



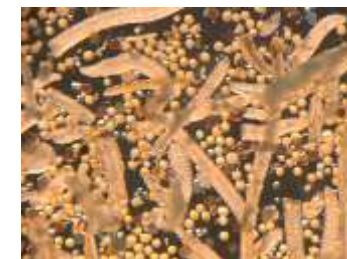
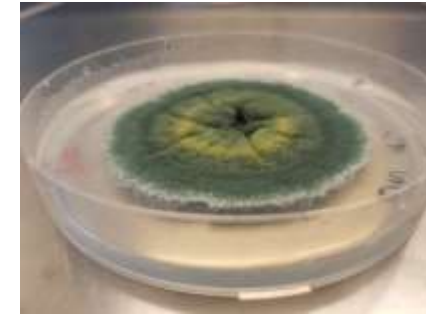
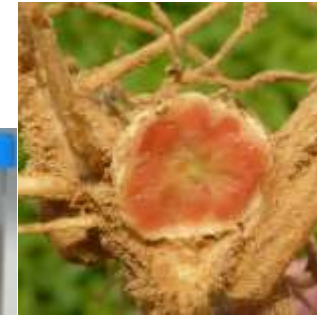
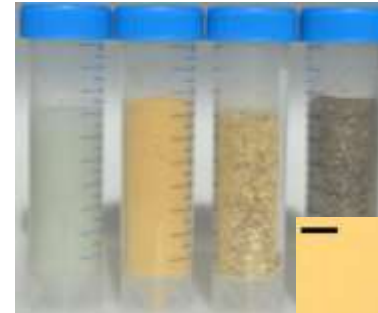
Microbial inoculations – Potentials, limitations and alternatives

Dominika Kundel, Martina Lori, Carina Lipp, Paul Mäder, Cecile Thonar, Sarah Symanczik

Jahrestagung der BGS/SGP/SGPW, 22.3.2024

Microbial inoculants

- Definition: Formulations containing living or latent cells of efficient microorganism strains (bacteria, fungi, arbuscular mycorrhizal fungi, etc.)
- Mode of action:
 - Biocontrol: to improve plant fitness
 - Biofertilization: to improve plant nutrition
 - Biostimulation: to improve plant growth
 - All-rounder



Microbial inoculants on the market

Example: FiBL input list

- Category Fertiliser - Additives: 38 preparations from 17 suppliers
- Category Plant protection: 30 preparations from 11 suppliers



The project Biofactor

Overall aim

- Reduce the input of mineral fertilizers in European agriculture
- Develop adapted inoculants to improve the efficiency of alternative fertilization strategies

