SUSTAINABLE INNOVATION OF MICROBIOME APPLICATIONS IN THE FOOD SYSTEM

Field microbial applications foster food quality and safety

For centuries one of the greatest impairments to mankind survival was posed by the lack of sufficient food supplies. In occidental modernised Countries, this struggle was overcome with the advent of the Green Revolution, when in few decades between the 40s and the 60s the concept of agriculture was upset by the introduction of genetically improved high yielding varieties aided by a new generation of chemical fertilizers and synthetic herbicides and pesticides.

The deletion of famine and starvation in Western developed Countries was not without cost. The abundant availability and consumption of highly refined wheat-based foodstuff led to a plethora of diet related health issues. Plus, the intensive use of land, accompanied by the indiscriminate employment of excessive amounts of chemicals caused/determined put at risk the safety of aliments and the safeguard of the environment.

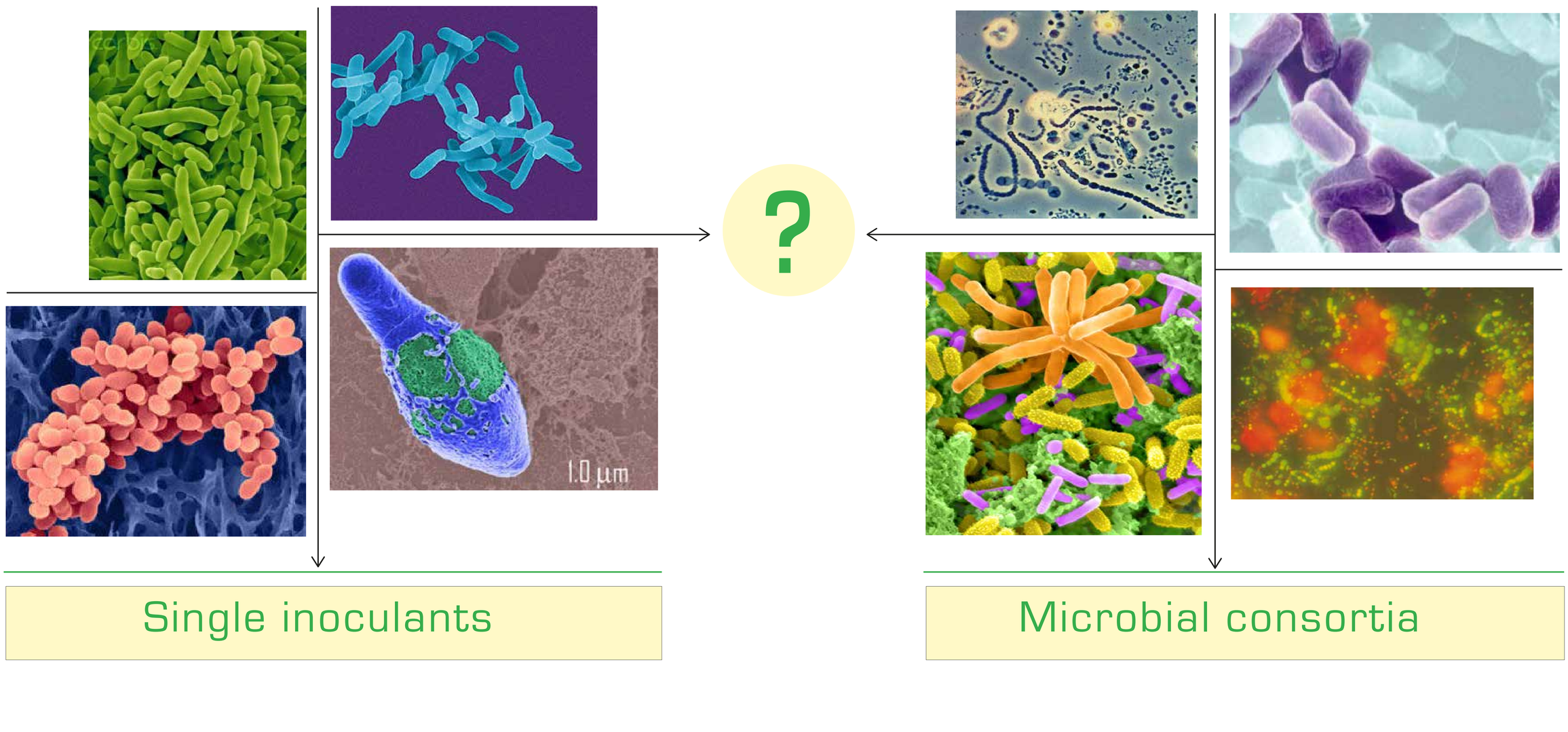
Awareness is rising, and so is concern. There is general consent about the need to define and adopt alternative more sustainable and environmentally-friendly ways to do agriculture. One possibility to reverse the course is offered by microorganisms. By understanding their role and mechanisms, microorganisms may grant reduction of chemical inputs and quality and safety of harvested yields and processed foodstuff.

