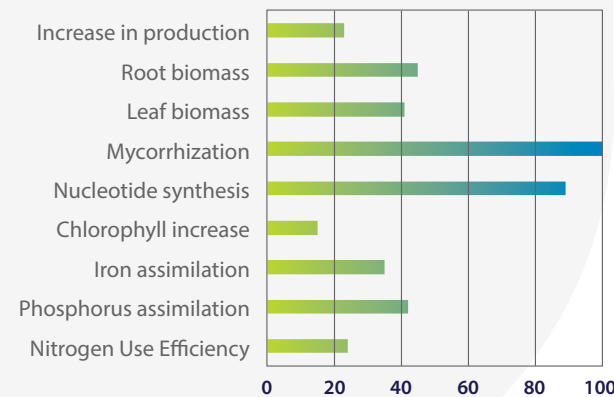


Bactrium works at various levels:

Agronomic Results

Based on average values recorded in **Bactrium** development process, the enhancement of multiple characteristics of agronomic interest has been observed.

Agronomic characteristics (increases with respect to the control)



Agronomic test to verify the effectiveness of Bactrium in lettuce cultivar capitata.



Bactrium

by R&D **Atens** Biotech

Plant growth promoting bacteria for better crop nutrition

Metabolomic results

Our metabolomic results show that **Bactrium** stimulates purine metabolism in the plant. These molecules are involved not only in DNA synthesis, but also in cell division and organic nitrogen assimilation in the plant.

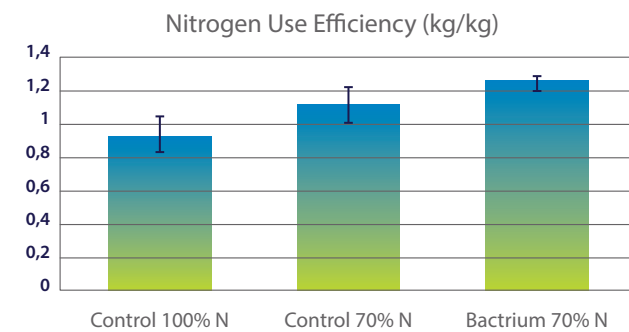
The stimulation of its synthesis pathway has been found to be 2 to 6 times higher in treated plants, which is why **Bactrium** has proven to be a powerful promoter of plant growth.

Plant growth due to the multiplying effect of bacteria



What is NUE?

The Nitrogen Use Efficiency (**NUE**) is calculated as the ratio between the production and the fertilizing nitrogen applied, and it is the way of assessing that the agricultural systems take advantage of this element in the most efficient way. Its evaluation is essential to avoid wasting resources in the form of agricultural inputs.



NUE calculated for maize plants with 100% nitrogen fertilization in the form of urea and with 70% fertilization with and without Bactrium. These last plants show an increase in NUE of 30% while maintaining agronomic performance.

Ganugi et al. Nitrogen use efficiency, rhizosphere bacterial community, and root metabolome reprogramming due to maize seed treatment with microbial biostimulants. *Physiologia Plantarum*, 174(2), e13679

What are plant growth promoting bacteria?

Bactrium contains highly competitive rhizosphere bacteria that colonize the root system. These bacteria improve plant nutrition, by optimizing fertilizer use efficiency, and making available blocked elements in the soil

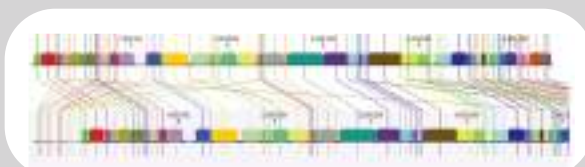
Genomic studies with Bactrium

Both *Bacillus megaterium* species contained in **Bactrium** have been fully sequenced in our next generation platform at **NGA lab**. Thanks to this work we can affirm that they contain coding genes that contribute to:

- Nitrogen uptake and assimilation (**Nitrite Transporter** and enzymes of the **Nitroreductase** family)
- Increased resistance to copper contamination (**Copper Resistance Protein**)
- Iron uptake (**siderophores**)
- The solubilization of phosphorus (**acid phosphatases** and **phytases**)

MHBM77

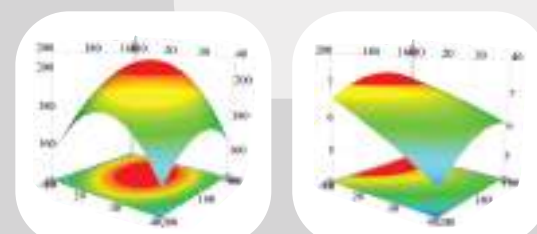
MHBM06



Sequencing of strains MHBM06 and MHBM77

Microbiological production optimization

Bactrium industrial production has been optimized thanks to **the response surface methodology**. This innovative development has allowed us to consider all the parameters of our liquid-state bioreactor such as pH, dissolved oxygen and agitation regime to regulate the growth of bacteria and the transition to viable spores.



Response surface methodology in **Bactrium**

Benefits associated to Bactrium

Bacillus megaterium MHBM06 and MHBM77



- **Bactrium** contributes to the **better use of agricultural inputs**



- **Increases the Nitrogen Use Efficiency**, avoiding losses due to leaching and volatilization.



- **Mobilizes the phosphorus** applied in previous campaigns and blocked in the soil, making it bioavailable for crops.



- The high production of siderophores also makes it possible to improve the **iron nutrition** of the cultures.



- The strains facilitate crop nutrition and micronutrients assimilation (Ca, Fe, Mg), resulting in **greater growth and production**.

Method of production

A.

The bacterial strains of this product were isolated by Atens laboratories.

B.

These bacteria reproduce in a liquid fermentor until they reach their full potential.

C.

In the last phase, sporulation of the cells is promoted.

D.

These spores are in the final formulation of the product together with the metabolites produced during its growth.

E.

The bioprocess does not require the transition to solid state, ensuring maximum vitality for the *Bacillus*, which have not undergone filtration or lyophilization that compromises their viability.



Composition

Bacillus megaterium MHBM06:
Bacillus megaterium MHBM77:
Total rhizosphere bacteria:



Mode of application and dosage

It is applied by fertigation in doses of 1-3 L/ha. Bactrium can be applied from transplantation until the fruit growing phase.



Origin of Bactrium – Mycorrhiza Helper Bacteria

Bacteria contained in **Bactrium** were isolated from mycorrhizal inoculum in our in vivo reproduction system.

Through a high-throughput sequencing process using **Illumina's Mi-Seq system**, a large number of genera were identified within the community of bacteria that coexist with our **Mycorrhiza**.

Once the growth promoting activity of the isolated bacteria had been verified, we selected to create **Bactrium** the two strains (MHBM06 and MHBM77) that showed better capacities.

These microorganisms in association with mycorrhiza facilitate and stimulate mycorrhization, for this reason they are also called **Mycorrhiza Helper Bacteria (MHB)**.



Bactrium generates synergies with our Mycorrhiza-based products

Bacteria contained in Bactrium interact with our Mycorrhiza:

- Increasing sporulation up to 4 times.
- Stimulating the germination of spores.
- Facilitating root colonization through the production of pectolytic enzymes.

