



SESSION 2 - Facilitator - Prof Pieter Swanepoel

Speaker 4: Mrs Nadia Loubser - MBFI

Mrs. Nadine Loubser is the Head of Microbiology at MBFi, where she develops microbial solutions for sustainable crop production. She focuses on improving Rhizobium, Trichoderma, Pseudomonas, and Bacillus strains in field and lab settings, with an interest in nodulation, abiotic stress, and plant communication.

With extensive experience in agricultural microbiology, Mrs. Loubser manages projects that use molecular techniques and create inoculants. Her research aims to produce biological inputs tailored for South African agriculture.

At the symposium, she will discuss how microbial innovations can enhance soybean productivity and connect science with practical applications.

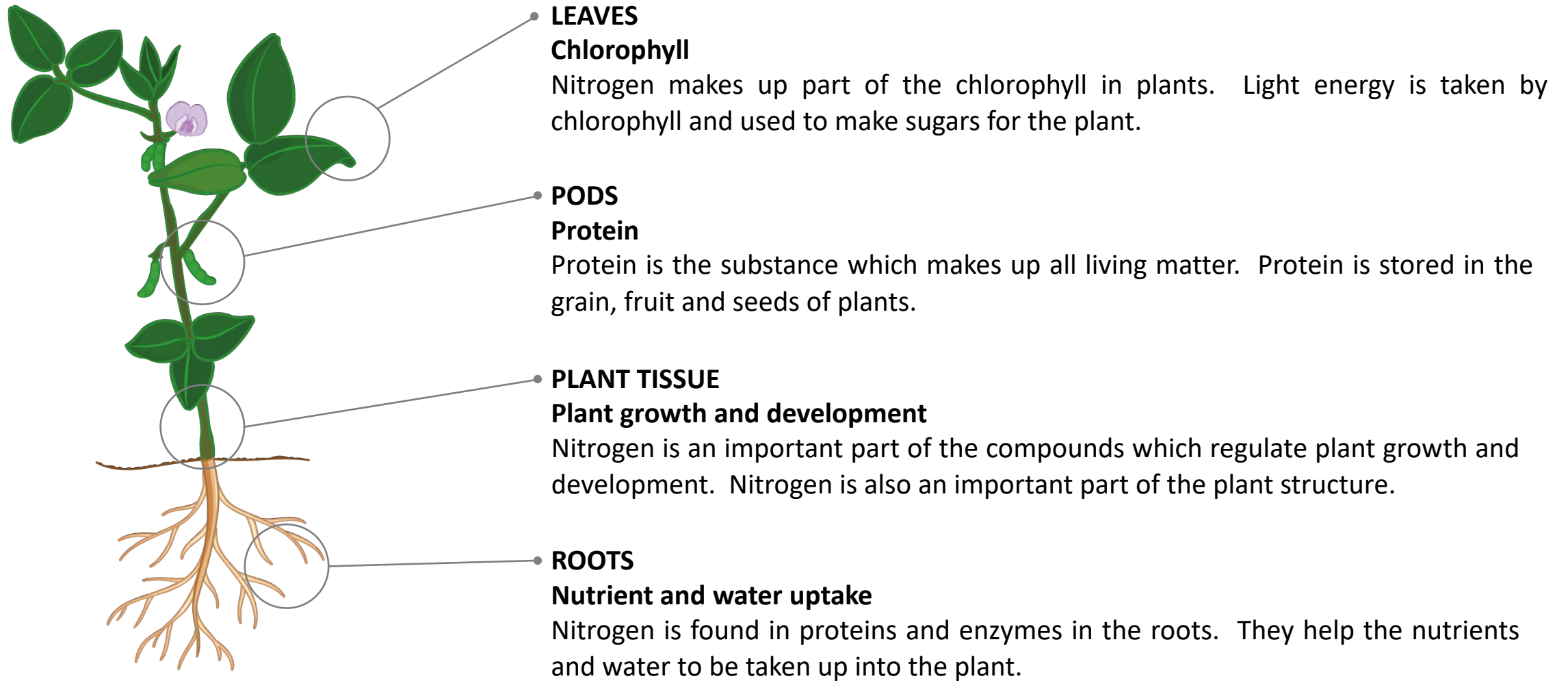


OPDT/OAC

Optimising Rhizobia Seed Treatments to Improve Yields

Mrs Nadine Loubser
MSc Microbiology

IMPORTANCE OF NITROGEN IN THE PLANT



IMPORTANCE OF NITROGEN IN THE PLANT

3,264,986,735L

of oil must be burned to produce 1846605 tons of nitrogen in the form of urea

TRUCKS WITH
CONVENTIONAL NITROGEN

57707

CONVENTIONAL
NITROGEN STOCK

MUST LEAVE
THE PREMISES

22

TRUCKS WITH
MBFi'S NITROGEN FIXATION
TECHNOLOGY

MBFi

MUST LEAVE
THE PREMISES

MBFi
USES

750 000L

INOCULANT TO BIND THE EQUIVALENT
AMOUNT OF NITROGEN FOR SOYBEAN PRODUCTION

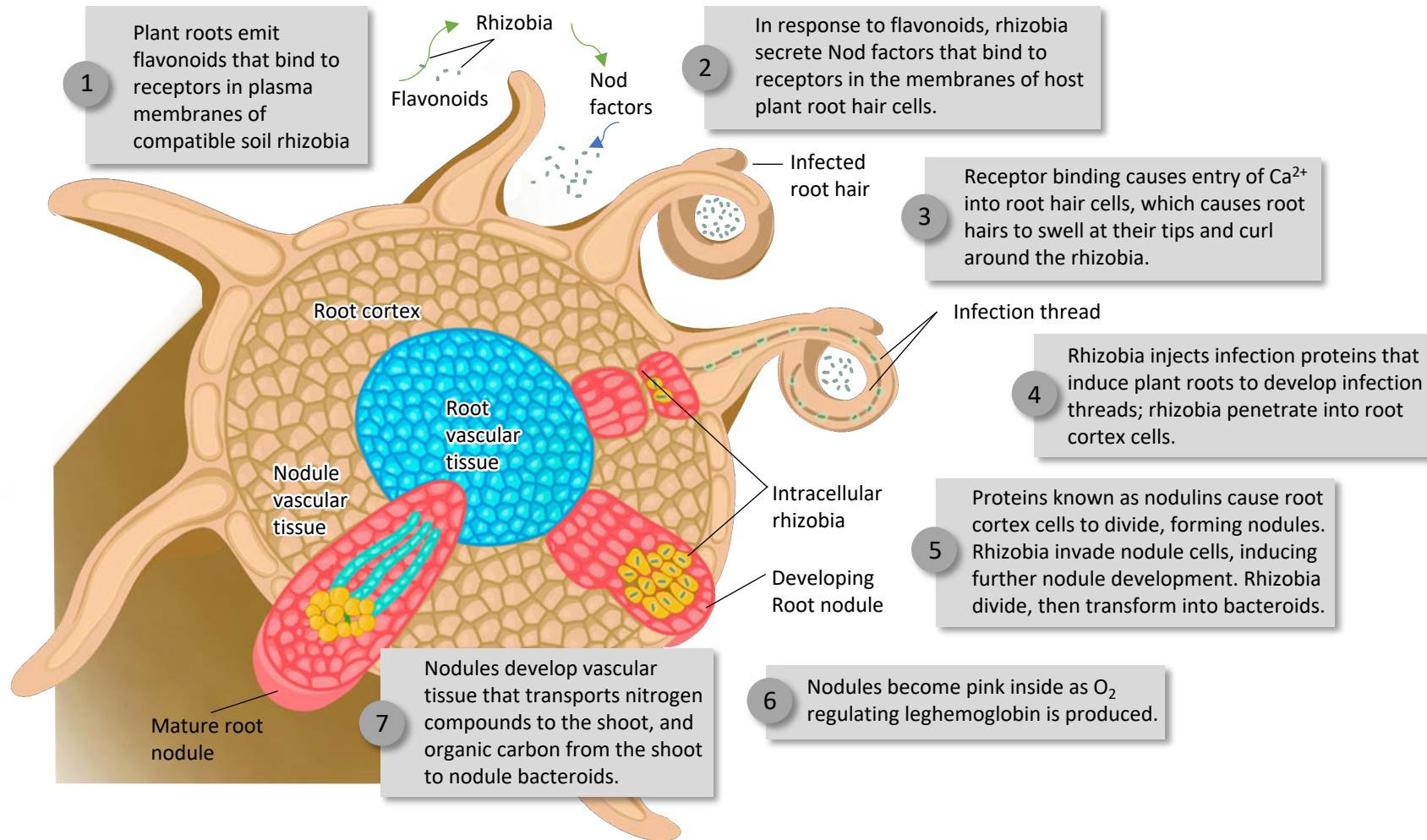
IMPORTANCE OF NITROGEN IN THE PLANT

Nitrogen Facts:

- 70-105 kg of Nitrogen is required per ton of soybeans
- 94% of yield is directly linked to nitrogen assimilation
- Nitrogen assimilation is directly linked to soybean yield increases
- Up to 4.5 Kg per day is required by the plants per hectare from R 1 through to R 5 phase
- Carbon / Nitrogen soil ratio influence nodulation and nitrogen fixation
- Synthetic nitrogen sources involve high oil demands and create high pollution effects

Crop	Species of Rhizobium	N Kg/Ha
Soybean	<i>B. japonicum, B. diazoefficiens, B. elkanii</i>	180-250
Peanuts	<i>Bradyrhizobium sp. or Rhizobium sp.</i>	100-120
Lupins	<i>Bradyrhizobium sp.</i>	130-150
Alfalfa	<i>Ensifer meliloti</i>	180-250
Chickpea	<i>Mesorhizobium cicerii</i>	70-90
Pea/Lentil	<i>Rhizobium leguminosarum biovar viceae</i>	60-110