How to identify the best microbes for sustainable agriculture

The use of efficient inoculants is considered an important strategy for sustainable management and for reducing chemical inputs in agriculture. Plant Growth-Promoting Microbes (PGPM) are important determinants of soil fertility and plant health for their potential to improve crop productivity and nutritional quality, as well as resistance to plant pathogens and plant tolerance to abiotic stresses.

Nevertheless, in open field numerous biotic and abiotic factors may hinder their plant growth-promoting efficacy and reproducibility, limiting their successful use in agriculture.

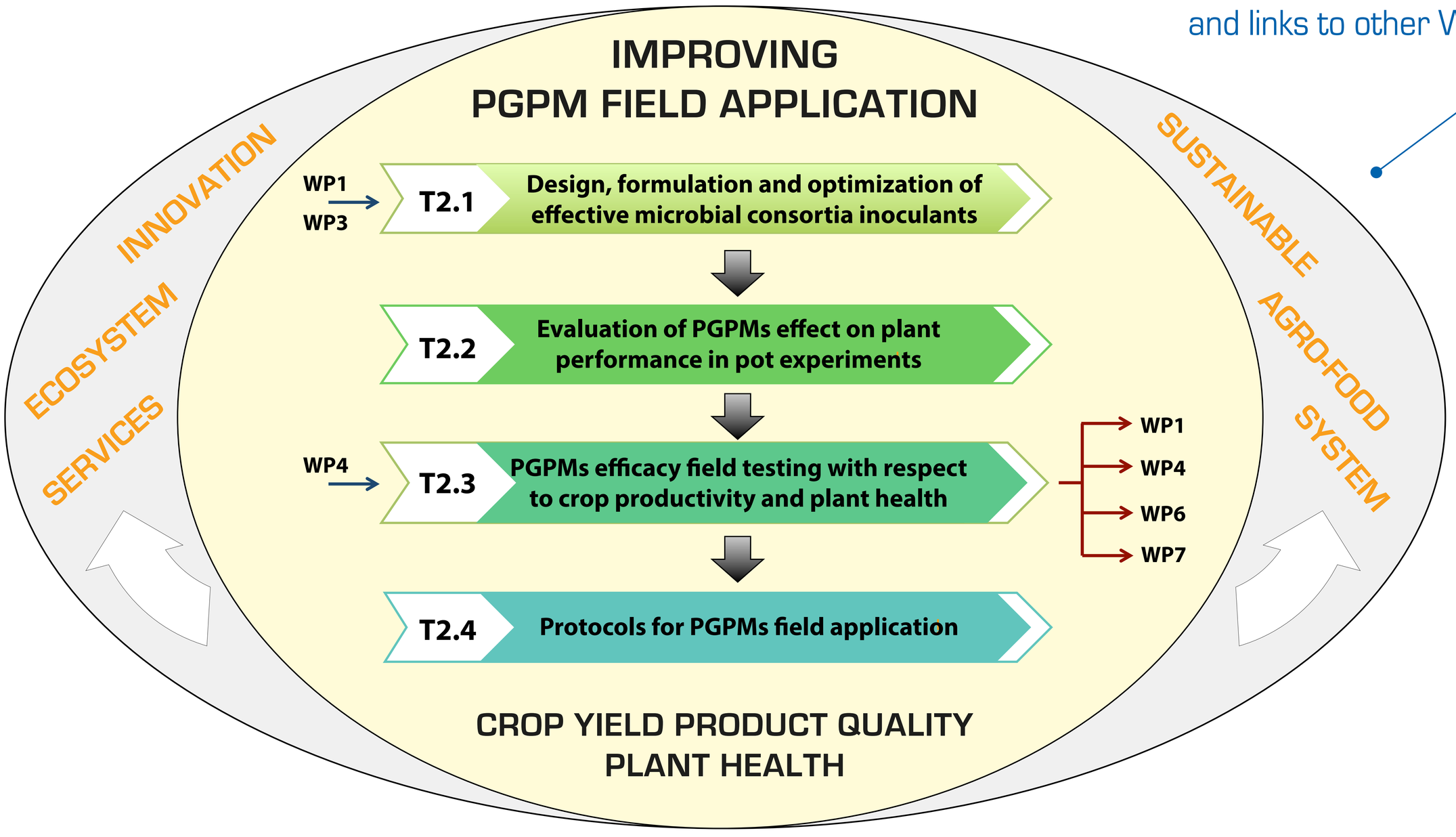
The first objective when considering inoculation with PGPM is to find the best bacteria available and to identify the best delivery method which determines the potential success of the inoculant. Most approaches for plant growth promotion imply the use of a single bacterial species as biofertilizer while only few consider a consortium of selected microorganisms. Mixed inoculants (the combination of two or more microbial species) that interact synergistically are currently being devised. Compared to single inoculation, co-inoculation, frequently, increases growth and yield, provides the plants with more balanced nutrition, and improves absorption of nitrogen, phosphorus, and mineral nutrients.



