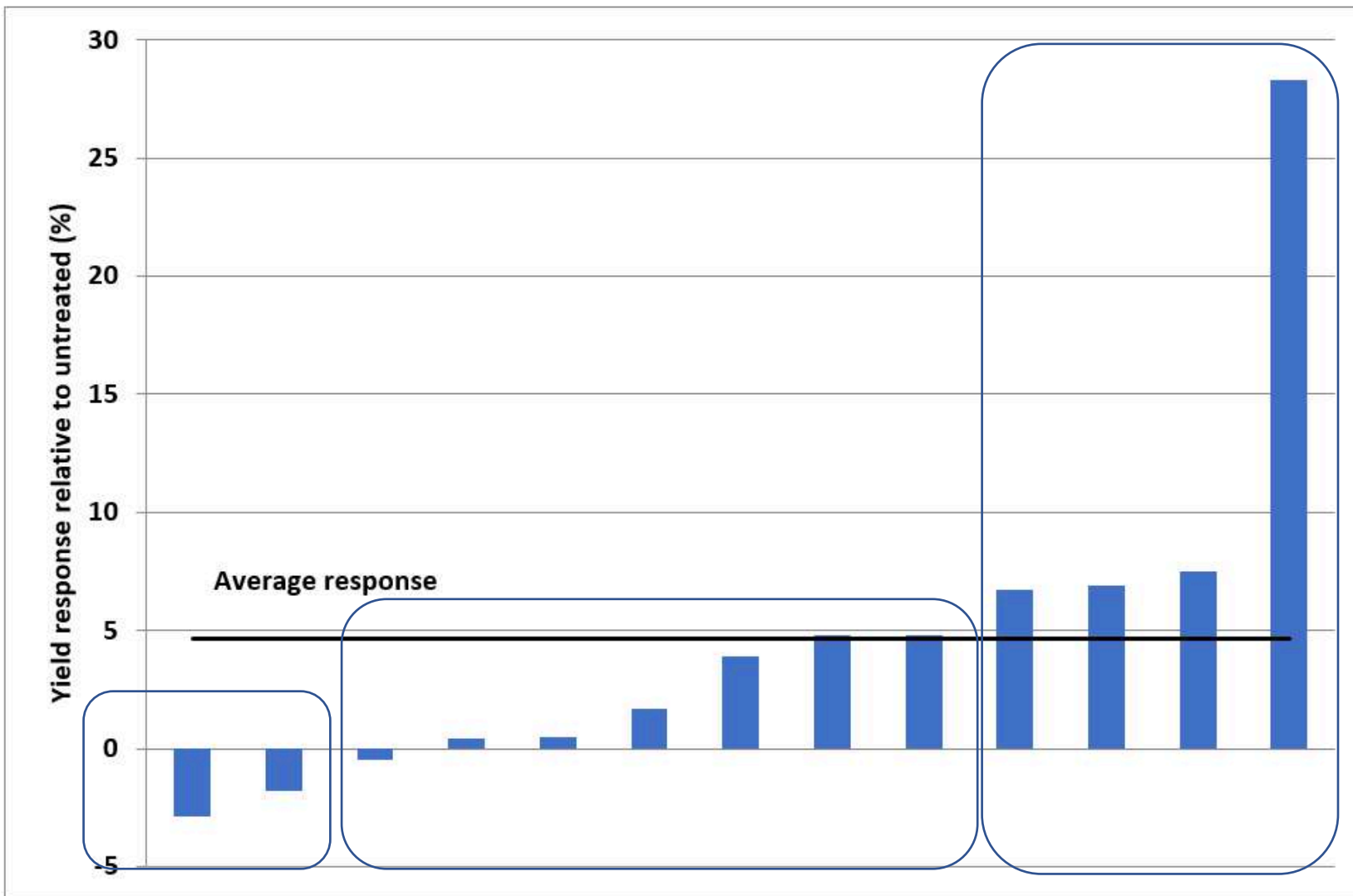
doi: <https://doi.org/10.1101/2021.02.09.430373>



