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Nuevos fertilizantes: hacia un cambio de paradigma

Proceso de fabricación de los nuevos fertilizantes

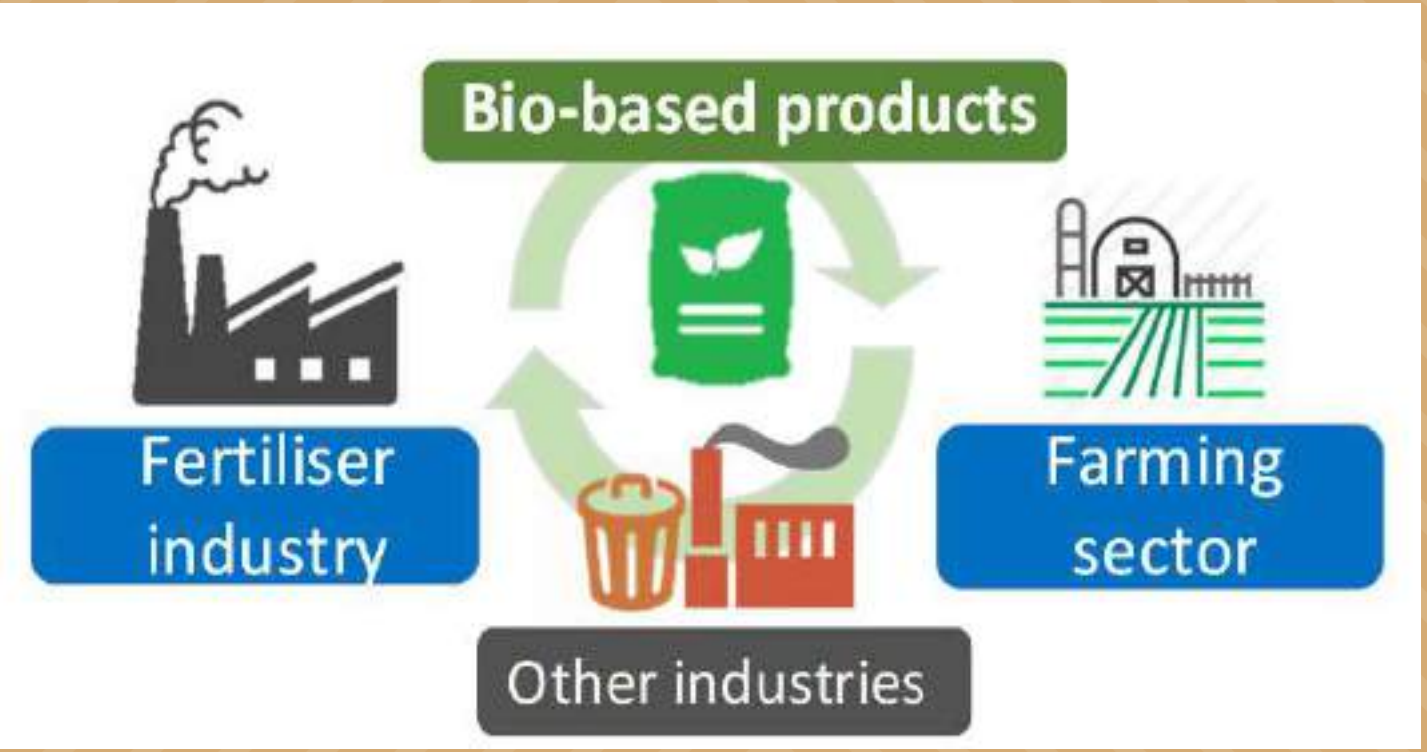
Antonio Morán, Universidad de León

BBI JU

Bio-based Industries Consortium

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 837583.

Farmers and fertiliser industry together for a sustainable agriculture



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Fertiberia

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NOVAMONT

FCC Aqualia

FKuR Polymers

vito vision on technology

agriSat Iberia, S.L.

Arcadia INTERNATIONAL

AgFutura TECHNOLOGIES

FONDAZIONE ICONS

IUNG Institute of Soil Science and Plant Cultivation

Objetivos

- ✓ El principal objetivo de B-FERST es integrar la valorización de los biorresiduos en los planes de gestión agrícola creando nuevas cadenas de valor circulares y de base biológica desde los biorresiduos, la gestión de residuos municipales, las industrias agroalimentarias hasta la cadena de valor de los fertilizantes, considerando una interacción bilateral entre los sectores agrícola y de los fertilizantes.

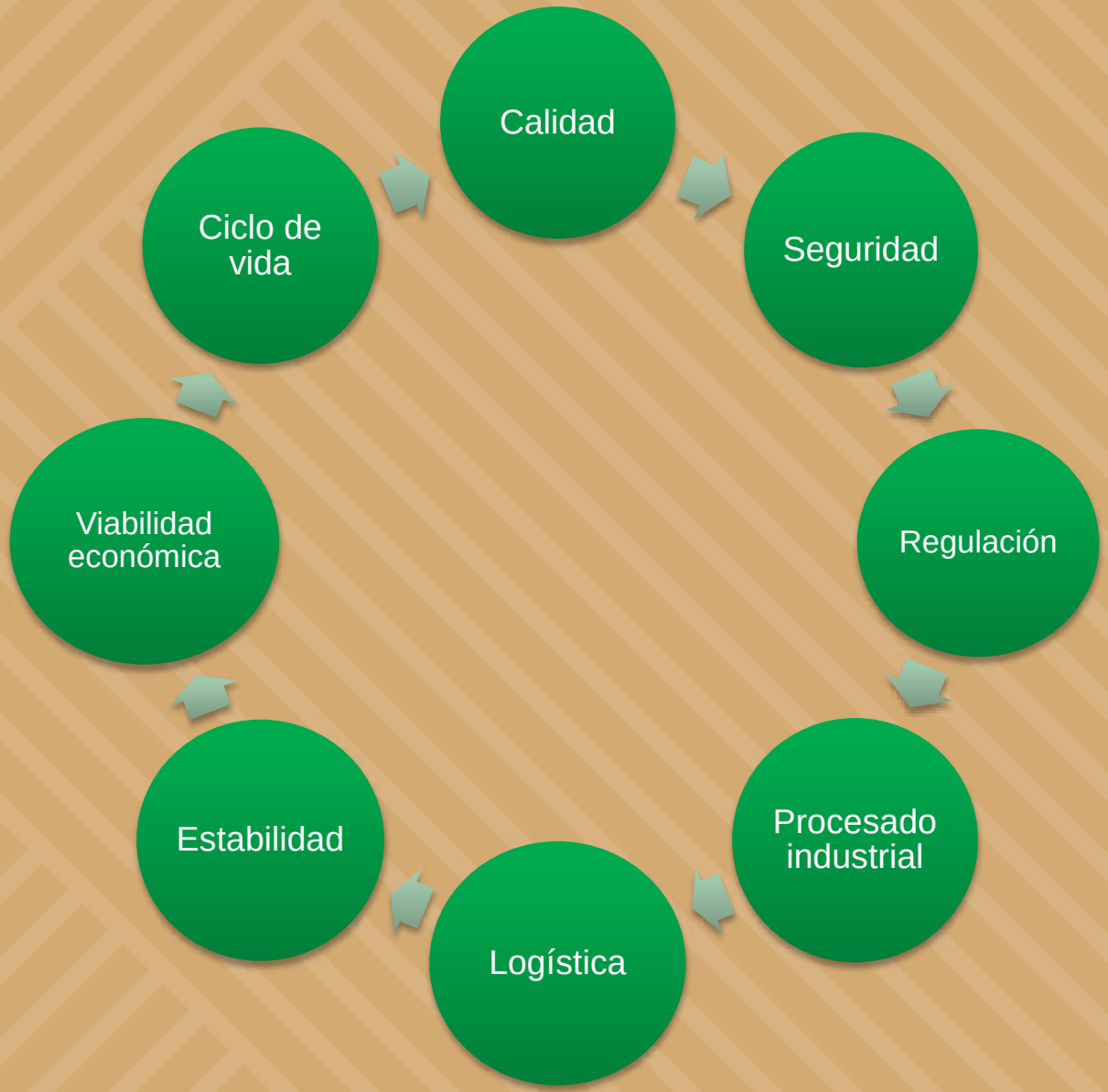
- ✓ Se centra en un cambio de paradigma en la cadena de valor de los fertilizantes con 8 fertilizantes especializados que combinan biorresiduos con nutrientes disponibles, bioestimulantes y recubrimientos biodegradables. Por este motivo, actualmente se está cponiendo en marcha una planta de demostración de recuperación de nutrientes y una planta de demostración de bio-revestimientos en las instalaciones de Fertiberia en la Planta de Huelva (España).

