



ESSAI 4

Nutrition innovante

COLZA / COMPARAISON ANUELLE D'EFFICACITÉ DE 2 BIOSTIMULANTS APPLIQUÉS AU SEMIS



BIOME MAKERS

better Soil, better Food, better Life



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Bioline

AgroSciences

Cultivating Bioalliances

Analysis of *Trichoderma harzianum* inoculation

B I O M E S
M A K E R S



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CHECKING YOUR AG-INPUT



Bioline
AgroSciences

Cultivating Bioalliances

Experimental design

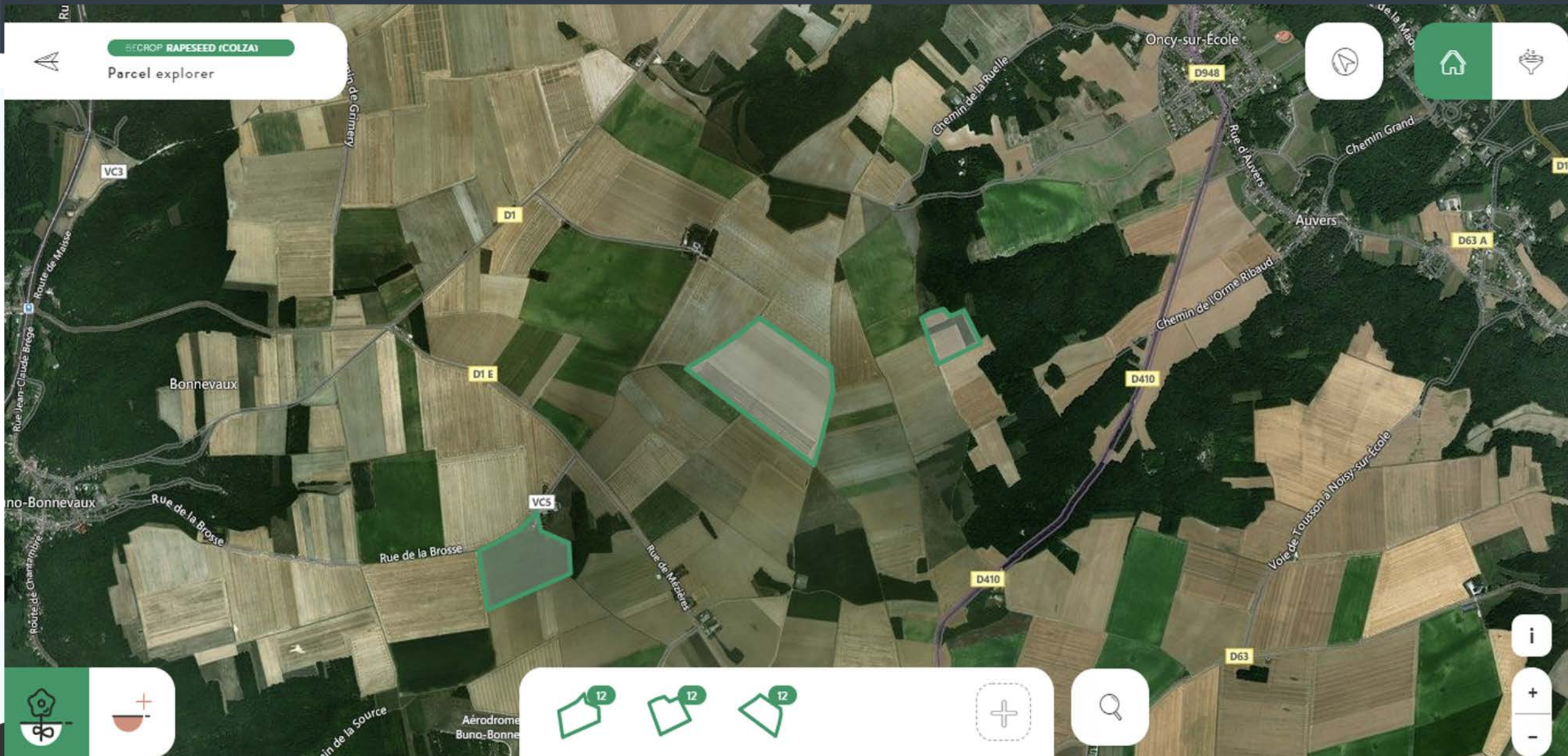
Inoculation *Trichoderma harzianum*

Location/Crop	Parcel	T0 (before the application) 2020-08-25			T1 (after the application) 2020-10-12		
		Block 1 La Brosse - Buno- Bonnevau	Block 2 Tousson - Le Mesnil	Block 3 Noisy-sur-Ecole Le Goulay	Block 1 La Brosse - Buno- Bonnevau	Block 2 Tousson - Le Mesnil	Block 3 Noisy-sur-Ecole Le Goulay
France /Rapeseed	Control	C22010	C2201C	C2201O	C22016	C2201I	C2201U
		C22011	C2201D	C2201P	C22017	C2201J	C2201V
		C22012	C2201E	C2201Q	C22018	C2201K	C2201W
	Inoculation <i>Trichoderma harzianum</i>	C22013	C2201F	C2201R	C22019	C2201L	C2201X
		C22014	C2201G	C2201S	C2201A	C2201M	C2201Y
		C22015	C2201H	C2201T	C2201B	C2201N	C2201Z

- Same soil type: silt loam. Non irrigation in all plots
- Different previous crop: **Block 1 : potatoes / Block 2 and 3 : Barley**
- Different plant performance in the different blocks (?)
- Inoculum concentration (?)

