Microbial consortia products

as biological inoculants for improved plant growth

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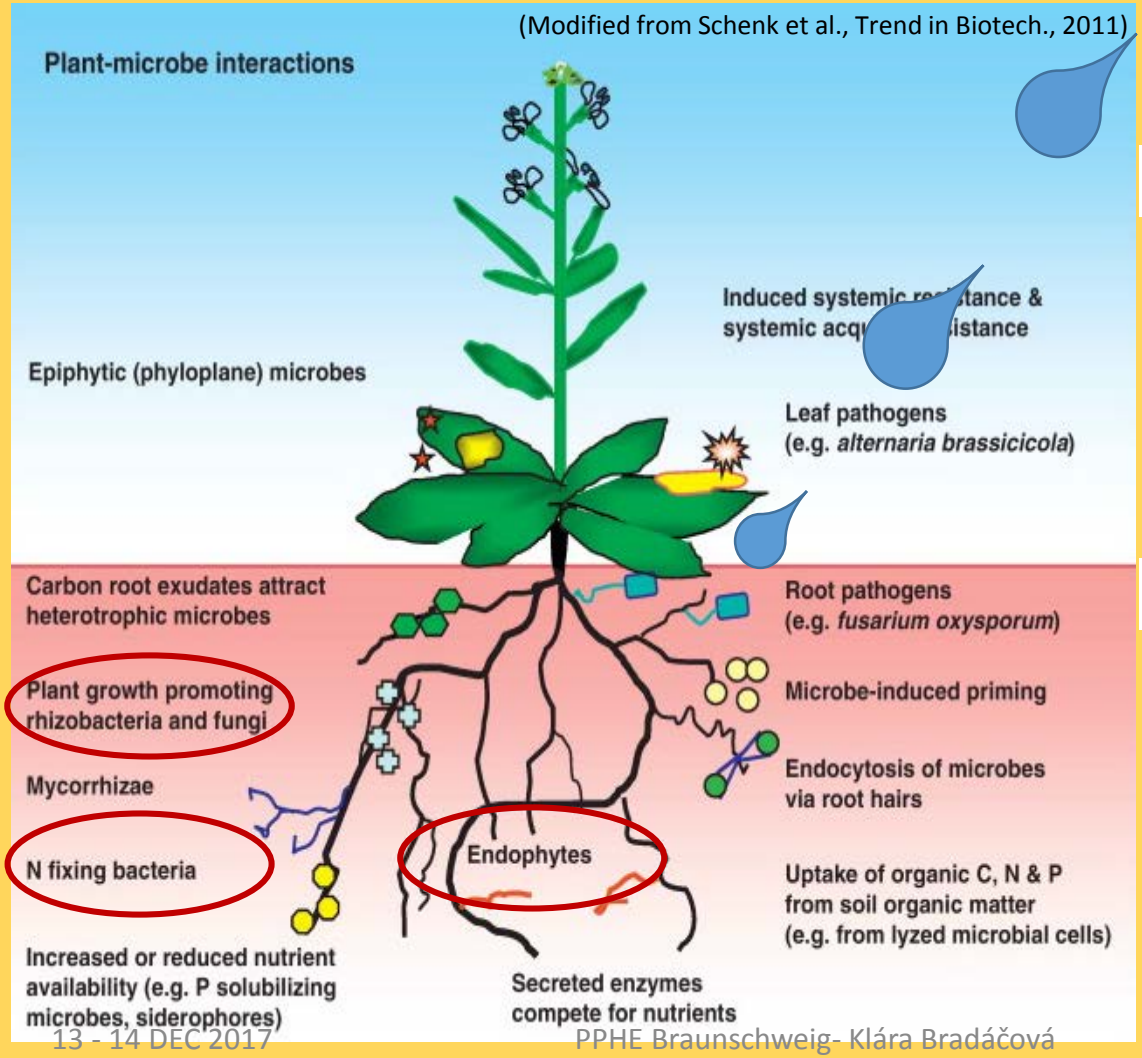
Microbial Consortia Products (MCP)



Plant response

Growth promotion
Biotic and abiotic stress tolerance
Vigorous, strong, healthy plants
Yield increase