Europa se enfrenta a grandes retos:

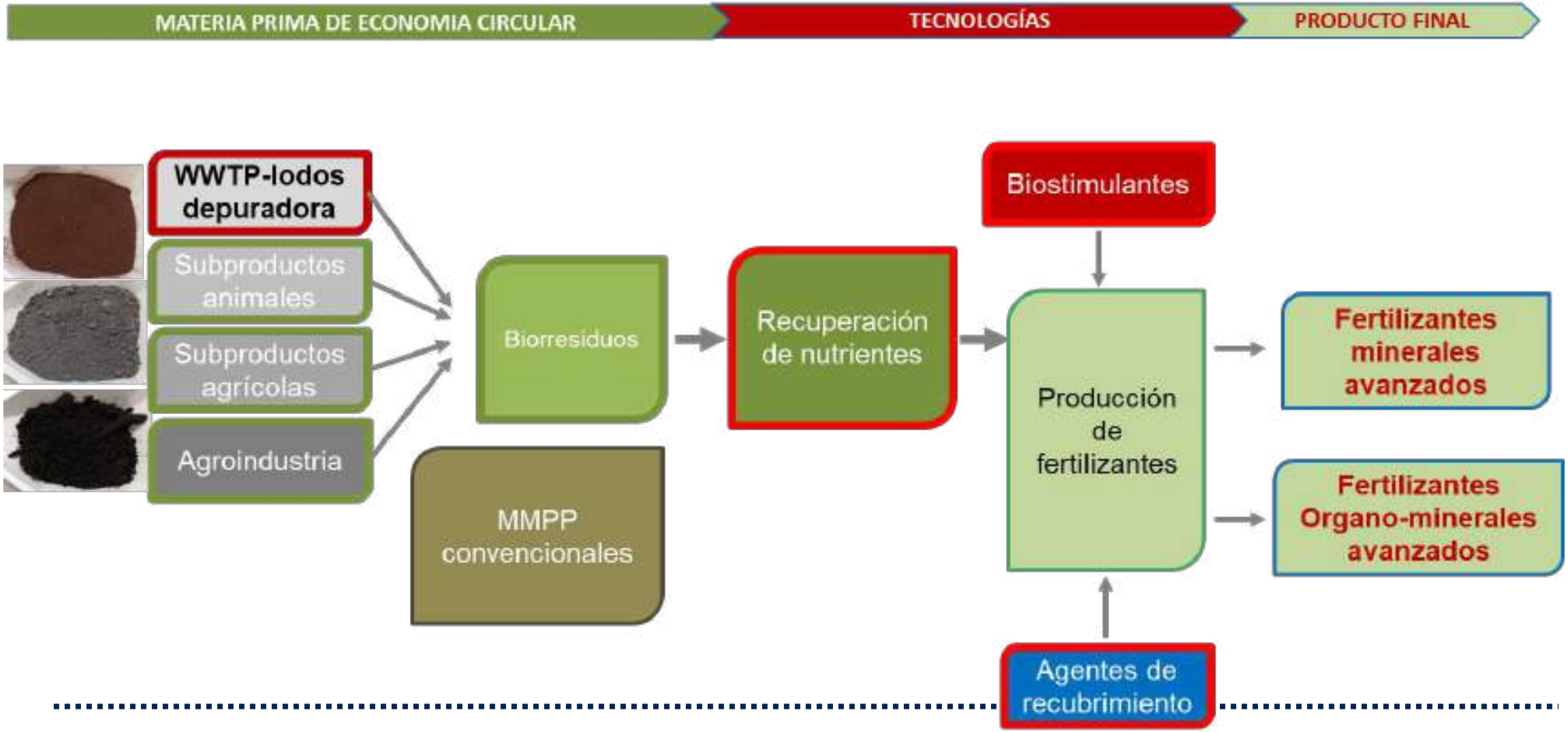
- **En primer lugar, en las regiones de la UE, grandes cantidades de corrientes ricas en nutrientes se dispersan en el medio ambiente a través de una amplia variedad de residuos tanto minerales como orgánicos.**

- **En segundo lugar, la UE depende en gran medida de recursos externos no renovables para el suministro de los principales fertilizantes utilizados en la agricultura.**

La incorporación de estos nuevos materiales de base biológica en el proceso industrial del fertilizante, nos hace identificar los siguientes **FACTORES** clave para el **ÉXITO**:



Scheme of Advanced Biobased-fertilisers production



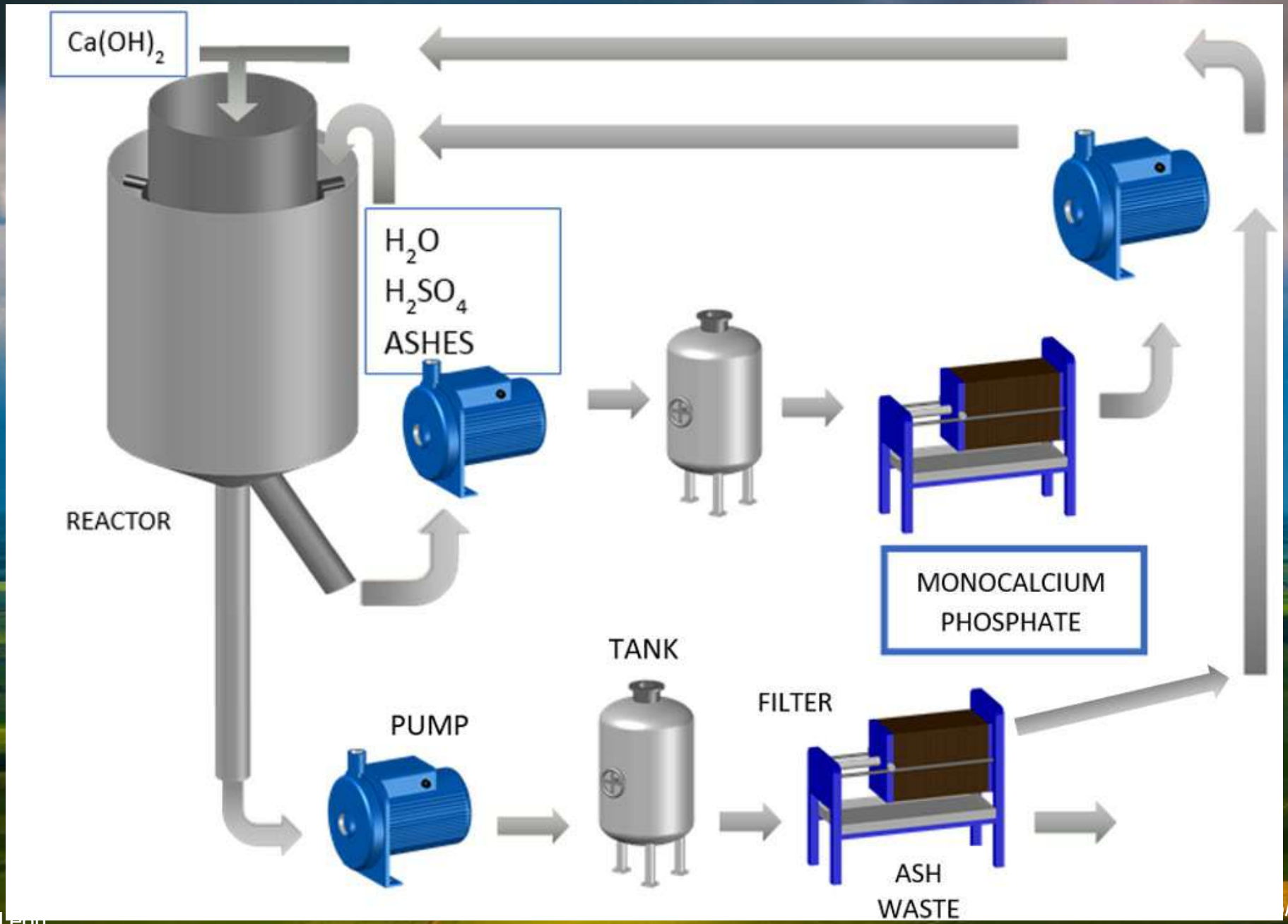
1) Digestión de las cenizas (reactor 1). Uso de ácido sulfúrico eficaz en la extracción de los diferentes elementos contenidos en las cenizas, además de abaratar el proceso respecto a otros ácidos. La temperatura utilizada está entre 60 y 75 °C y el TRH 1 hora.

