Benefits of Ammonium Fertilization for Plant-PGPR Interactions

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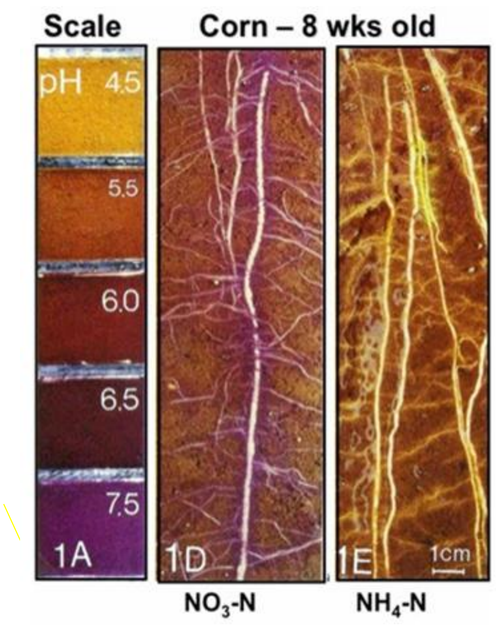
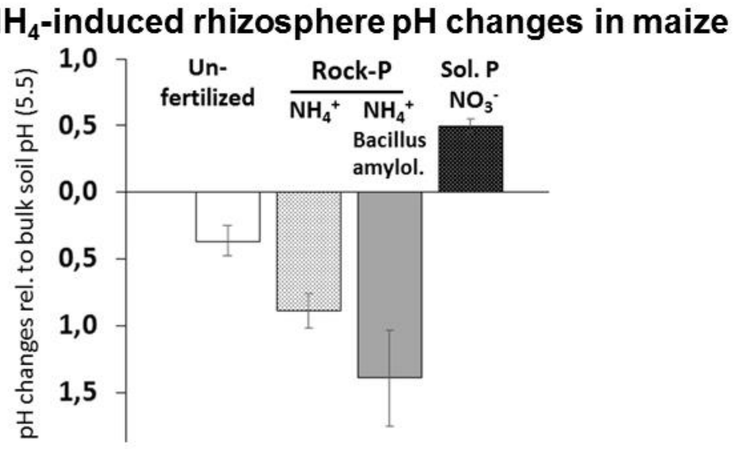
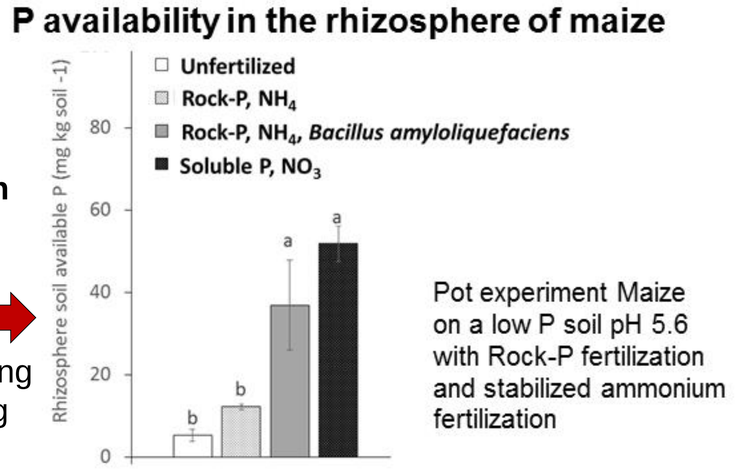
Introduction

- Synergistic interactions between plant-growth promoting effects of microbial bio-effectors (BE) and stabilized ammonium fertilization have been repeatedly reported for various crop-BE combinations during the project runtime. This study summarizes factors potentially respobsible for the observed synergisms.