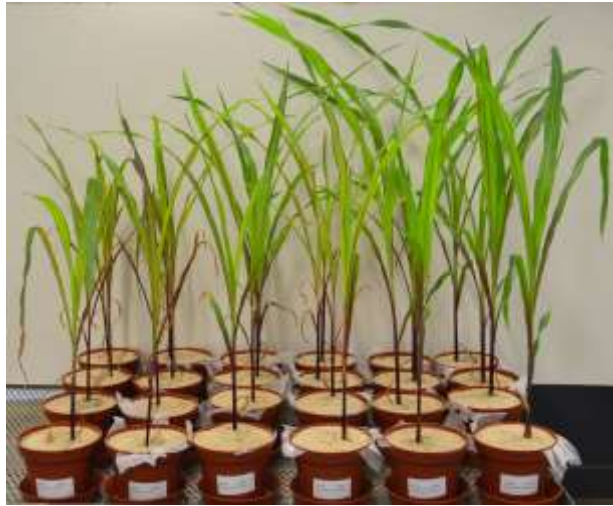


21 Institution in 11 countries



From controlled to field conditions

Biofactor @ FiBL – Testing across scales



**Screening experiment
(4 weeks)**



**Validation experiment
(8 weeks)**



**Field testing
(17-27 weeks)**

Biofactor @ FiBL – Testing across scales

Screening experiment



Validation experiment



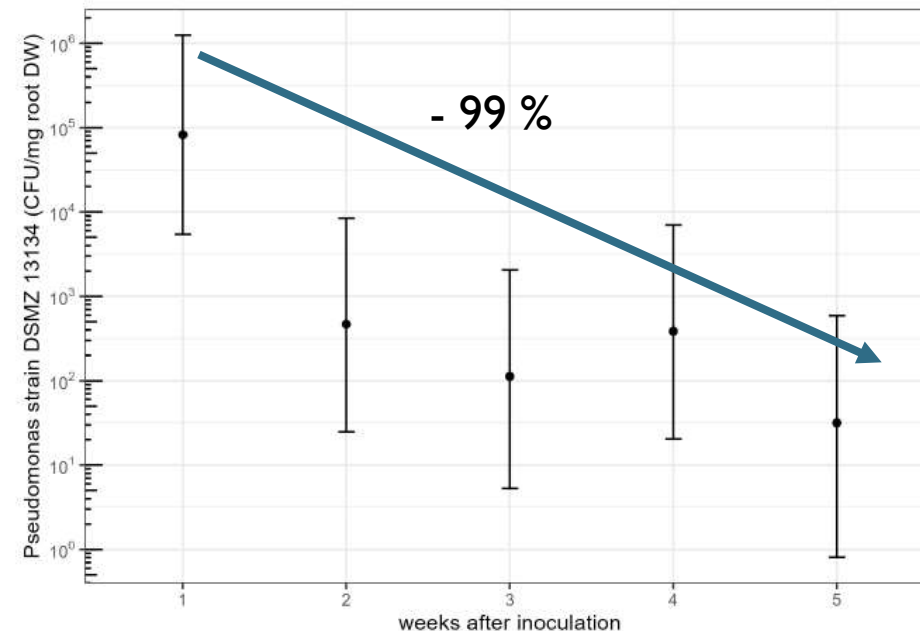
Field testing



- Minor growth promoting effects after 4 weeks
- No effects after 8 weeks and under field conditions

- Tracing experiment → ineffective establishment of inoculated strains

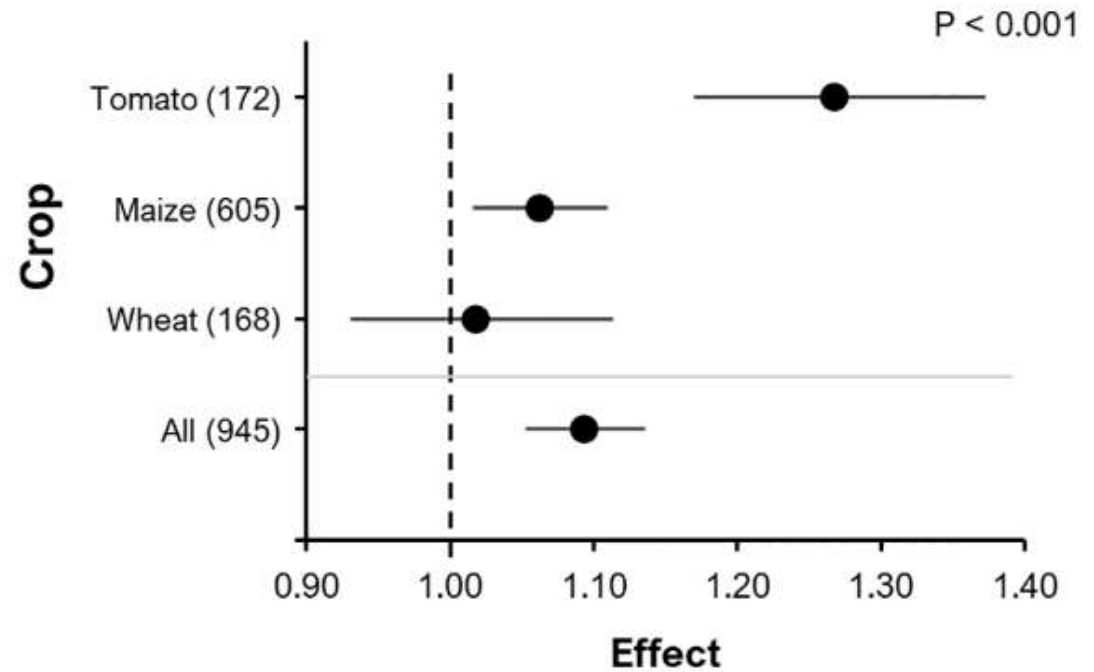
Symanczik et al. (2023) Limited effectiveness of selected bioeffectors combined with recycling phosphorus fertilizers for maize cultivation under Swiss farming conditions. *Front. Plant Sci.* 14:1239393. doi: 10.3389/fpls.2023.1239393



Bioeffector Meta Study - Main Results

Nkebiwe et al. (accepted) Effectiveness of bio-effectors on maize, wheat and tomato performance and phosphorus acquisition from greenhouse to field scales in Europe and Israel: a meta-analysis. *Front. Plant Sci.* 15:1333249. doi: 10.3389/fpls.2024.1333249