Beneficial microbes

Nutrient mobilization
Root exudates
Enzyme secretion
Activation of C, N, P turnover enzymes
Siderophores

Introduction of Microbial Consortia Product (MCP)

- <u>description:</u> dark brown liquid, should provide nutrient acquisition and enhancement of BNF

- <u>bacterial composition:</u> *Azotobacter vinlandii, Clostridium sp., Lactobacillus sp.,* ***Bacillus amyloliquefaciens****, B. subtilis* (SILoSil® BS)*, B. thuringiensis,* ***Pseudomonas fluorescens****, Acetobacter, Enterococcus, Rhizobium japonicum*

- <u>funghal composition:</u> *Saccharomyces, Penicillium roqueforti, Monascus, Aspergillus oryzae,* ***Trichoderma harzianum*** (TRICHOSIL)

- <u>plant composition:</u> *Arthrospira platensis (Spirulina), Ascophyllum nodosum*

Principal approaches for practical applications

Targeted Selection Hypothesis
(Concept of BIOFECTOR)

Beneficial effects on plants achieved by targed selection and inoculation with BEs particularly efficient for specific applications *(e.g. nutrient mobilisation, root growth promotion, pathogen antagonism)*

x

Auto-Selection Hypothesis
(MCP Concept, EM Concept)

Inoculation with huge consortia of plant growth-promoting bacteria with different functions. Different stress conditions will activate the most suitable populations (*also targeted pre-activation is possible prior to inoculation*)

Maize pot experiments

- **Pot experiment** (*3 kg substrate: 1:3 sand/ soil mix)* Maize cv. Jessy, 6 weeks)

- **Soil**: - Horb field site pH 6.5, silty loam, CAL-P 52, N_{min} 11.3 (mg/kg soil)
- - Practical course, stored soil, pH 5.6, silty loam, CAL-P 18

- **BE Treatments:** ECAG 2895 (*3 weekly fertigations, dosage according to manufacturer´s recommendations)*

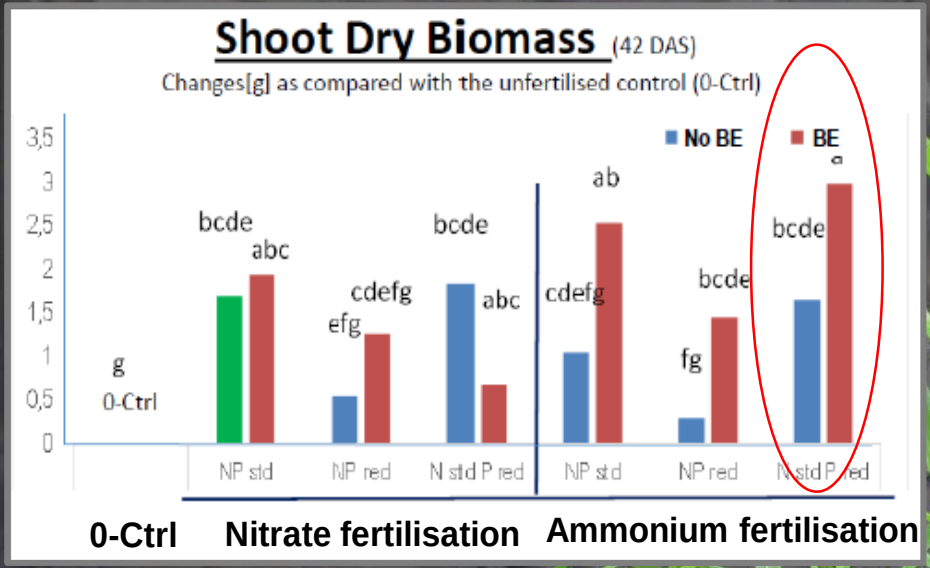
- **Fertilisation levels (**mg/kg soil**):**