Rhizosphere Acidification







Pot experiment Maize on a low P soil pH 5.6 with Rock-P fertilization and stabilized ammonium fertilization

➢ **NH_4-induced rhizosphere acidification** synergistically supports rhizosphere acidification by P-solubilizing bacteria (e.g. *Bacillus amyloliquefaciens* FZB42)

➢ is supported also by root growth-promoting BEs due to formation of a larger acidifying root system

Root hairs and Rhizosheaths

Treatment	Rizosheath Diameter [mm]	Root hair length [mm]
RockP_NO_3	**1.6** b	**0.67** b
RockP_NH4	**2.5** a	**0.98** a
Soluble P	**1.9** ab	**0.86** ab

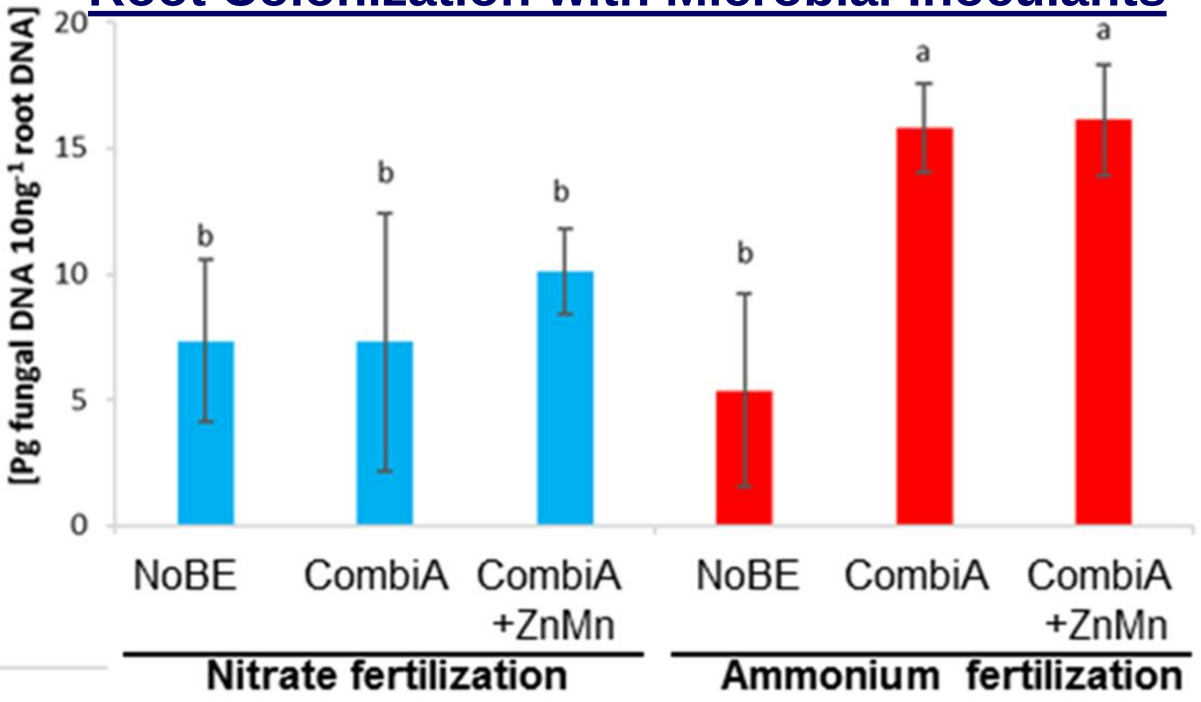
Ammonium fertilization stimulates root hair elongation and formation of rhizosheaths in maize