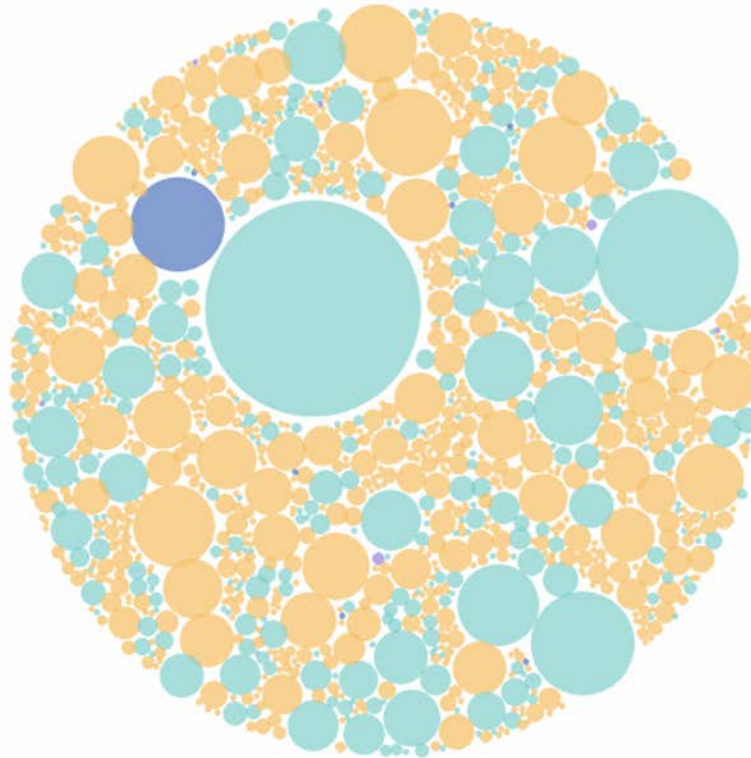


Experimental design



1. TAXONOMY ANALYSIS

 Fungus  Bacteria  Archaea  Yeast  Protist

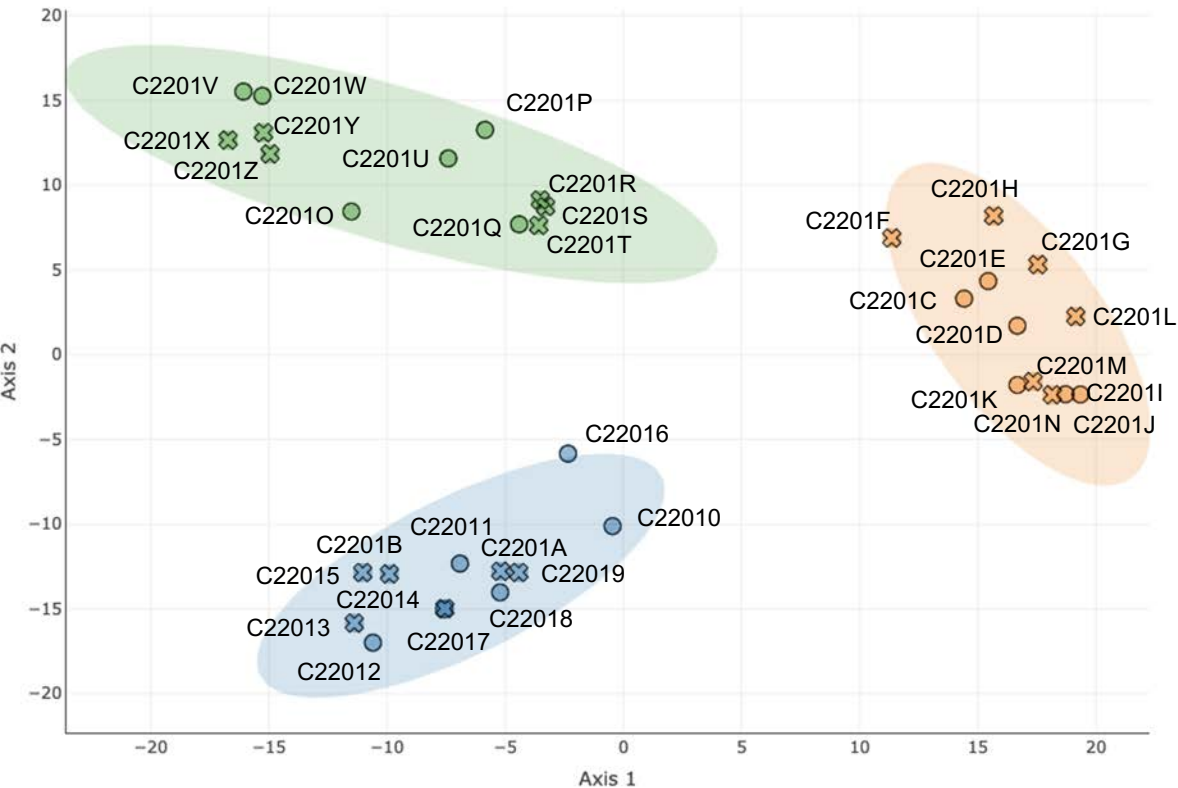


Comparative analysis of the microbiome community composition

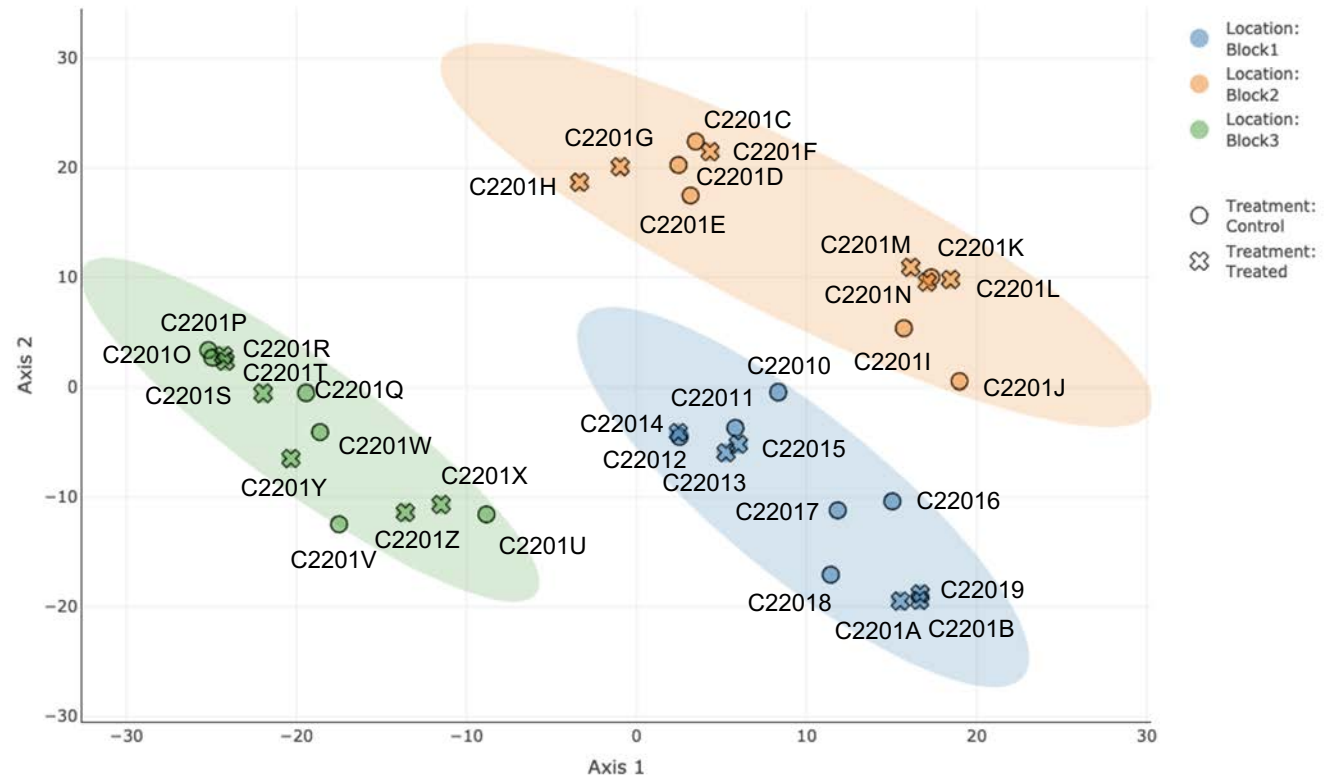
Bacteria and Fungi

Clear significant discrimination by block for bacteria and fungal community composition