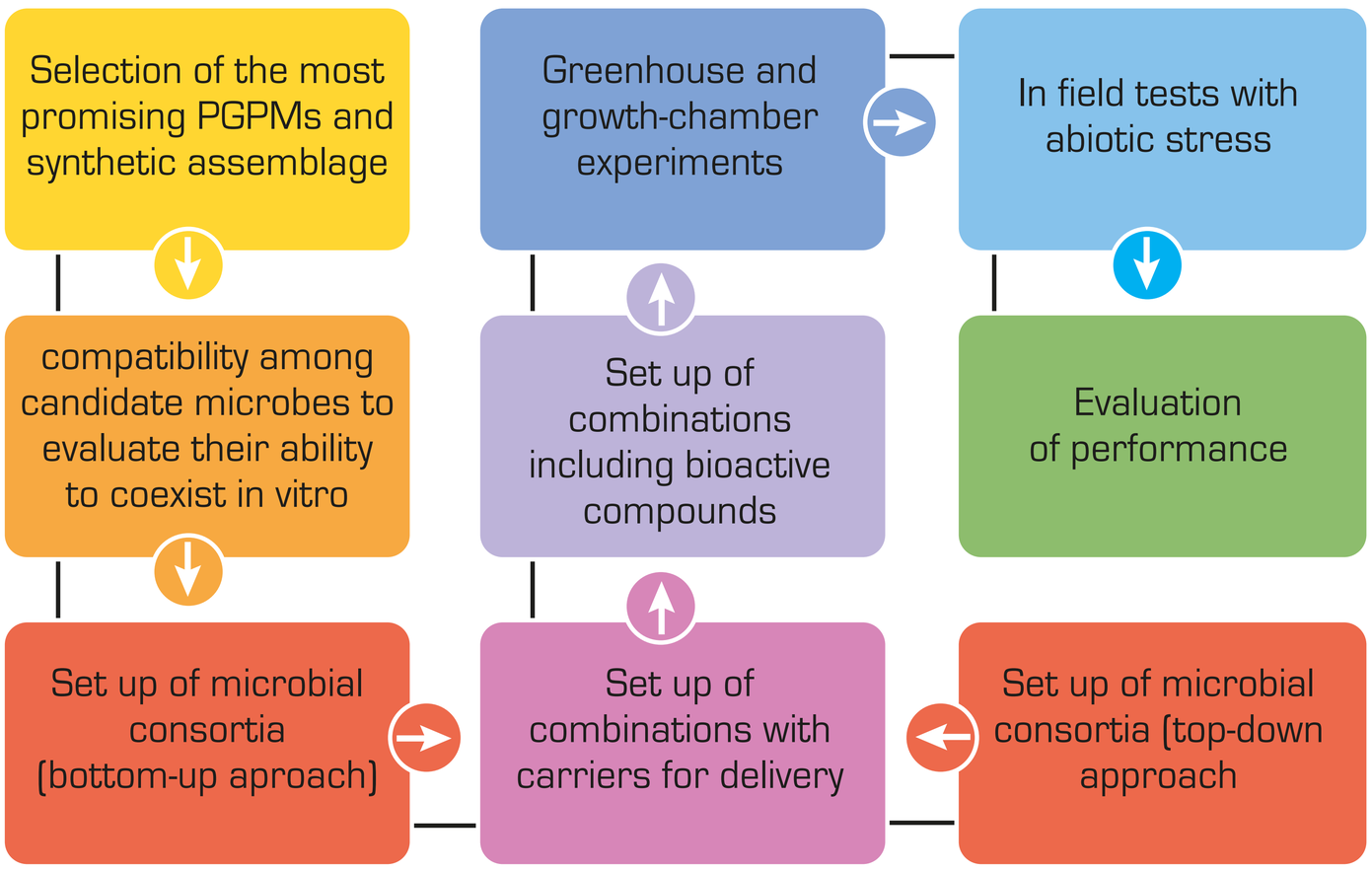
The role of SIMBA projectLorem ipsum

In our current research within SIMBA project, we aim to exploit the full potential of PGPMs for sustainable crop production by optimising the efficacy and reproducibility of field applications.

The flow-chart and relative tasks of WP2 and links to other WPs



This WP builds on pre-existing knowledge of PGPMs associated with maize, wheat, potato and tomato in order to identify efficient microbial formulations to be applied as inoculants in arable crops in Italy and Germany.
Two type of approaches were taken into-account to obtain microbial consortia for sustainable agriculture: i) identification and synthetic assemblage from scratch by combining several isolated PGPMs with different functions (bottom-up approach) followed by the in vitro analysis of their ability to coexist, or ii) obtainment of complex microbial communities from environmental sample (top-down approach).



Following these two types of approach, three microbial consortia composed by compatible bacteria and fungi isolates were identified, and a cluster of four bacteria isolated from maize seedling leaves displaying synergistic biofilm formation properties has been characterised and adopted.

The outputs of greenhouse and growth-chamber experiments are expected to provide useful indications for work follow-up.

Definition of microbial consortia: experimental design

Work Package Leader: Annamaria Bevivino (email: annamaria.bevivino@enea.it) - WP2: Improvement of PGPMs field applications efficacy and reproducibility

Annamaria is Head of the ENEA Laboratory for AgriFood Sustainability, Quality and Safety and Professor of AgroFood Microbiology, Master's Degree in Food Science and Human Nutrition, at University Campus Bio-Medico of Rome, Italy. Her research interests include agro-food microbiology, characterization and biodiversity of soil-root-food microbiome, plant growth-promoting microbes and plant-microbe interactions.