NODULATION PROCESS



PRIMARY VS SECONDARY NODULES

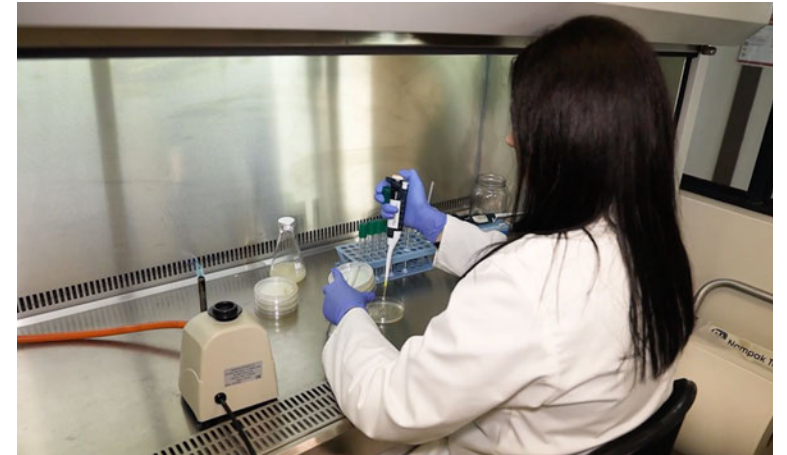
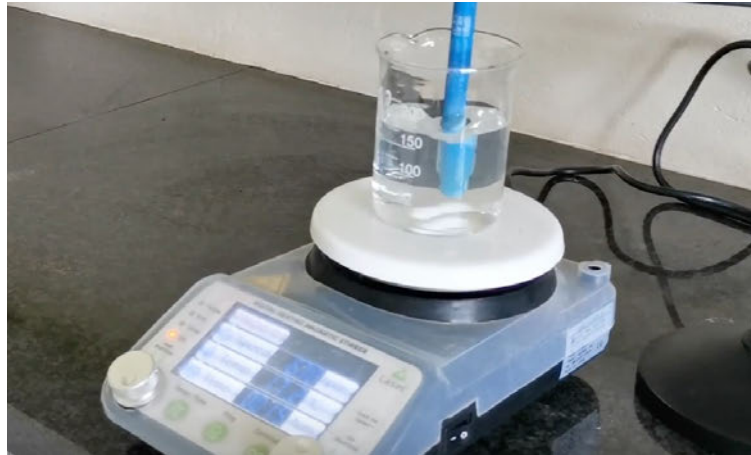
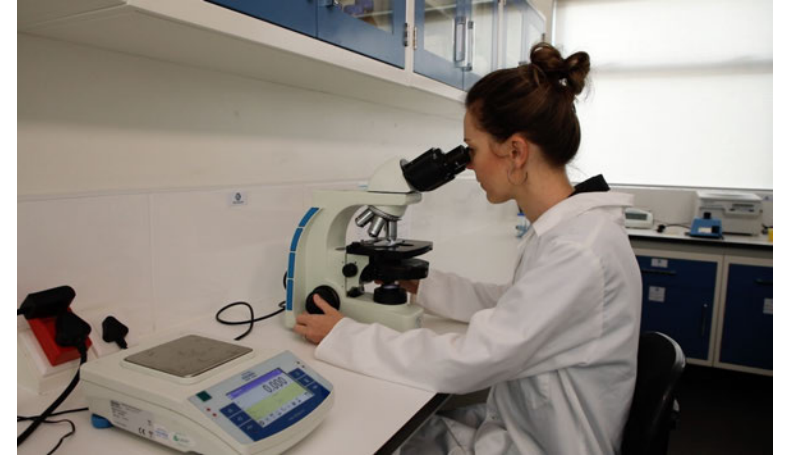
**PRIMARY
ROOT NODULES**



**SECONDARY
ROOT NODULES**



WHAT ARE THE MOST IMPORTANT FEATURES OF AN INOCULANT?



WHAT ARE THE MOST IMPORTANT FEATURES OF AN INOCULANT?



WHAT ARE THE MOST IMPORTANT FEATURES OF AN INOCULANT?



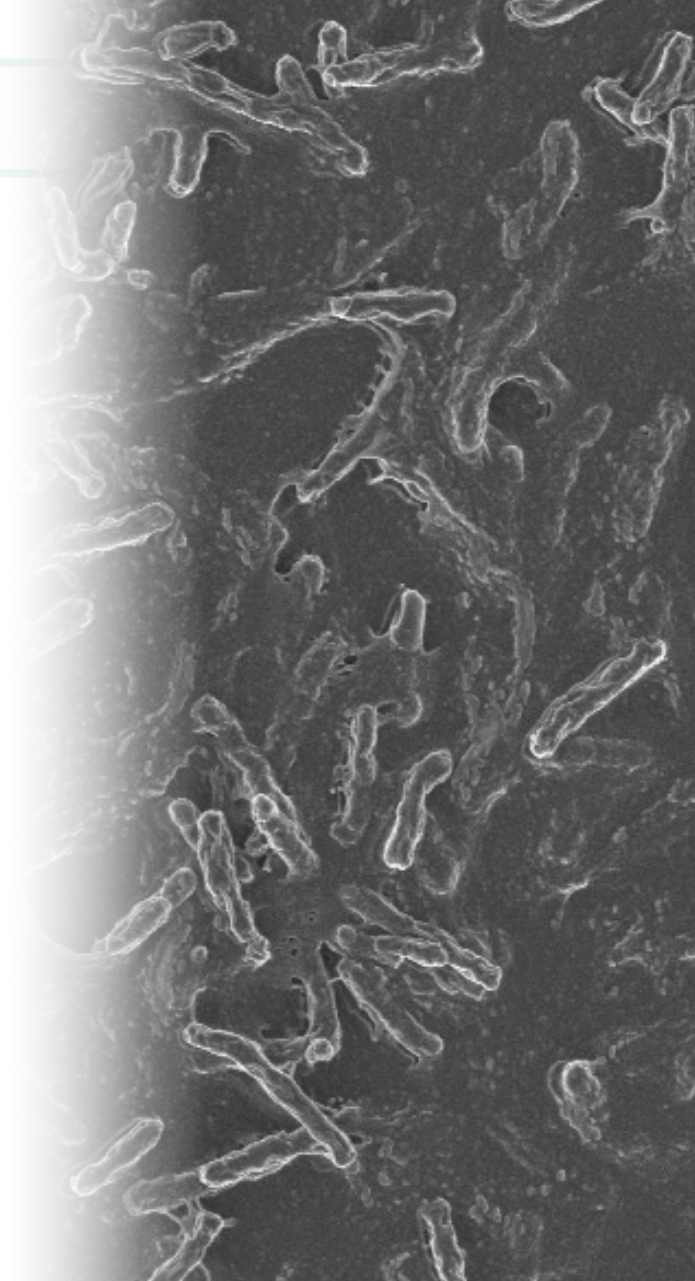
DIFFERENT APPLICATION RATES

COUNTRY			
			
APPLICATION RATE			
200 ml / 100 kg	200 ml / 100 kg	300 ml / 100 kg	130 ml / 100 kg
21 days pre treatment on seed	21 days pre treatment on seed	21 days pre treatment on seed	150 days pre treatment on seed
Rainfall 1000-1500 mm/year	Rainfall 1000-1500 mm/year	Rainfall 400-800 mm/year	Rainfall 750-1500 mm/year
Organic Matter 1-10% Norm is 3-6%	Organic Matter 1-10% Norm is 1-4%	Organic Matter 0.5-1%	Organic Matter 3-6%
Ave N / Ha - 22-44 kg/ha N from 1% OM = 66-264 N	Ave N / Ha - 22-44 kg/ha N from 1% OM = 22-176 N	Ave N / Ha - 22-44 kg/ha N from 1% OM = 11-44 N	Ave N / Ha - 22-44 kg/ha N from 1% OM = 66-264 N

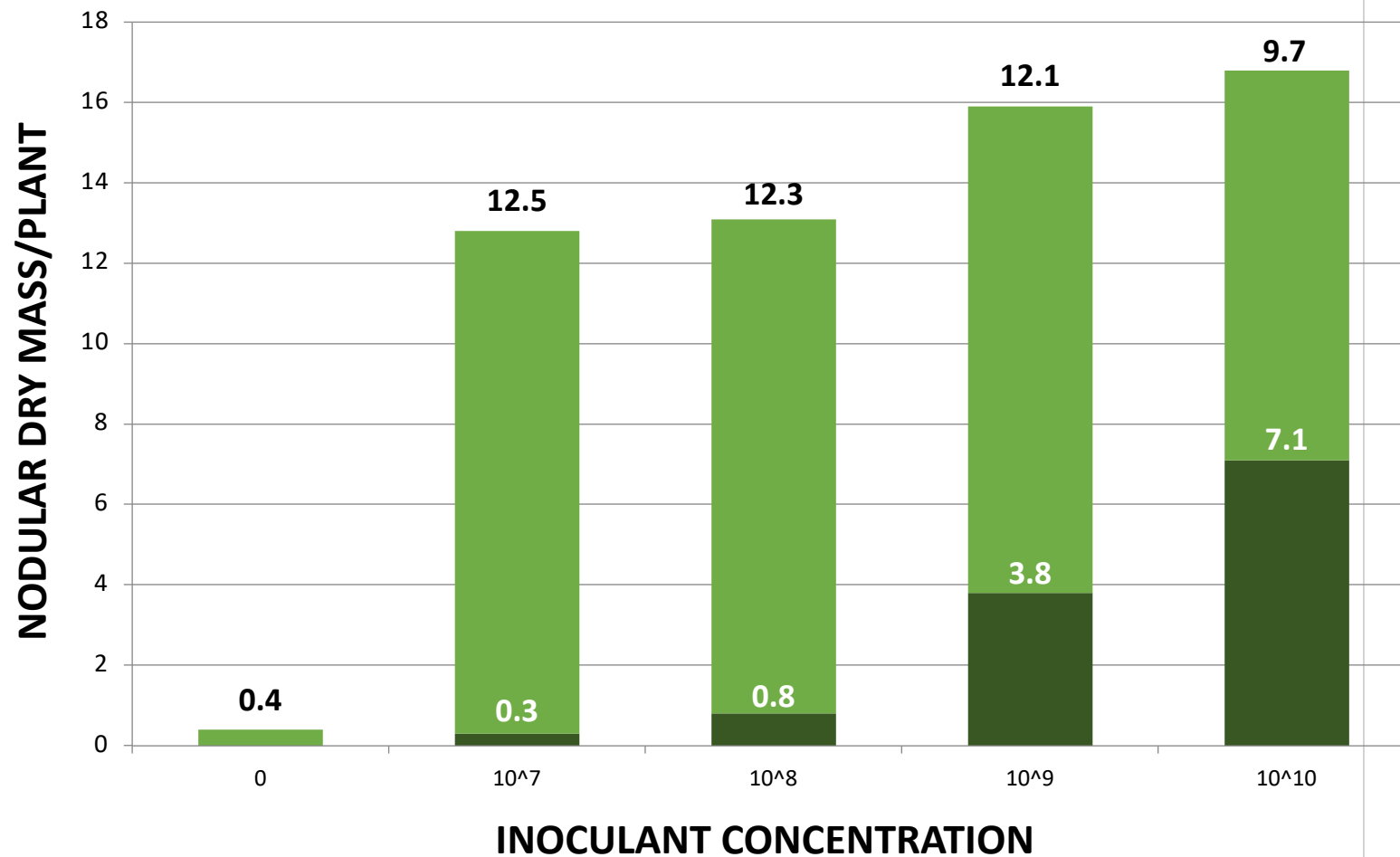
HOW BACTERIAL INOCULANTS WORK

Approximately 5×10^4 to $>5 \times 10^5$ bacterial cells occupy a seed coat post on-seed treatment to facilitate effective symbiosis.