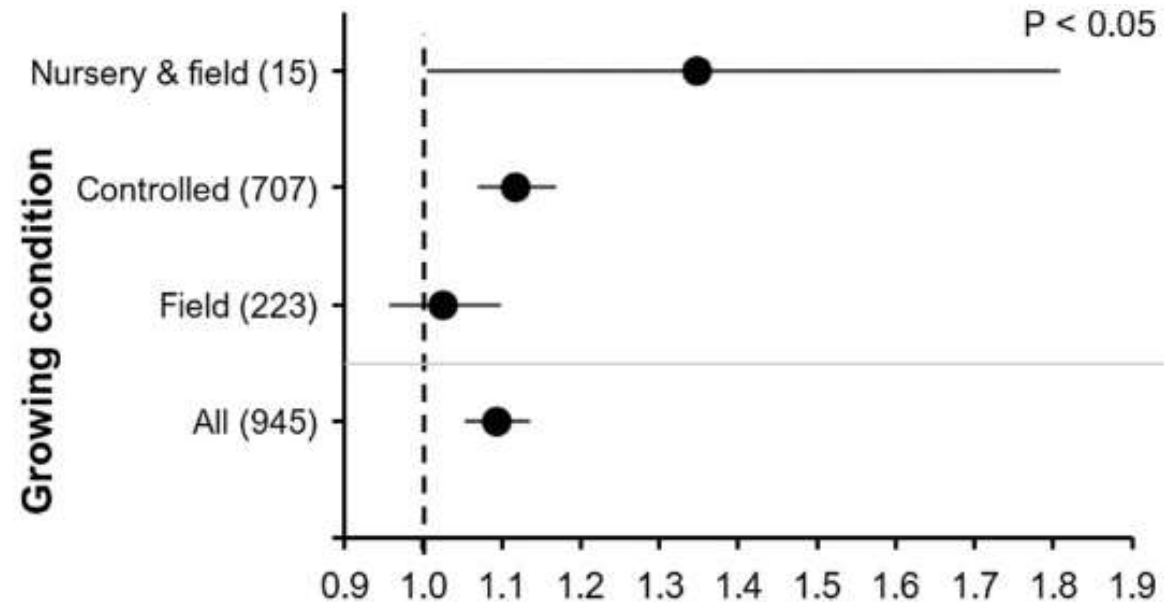
- Results based on 94 pot trials and 47 field trials
- Effectiveness depending on
 - Crop



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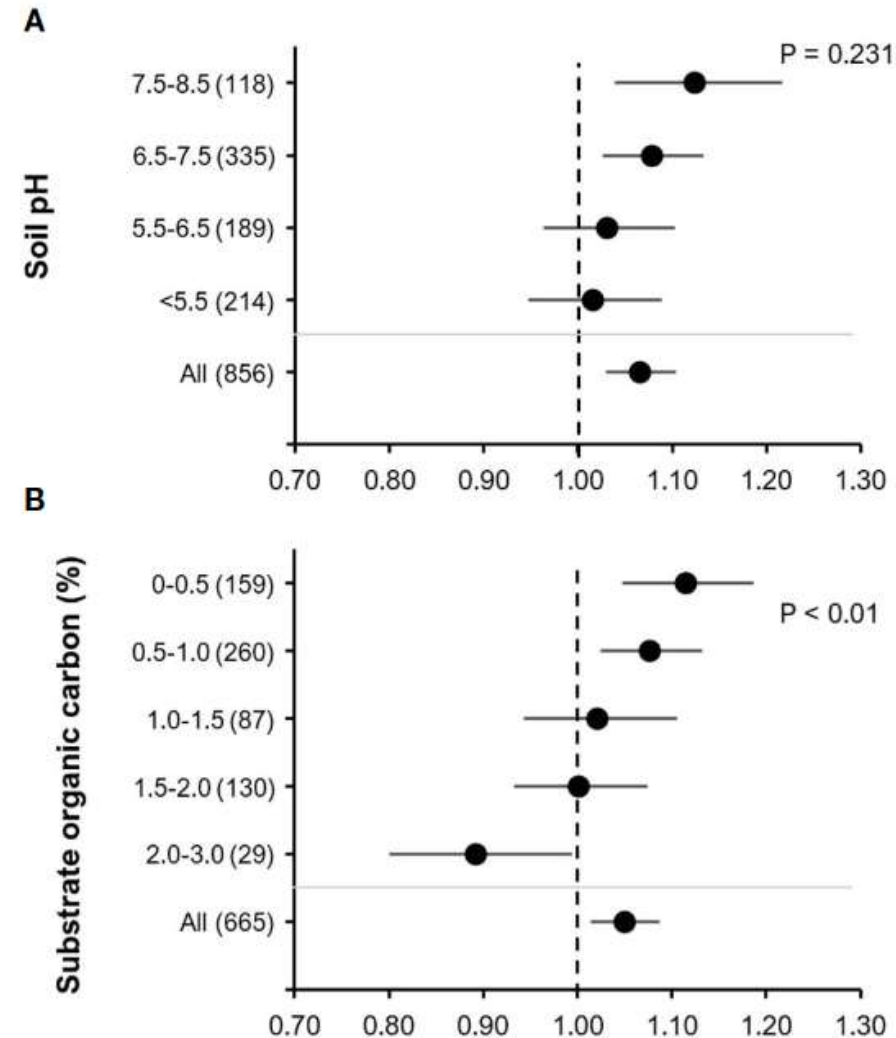
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- Results based on 94 pot trials and 47 field trials
- Effectiveness depending on
 - Crop
 - Growing conditions
 - Soil properties