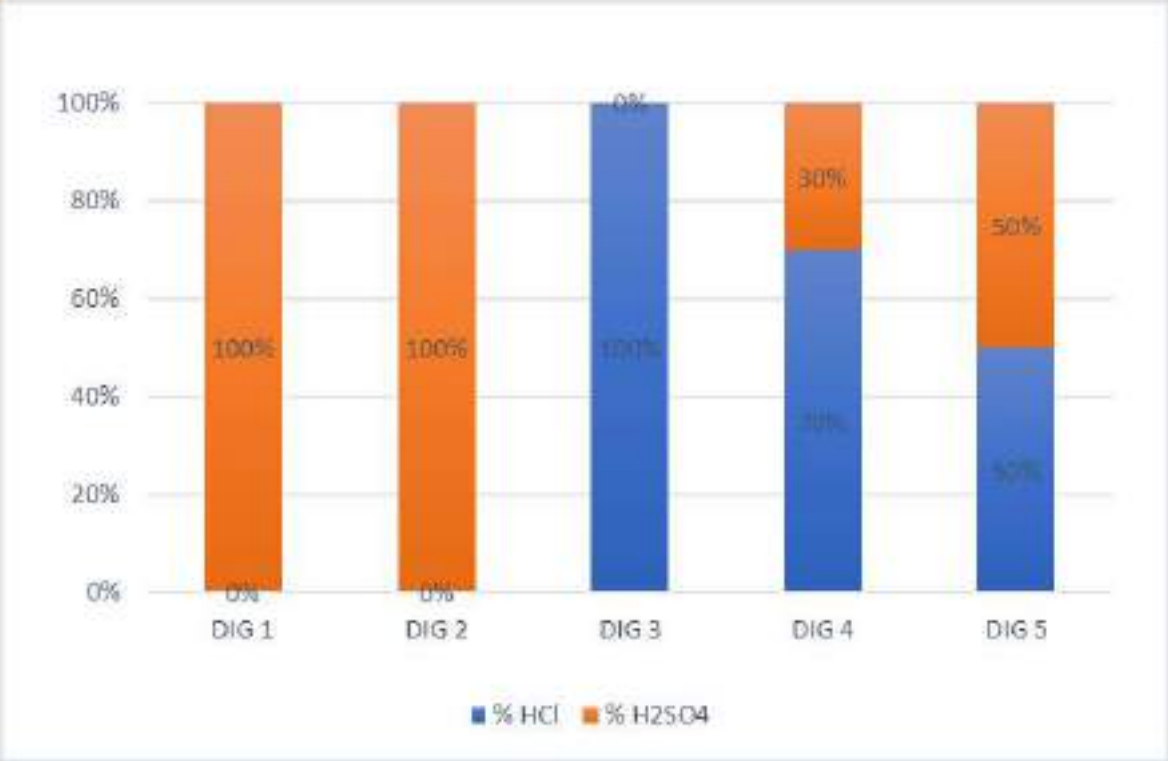
2) Filtración: el filtrado obtenido contiene los iones fosfato presentes en la ceniza, sin la mayoría de las impurezas presentes, ahora en la fase sólida.

3) Adición de $Ca(OH)_2$ al líquido procedente de la filtración (reactor 2) produce una precipitación de los iones fosfato contenidos en la fase líquida, dando lugar a una segunda fase líquida ácida y a una segunda fase sólida que contiene los iones fosfato separados. Esta precipitación se acopla térmicamente a la digestión de las cenizas (primera etapa) en el mismo recipiente.

$$Ca(OH)2 + 2\ H3PO4 \rightarrow Ca(H2PO4)2 \cdot 2\ H2O$$

4) Filtración: la fase líquida es ácida y puede recircularse de nuevo a la etapa 1. La fase sólida es una mezcla de fosfato monocálcico, fosfato dicálcico y sulfato cálcico.