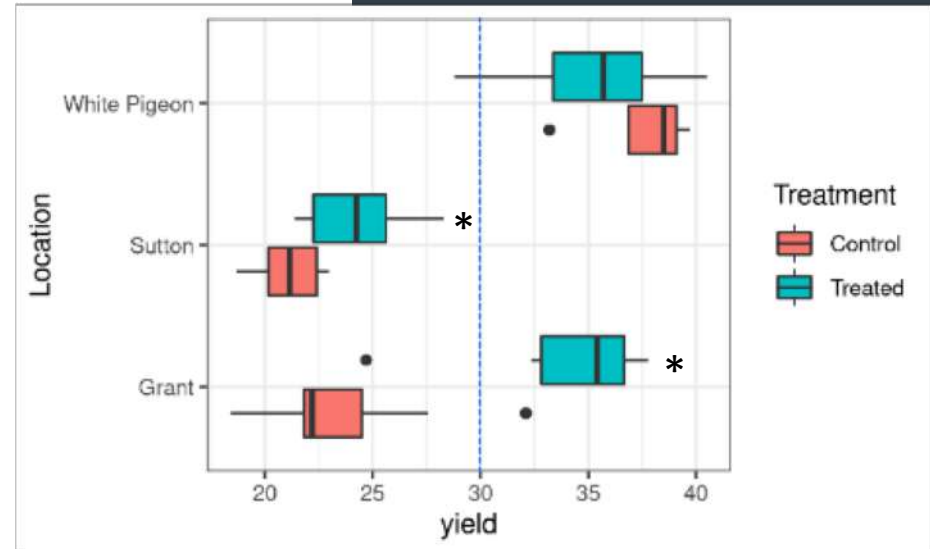
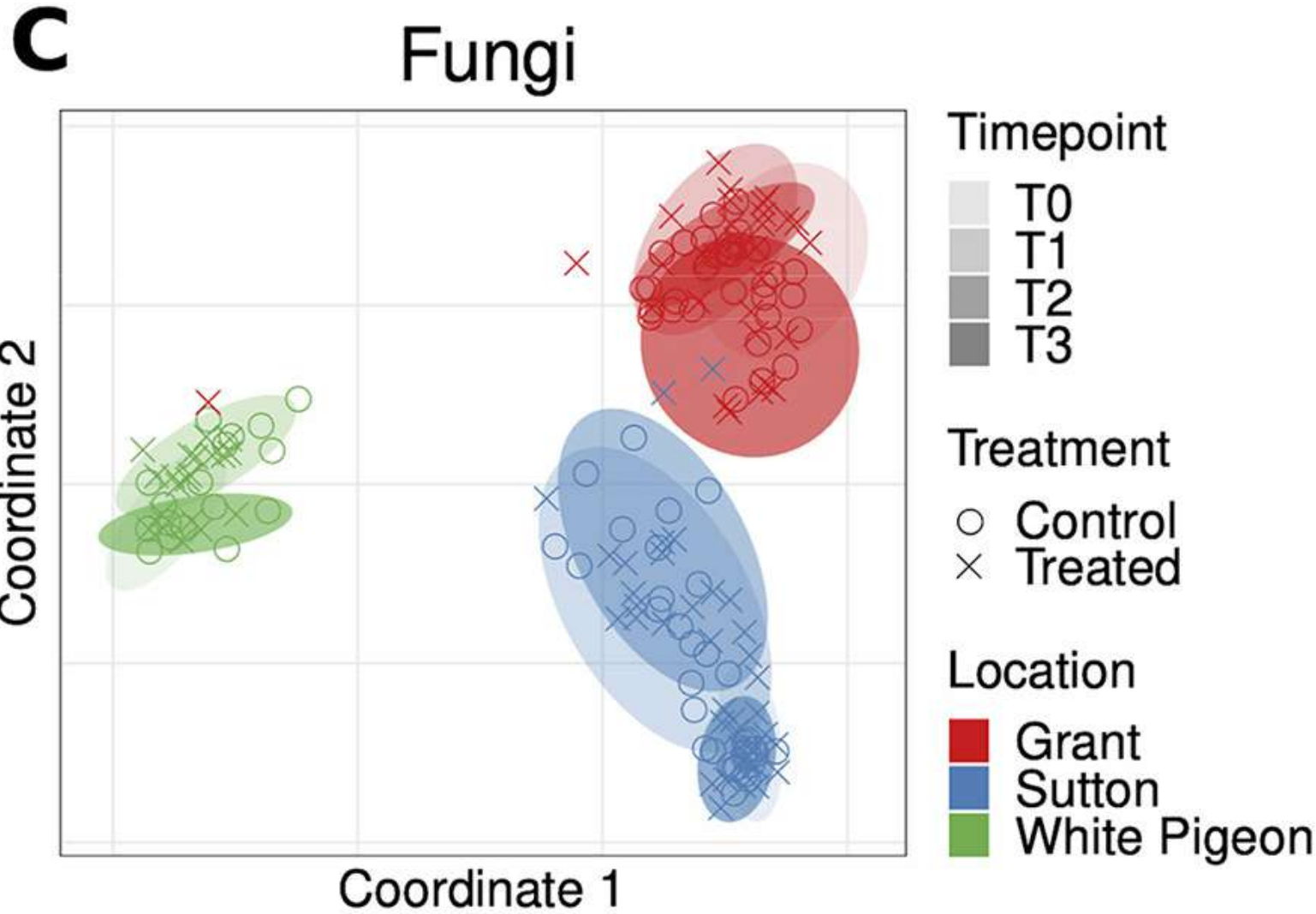
Patoto Biocontrol and Yield improvement