Bacteria



Fungi

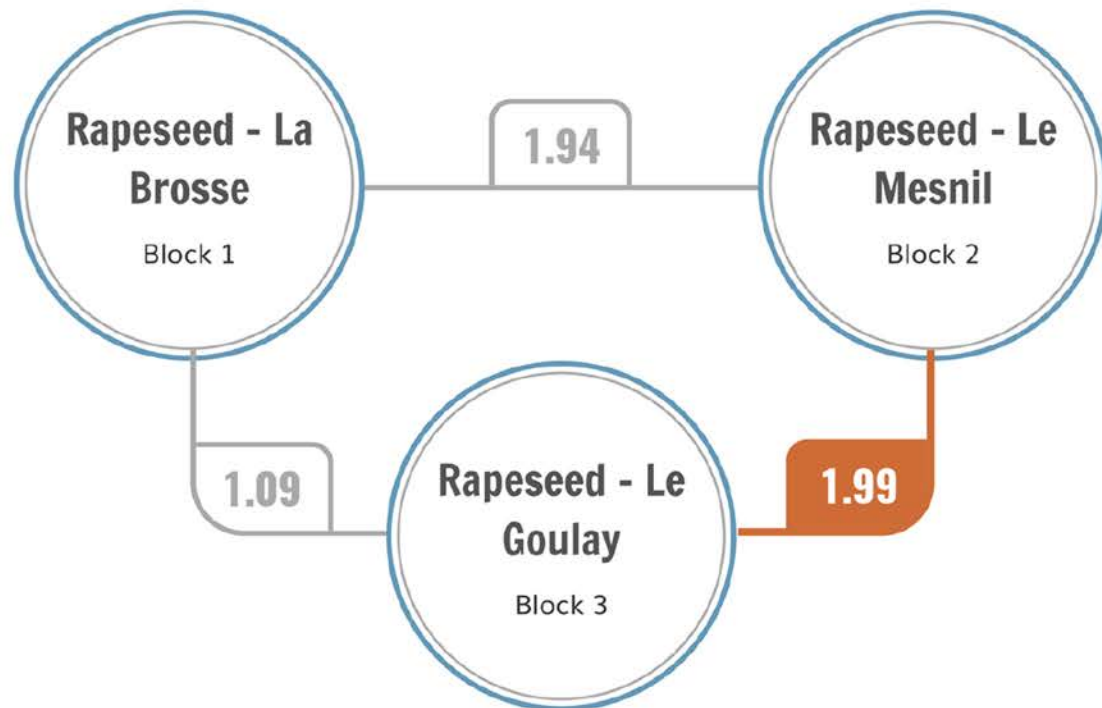


Comparative analysis of the microbiome community composition - Gheom report

Bacteria and Fungi

Macroscale: Among Locations

Microbiome Affinity



Pre-Evaluation

Good microbiome affinity

Locations present a reasonable distance in terms of microbiome

Same-crop locations

Locations grow the same crop, comparison makes sense

Block 3 and Block 2 have the highest difference regarding microbial community composition.

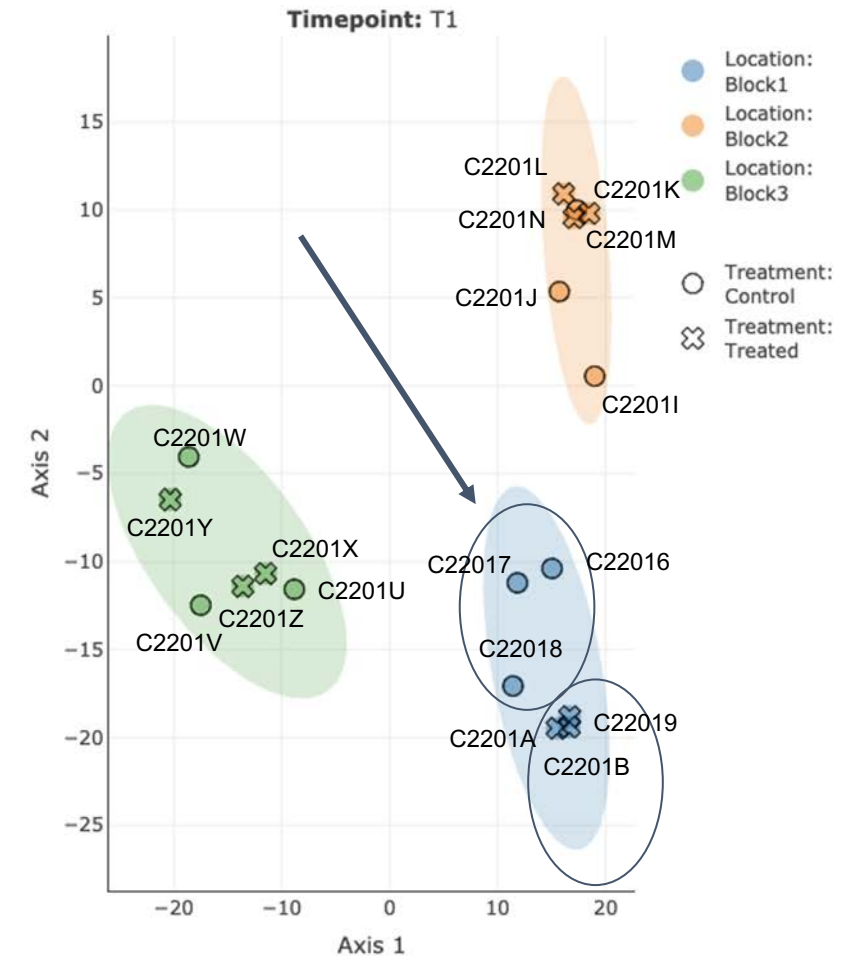
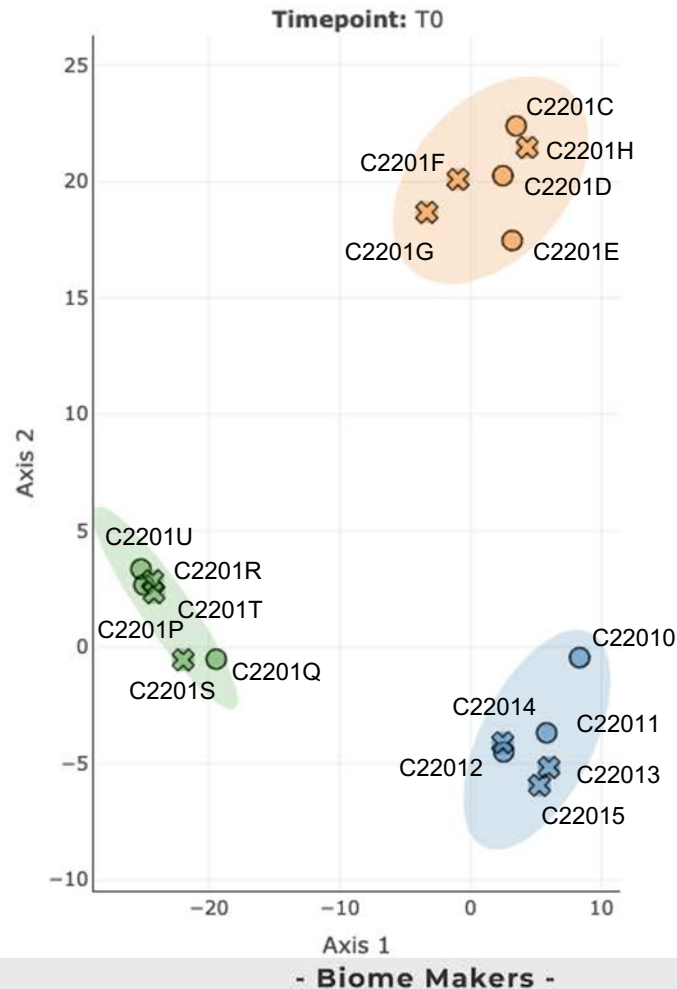


Comparative analysis of the microbiome community composition

Fungi over time and treatment

- Block 1 and Block 3 have more similar fungi community composition than Block 2.
- Differences by treatment for fungal community composition over time in Block 1
- No significant differences by treatment in block 2 and block 3