$Ca(OH)_2$
H_2O
H_2SO_4
ASHES
REACTOR
MONOCALCIUM PHOSPHATE
TANK
PUMP
FILTER
ASH WASTE

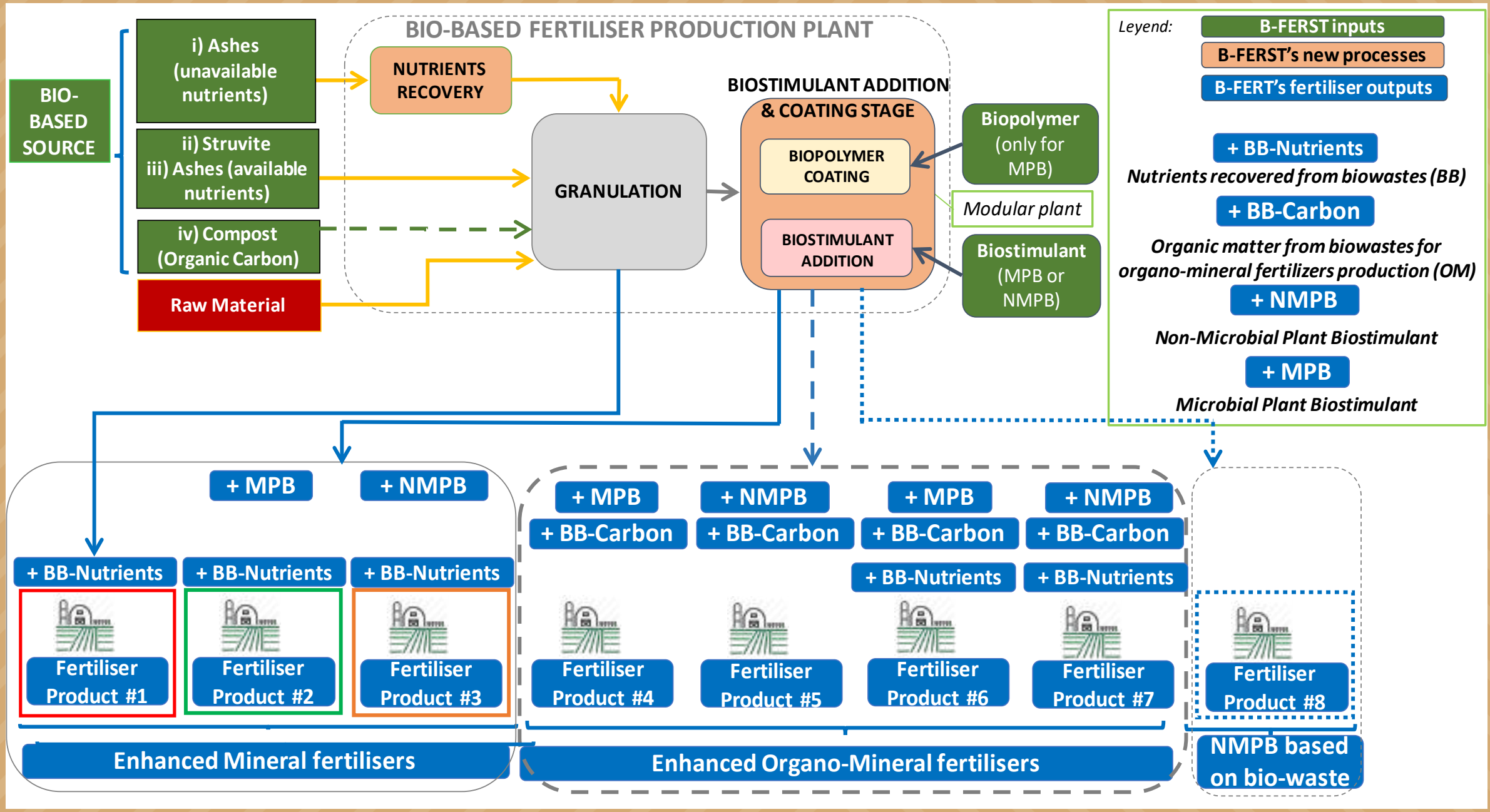


Percent of each acid in the 5 different types of digestion performed (DIG 1-DIG 5). The difference between DIG 1and DIG 2 is the amount of ash added that was for DIG2 and the liquid phase was reduced by half in DIG 2

DIGESTION	P_2O_5 (mg/L)	P_2O_5 recovery (%)	sulphate/phosphate ratio
DIG 1	12	70	24
DIG 2	58	95	4
DIG 3	67	91	0
DIG 4	71	90	0
DIG 5	74	94	0

Average result for each of the 5 types of digestion carried out

Proceso de recubrimiento


BIO-BASED FERTILISER PRODUCTION PLANT
BIO-BASED SOURCE
i) Ashes (unavailable nutrients)
ii) Struvite
iii) Ashes (available nutrients)
iv) Compost (Organic Carbon)
Raw Material
NUTRIENTS RECOVERY
GRANULATION
BIOSTIMULANT ADDITION & COATING STAGE
BIOPOLYMER COATING
BIOSTIMULANT ADDITION
Biopolymer (only for MPB)
Modular plant
Biostimulant (MPB or NMPB)
Leyend:
B-FERST inputs
B-FERST's new processes
B-FERT's fertiliser outputs
+ BB-Nutrients
Nutrients recovered from biowastes (BB)
+ BB-Carbon
Organic matter from biowastes for organo-mineral fertilizers production (OM)
+ NMPB
Non-Microbial Plant Biostimulant
+ MPB
Microbial Plant Biostimulant
+ MPB
+ NMPB
+ BB-Nutrients
Fertiliser Product #1
Fertiliser Product #2
Fertiliser Product #3
Enhanced Mineral fertilisers
+ MPB
+ NMPB
+ BB-Carbon
+ BB-Nutrients
Fertiliser Product #4
Fertiliser Product #5
Fertiliser Product #6
Fertiliser Product #7
Enhanced Organo-Mineral fertilisers
Fertiliser Product #8
NMPB based on bio-waste

Recubrimiento

https://www.youtube.com/watch?v=SXEduweiViw

https://www.glatt.com/technologies/coating/spray-coating-in-fluidized-or-spouted-bed/

Thank you

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bferst.eu BFERST project @BFERSTproject

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Nuevos fertilizantes: Hacia un cambio de paradigma

Resultados agronómicos y efectos sobre el medio ambiente (biociversidad del suelo)

Fernando González-Andrés
ULE

ULE 25th April 2024

This project has received funding from the Bio Based Industries Joint Undertaking (JU) under Grant Agreement N° 837583. The JU's receives support from the European Union's Horizon 2020 research and innovation programme and the bio Based Industries Consortium.

Fertiberia

Agronomic & environmental effects of the biobased fertilisers

Questions about “B-FERST fertilizers”:

- What did we find out about the agronomic performance of fertilizers that partially replace conventional sources of N/P/K with others of bio-based origin?
- What did we find out about the agronomic performance of bio-based fertilizers coated with innovative biopolymers and amended with Microbial and Non-Microbial Plant Biostimulants?
- But wait!! And what happens to the soil microbiome when we introduce a new product that contains an “allien”?

Agronomic & environmental effects of the biobased fertilisers

The key features of the “B-FERST fertilizers” that have been tested

- The bio-based raw material used: batch of ashes from olive oil industry
- The coating: biopolymers
- The MPB and NMPB used

Microbial Plant Biostimulants	Strain code	Strain identification
MPB1	SRN 3-1	*Bacillus megaterium*
MPB2	SCB 1-1	*Pseudmonas koreensis*
MPB3	SCFB 3-1	*Bacillus siamensis*
MPB4	VCV 3-1	*Pseudomonas brassicacearum* subsp. *neoaurantiaca*
MPB5	SM651	*Azotobacter chroococcum*
MPB6	SM665	*Azotobacter salinestris*

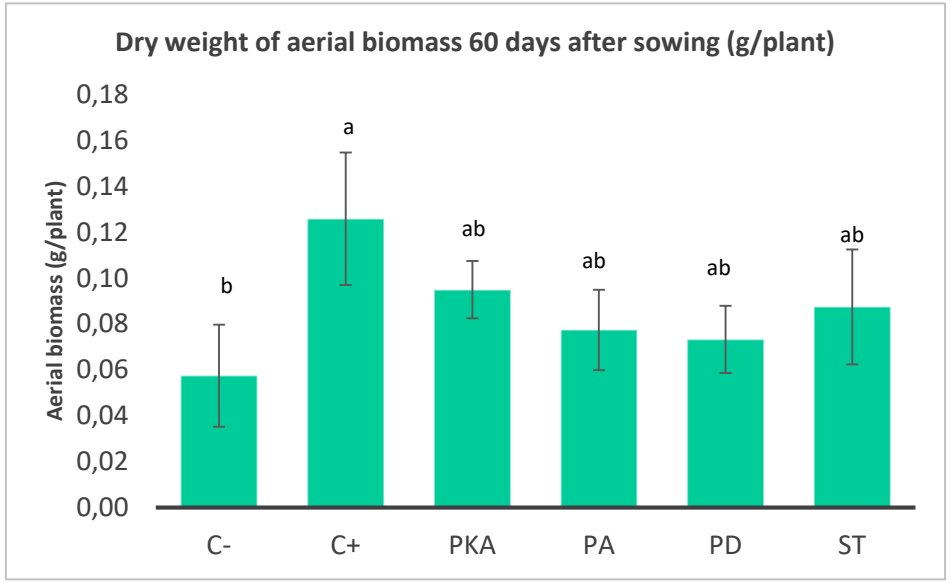
Non-Microbial Plant Biostimulans	Product description
Nv1	NMPB from Cardoon Oil Meal
Nv2	NMPB from Safflower Oil Meal
Nv3	NMPB from Cardoon Oil Meal
Nv4	NMPB from Safflower Oil Meal
VC1	NMPB from vegetable waste compost
MC1	NMPB from manure waste compost

