Microbiome-based inputs: a technology to enhance agricultural productivity while replacing traditional synthetic inputs?

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Research background

Microbiome-based inputs (MBI) make use of microorganisms like fungi, bacteria or archaea and their benefits.

MBIs are portrayed as a promising solution to stimulate agricultural productivity while replacing traditional fossil-fuel based inputs.

Research on this area, however, remains fragmented and focused only on specific traits of selected microorganisms and impact domains. Thus, there is a gap for exploring the potential of MBI innovations to promote a sustainable agriculture.

Research objective

Our aim is to summarize evidence on the contribution of MBIs to agricultural productivity and discuss their potential for the substitution of synthetic inputs in varying agricultural systems.

Research questions

(i) Do MBI boost agricultural yield in different agro-ecological production systems?

(ii) What is the potential of MBI to substitute traditional synthetic inputs?

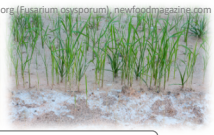
Definition of MBI

Microorganisms or microbial consortia artificially cultured with suitable carriers *(Sammauria et al. 2020).*

MBI are known under many names, depending on their component and function.

function

Biofertilizer



Biostimulant

Biocontrol agent

component

Fungi

Bacteria

Archaea & others

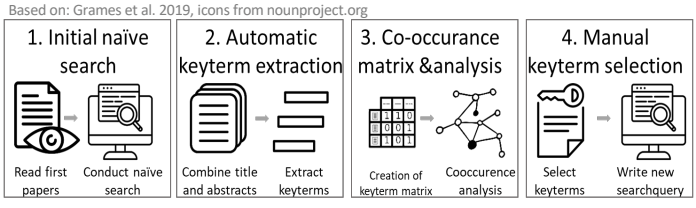
Methodology

Systematic Literature Review with quantitative summary if possible

1. PRISMA protocol and definition of PICO (population, intervention, comparison, outcomes)

2. Semi-automated keyterm analysis with R-package "litsearchr" by Grames et al. 2019

Based on: Grames et al. 2019, icons from nounproject.org



3. Paper classification and data extraction through CADIMA

	Concept groups				
Search engine	Results	Input component	Input function	Outcomes	context
Web of science	3682	Microb* OR fungi OR bacteria OR microorganism OR mycorrhiza OR rhizob* OR gram positive OR gram negative OR archaea	Biofertili* OR biostimulant OR biocontrol OR bioinocu* OR "biological control" OR AM fungi OR PGP*	Carbon sequestration OR water quality OR greenhouse gas emission OR biodiversity OR profic OR cost efficiency OR cost benefit OR (fertilizer OR agrochemical OR NPK OR pesticide) AND (substitut* OR replace OR reduc*) OR nutrient leaching OR yield	Plant OR crop OR agriculture
Science direct	2117				

4. Results summary using statistical methods, conditional on data availability (Adapted from McKenzie JE et al. (2022), Table 9.5.a)

Non-quantitative method	**Statistical method**					
Narrative Systematization	Vote counting	Combination of P-values	Summary of effect estimates	Pairwise meta-analysis	Network meta-analysis	Subgroup analysis/meta-regression

Contribution and expected outcomes:

- Provide summarized evidence on the potential of MBIs to contribute to sustainable agricultural production:
  - Quantifying (if possible) the effects of MBI on (i) agricultural yields and (ii) substitution of fossil-based inputs, by agro-ecological system;
- Identify further literature gaps on the topic;
- Provide a basis for additional research on MBIs from the socio-economic perspective.

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