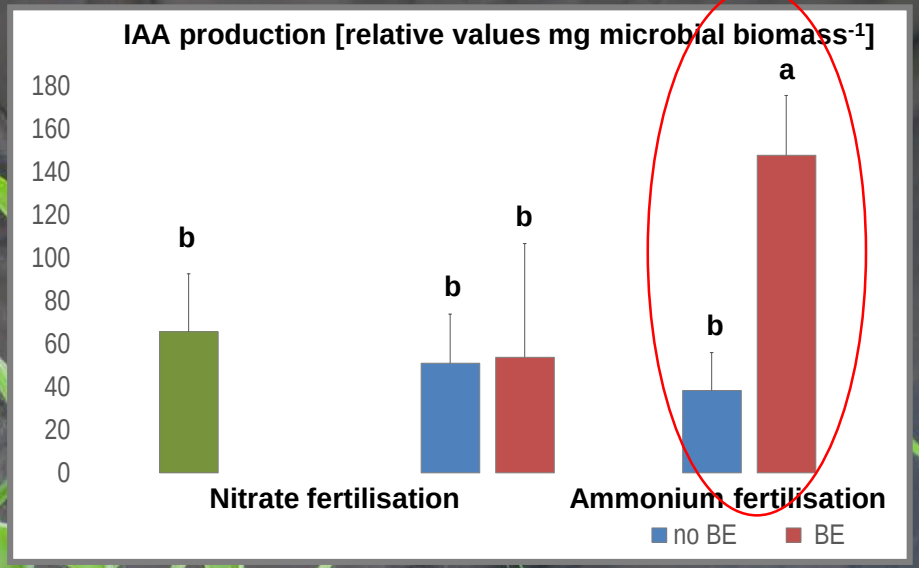
- 1.(N140, P130, K150, Mg50) Standard full nutrient supply
- 2. Reduced N/P fertilisation (N 70,P 50) or StdN and reduced P supply

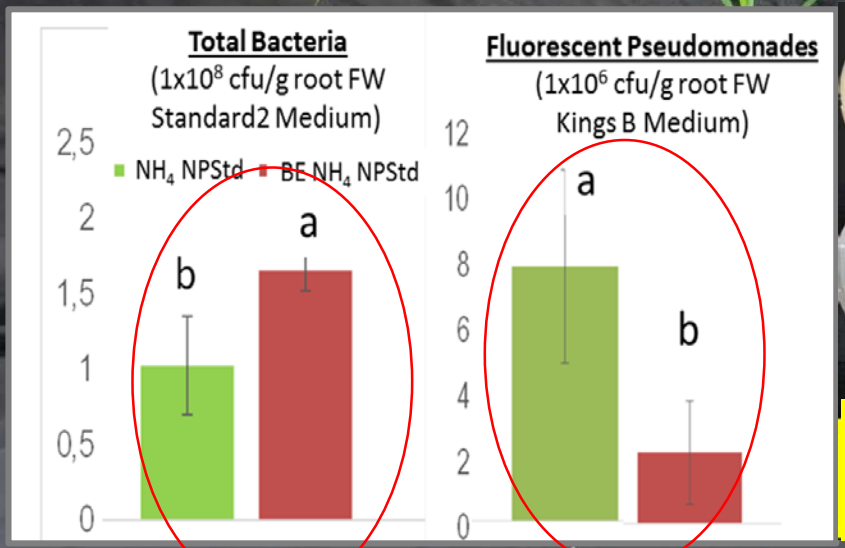
- **Different N forms:** Nitrate N vs Ammonium N
  (ENTEC-stabilised Ammoniumsulfate, Novatec Solub, Compo)

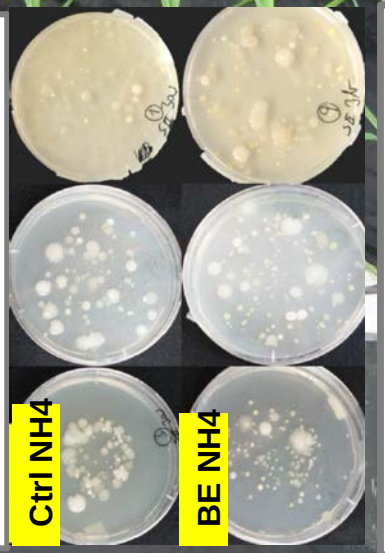
- **General measurements:**
  plant growth (height, stem diameter), shoot and root DM, root morphology (length diameter, fine roots) plant nutritional status