Biocontrol to increase yield?

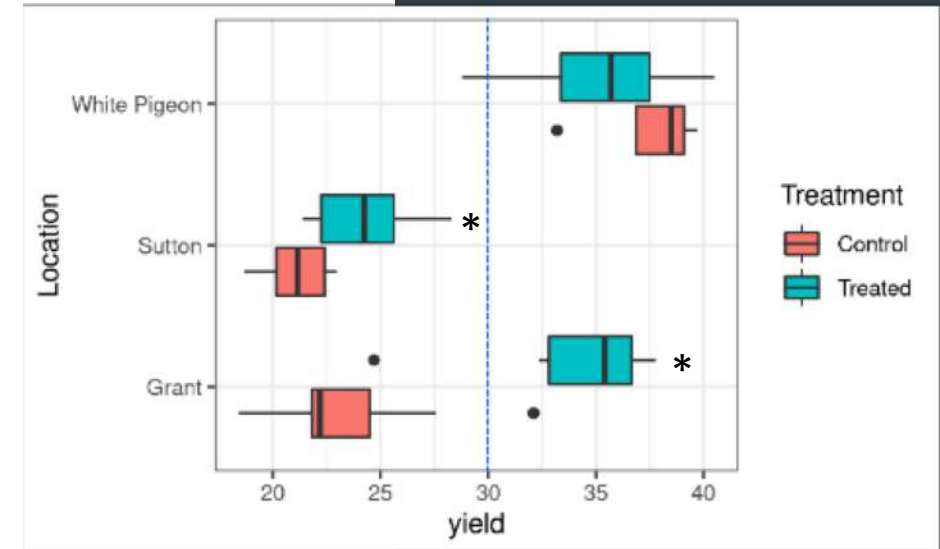
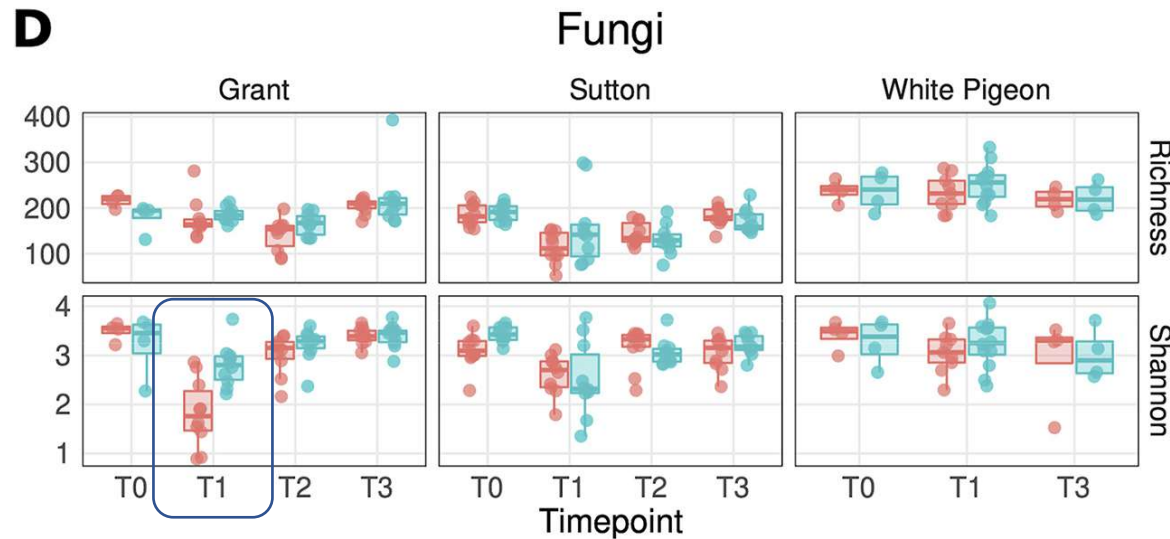