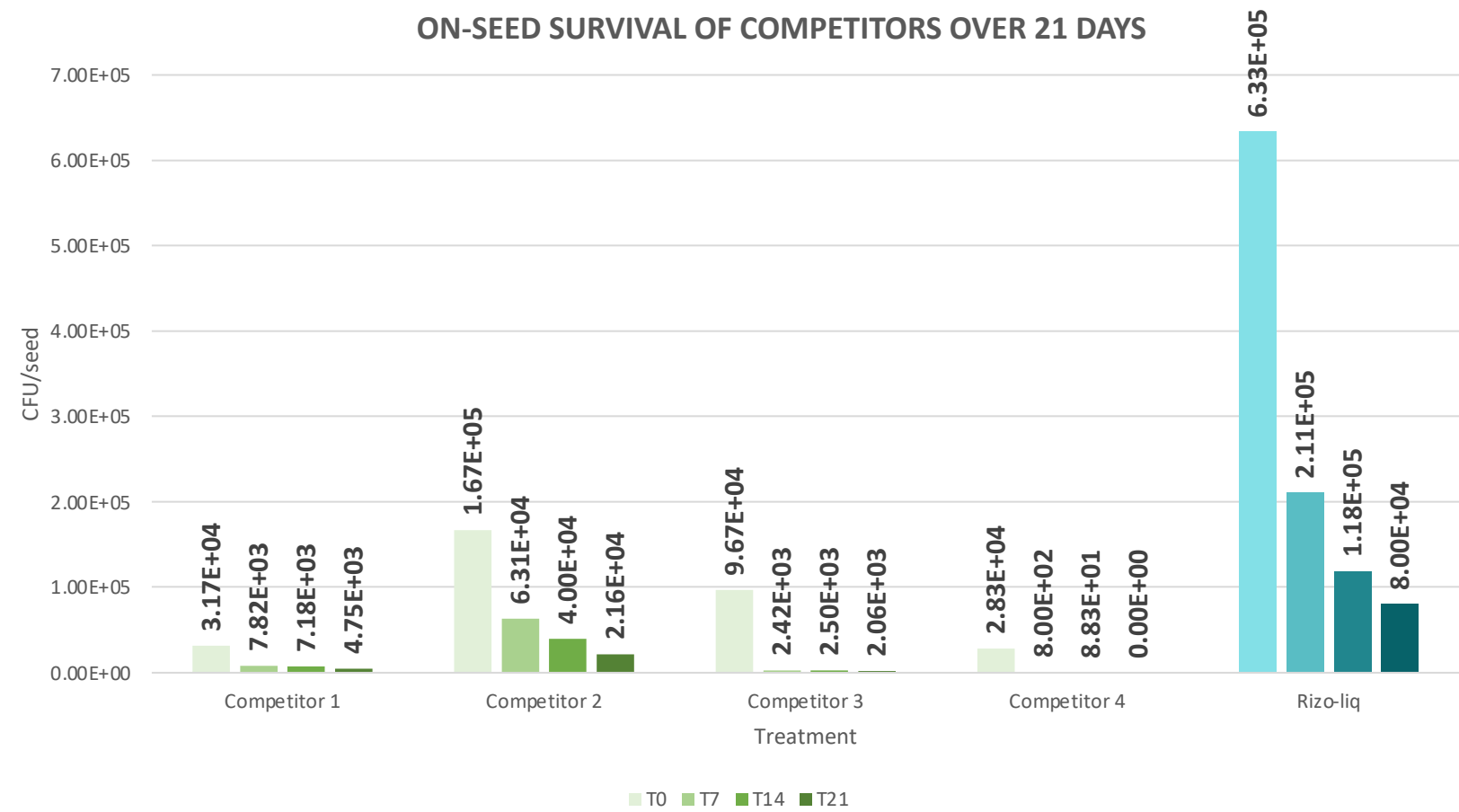
CLASSIFICATION	CFU/SEED
Very Good	$\geq 5 \times 10^5$
Good	5×10^4 a $< 5 \times 10^5$
Average	1×10^4 a $< 5 \times 10^4$
Bad	$< 1 \times 10^4$



EFFECT OF INOCULANT CONCENTRATION ON NODULAR DRY MASS

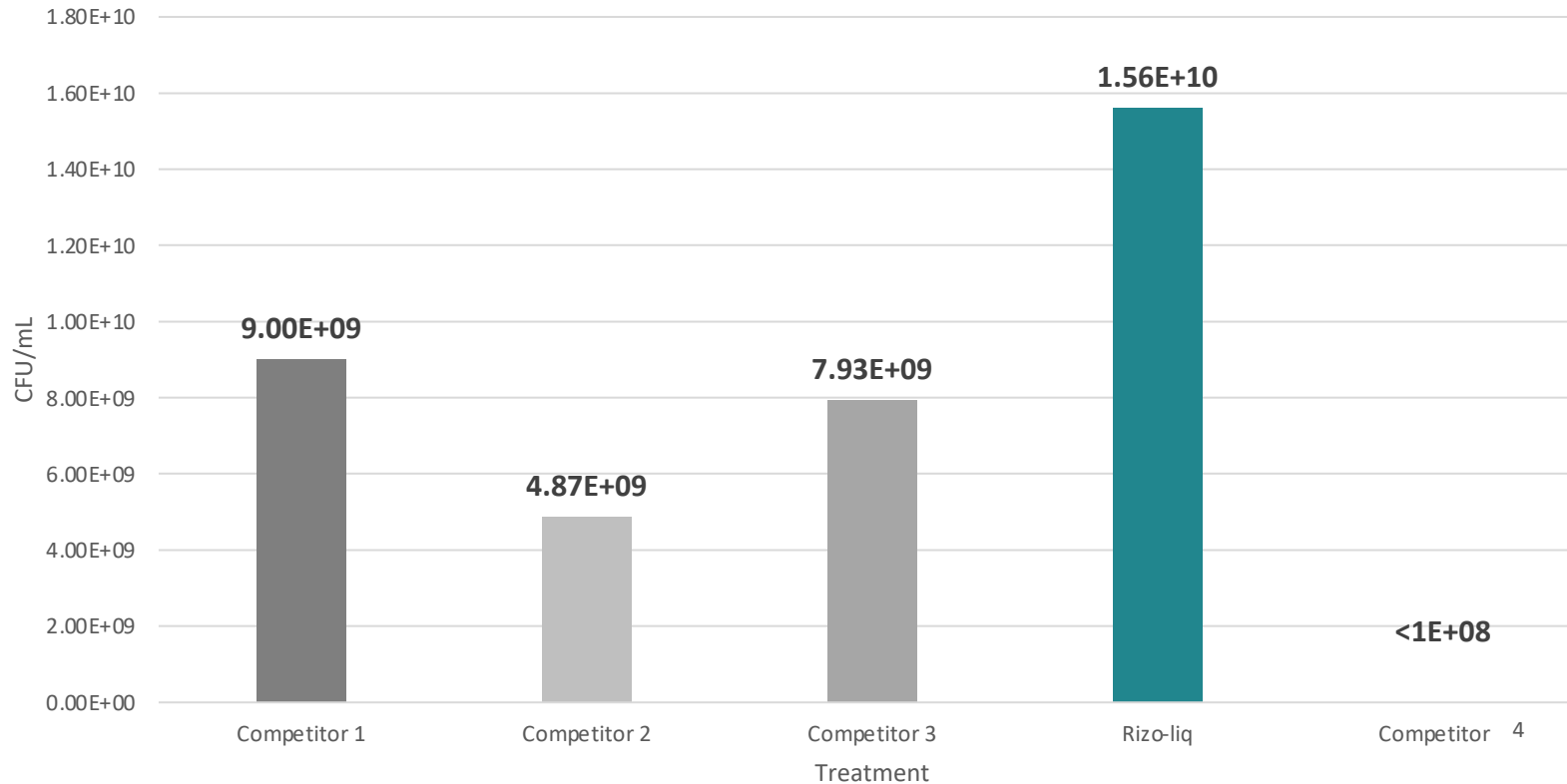


MBFi INOCULANTS VS COMPETITORS



MBFi INOCULANTS VS COMPETITORS

CFU COUNTS OF RIZO-LIQ VS COMPETITORS



INTRODUCTION

MBFi has scientifically developed a range of world-class quality rhizobium inoculants and Bio Protector for soybean crops.

We have 6 categories of products:

1. **NITROLIQ[®]**
SOYBEAN
 - Premium liquid soybean inoculant
2. **RIZOLIQ[®]**
SOYBEAN
 - High concentration soybean inoculant containing *OSMO Protection*
3. **RIZOGEN[®]**
SOYBEAN
 - High concentration inoculant with *OSMO Protection* and *EXO Activation technology*
4. **SIGNUM[®]**
SOYBEAN
 - High concentration inoculant with *Signal generation* and *OSMO protection* technology

O₂
PACKAGING

PLR
PREMIUM
LIQUID RHIZOBIUM

OSMO[™]
PROTECTION

EXO
ACTIVATION

SIGNAL
GENERATION

MMP
Microbial Membrane Protection

INTRODUCTION

We have 6 categories of products:

5. **ELITE[®]**
SOYBEAN
 - High concentration inoculant with membrane protection technology
6. **Bio-Shield[®]XT**
with **Hydrolock**
 - Bio Protector with hydrocolloids

O₂
PACKAGING

PLR
PREMIUM
LIQUID RHIZOBIUM

OSMO[™]
PROTECTION

EXO
ACTIVATION

SIGNAL
GENERATION

MMP
Microbial Membrane Protection

A close-up photograph of several green, fuzzy soybean pods hanging from a plant stem. The background is a soft-focus green with some blue sky visible at the top.

NITROLIQ[®]

SOYBEAN

 **INOCULANT TECHNOLOGY**

MBFi 
Leaders in Science. Partners in Growth.

NITRO-LIQ SOYBEAN INOCULANT

Nitro-liq soybean inoculant is a high-quality liquid rhizobium bacterial inoculant with high viable bacterial counts per ml product. The product is perfect for a grower looking for economical but high-quality treatment.

Features:

- Contains a min of 2×10^9 cfu/ml *Bradyrhizobium japonicum* at expiry date
- 12 months shelf-life
- High-quality liquid inoculant
- High viable bacteria counts
- Uniform application with liquid formulation
- Compatible with most of the seed care products
- Up to 5 days on seed with Trillum DS and Bio-Shield XT (Protector)
- 300ml/100kg seed
- Packed in 150ml and 3L O₂ breathable packaging for increased bacterial viability throughout storage



N-Factor 1[®]

O₂
PACKAGING

RIZOLIQ[®]
SOYBEAN

 **INOCULANT TECHNOLOGY**

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RIZO-LIQ SOYBEAN INOCULANT

MBFi has developed a technology that plays an important role in the survival of *Rhizobium* and the symbiosis with soybeans. The technology allows cells to maintain osmotic balance by accumulating osmolytes in cytoplasm, this prevents water inside the cell from moving to the environment where solute concentrations are higher; assisting with protection from damage.