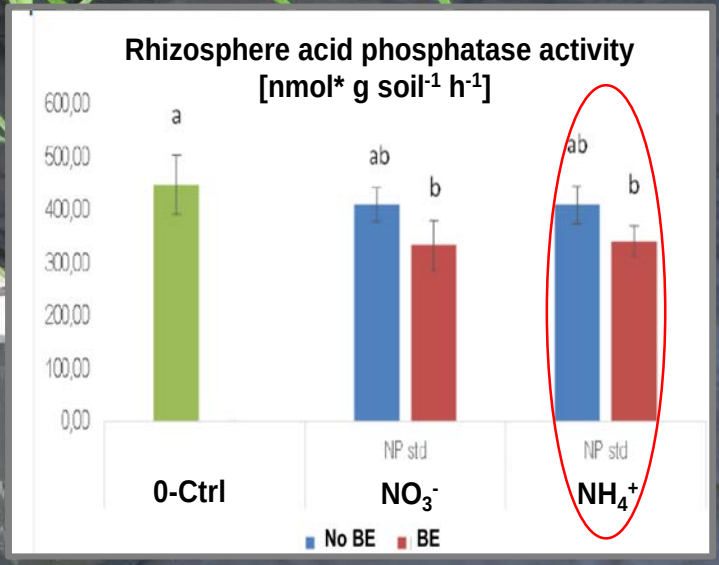
- **Specific measurements:**
  Functional charcterisation of rhizosphere-microbial activities:
  *(**Enzyme assays** in rhizosphere soil **Tracing for microorganisms**, **Auxin production potential**)*

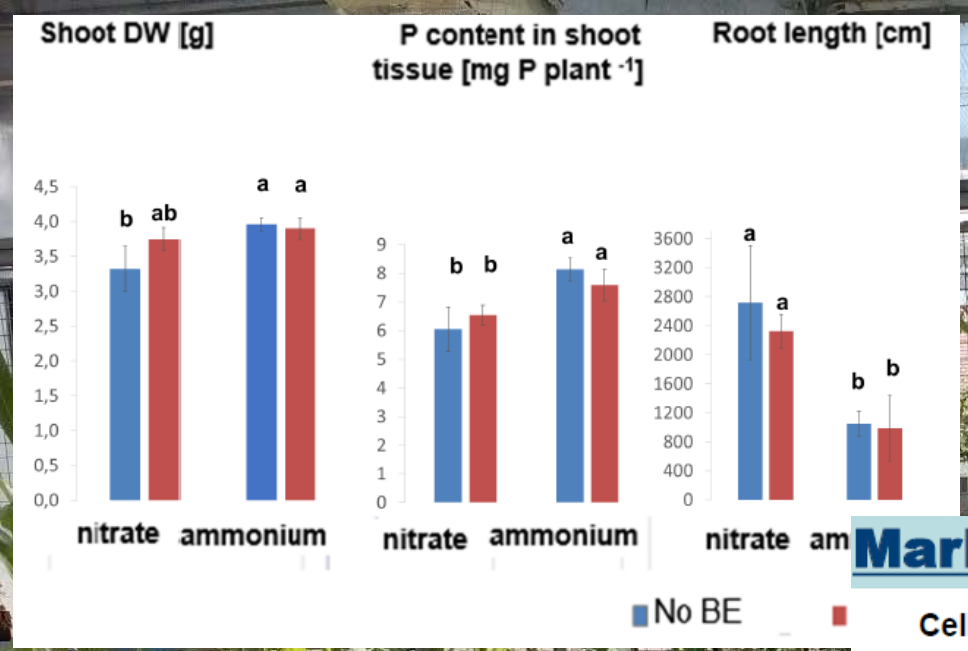

Shoot Dry Biomass (42 DAS)
Changes[g] as compared with the unfertilised control (0-Ctrl)
No BE
BE
3,5
3
2,5
2
1,5
1
0,5
0
g
0-Ctrl
bcde
abc
cdefg
efg
bcde
abc
cdefg
ab
bcde
fg
bcde
a
NP std
NP red
N std P red
NP std
NP red
N std P red
0-Ctrl
Nitrate fertilisation
Ammonium fertilisation