Fungi



Microscale: Locations over Time

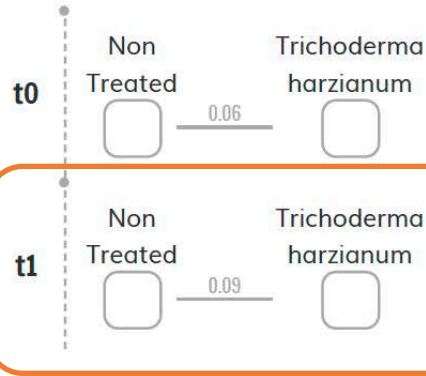
Buno-Bonnevaux

Rapeseed - La Brosse

Among times



In each time



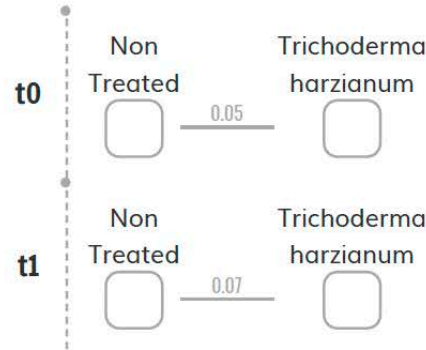
Tousson

Rapeseed - Le Mesnil

Among times



In each time



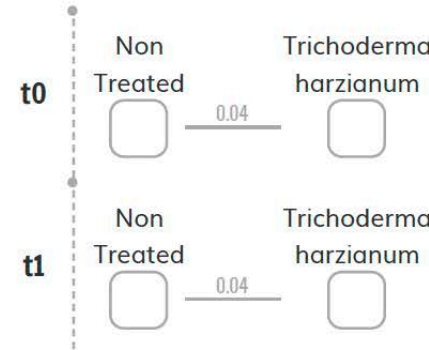
Noisy-sur-Ecole

Rapeseed - Le Goulay

Among times



In each time

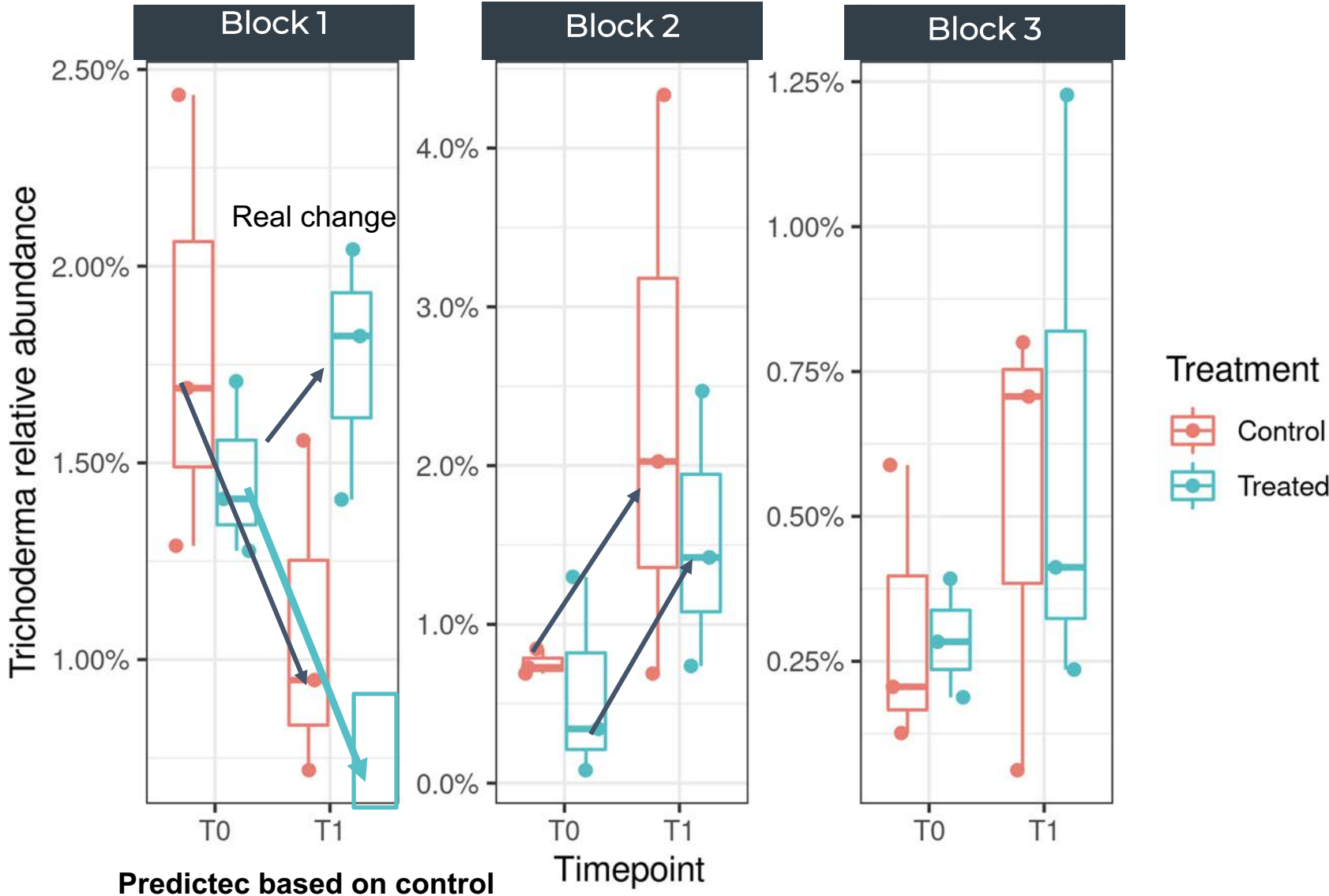


- Buno-Bonnevaux block Shows more variability between Control and Treated plot



Differences in the *Trichoderma sp.* abundances by blocks

Comparative analysis of *Trichoderma sp.* abundance in different blocks and time points



≈ 1.2 % of increase of *Trichoderma sp.* abundance in treatment plots over time (from T0 to T1)

Slightly increase of *Trichoderma sp.* abundance in control and treatment plots over time (from T0 to T1). This suggest only a time effect, not treatment effect in this Block

No important differences between control and treated plot over time. (slightly increase in control plots)



Microbial biomass



≈ double of microbial biomass than block 1 and block 2

PF OPENFIELD
Colza - La Brosse (000/01/0114)

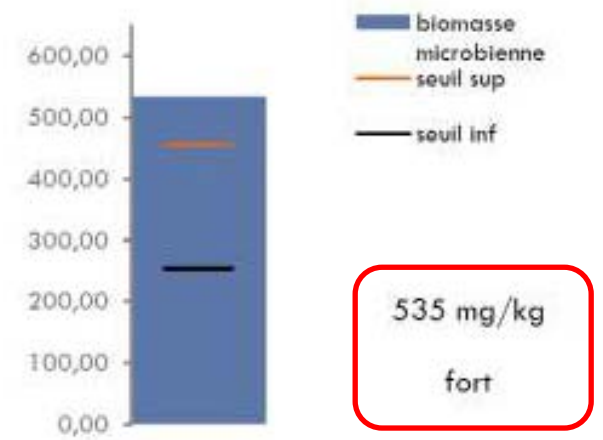
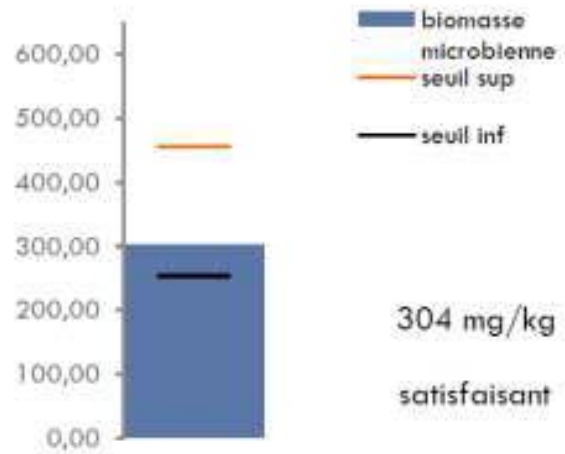
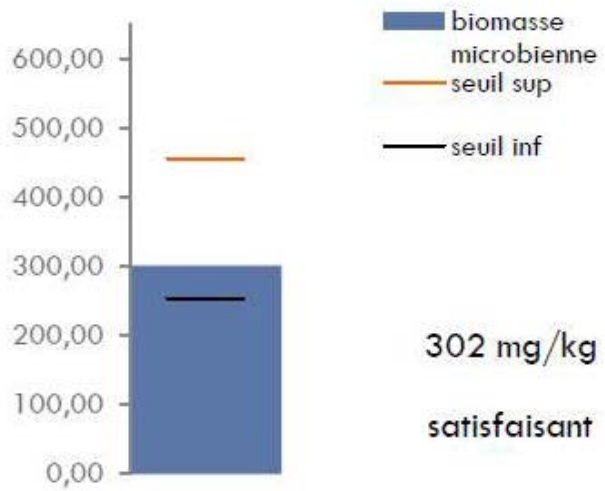
VDC Milly
Colza - Le Mesnil (1 ZA 029)