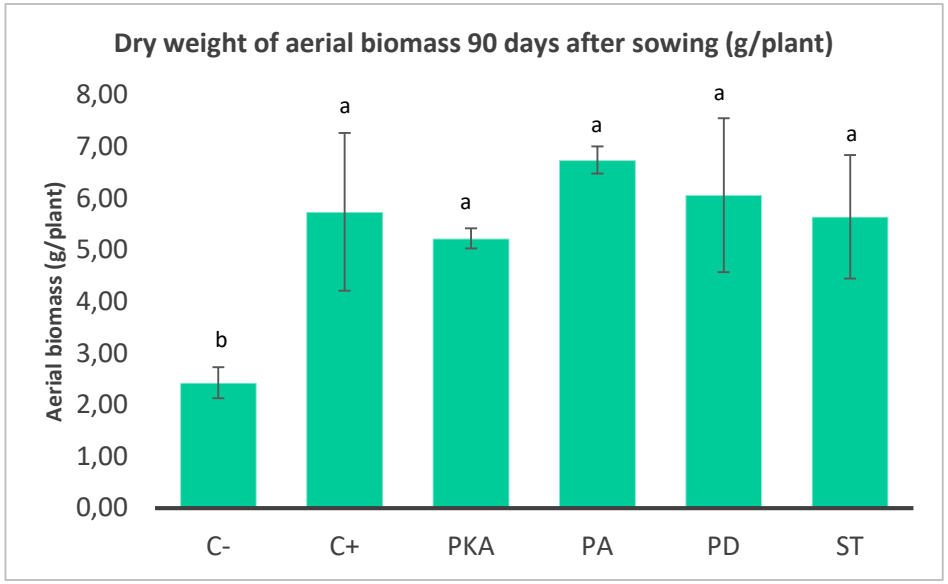
Agronomic & environmental effects of the biobased fertilisers

What did we find out about the agronomic performance of fertilizers that partially replace conventional sources of N/P/K with others of bio-based origin?

☞ Microcosm with maize

They are a little slower in action, but perform as well or better than the conventional ones.
(Barquero et al. submitted to journal as an outcome from B-FERST)





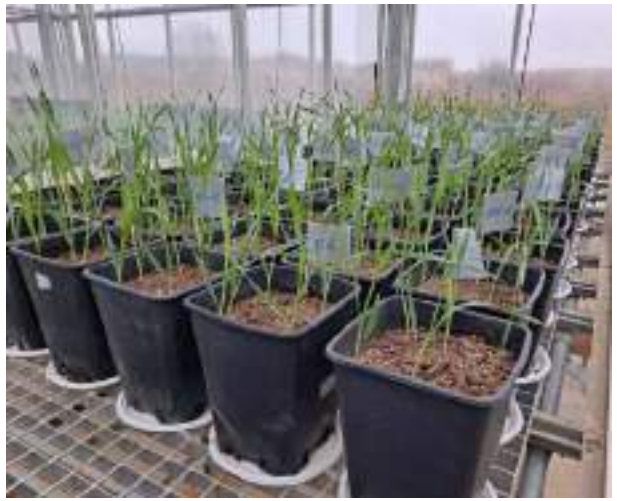
Agronomic & environmental effects of the biobased fertilisers

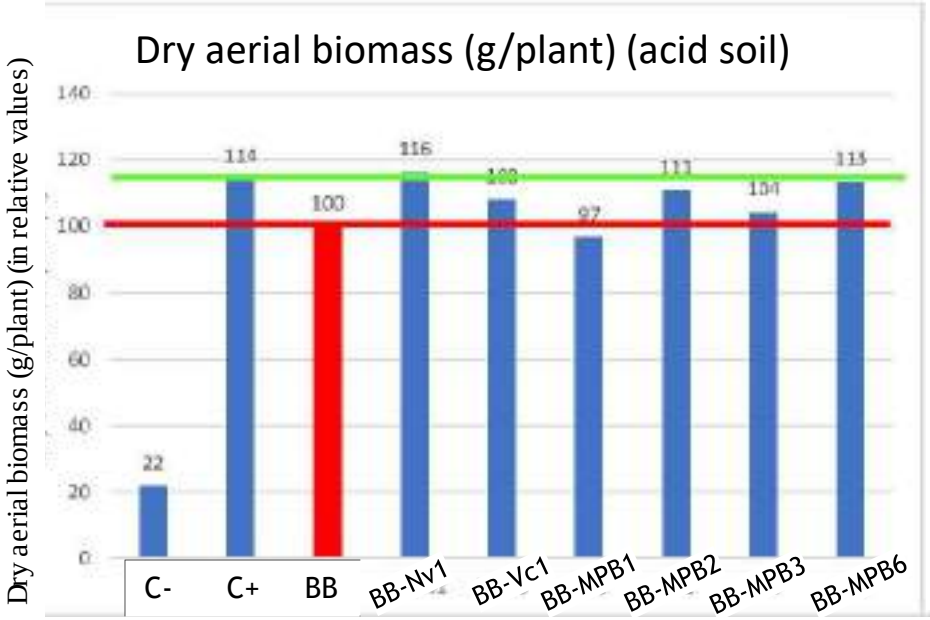
What did we find out about the agronomic performance of bio-based fertilizers coated with innovative biopolymers and amended with Microbial and Non-Microbial Plant Biostimulants?

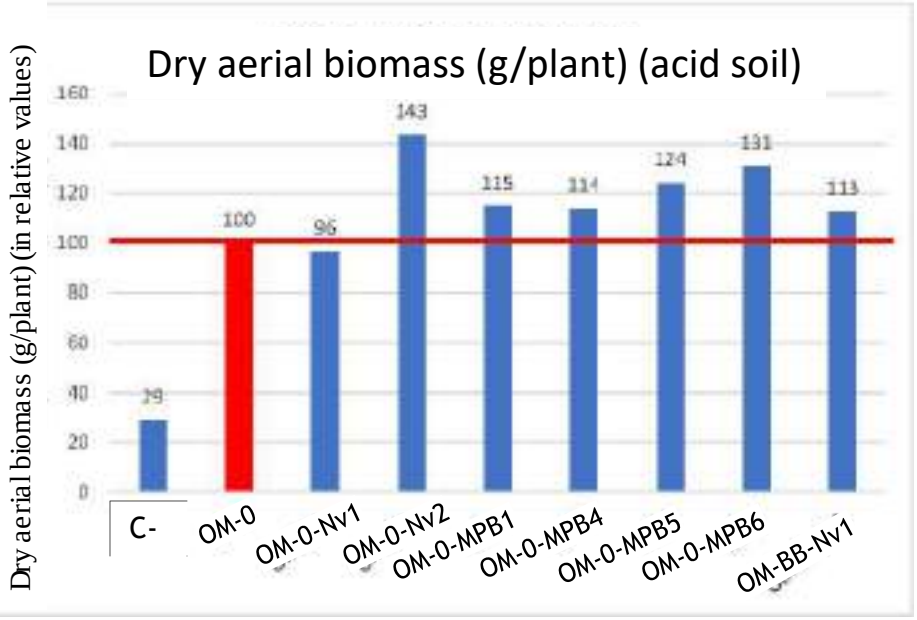
- ☞ Microcosm with barley

The NMPB / MPB improved the performance of its own control

The NMPB /MPB overcame the slower action of the fertilizers from a bio-based origin







Agronomic & environmental effects of the biobased fertilisers

Ok, Ok this is in microcosm conditions where you control the soil, the climate, etc. And what happens in field conditions?