IAA production [relative values mg microbial biomass-1]
180
160
140
120
100
80
60
40
20
0
b
b
b
b
a
Nitrate fertilisation
Ammonium fertilisation
no BE
BE

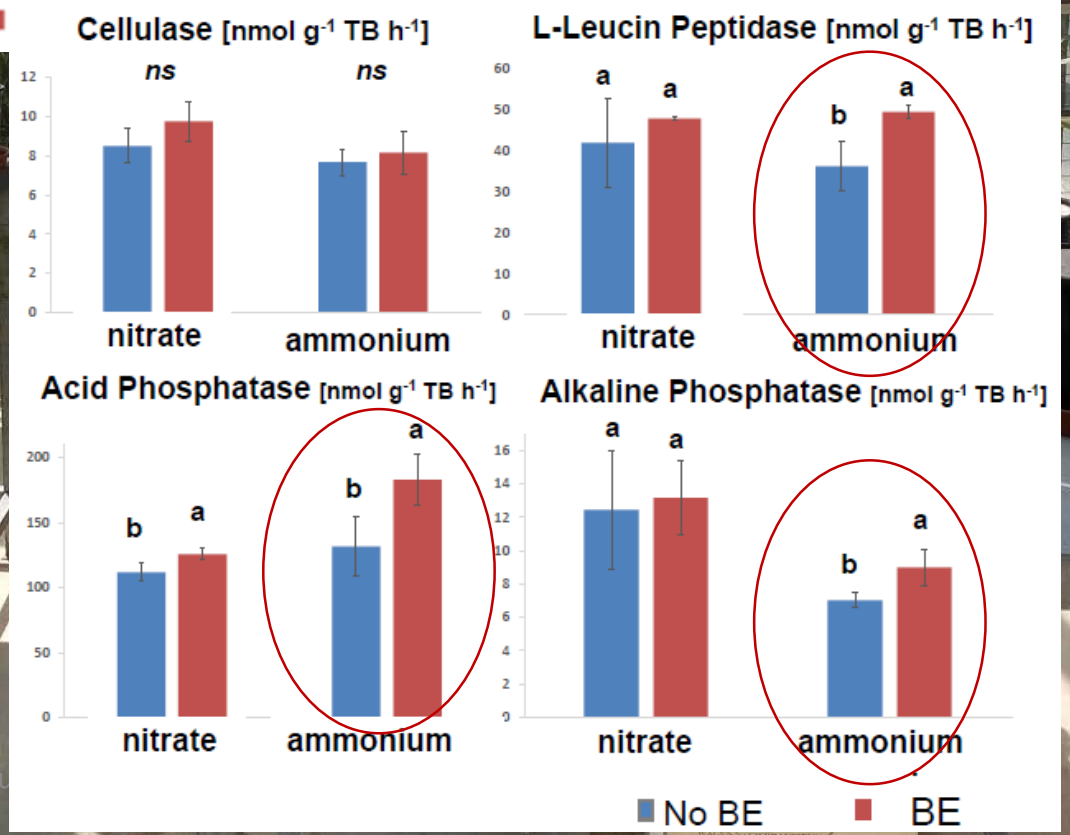

Total Bacteria
(1x10^8 cfu/g root FW
Standard2 Medium)
NH4 NPStd
BE NH4 NPStd
2,5
2
1,5
1
0,5
0
b
a
Fluorescent Pseudomonades
(1x10^6 cfu/g root FW
Kings B Medium)
12
10
8
6
4
2
0
a
b