David
Colza Le Goulay (2/E/094)

Carbone	Biomasse Microbienne (BM)	
	g/kg terre	en % C
22,6	302	1,3
fort	satisfaisant	très faible

Carbone	Biomasse Microbienne (BM)	
	g/kg terre	en % C
10,2	304	3,0
faible	satisfaisant	fort

Carbone	Biomasse Microbienne (BM)	
	g/kg terre	en % C
10,3	535	5,2
faible	fort	très fort



Block 1

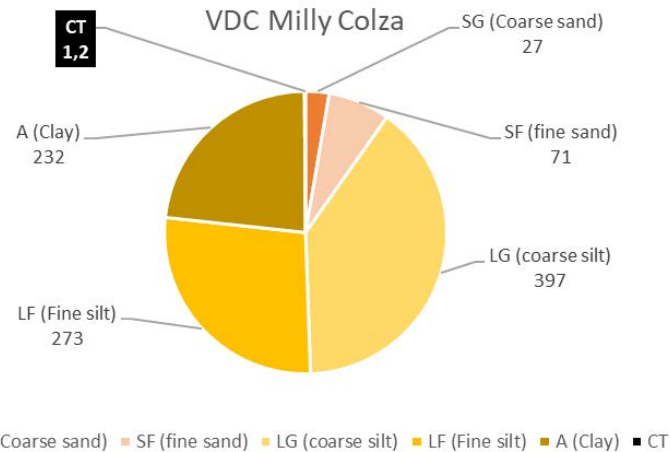
Block 2

Block 3

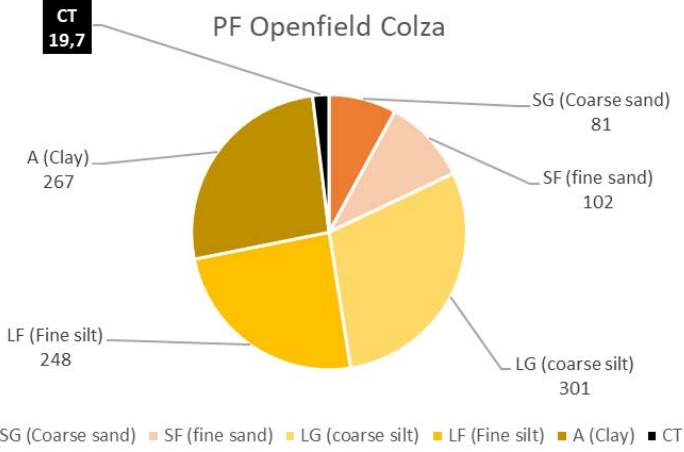
Texture & Total calcareous



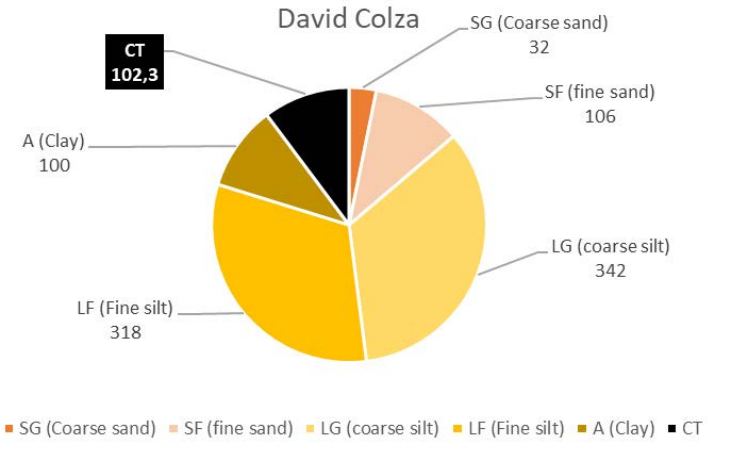
Block 2



Block 1



Block 3




	VDC Milly	PF OPENFIELD	David - Colza Le Goulay (2/E/094)
Parcelle (cadastre)	Le Mesnil (TOUSSON 1ZA 029)	La Brosse (BUNO BONNEVAUX 000/01/01114)	Le Goulay (NOISY SUR ECOLE 2/0E/0494)
CEC	106,5	132,6	145
CT	1,2	19,7	102,3
pH	7,5	8,2	8,3
Organic matter	17,6	18,5	28,5



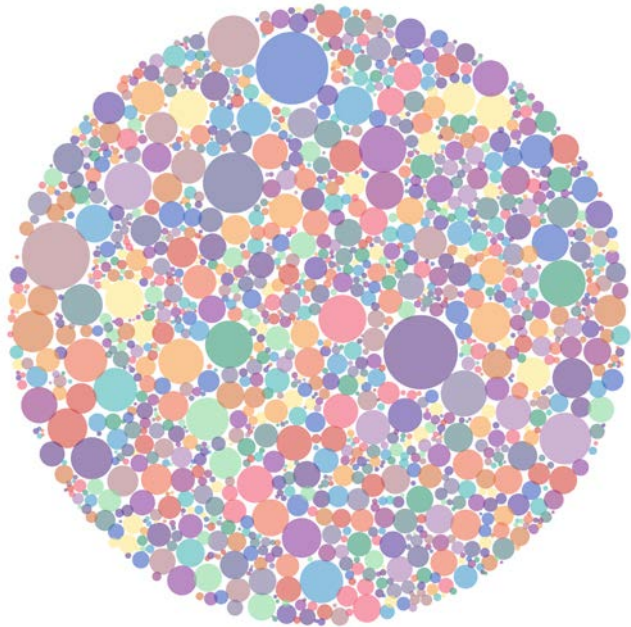
Higher OM and CT (Total calcareous) in block 3

Crops

	Block 2	Block 1	Block 3
	VDC Milly	PF OPENFIELD	David - Colza Le Goulay (2/E/094)
	Le Mesnil (TOUSSON 1ZA 029)	La Brosse (BUNO BONNEVAUX 000/01/01114)	Le Goulay (NOISY SUR ECOLE 2/0E/0494)
2021	OSR	OSR	OSR
2020	Winter barley ?	Potatoes	Winter barley ?
2019	Winter wheat	Winter wheat	Winter wheat
2018	Sugar beet	Winter wheat	OSR
2017	Spring barley	Winter barley	Winter barley
2016	Winter wheat	Winter wheat	Winter wheat