Features:

- Contains a min of $6,5 \times 10^9$ cfu/ml *Bradyrhizobium japonicum* at expiry date
- Manufactured at $>1,5 \times 10^{10}$ cfu/ml *Bradyrhizobium japonicum*
- High-quality liquid inoculant
- High viable bacteria counts
- 18-month shelf-life
- Uniform application with liquid formulation
- Compatible with most of the seed care products
- Up to 21 days on seed with Trillum DS and Bio-Shield XT (Protector)
- 300ml/100kg seed
- Packed in 150ml and 3L O₂ breathable packaging for increased bacterial viability throughout storage



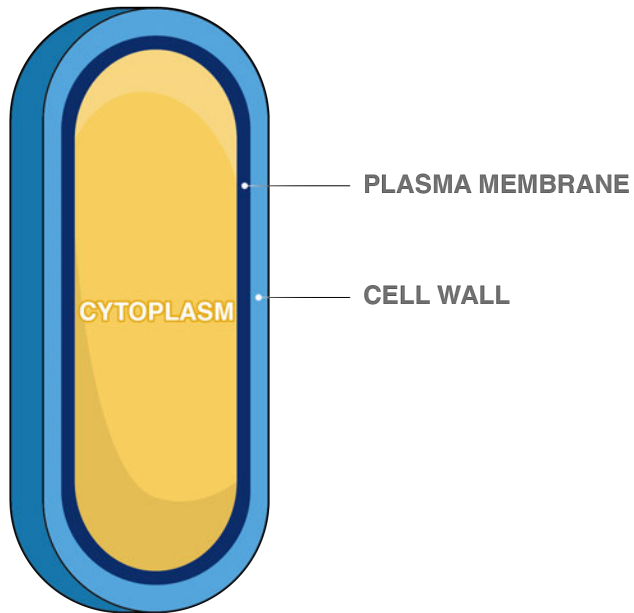
N-Factor 2®

O₂
PACKAGING

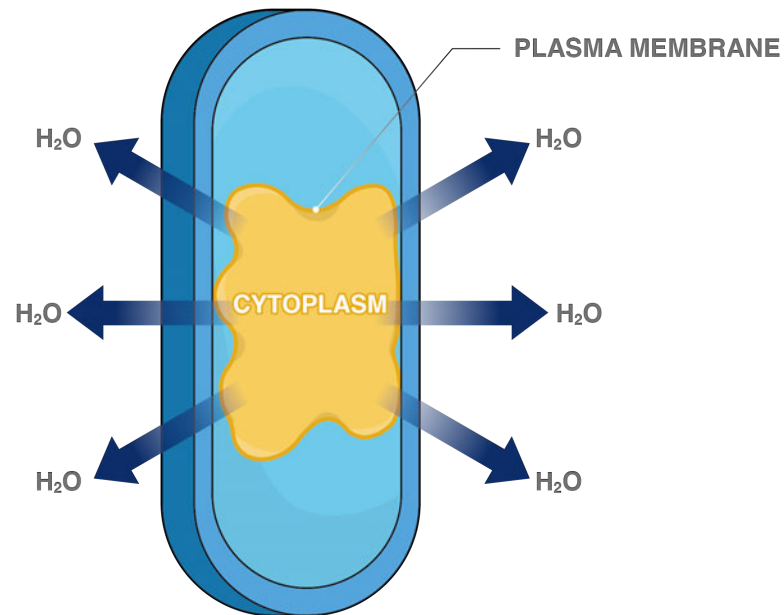
OSMO PROTECTION TECHNOLOGY

IMPROVED SURVIVAL OF RIZOBIUM

WITH OSMO PROTECTION



WITHOUT OSMO PROTECTION



OSMO PROTECTION TECHNOLOGY



In a hyperosmotic environment, the concentration of solutes outside the cell is higher than inside the cell. Water will therefore move from the cell from an area with a high water potential to an area with a lower water potential. The cell will therefore shrink.



TRIAL DATA - TREATED VS UNTREATED



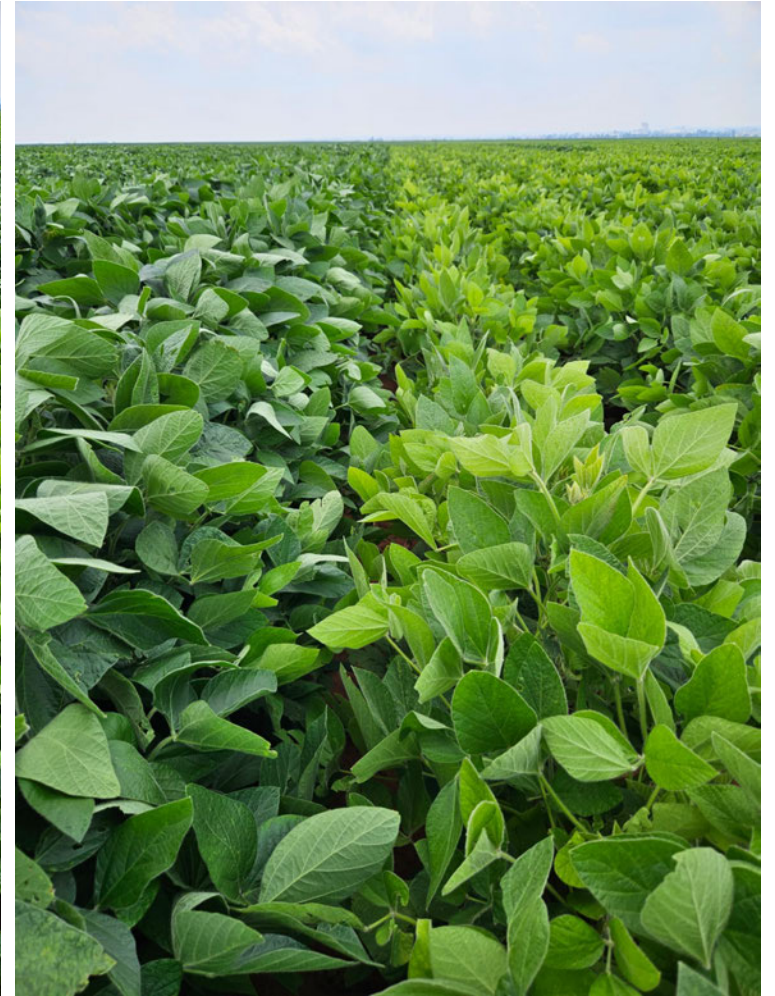
UNTREATED
CONTROL



TREATED WITH
RIZOLIQ[®]
SOYBEAN



TRIAL DATA - TREATED VS UNTREATED





SIGNUM[®]

SOYBEAN

 **INOCULANT TECHNOLOGY**

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SIGNUM SOYBEAN INOCULANT

Signum soybean is an inoculant with signal generation and OSMO protection technologies. Signal generation allows the infection process to occur quicker during unfavourable temperatures, water stresses, and pH's.

Features:

- Contains a min of $6,5 \times 10^9$ cfu/ml *Bradyrhizobium japonicum* at expiry date
- Manufactured at $>1,5 \times 10^{10}$ cfu/ml *Bradyrhizobium japonicum*
- High-quality liquid inoculant
- High viable bacteria counts
- 18-month shelf-life
- Uniform application with liquid formulation
- Compatible with most of the seed care products
- Up to 21 days on seed with Trillum DS and Bio-Shield XT (Protector)
- 300ml/100kg seed
- Packed in 150ml and 3L O₂ breathable packaging for increased bacterial viability throughout storage



RIZOGEN[®]

SOYBEAN

 **INOCULANT TECHNOLOGY**

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SOYBEAN INOCULANT

Soybean inoculants is a highly concentrated liquid rhizobia inoculant containing proprietary EXO Activation Technology. EXO Activation Technology is responsible for increasing the nitrogen fixation capabilities of the plant, even under adverse and stressful environmental conditions. This technology is created using a unique fermentation process; through stress, the organisms become more resilient and produce additional signaling molecules which induce accelerated nodulation at the time of inoculation.

Features:

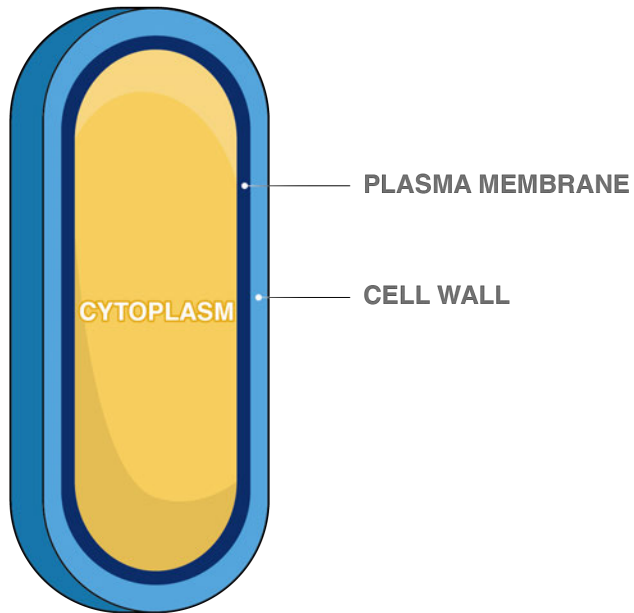
- Contains a min of $6,5 \times 10^9$ cfu/ml *Bradyrhizobium japonicum* at expiry date
- Manufactured at $>1,5 \times 10^{10}$ cfu/ml
- Contains OSMO Protection and EXO activation technology
- Tougher, more resilient bacteria over a wider range of conditions
- Accelerated nodulation process with increased biological nitrogen fixation
- Compatible with most of the seed care products
- 18-month shelf-life
- Up to 21 days on seed with Trillum DS and Bio-Shield XT (Protector)
- 250ml/100kg seed
- Packed in 125 ml and 2.5L O₂ breathable packaging for increased bacterial viability throughout storage