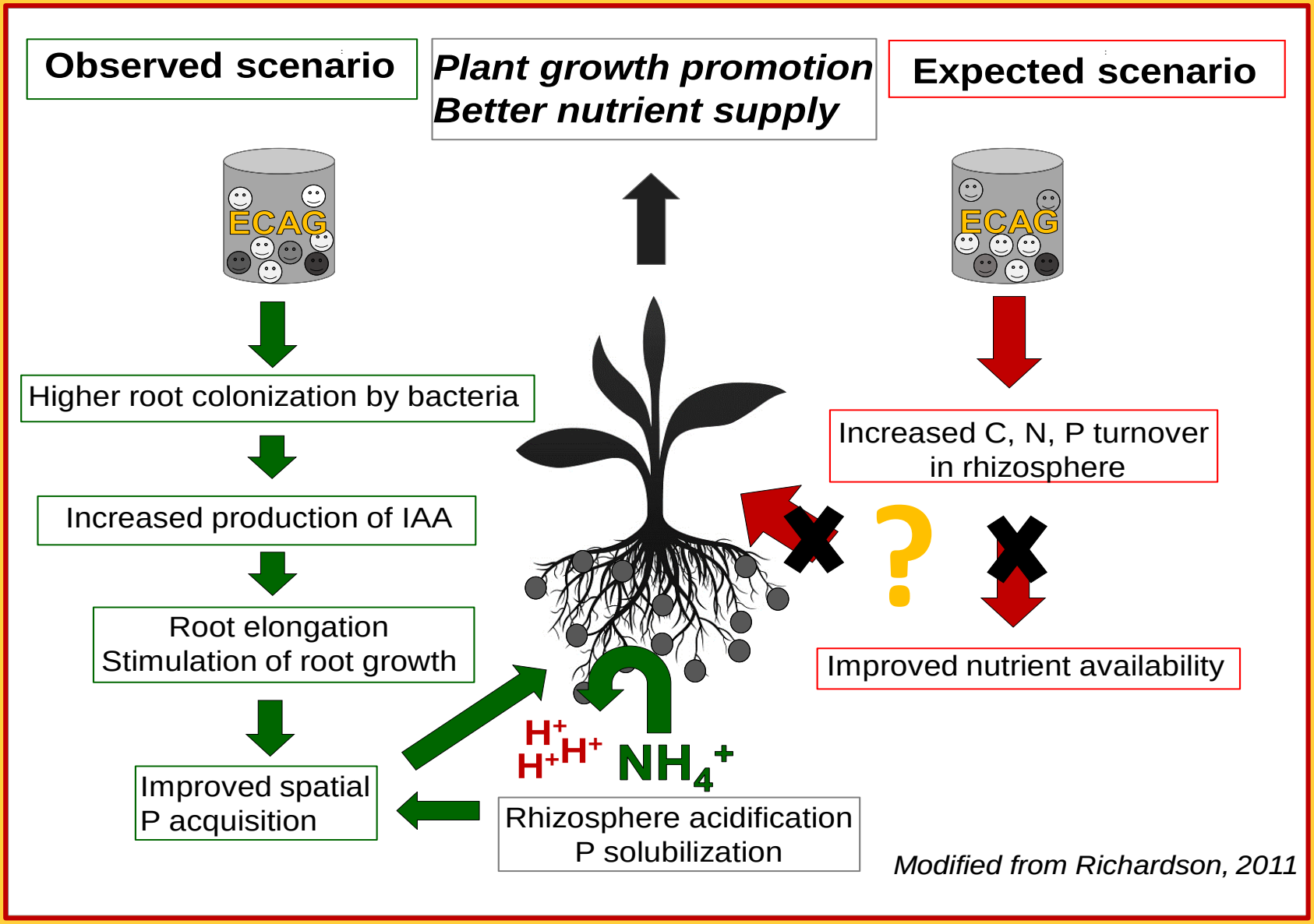

Ctrl NH4
BE NH4

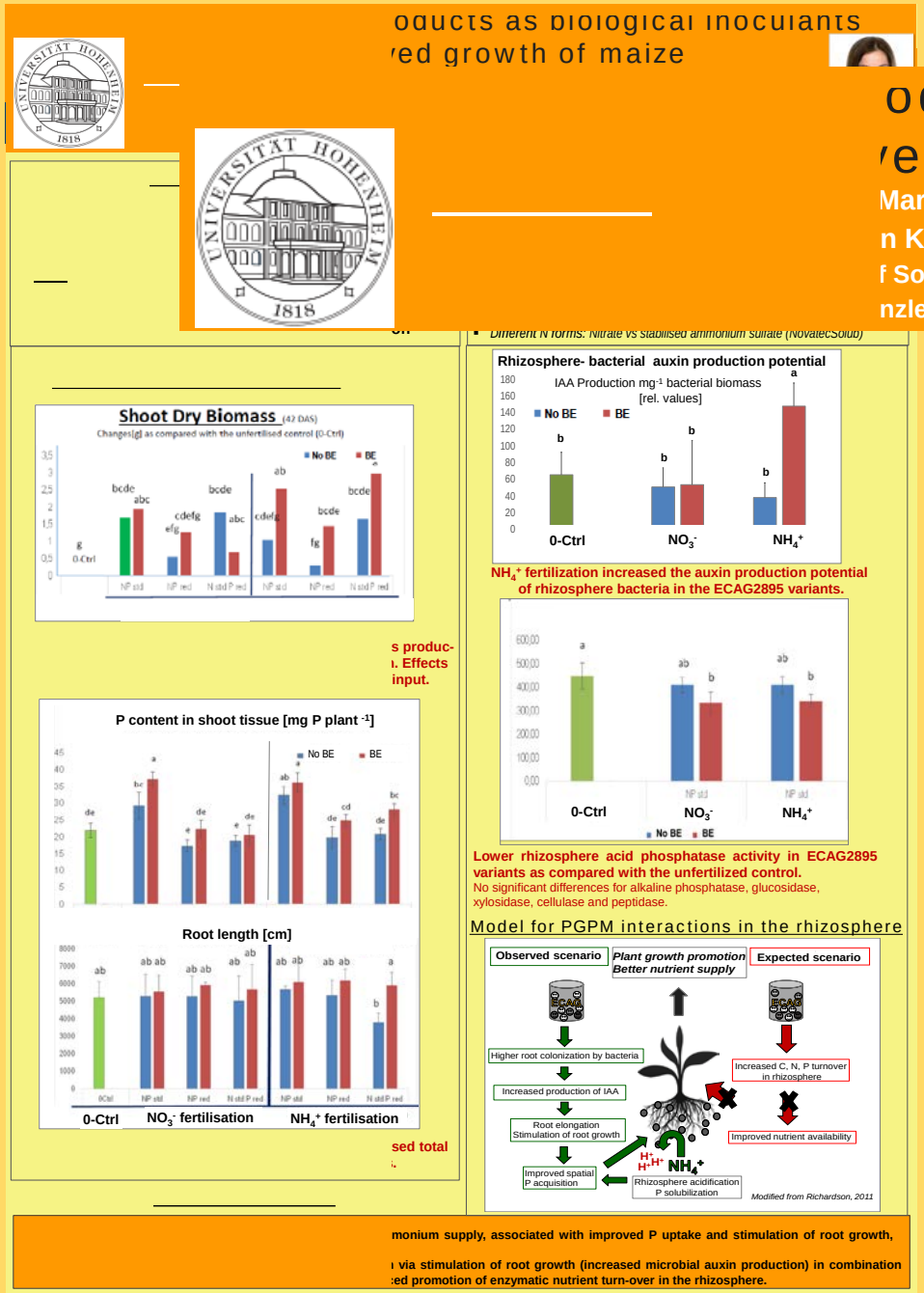

Rhizosphere acid phosphatase activity
[nmol* g soil-1 h-1]
600,00
500,00
400,00
300,00
200,00
100,00
0,00
a
ab
b
ab
b
NP std
NP std
0-Ctrl
NO3-
NH4+
No BE
BE



Marker enzymes in rhizosphere soil




Observed scenario
Plant growth promotion
Better nutrient supply
Expected scenario
ECAG
ECAG
Higher root colonization by bacteria
Increased production of IAA
Root elongation
Stimulation of root growth
Improved spatial
P acquisition
Rhizosphere acidification
P solubilization
H+
H+H+
NH4+
Increased C, N, P turnover
in rhizosphere
?
Improved nutrient availability
Modified from Richardson, 2011



oducts as biological inoculants
ed growth of maize

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Thank you for your attention!

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