Microbial inoculations – Potentials and limitations

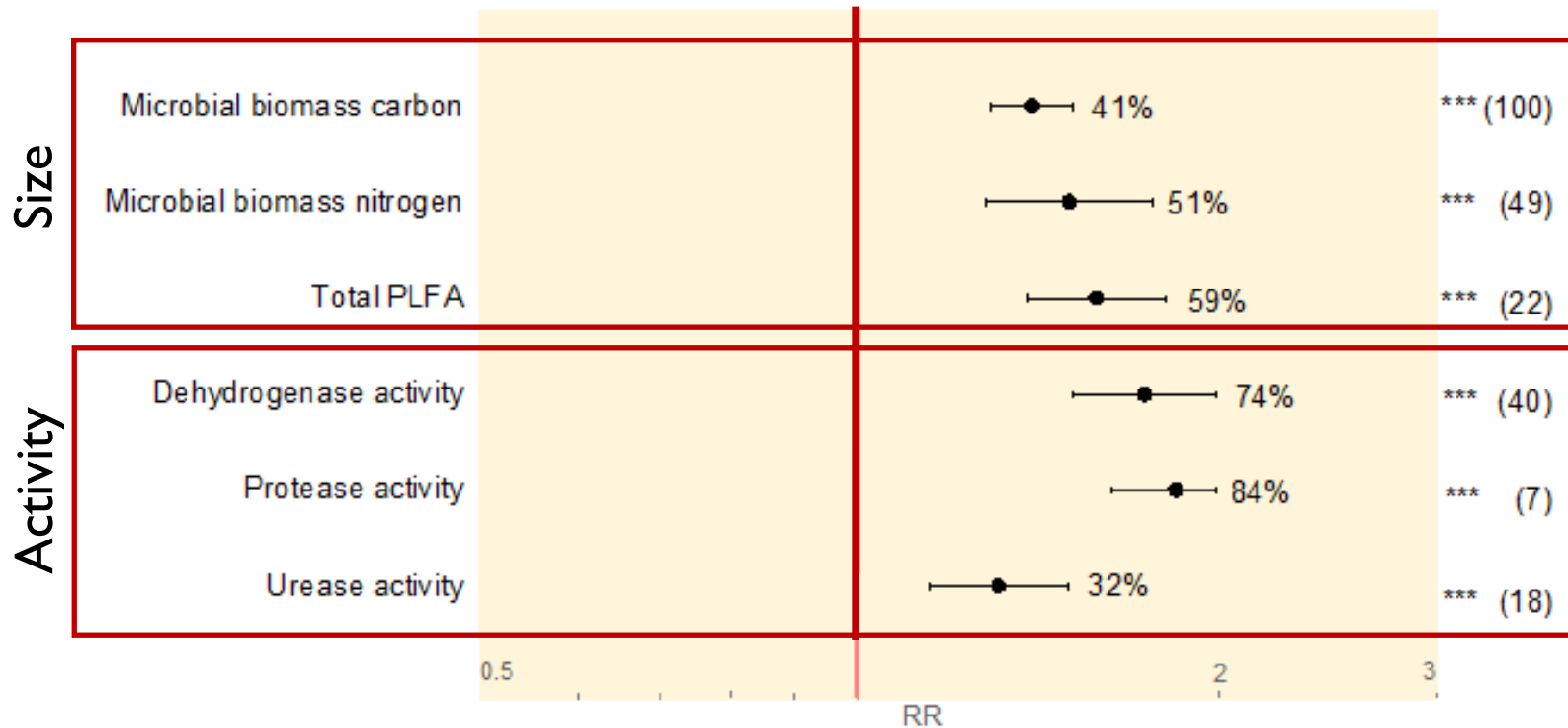
Potentials

- Soils with low fertility
- Vegetables involving nursery cultivation (low microbial substrates)
- Dry and tropical climates (Schütz et al. 2017)
- Disease infested soils (Lutz et al. 2023)