➢ increased root surface and improved root-soil contact for nutrient acquisition

➢ increased root surface area for plant-microbial interactions

➢ Increased water-holding capacity of rhizosheaths

Root Colonization with Microbial Inoculants

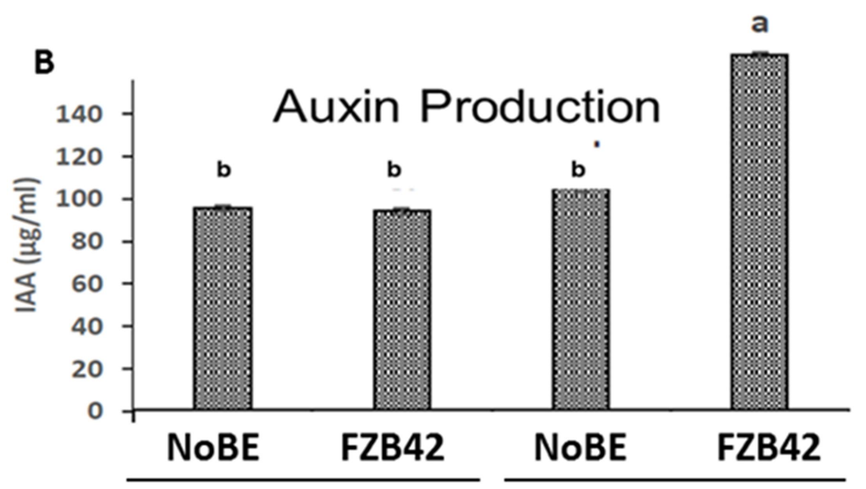


➢ **Ammonium fertilization promotes root colonization of maize by *Trichoderma harzianum* OMG 16** (fungal BE strain in CombifectorA and B)

Bacterial Auxin Production

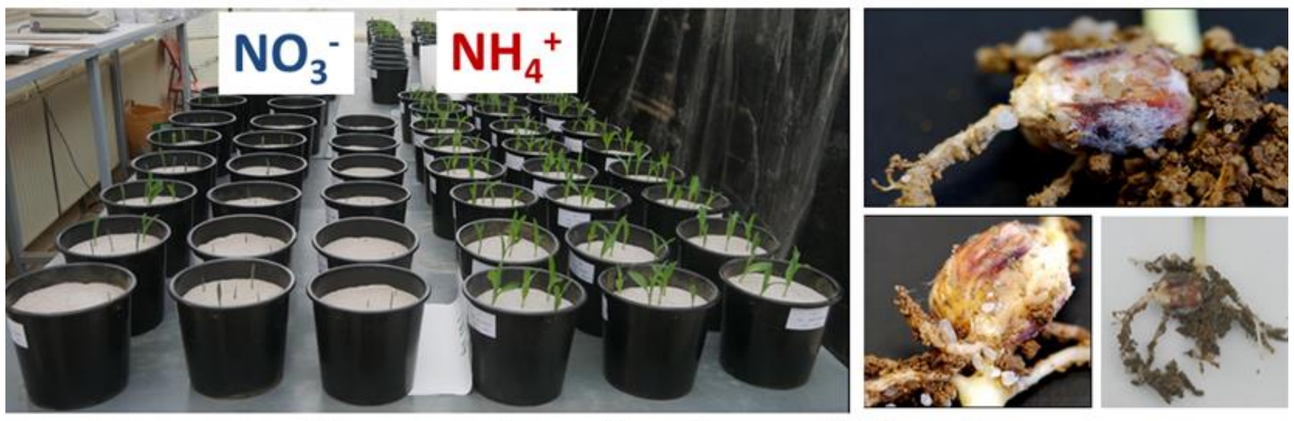
A **N-form-dependent auxin production of different BE strains** [µg IAA ml^{-1} $48h^{-1}$]

BE Strain	KNO_3	$Ca(NO_3)_2$	$(NH_4)_2SO_4$
Proradix	**12.1 c**	**171.4 b**	**217.7 a**
FZB42	**12.2 c**	**189.0 b**	**236.6 a**



➢ **Ammonium as N source increases the auxin production potential of various BE strains, both *in vitro* (A) and after re-isolation from the maize rhizosphere (B)**

Plant-Pathogen Interactions



Suppression of pathogenic fungi

(infection scoring [%] *Fusarium proliferatum* in maize)

Fertilization	Seeds steril.ized	Seeds nonsterilized	Roots	Shoot	Rhizosphere Soil	Bulk Soil
NO_3^-	27%	60%	60%	0%	0%	0%
DMPP-NH_4^+	0%	0%	0%	0%	0%	0%

➢ **DMPP-Ammonium fertilization suppressed the proliferation of *Fusarium proliferatum* from infected seeds in a pot experiment with maize cv Ronaldinio and enabled normal seedling development**

CONCLUSIONS

➢ Stabilized ammonium fertilization obviously induces a range of responses in host plants and rhizosphere microorganisms, with beneficial effects on the establishment of plant-PGPR interactions.

➢ However, also the expression of these responses is influenced by external factors (e.g. soil pH and buffering capacity, back-ground nitrate levels etc.) and knowledge on suitable application conditions is essential for the exploitation of synergisms with PGPRs.

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