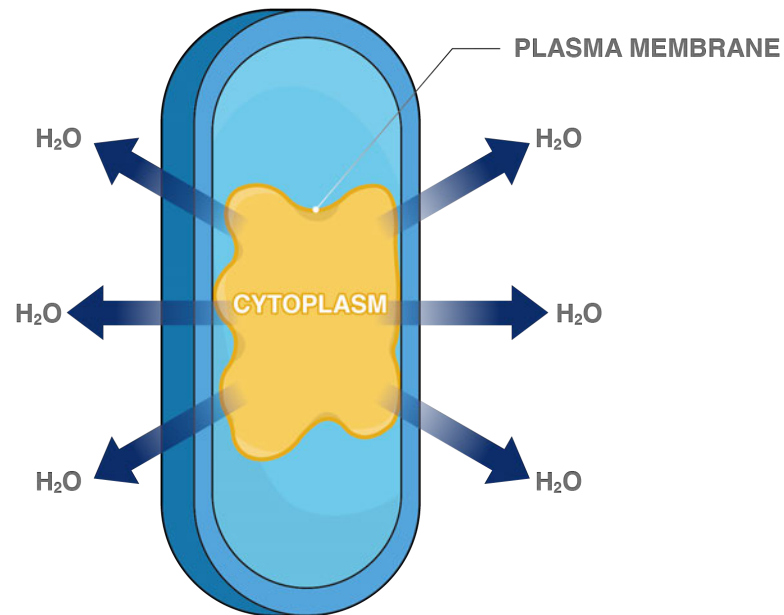
OSMO PROTECTION TECHNOLOGY

IMPROVED SURVIVAL OF RIZOBIUM

WITH OSMO PROTECTION



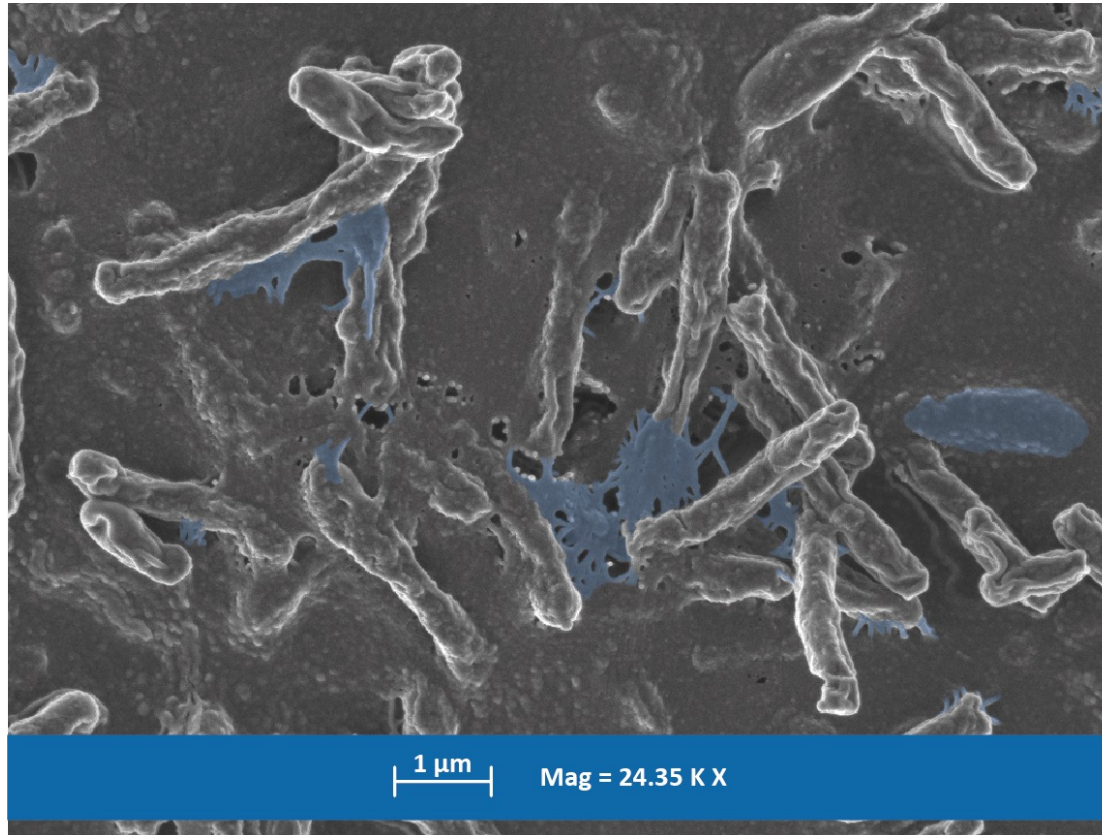
WITHOUT OSMO PROTECTION



EXO TECHNOLOGY

What is EXO activation technology?

Scanning Electron Microscopy photo of the formation of EPS between cells of *B. japonicum*.



**2.1-3.3x
HIGHER EPS IN
RIZOGEN**

**CAN
PRODUCE UP TO
50-200MG/L
EPS**

DUAL ACTION TECHNOLOGY - BENEFITS

1. OSMOLITIC PROTECTION OF THE CELL MEMBRANE

Dehydration of rhizobia and survival of rhizobia is important to increase viable and high concentration bacteria on seed.

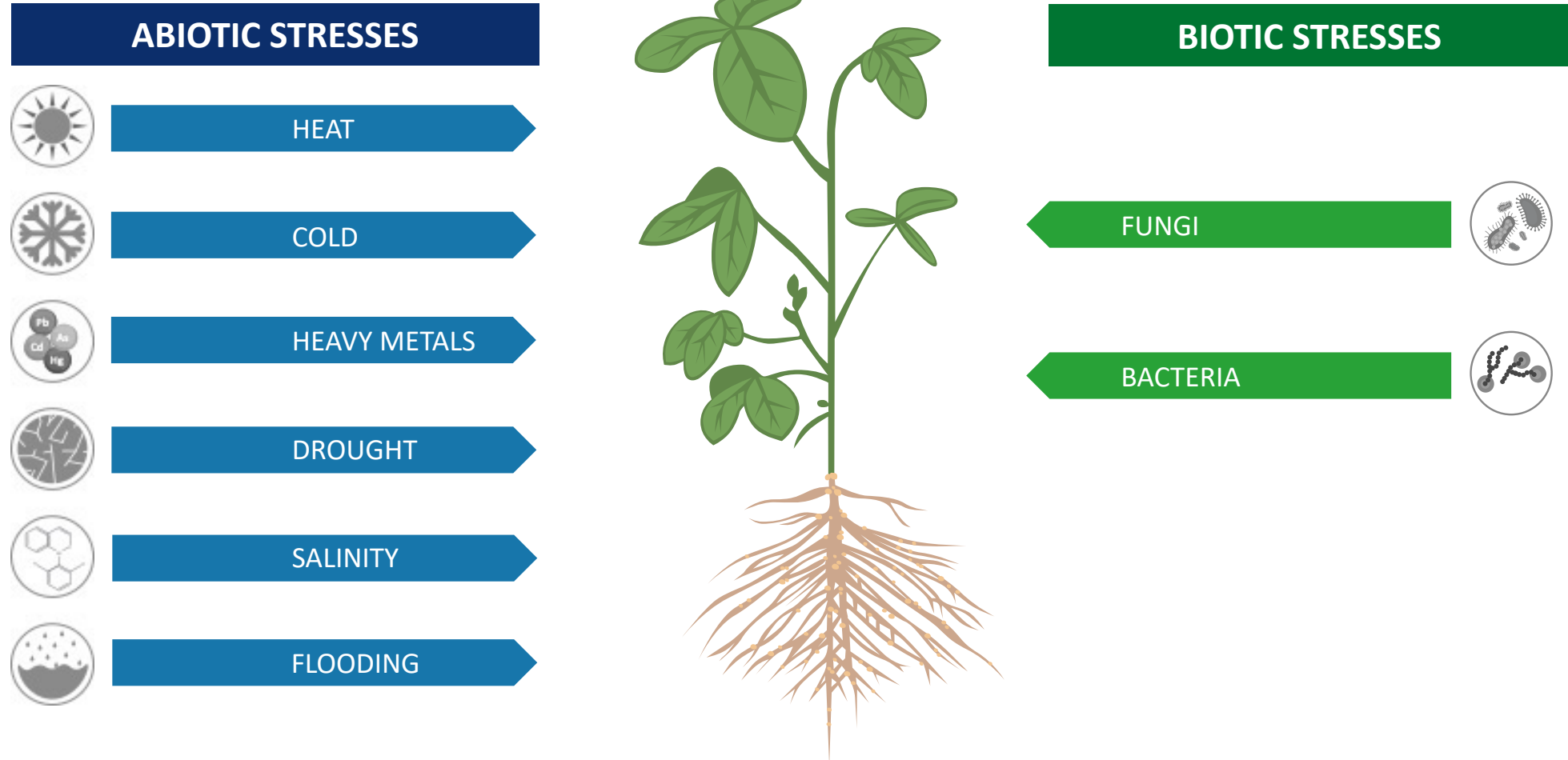
2. IT PROTECTS BACTERIA AGAINST BIOTIC AND ABIOTIC STRESS

EXO technology forms a protective barrier around the bacterial cells and improves microbial habitability and survivability.



DUAL ACTION TECHNOLOGY - BENEFITS

2. PROTECTING BACTERIA AGAINST BIOTIC AND ABIOTIC STRESSES



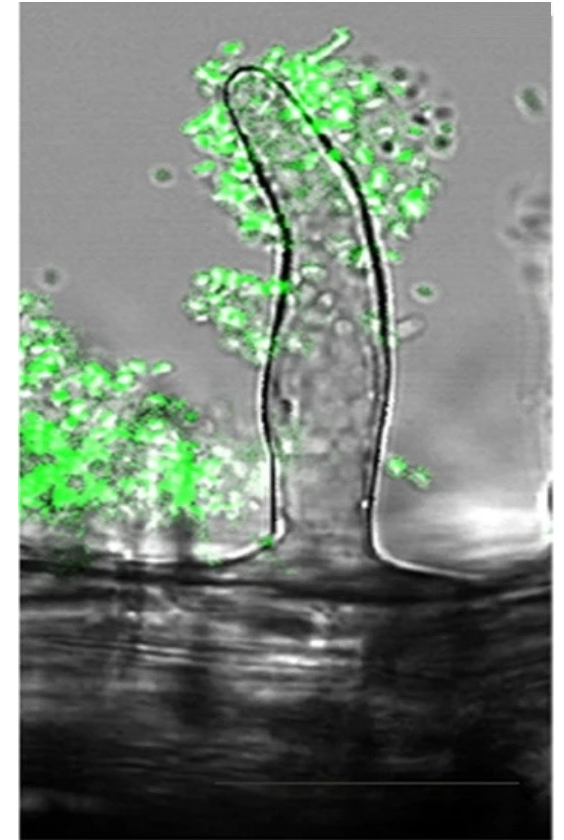
DUAL ACTION TECHNOLOGY - BENEFITS

3. ENHANCED INTERACTION BETWEEN RHIZOBIA AND PLANT

Recognition of EXO by the host plant accelerates host bacteria communication, thereby increasing the attachment process.

4. SUPPRESSION OF PLANT DEFENCE RESPONSE

EXO results in the suppression of host defense responses and can therefore increase nodulation infection.