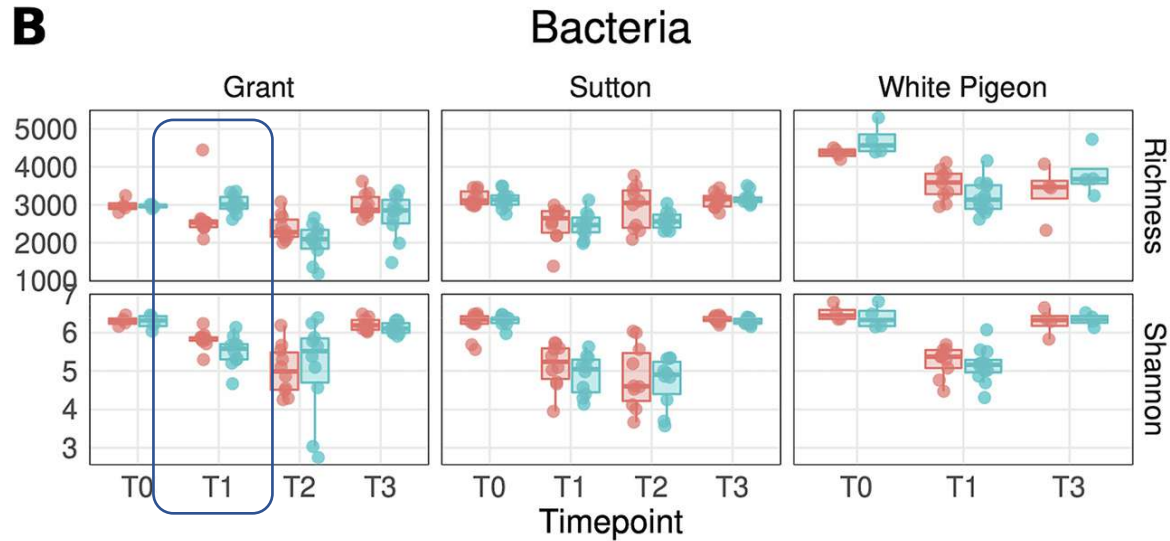
Bacillus amyloliquefaciens inoculant (strain QST713)