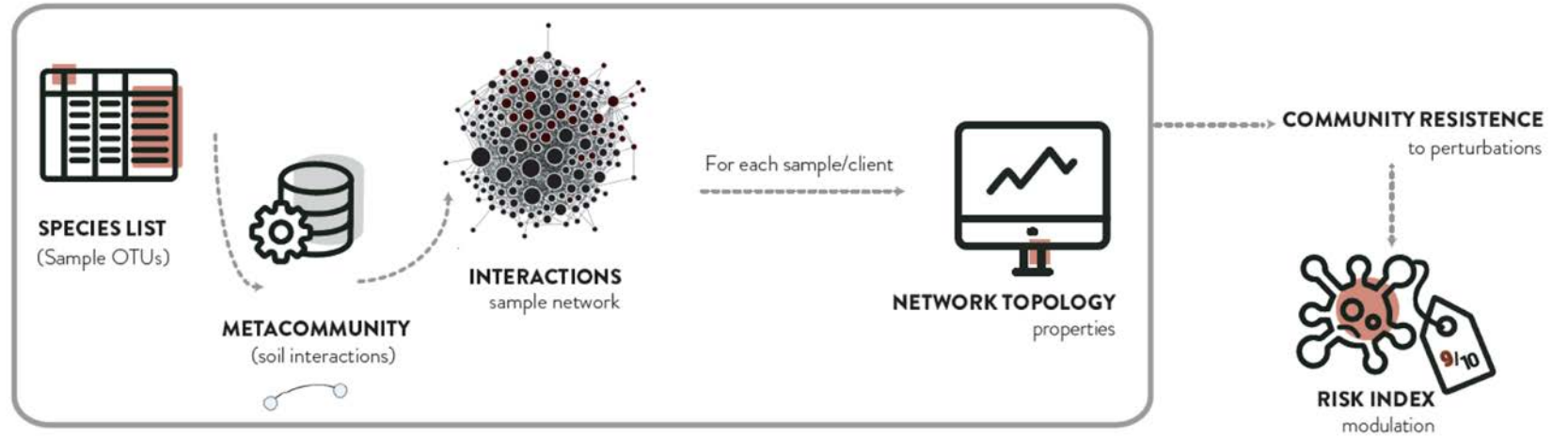
Source : Registre parcellaire graphique 

Potatoes previous crop in Block 1, were the inoculation of mycorrhiza have more success.



Ecological community networks

Impact on community ecology and client metrics

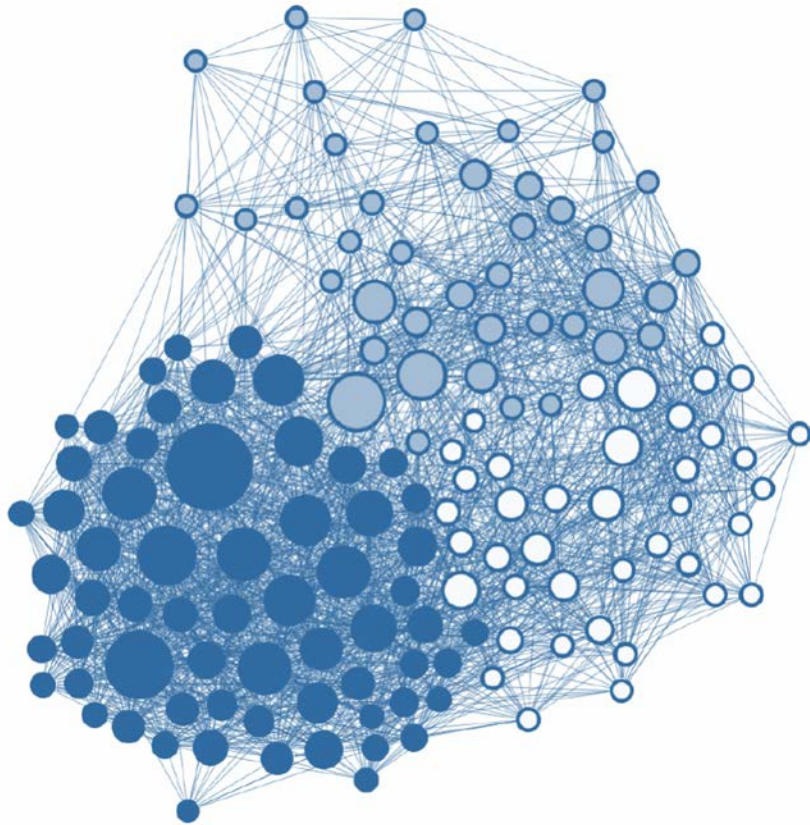


Novel strategy, only in Biome Makers: using potential **species interactions** to understand soil properties and **modulate** indexes

Ongoing development: ecological understanding of **multiple network topology properties** to predict accurately **soil behaviour**

- Pathogen colonization
- Fertilization effects
- Biologically active compounds effects
- Management practises
- Vulnerabilities





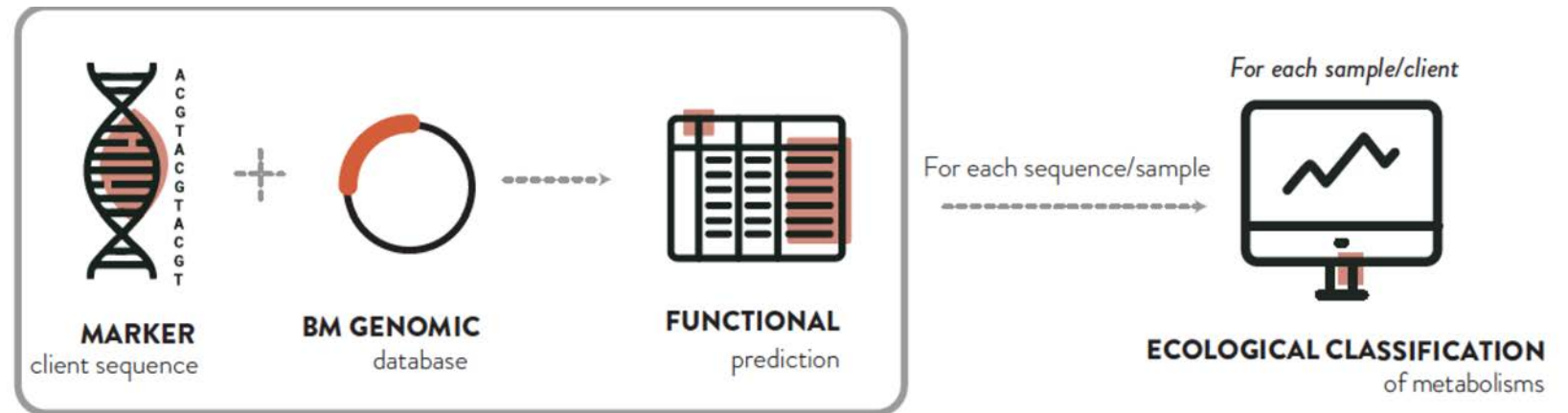
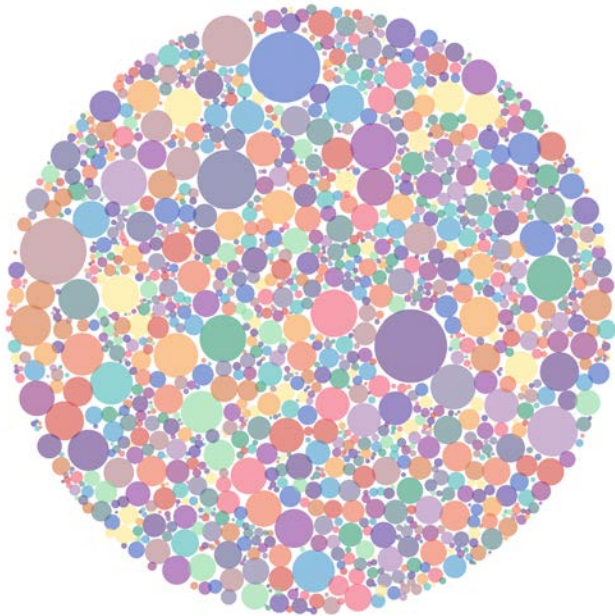
TREATMENT IMPACT SCORE	
Block	Impact score
Block 1 La Brosse - Buno-Bonnevaux	1.12
Block 2 Tousson - Le Mesnil	1.00
Block 3 Noisy-sur-Ecole Le Goulay	0.76

Higher impact score in the Block 1 by the treatment than in Block 2 and Block 3



Functional predictions

How to infer nutrition-related pathways



First level of intelligence: predict functional potential of **microbial species** according to **metabolic pathways** of interest (i.e., phosphorus solubilization)

Second level of intelligence: classification of microbial **metabolic pathways** according to its **impact on crops** (i.e., nutrient supply, nutrient use)



Healthiness indexes - Gheom report

Rate of increase by the product applied (trends)

Pathogens Evolution



Different effect Buno-Bonnevaux Vs Tousson & Noisy

Hit

RapeSeed Pathogens Evolution

0

Claims for *Trichoderma harzianum*

RapeSeed Pathogens Ev...