Limitations

- Ineffective microbial strains
- Poor product quality (Salomon et al. 2022)
- High investments

Alternatives: Indirect management of soil microbes via improved management practices



→ Organic farming has a strong positive effect on the size and activity of microbial communities

Alternatives: Indirect management of soil microbes via improved management practices

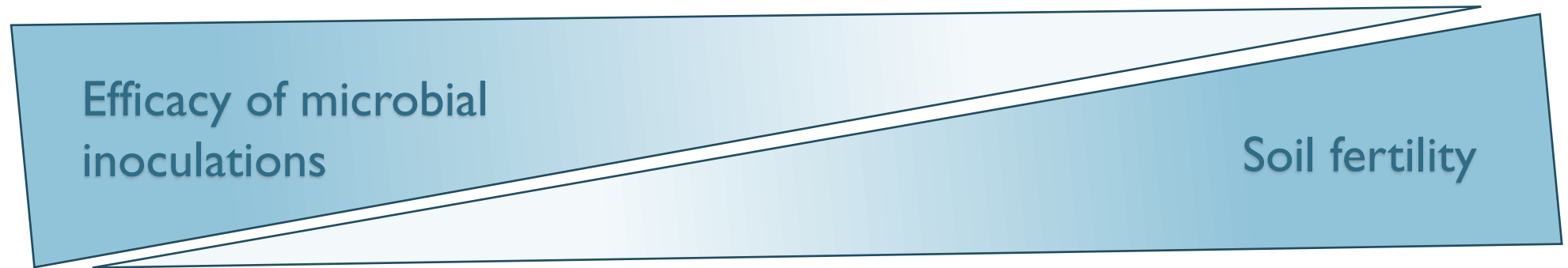
Positive effects on soil microbes through:

- Diverse crop rotations (with legumes)
- Organic fertilizers
- High organic carbon content



Conclusion

- Context specific effectivity of microbial inoculants



- Careful consideration of limitations
- Adoption of management practices promoting soil microorganisms

Many thanks for your attention

Many thanks to all my colleagues of the soil science department at FiBL and project collaborators



For more information

Factsheet
2020 | No. 1121

Biofertilisers

In the last years, organic amendments, active microbial biofertilisers or beneficial microorganisms are increasingly used in crop production. The use of microbial-based biofertilisers and the application of beneficial microorganisms with plants has gained increasing attention worldwide. Beneficial microbes can enhance plant growth by increasing their tolerance to adverse soil and environmental conditions or by improving the plants' nutrient uptake efficiency. However, developing specific microbial-based biofertilisers or so-called biofertilisers with beneficial effects that are also suitable for agricultural application under different environmental conditions is challenging. Currently, some commercially available biofertilisers are of low quality or are difficult to apply. This results in a loss of productive time for farmers. However, the quality assessment of microbial-based biofertilisers and the advancement in the stable binding of biological inoculants have noticeably helped to reduce the efficiency of field level. This fact sheet summarizes the latest research findings.



Agriculture and the role of soil microorganisms

The Green Revolution of the 20th century allowed the high increase in global food production. Two main developments characterised it: chemical inputs (such as pesticides, herbicides and chemical fertilisers) and improving crop plants through targeted breeding and genetic manipulations. However, advantages achieved through chemical fertilisers have high environmental costs. In the last few years, there has been a rising demand to reduce the use of chemical products and to develop more sustainable agricultural systems both for environmental and human health. A promising approach to achieve this goal is based on natural agents with reduced environmental impact, such as the utilisation of microbial-based inoculants and manipulations of the microbial community structure.

Soil microorganisms are the most abundant organisms on the Earth; there are more microbes in one teaspoon of soil than there are people on Earth. At an area of one square meter to a depth of 15 cm, there can be up to 200 g of bacteria, 20 g of actinomyces and 1.5 kg of fungi depending on the type of ecosystem. Some of these are essential for decomposing organic matter and recycling of nutrients, while others form relationships with plant roots and provide important nutrients. Their potential was recognised, leading to their

<https://fibel.com/eh/Recherche/2020-11>

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