

SIMBA: Design, formulation and optimization of plant growth-promoting microbes (PGPMs) for their use as microbial consortia inoculants

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Work Package 2 of SIMBA project is aimed to exploit the full potential of PGPMs for sustainable crop production by optimizing the efficacy and reproducibility of field applications.

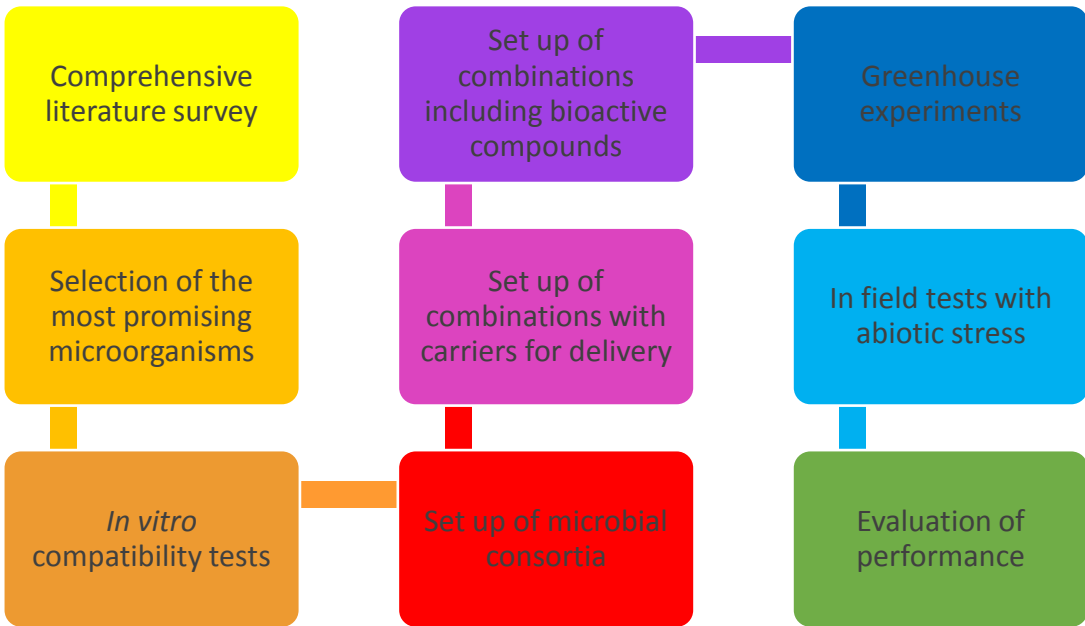
AIM OF THE PRESENT WORK:

Identify efficient microbial formulations to be applied as bioinoculants in arable crops in Italy and Germany, i.e. **WHEAT, MAIZE, POTATO and TOMATO**

- ✓ To improve soil fertility and functionality
- ✓ To enhance plant resistance to abiotic and biotic stresses
- ✓ To improve plant productivity for the sustainable use of soil in different European farming systems



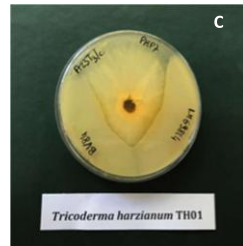
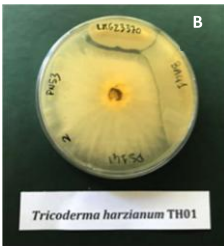
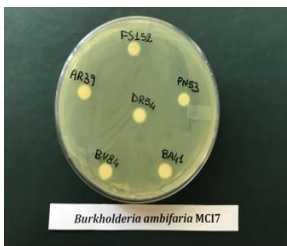
Experimental Procedure