Gheom result: different biodiversity composition – different yield

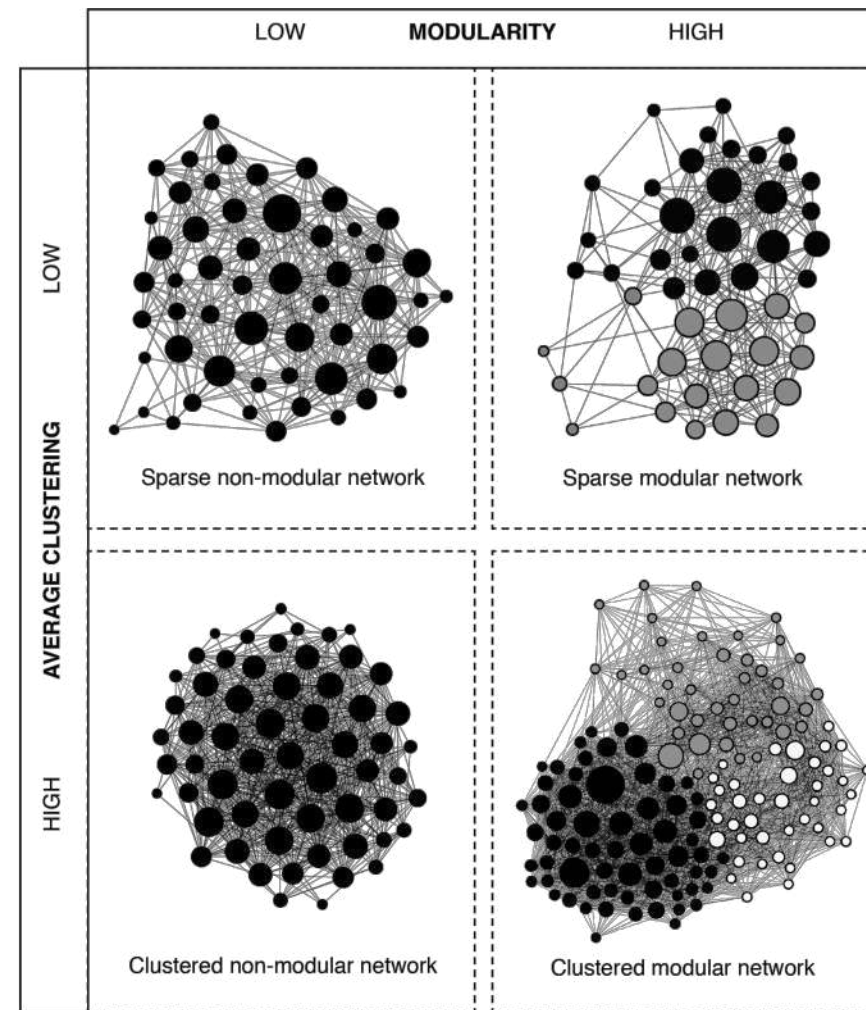
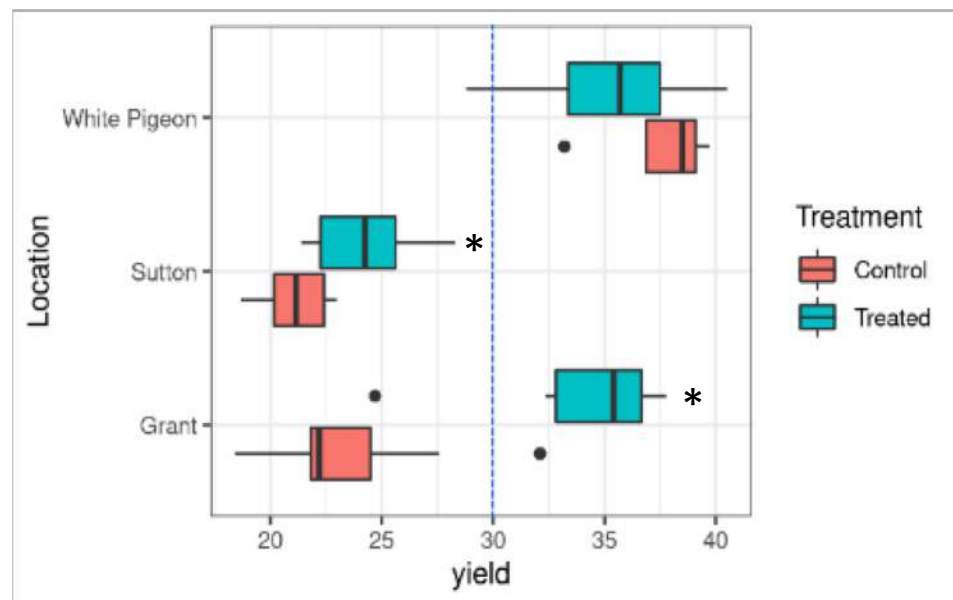


Gheom result: effect on biodiversity– different yield



significant changes only in Grant at T1 for bacterial OTU richness and Shannon index as well as fungal Shannon index