DUAL ACTION TECHNOLOGY - BENEFITS

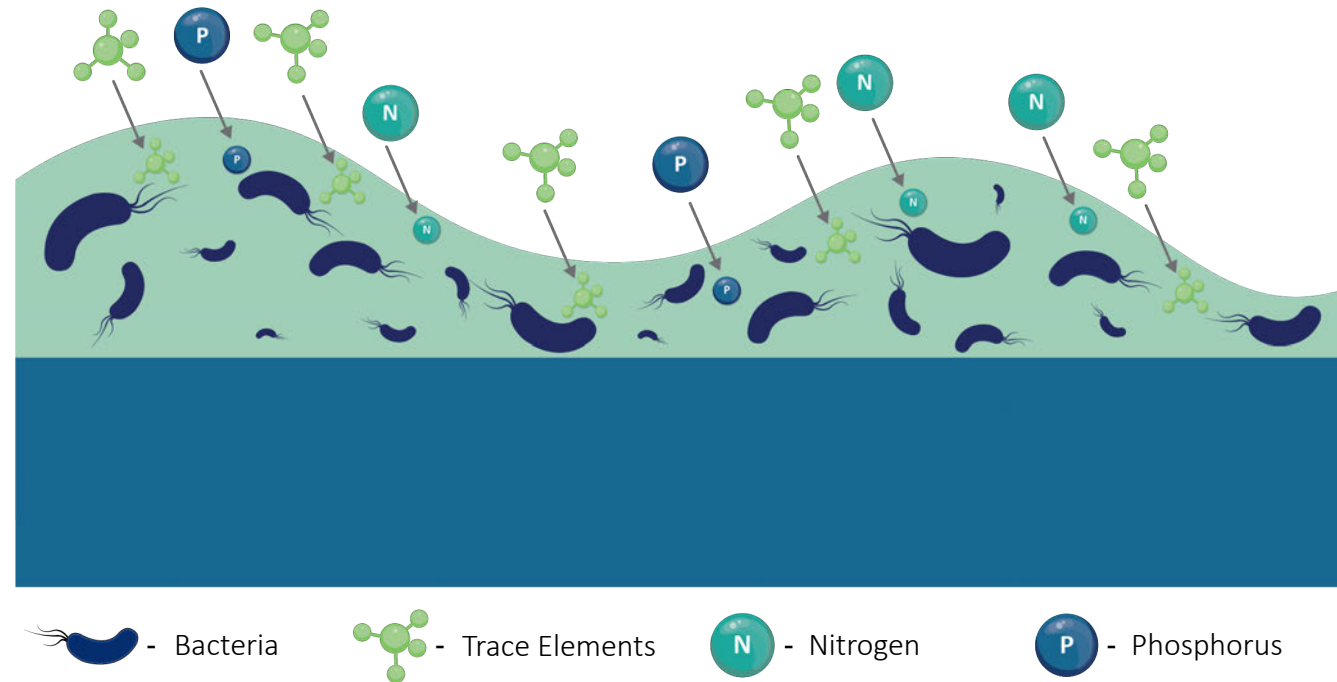
5. ACTING AS A WATER AND NUTRIENT TRAP

INCREASED SURVIVAL DURING DROUGHT CONDITIONS

MW RANGES BETWEEN 1×10^6 AND 3×10^6 DALTONS

INCREASE IN WATER-STABLE AGGREGATES

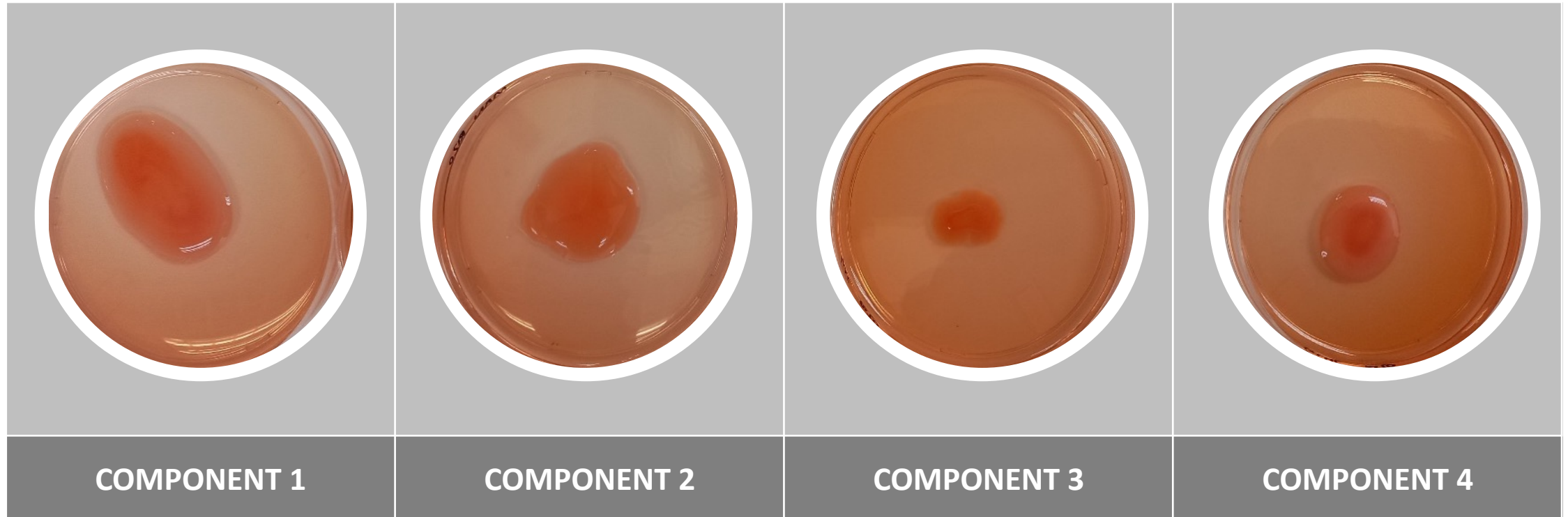
EPS IS HYGROSCOPIC IN NATURE



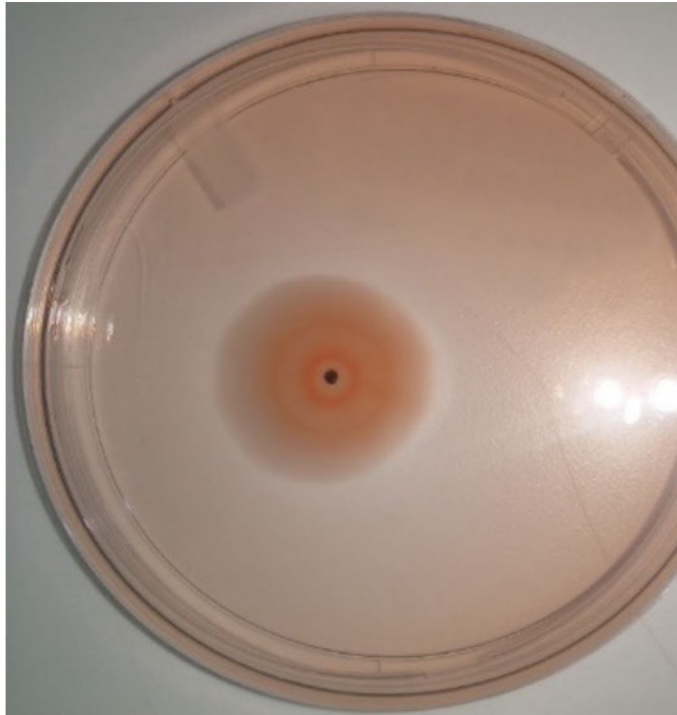
DUAL ACTION TECHNOLOGY - BENEFITS

6. THE SWARMING CAPABILITY TOWARDS THE ROOT SYSTEM

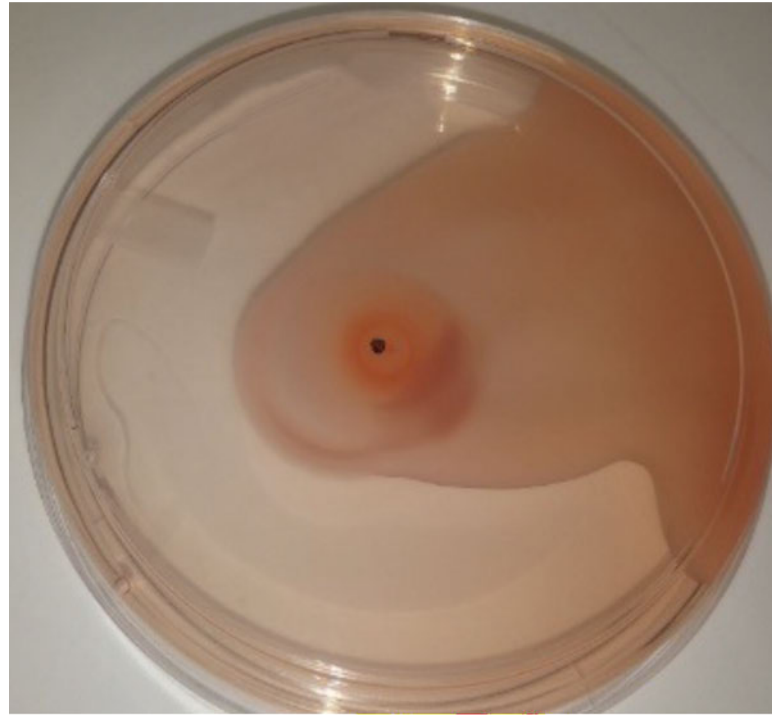
Swarming is a multicellular movement towards/over surfaces. EXO Technology improves swarming capabilities of rhizobia.