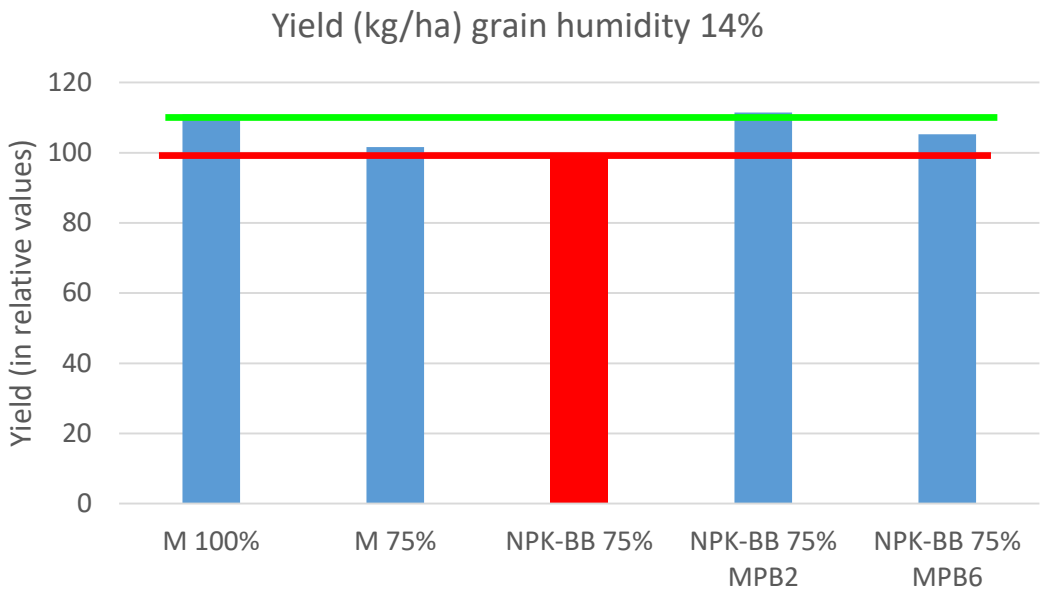
- They are not miracle products. Where there is no crop response to conventional fertiliser, there will be no crop response to B-FERST fertiliser, e.g. on over-fertilised soils.
- Plant Biostimulant products work best under average/fair or low nutrient conditions. This is when the role of the soil microbiome in crop performance is more relevant. (Lankau et al. 2022; Barquero et al., 2019)

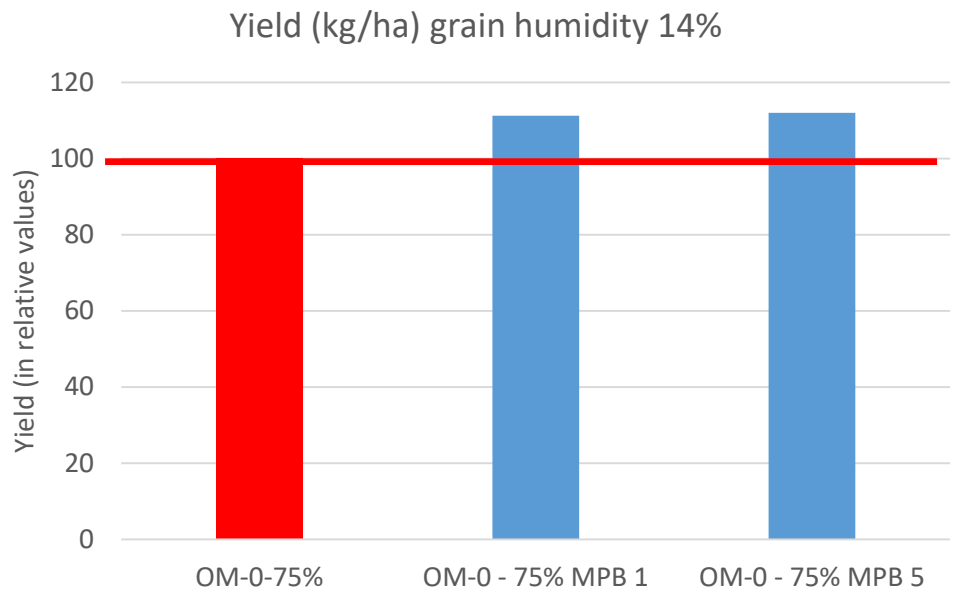
Lankau, R.A.; George, I:; Miao, M. 2022. https://doi.org/10.1002/ecs2.4029
Barquero, M.; Pastor-Bueis, M.; Urbano, B.; González-Andrés, F. 2019. https://doi.org/ 10.1007/978-3-030-17597-9_6

Agronomic & environmental effects of the biobased fertilisers

Ok, Ok this is in microcosm conditions where you control the soil, the climate, etc. And what happens in field conditions?

Maize in Spain, 2023

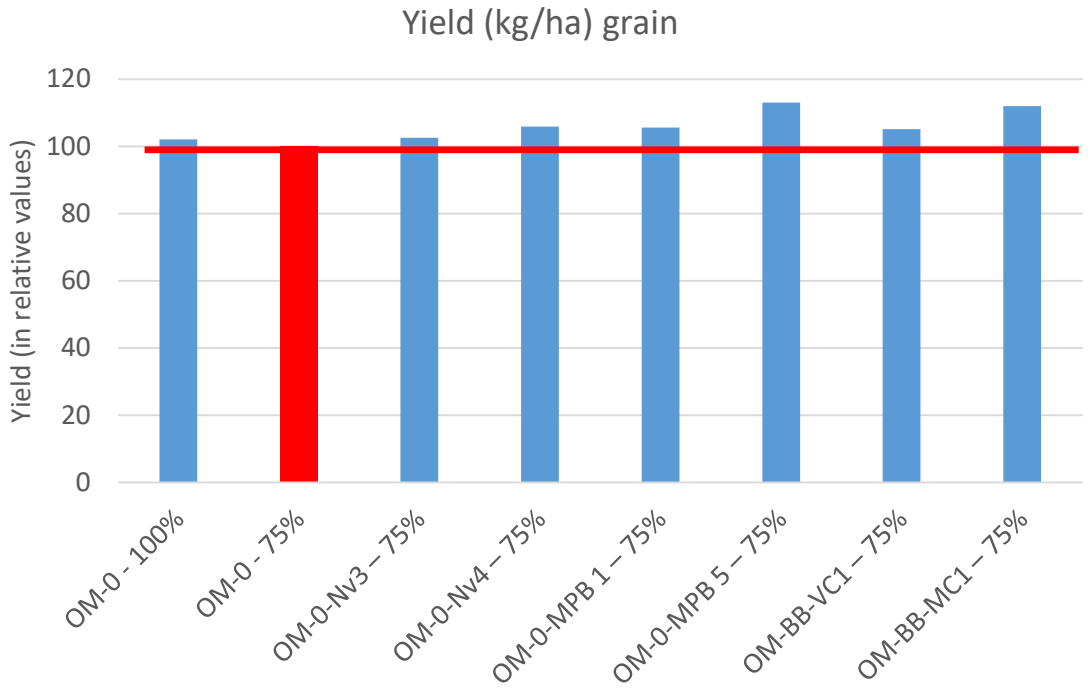




Agronomic & environmental effects of the biobased fertilisers

Ok, Ok this is in microcosm conditions where you control the soil, the climate, etc. And what happens in field conditions?