- ◆ Damping off
- ◆ Fungal root rot
- ◆ Seedling disease complex

Buno-Bonnevaux

Rapeseed - La Brosse

Change

Chart

47.27%

96.43%

220.48%

Tousson

Rapeseed - Le Mesnil

Change

Chart

-21.09%

-29.37%

6.24%

Noisy-sur-Ecole

Rapeseed - Le Goulay

Change

Chart

-39.97%

-41.01%

1.22%



Biocontrol indexes - Gheom report

Rate of increase by the product applied (trends)

Biocontrol Evolution

■ Different effect Buno vs Tousson & Noisy
Buno and Tousson share a trend on Nematicide index increase

Bi

Biocontrol

1

Claims for *Trichoderma harzianum*



x1

■ Biocontrol

◆ Fungicide Agents

◆ Insecticide Agents

◆ Nematicide Agents

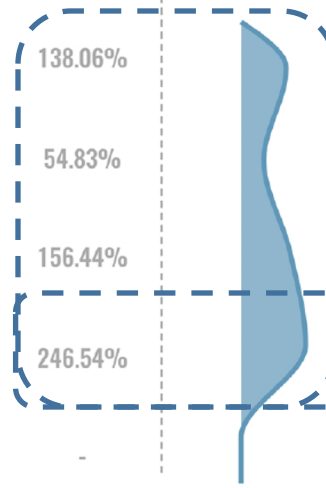
◆ Bactericide Agents

Buno-Bonnevaux

Rapeseed - La Brosse

Change

Chart

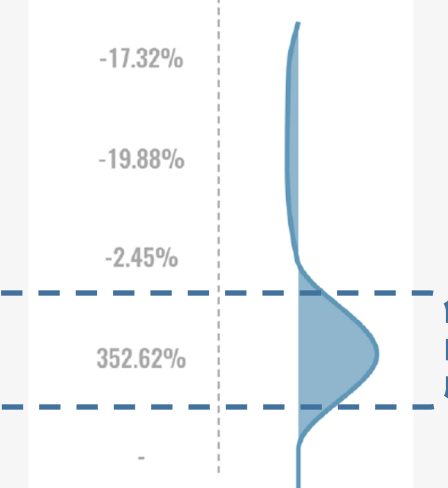


Tousson

Rapeseed - Le Mesnil

Change

Chart

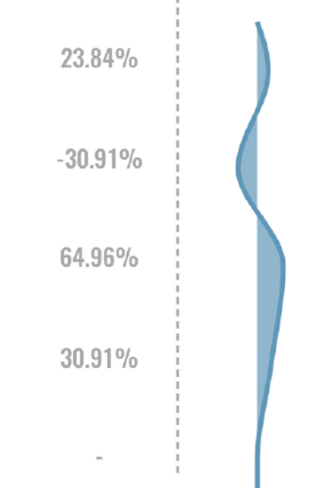


Noisy-sur-Ecole

Rapeseed - Le Goulay

Change

Chart



Comparative analysis of changes in the potential NPK metabolic pathways driven by microbes

P

Phosphorus Pathways

Small impact on P
Trend to improve P solubilisation in all locations.

1

Claims for *Trichoderma harzianum*

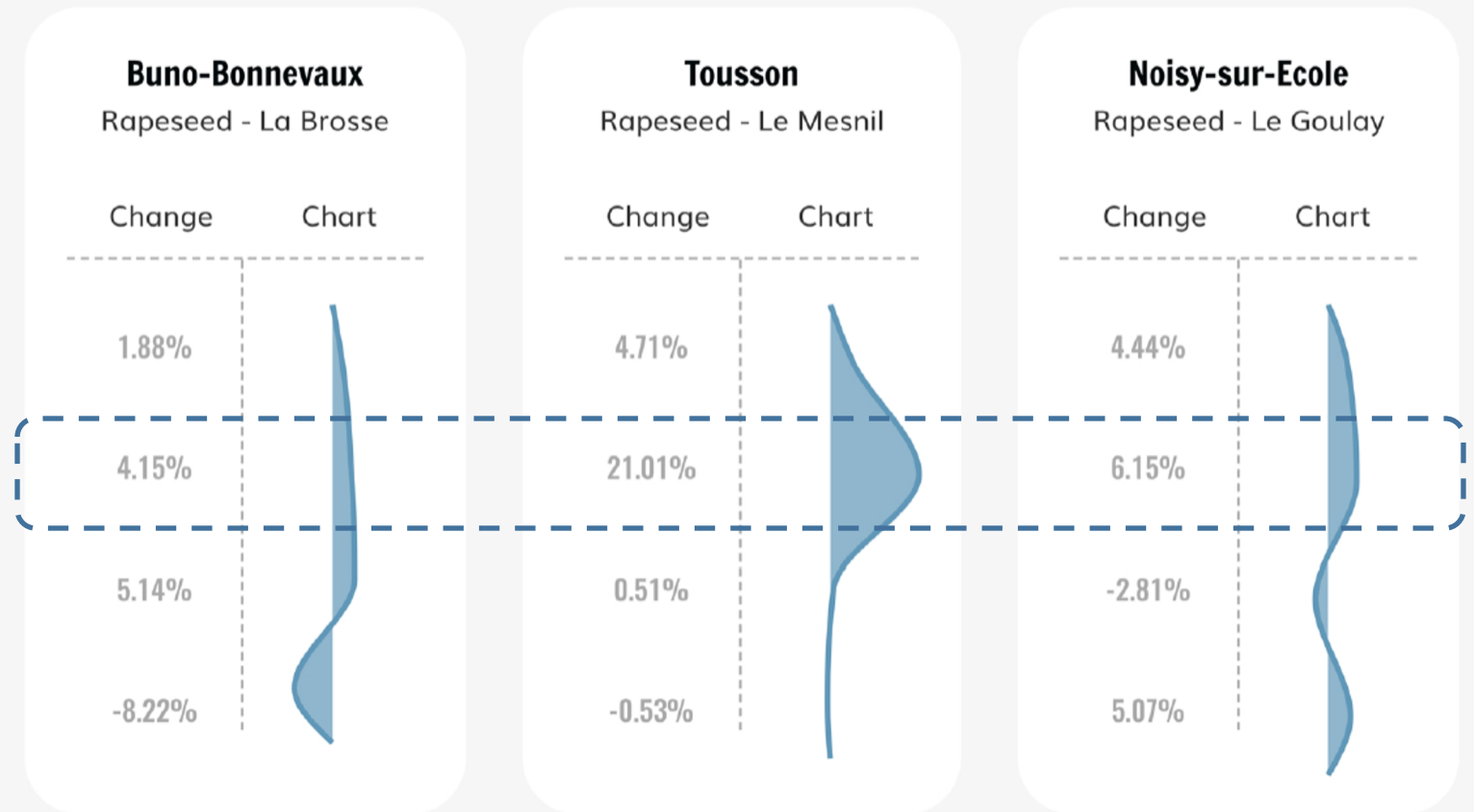
◆
x1

Phosphorus Pathways

◆ Inorganic P solubilization

◆ Inorganic P consumption

◆ Organic P assimilation



Comparative analysis of changes in the potential NPK metabolic pathways driven by microbes