SOYBEAN INOCULANT



WITHOUT
EXO TECHNOLOGY

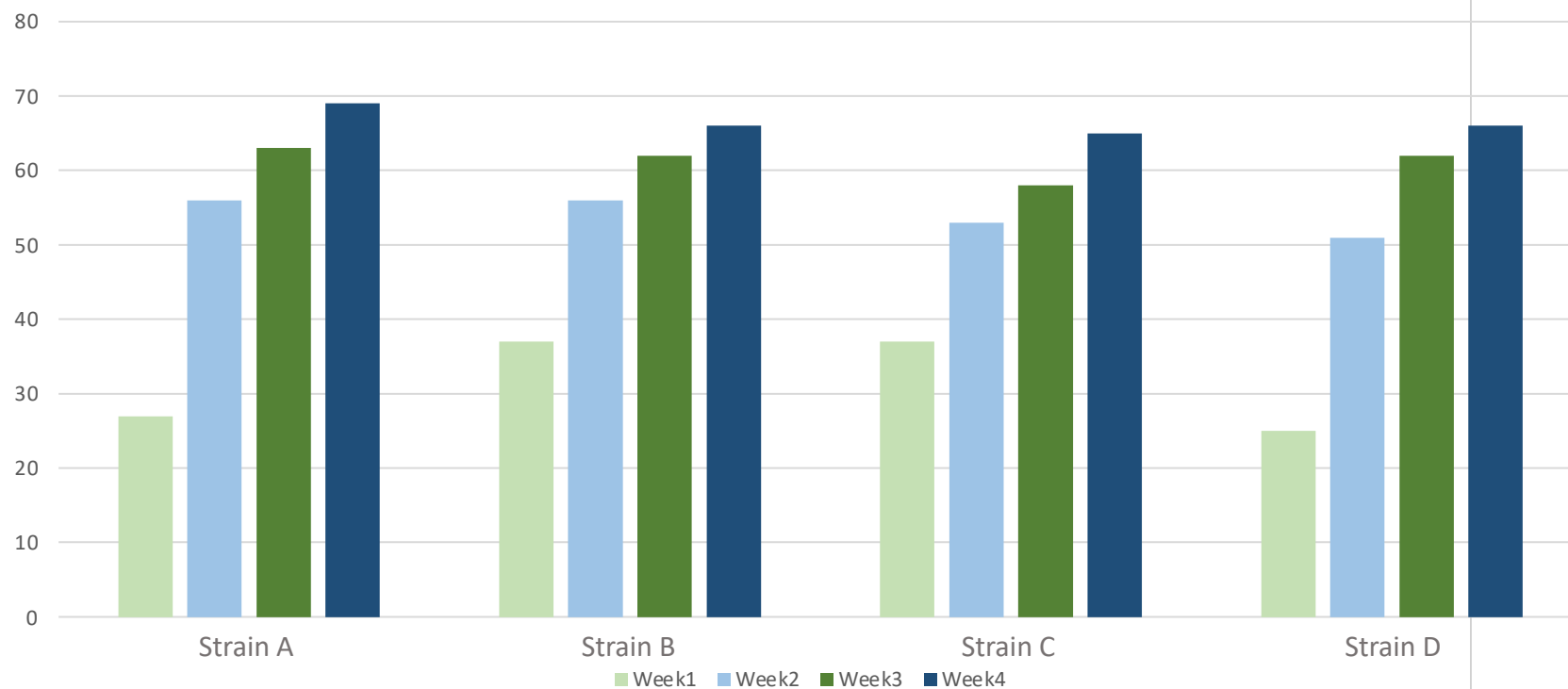


WITH



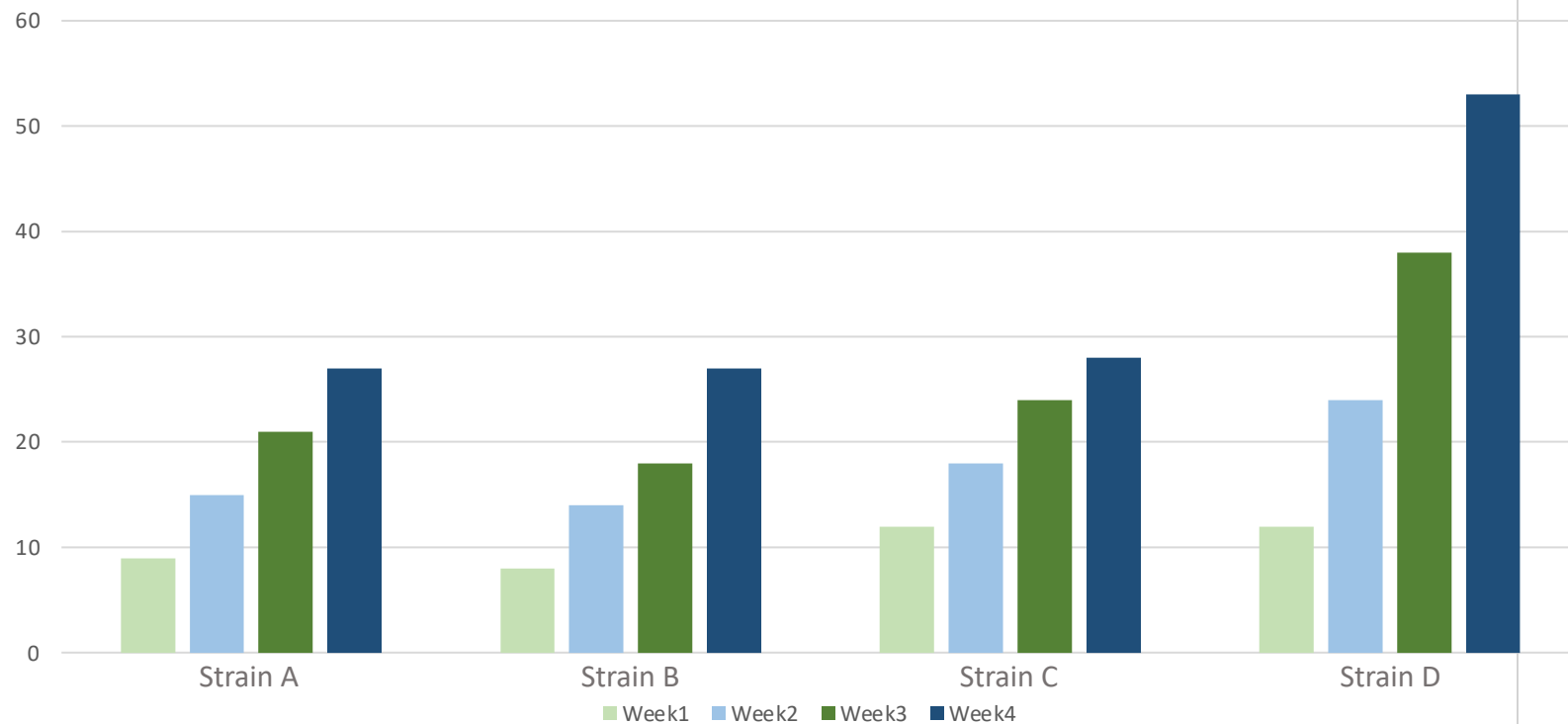
SOYBEAN INOCULANT

SWIMMING WITH ADDITION OF VARIOUS COMPONENTS DURING
FERMENTATION



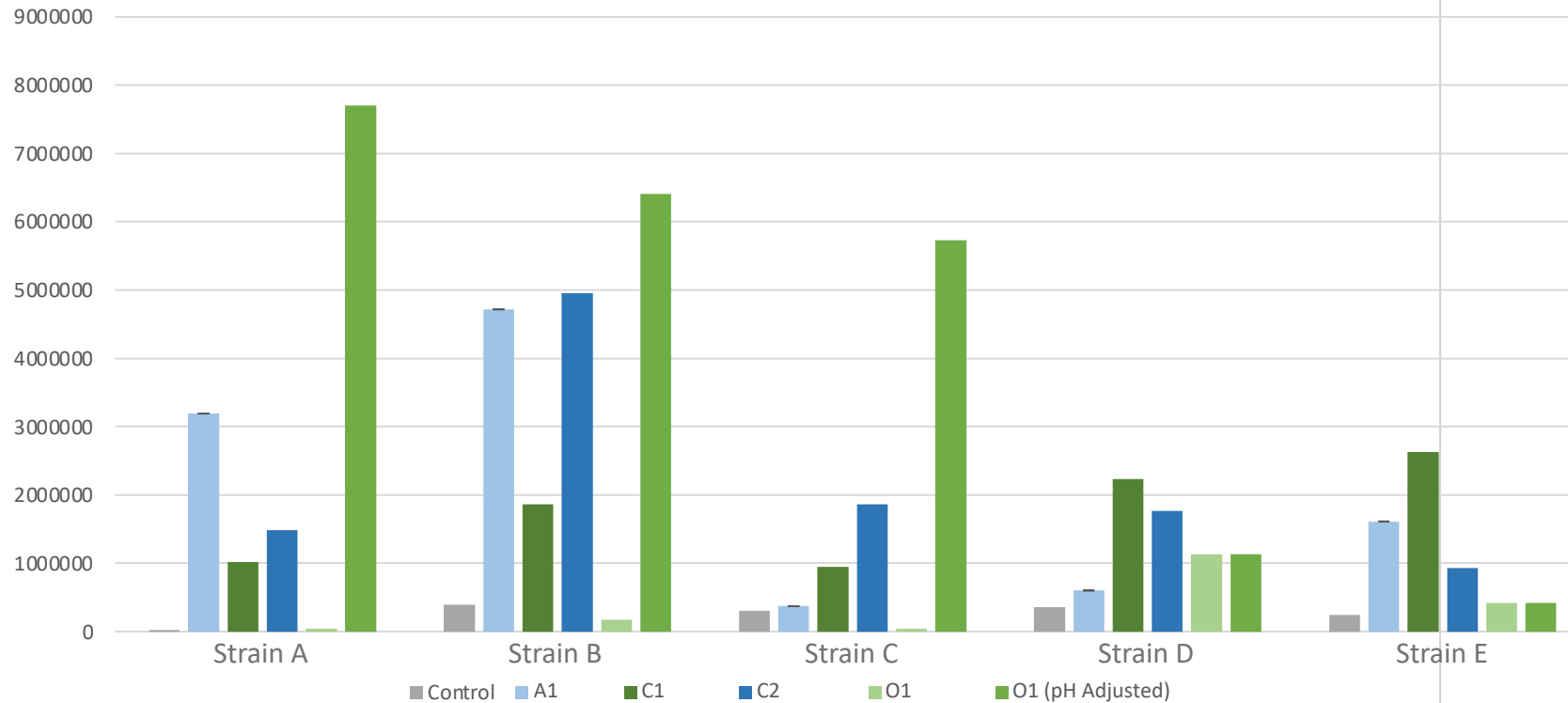
SOYBEAN INOCULANT

SWARMING WITH ADDITION OF VARIOUS COMPONENTS DURING
FERMENTATION



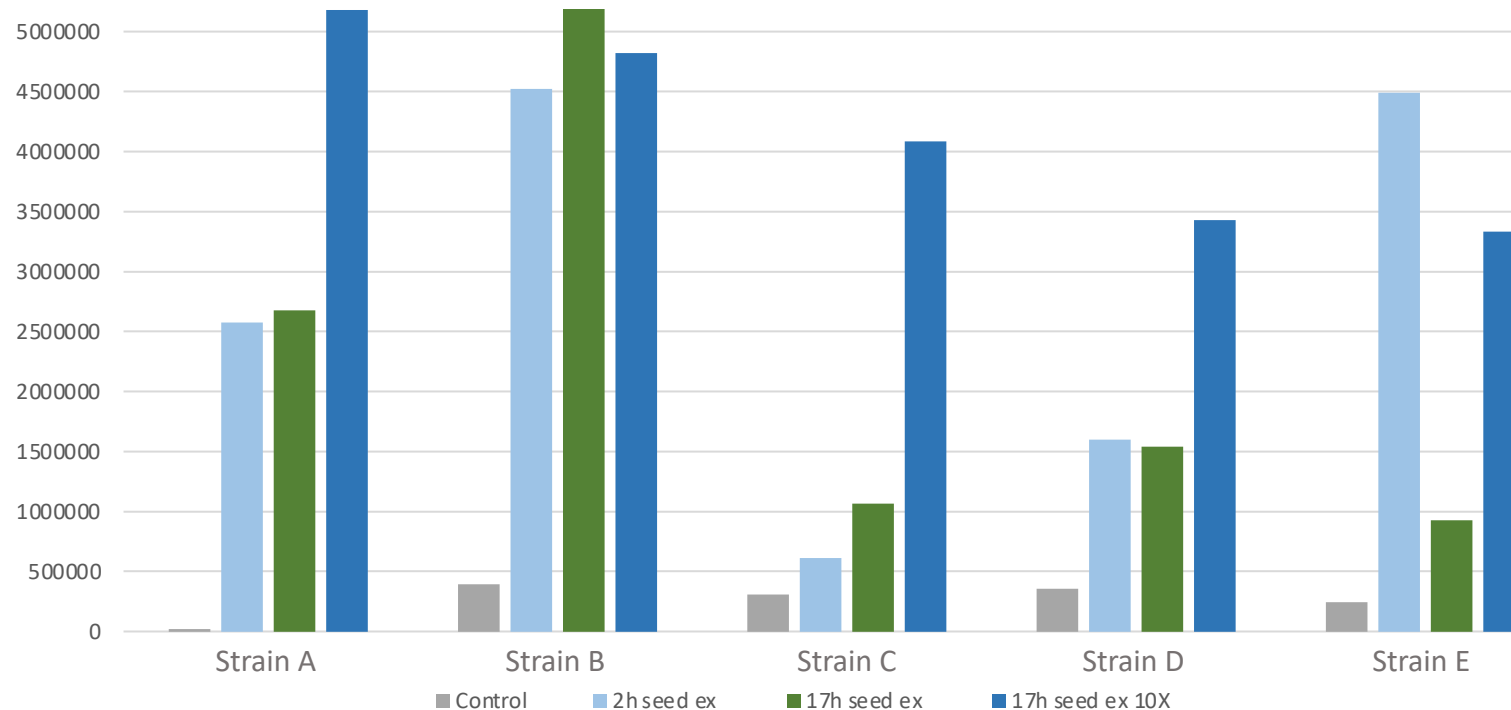
SOYBEAN INOCULANT

CHEMOTAXIS OF VARIOUS *BRADYRHIZOBIUM* STRAINS TOWARDS DIFFERENT CARBON SOURCES, AMINO ACIDS AND ORGANIC ACIDS



SOYBEAN INOCULANT

CHEMOTAXIS OF VARIOUS *B. JAPONICUM* STRAINS TOWARDS SEED EXUDATES



A close-up photograph of a young plant seedling with two bright green leaves and a fuzzy stem, growing out of dark, rich soil. The background is softly blurred, showing more foliage and a warm, golden light source in the upper left corner. A semi-transparent dark horizontal band is overlaid across the middle of the image, serving as a background for the product name.