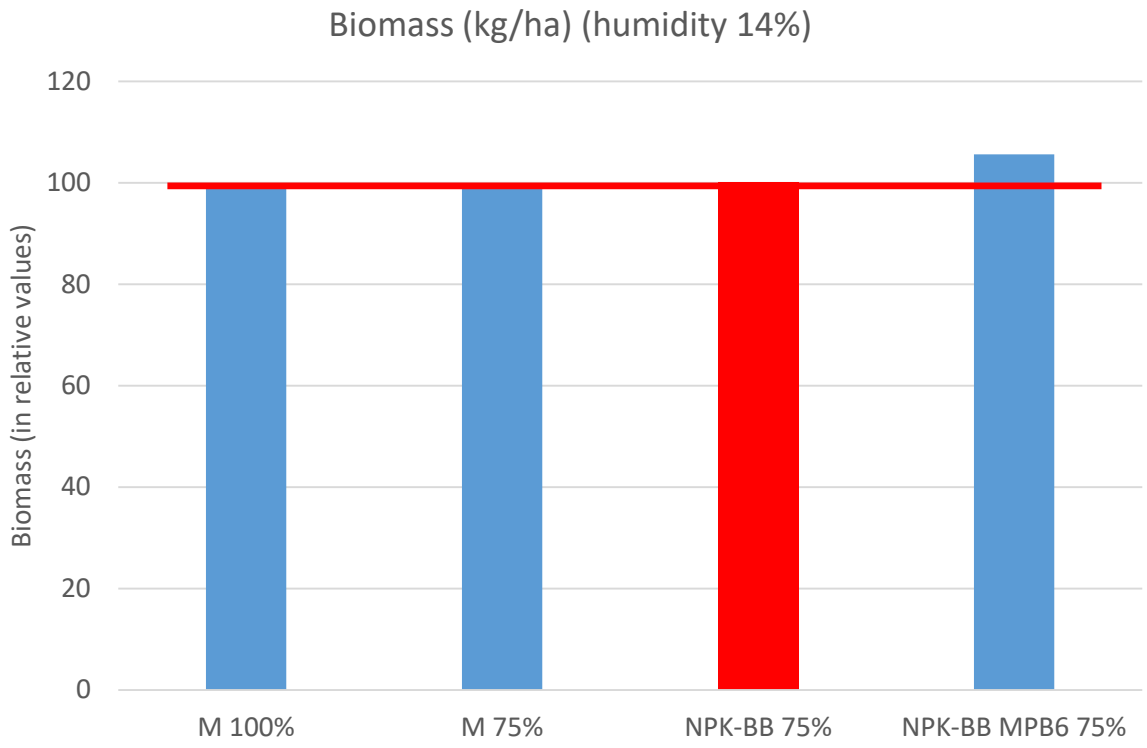
Sunflower in Italy, 2023



Agronomic & environmental effects of the biobased fertilisers

Ok, Ok this is in microcosm conditions where you control the soil, the climate, etc. And what happens in field conditions?

Maize in Portugal, 2023



Agronomic & environmental effects of the biobased fertilisers

But wait!! And what happens to the soil microbiome when we introduce a new product that contains an “allien”?

☞ The microbiome composition was assessed in the rhizospheric soil, not in the bulk soil, because, commonly, treatments only affect to the rhizospheric soil (Ortiz-Liebana et al., 2022, 2023)

The new fertiliser inoculated with a PGPR generally has no effect on soil biodiversity or even a positive effect

Soil background conditions determine the ultimate effect of treatments on soil diversity

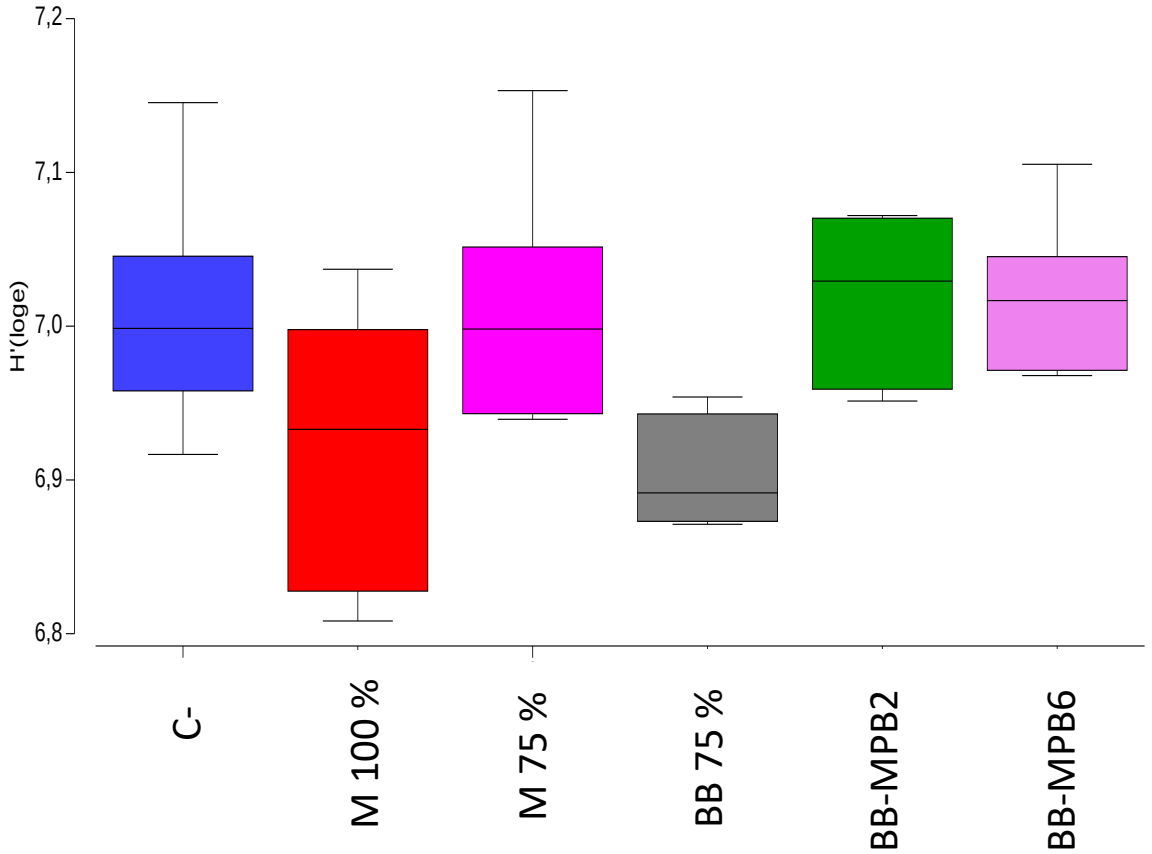
Agronomic & environmental effects of the biobased fertilisers

But wait!! And what happens to the soil microbiome when we introduce a new product that contains an “allien”?