Selected PGPMs

Microorganism	Strain	Origin	Country of isolation	Properties
<i>Acaulospora marowiae</i>	CL290	Rhizosphere	STATI UNITI	PGP
<i>Agrobacterium radiobacter</i>	AR 39	soil near peach tree	Ascoli Piceno, IT	biocontrol / PGP
<i>Azospirillum brasilense</i>	CD/ATCC 29710	Cynodon dactylon rhizosphere	USA	N-fixation
<i>Azospirillum brasilense</i>	NCCB 78036	soil under soy field	India	N-fixation
<i>Azospirillum lipoferum</i>	CR11	field grown maize	FR	N-fixation
<i>Bacillus chroococcum</i>	704	soil	South IT	Nitrogen fixation
<i>Bacillus chroococcum</i>	DSM 2286	unknown	unknown	Nitrogen fixation
<i>Bacillus chroococcum</i>	LS132	Rhizosphere	South IT	N-fixation
<i>Bacillus chroococcum</i>	LS163	Rhizosphere	South IT	N-fixation
<i>Bacillus chroococcum</i>	S-5	unknown	Iran	N-fixation
<i>Bacillus chroococcum</i>	DSM 2289	unknown	unknown	N-fixation
<i>Bacillus sp.</i>	BV84	Grape leaves	Ascoli Piceno, IT	biocontrol/PGP
<i>Bacillus amyloqueliciens</i>	BA41	Wheat rhizosphere	Ascoli Piceno, IT	biocontrol/PGP
<i>Bacillus amyloqueliciens</i>	F2847	Plant pathogen infested soil	DE	biocontrol/PGP
<i>Bacillus amyloqueliciens</i>	LMG 9814	soil	UK	alpha-amylase, alpha-glucosidase, iso-amylase production
<i>Bacillus atrophaeus</i>	AB102A		Berlin, DE	PGP
<i>Bacillus licheniformis</i>	PS141	Rhizosphere	South IT	Indole acetic acid (IAA) production
<i>Bacillus megaterium</i>	M3	rice	unknown	P-solubilisation
<i>Bacillus megaterium</i>	PMC 1855	unknown	unknown	P-solubilisation
<i>Bacillus pumilus</i>	LMG 24415	soil	Ecuador	PGP
<i>Bacillus simplex</i>	R49538	unknown	Ecuador	PGP/IAA production
<i>Bacillus subtilis</i>	F2824 WG		Berlin, DE	PGP
<i>Bacillus subtilis</i>	LMG 23370	Forest soil	India	PGP/ biocontrol against <i>Rhizoctonia solani</i>
<i>Bacillus subtilis</i>	LMG 24418	soil	Ecuador	PGP
<i>Bacillus subtilis</i>	OSU-142	pepper	unknown	N-fixation, biocontrol
<i>Burkholderia ambifaria</i>	MC17	Maize rhizosphere	Lazio, IT	PGP
<i>Burkholderia ambifaria</i>	PHP7/ LMG 11351	Maize rhizosphere	FR	PGP
<i>Gigaspora gigantea</i>	PA125	Rhizosphere	STATI UNITI	PGP
<i>Gigaspora rosea</i>	NY328A	Rhizosphere	STATI UNITI	PGP
<i>Komagataella pastoris</i>	PP59	Grape rhizosphere	Ascoli Piceno, IT	PGP
<i>Pantibacillus sp</i>	R47065	unknown	Ecuador	PGP/IAA production
<i>Paraburkholderia tropica</i>	MDIIIAzo225	Maize rhizosphere	Caserta, IT	Nitrogen fixation
<i>Pseudomonas granadensis</i>	A23/T3c	soil	Lazio, IT	PGP
<i>Pseudomonas fluorescens</i>	DR54	Sugar beet rhizosphere	Holeby, DK	biocontrol
<i>Pseudomonas putida</i>	P1-20/08	soil	Ecuador	PGP
<i>Pseudomonas sp.</i>	PN53	Grass rhizosphere	Ascoli Piceno, IT	PGP
<i>Rahnella aquatilis</i>	BB23/74d	soil	Lazio, IT	PGP
<i>Raoultella terrigena</i>	FS152	Rhizosphere	South IT	Phytase activity, siderophore production
<i>Septoglossum constrictum</i>	FL328	Rhizosphere	STATI UNITI	PGP
<i>Streptomyces sp.</i>	SA 51	Rhizosphere	Liguria, IT	biocontrol
<i>Trichoderma gamsii</i>	6085	uncultivated soil	Crimea, UA	biocontrol
<i>Trichoderma harzianum</i>	DMG-08	Drichid roots	Bernburg, DE	P-solubilisation
<i>Trichoderma harzianum</i>	DMG-16		Bernburg, DE	P-solubilisation
<i>Trichoderma harzianum</i>	T6776	soil	Pisa, IT	biocontrol/PGP
<i>Trichoderma harzianum</i>	TH01	Grass soil and rhizosphere	Ascoli Piceno, IT	PGP
<i>Trichoderma harzianum</i>	CBS 354.33/ATCC 48131	soil	USA	chitinase production, biocontrol

In vitro compatibility



Selected microbial consortia

MICROBIAL CONSORTIA (MC)	MICROORGANISMS
A	<i>Trichoderma harzianum</i> TH01
	<i>Pseudomonas granadensis</i> A23/T3c
	<i>Paraburkholderia tropica</i> MDIII Azo225
	<i>Bacillus licheniformis</i> PS141
	<i>Azotobacter chroococcum</i> LS132
	<i>Pichia pastoris</i> PP59
B	<i>Bacillus amyloliquefaciens</i> LMG9814
	<i>Pseudomonas fluorescens</i> DR54
	<i>Bacillus</i> sp. BV 84
	<i>Rahnella aquatilis</i> BB23T3/d
	<i>Azotobacter vinelandii</i> DSM2289

Microbial combinations

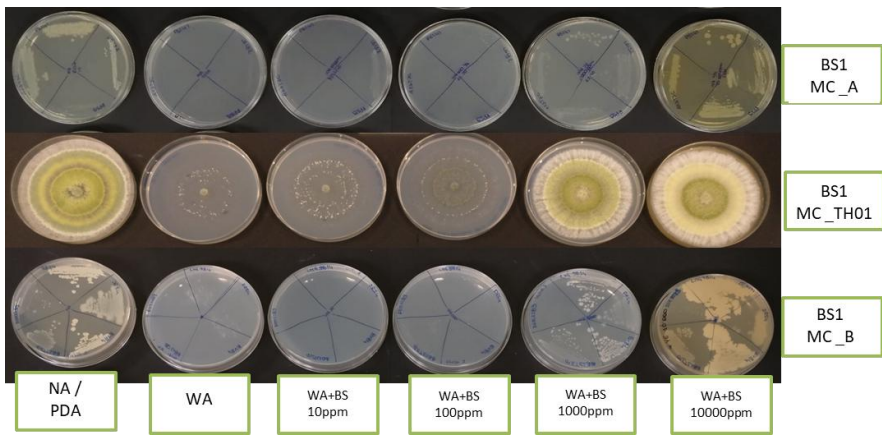
Combination	MC	MC_AMF	BS
C-1	X		
C-2	X	X	
C-3	X		X
C-4	X	X	X

MC: Microbial Consortium (A or B); MC_AMF: consortium of arbuscular mycorrhizal fungi; BS: Biostimulant compounds



PGP effect of consortium B on maize plants

Prebiotic test of biostimulant compounds



Green House Experiments: 2 crops, 2 cultivars, 2 delivery systems, 2 consortia, with and without AMF