Bio-Shield[®] XT

with Hydro lock[®]

 **INOCULANT TECHNOLOGY**

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BIO-SHIELD XT

Characteristics and mode of action:

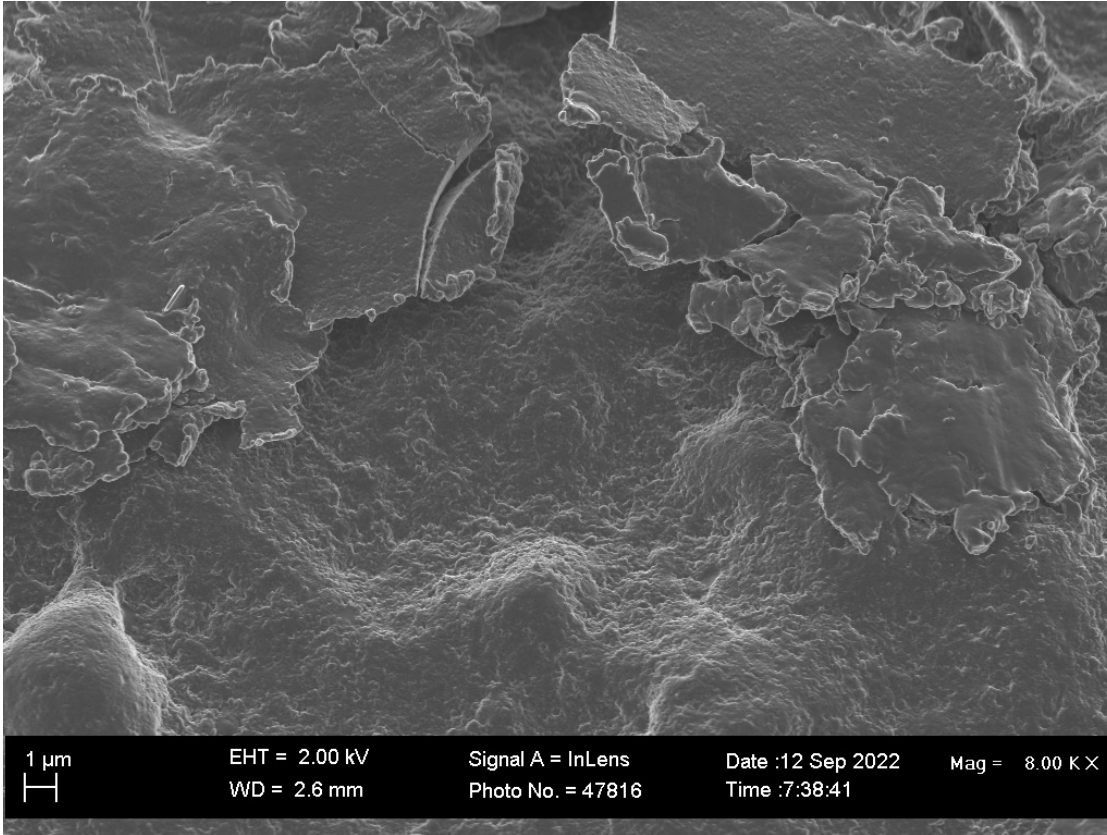
1. Limit heat transfer from the environment to the microorganisms on the seed due to low thermal conductivity potential
2. Slows dehydration due to high water activity (contains “hydrocolloids” – high affinity for water)
3. Improves attachment of microorganisms on the seed
4. Protects against toxic seed components produced by seed by binding or inactivating
5. Identification of treated seed due to the presence of pigments
6. Carbon source for rhizobia, by increasing water activity in keeping bacterial activated and protected
7. Create a dry cover on the outside of seed for *Trichoderma* to flourish



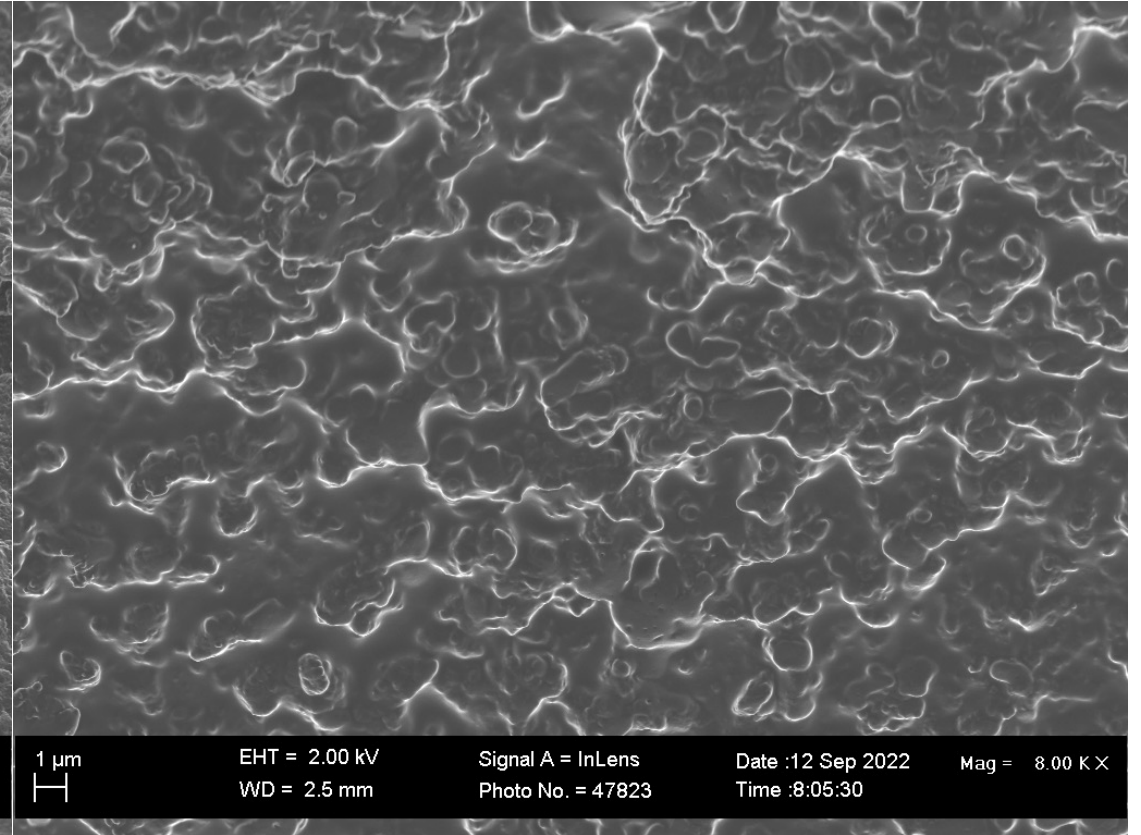
Hydro lockTM
technology

BIO-SHIELD XT

SEED SURFACE SEM PHOTOS

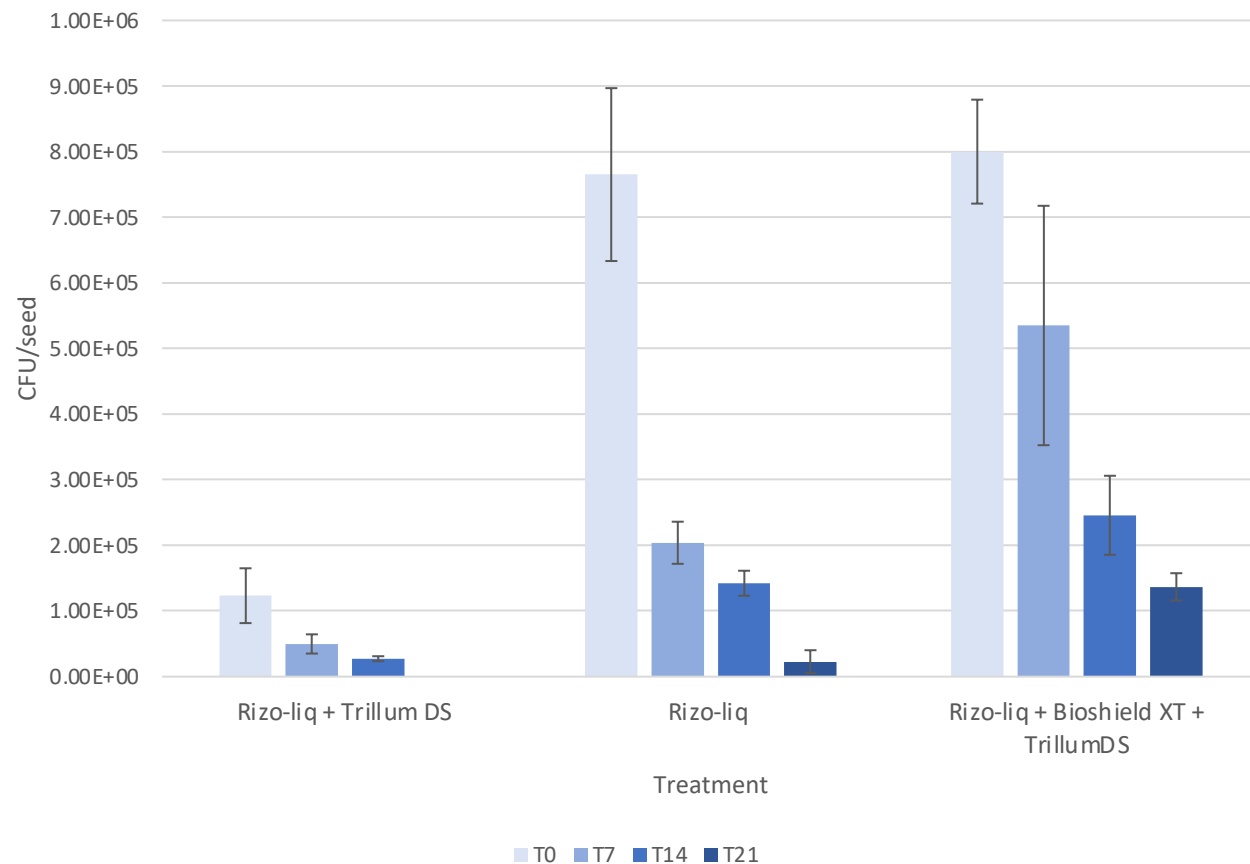


UNCOATED



COATED WITH **Bio-Shield[®] XT**

IMPORTANCE OF A PROTECTOR



HydrolockTM
technology

**THE FUTURE OF AGRICULTURE IS NOT JUST GROWING CROPS
IT'S GROWING SMARTER.
AND MBFi'S TECHNOLOGIES ARE LEADING THE WAY!**

 **INOCULANT TECHNOLOGY**

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