Gheom result: effect on ecology – different yield



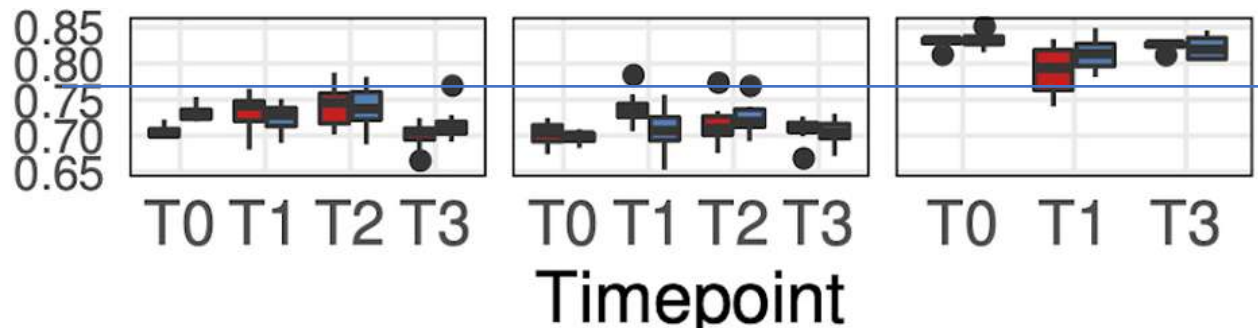
B

Fungi

Grant

Sutton

White Pigeon



Co-occurrence transitivity

Gheom result: prediction

A

		Actual	
		≤ 30 t/ha	> 30 t/ha
Predicted	≤ 30 t/ha	15	1
	> 30 t/ha	3	7

**Random forest Model v1
Prediction**

high accuracy (84.6%)

B

Variable	Importance
PC25	2.838
PC3	1.675
Fungal co-occurrence transitivity	1.657
PC5	1.196
Fungal co-occurrence modularity	0.920
Bacterial co-occurrence transitivity	0.881
Location	0.808

Bacillus sp

Location

- 1
- 2
- 3
- 7
- 8
- 9
- 10
- 11
- 14
- 16
- 17
- 18
- 19
- 20
- 21
- 22
- 23



The first **AI virtual assistant** for
sustainable farming

Bigger soil microbiome database worldwide



Soil Microbiome, a reliable biomarker

predict product/management effectiveness – 2022 test – you are welcome



The screenshot shows a user interface for 'BeCrap TOMATO' reports. At the top, there is a navigation bar with the BeCrap logo, a 'Reports List' title, a clock icon, and a user profile for 'ENEAS MARIN Biome Makers'. Below the navigation bar, a message states 'Listing your 6 reports for BECRAP TOMATO'. A summary card on the left indicates '9 REPORTS'. A central orange callout box features a tomato icon and an upward arrow, stating '+20% in 50% of your analyzed parcels POTENTIAL YIELD INCREASE'. To the right, there is a search bar with the text 'Search for a Report' and a magnifying glass icon. Below these elements is a table with columns for Name, Date, Variety, Summary, Potential, and Actions. The table contains six rows of report data.

Name	Date	Variety	Summary	Potential	Actions
UpHill #00000A	28Apr2018	Raf		+20% +15%	
Sunset Field #00012A	15Jul2018	Reefstaak			
The Triangle #00057B	22Oct2018	Big Rainbow		+15%	
RM Testing Parcel #000895	20Feb2018	Plum Tomato			
BioTomato #000775	5May2018	Super Sweet 100		+20%	
Trad4Prod #000452	13Sep2018	Jubilee		+20%	

The background is white and filled with various light gray icons of microorganisms, including bacteria, viruses, and cells. In the center, there is a large orange heart outline. To its right, the word "your" is written in a lowercase, black, sans-serif font. Below "your", the word "MICROBES" is written in a large, bold, black, uppercase, sans-serif font.

your
MICROBES

The logo for Biomemakers, featuring a stylized black icon of a microorganism with three circular protrusions. To its right, the word "BIOMEMAKERS" is written in a black, uppercase, sans-serif font.

BIOMEMAKERS

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