Maiz in Spain 2022

BACTERIA

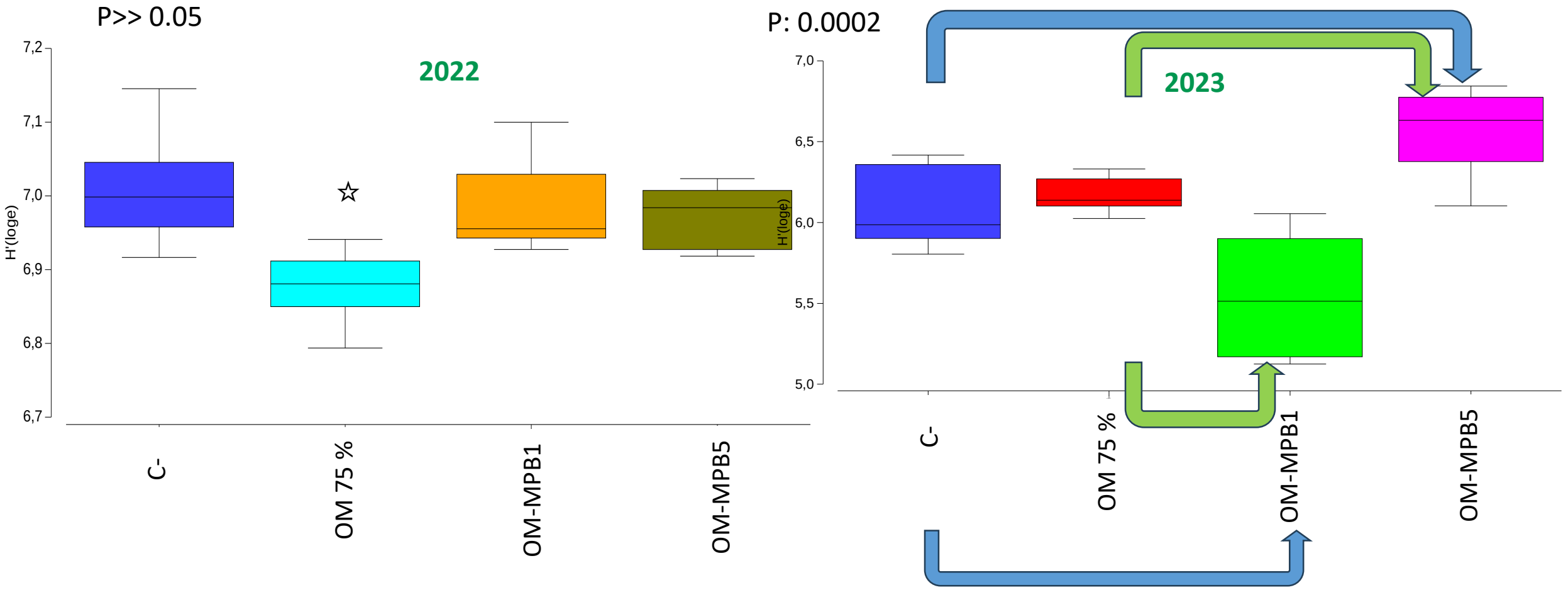
H Index (P=0.531)



Agronomic & environmental effects of the biobased fertilisers

But wait!! And what happens to the soil microbiome when we introduce a new product that contains an “allien”?

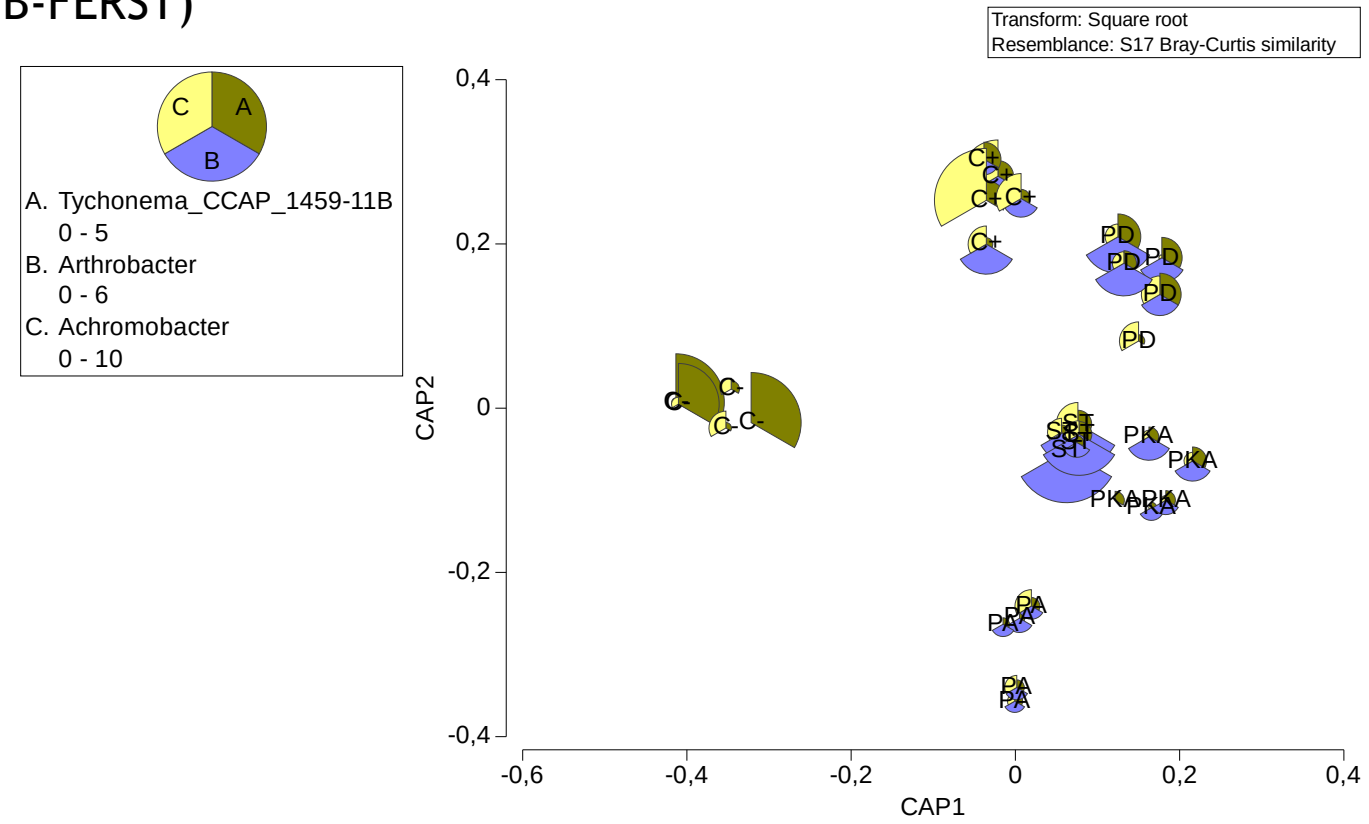
Maiz in Spain (2022 vs. 2023) **BACTERIA H Index**



Agronomic & environmental effects of the biobased fertilisers

But wait!! And what happens to the soil microbiome when we introduce a new product that contains an “allien”?

- But positive results do not end there, fertilization, specially with the bio-based fertilizers **without NMPB or MPB**, seems to attract to the rhizosphere beneficial bacteria general (PGPR) (Barquero et al. submitted to journal as a outcome from B-FERST)



Agronomic & environmental effects of the biobased fertilisers

But wait!! And what happens to the soil microbiome when we introduce a new product that contains an “allien”?

☞How do the inoculation with MPB affect to the composition of the microbiome? … ongoing, please follow us …

Expectations are good. The inoculation with MPB often attracts other PGPR and that explains in part the good agronomic results (Ortiz-Liebana et al., 2023)

Ortíz-Liébana, N.; Zotti, M.; Barquero, M.; González-Andrés. 2023 https://doi.org/10.1016/j.scienta.2023.112277

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