K

Potassium Pathways

Small impact on K
Trend to improve K solubilisation in all locations

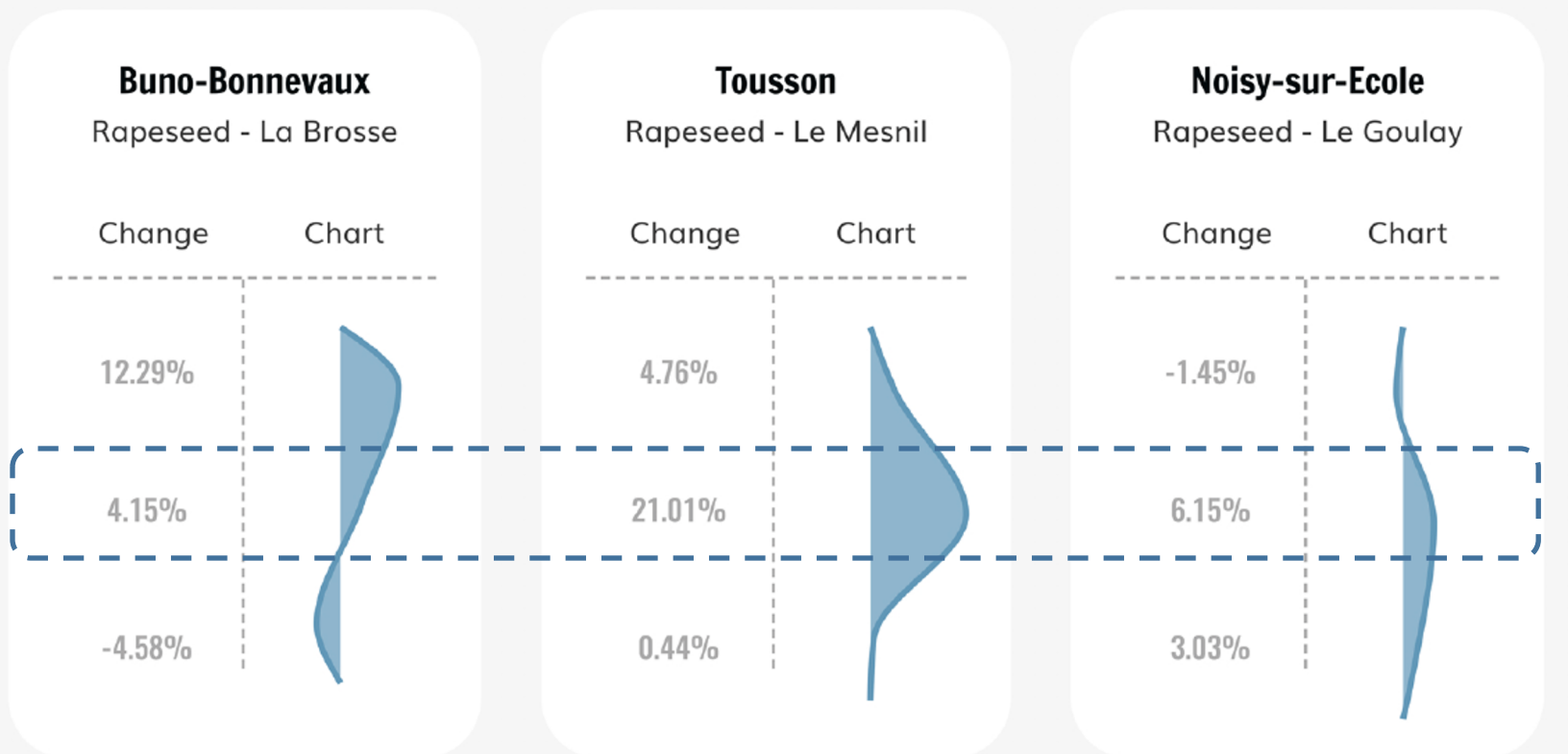
1
Claims for *Trichoderma harzianum*

◆
x1

■ Potassium Pathways

◆ Potassium solubilization

◆ Potassium consumption



Hormones and stress adaptation indexes

Gheom report

Rate of increase by the product applied

Phytohormones and Stress Adaptators Evolution



Different effect Buno vs Noisy
 Buno & Noisy share the same trend in Cytokin
 No effect on Tousson

Ho

Hormone Production Evolution

1

Claims for *Trichoderma harzianum*

◆ x1

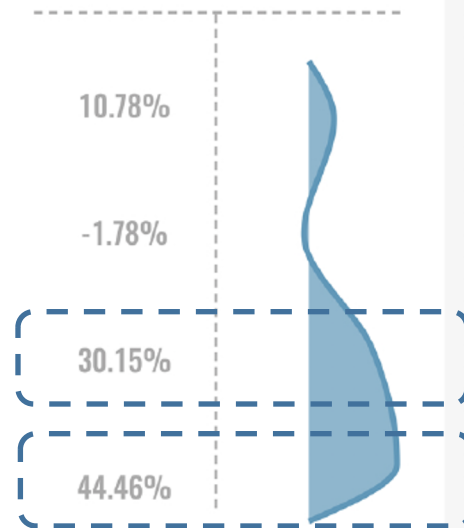
Hormone Production Ev...

- ◆ Auxin Production (IAA)
- ◆ Cytokinin Production (CK)
- ◆ **Gibberellin Production (GA)**

Buno-Bonnevaux

Rapeseed - La Brosse

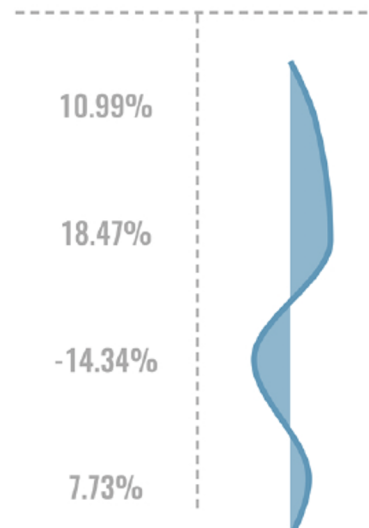
Change Chart



Tousson

Rapeseed - Le Mesnil

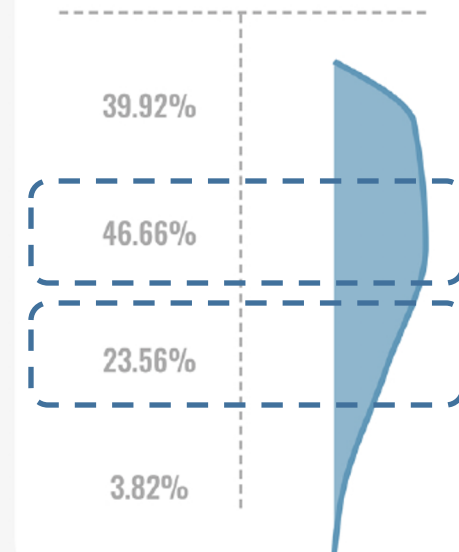
Change Chart



Noisy-sur-Ecole

Rapeseed - Le Goulay

Change Chart



Analysis of *Trichoderma harzianum* inoculation Conclusions



✓ Product trends but had not significant changes in the three locations selected

- ✓ Product in general has a trend to
- Improve K and P solubilization
 - Increase Nematicide effect

✓ Product has more effect on La Brosse – Buno-Bonnevaux

Product has a trend to

- Change **fungal microbiome composition**
- Change **Ecology** structure (network)
- Increase on *Trichoderma sp.* abundance
- Increase **biocontrol activity**
- Increase **healthiness indexes** (decrease diseases risk)
- Increase **Cytokinin and Gibberellin** microbial production



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