Harnessing Plant Growth-Promoting Bacteria to Increase Tomato Resilience to Salinity in Soilless Greenhouse Systems

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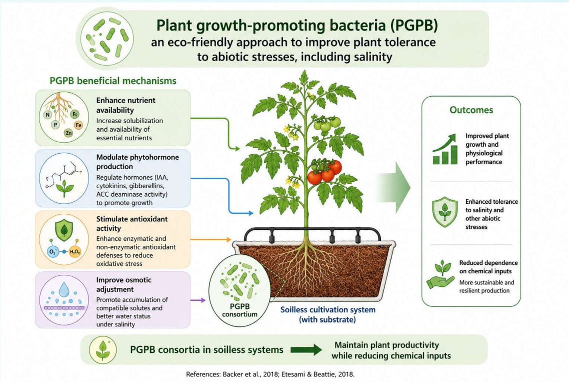
Introduction

Salinity is one of the main abiotic stresses limiting greenhouse horticultural production worldwide, particularly in intensive soilless cultivation systems where salt accumulation in the nutrient solution can severely affect plant growth, yield, and fruit quality (Munns & Tester, 2008).
Tomato (*Solanum lycopersicum* L.), one of the most economically important greenhouse crops, is moderately sensitive to salinity, exhibiting reduced photosynthetic activity, nutrient imbalance, oxidative stress, and impaired water uptake under saline conditions (Cuartero et al., 2006). The increasing scarcity of high-quality irrigation water and the intensification of protected cultivation systems further aggravate salinity-related challenges, highlighting the need for sustainable mitigation strategies.



This study investigates the potential of PGPB to enhance tomato resilience to salinity stress by identifying effective consortia that improve growth and physiological performance in soilless systems, contributing to more sustainable greenhouse production strategies

Methodology

1. Assessment of bacterial plant growth-promoting (PGP) traits under salt stress conditions

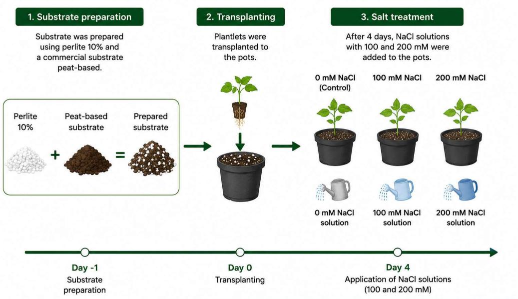
10 isolates were selected from CBQF collection:

Bacillus pumilus 1Z2
Bacillus subtilis 1ZP2
Bacillus megaterium 3AP1
Arthrobacter nicotinovorans EAPAA
Pseudomonas graminis LR 1-9
Pseudomonas frederiksbergensis LR 3-10
Bacillus aryabhattai LS 1-2
Bacillus cereus LS 3-1
Pseudomonas fluorescens S3X

- Indole-3-acetic acid production
- P solubilization
- Nitrogen fixation
- Siderophore production
- Biocompatibility assays

0, 0.5 and 1M NaCl

2. Preliminary evaluation of salinity stress effects on tomato growth



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Results

1. Selection of salt-tolerant PGPB consortia based on PGP traits

	P Solubilization			Nitrogen Fixation			Siderophore production (% of 0M NaCl)		IAA production (% of 0M NaCl)	
Isolate	0M NaCl	0.5M NaCl	1M NaCl	0M NaCl	0.5M NaCl	1M NaCl	0.5M NaCl	1M NaCl	0.5M	1 M
Bacillus pumilus 1Z2	+	+	–	+	–	–	-20%	9%	-38%	-46%
Bacillus subtilis 1ZP2	+	+	–	+	–	–	-4%	9%	-32%	-21%
Bacillus megaterium 3AP1	+	+	+	–	–	–	2%	6%	-60%	-36%
Arthrobacter nicotinovorans EAPAA	++	–	–	++	+	–	5%	11%	-29%	-23%
Pseudomonas graminis LR 1-9	+	–	–	–	–	–	8%	18%	-25%	-14%
Pseudomonas frederiksbergensis LR 3 -10	+	–	–	–	–	–	4%	5%	-11%	-7%
Bacillus aryabhattai LS 1-2	+	+	++	–	–	–	-15%	15%	-58%	-39%
Bacillus cereus LS 3-1	–	–	–	–	–	–	-2%	7%	131%	194%
Pseudomonas fluorescens S3X	++	+	–	++	+	–	7%	14%	-21%	-21%

(–) absent; (+) moderate; (++) high

Biocompatibility tests

3 consortium were selected

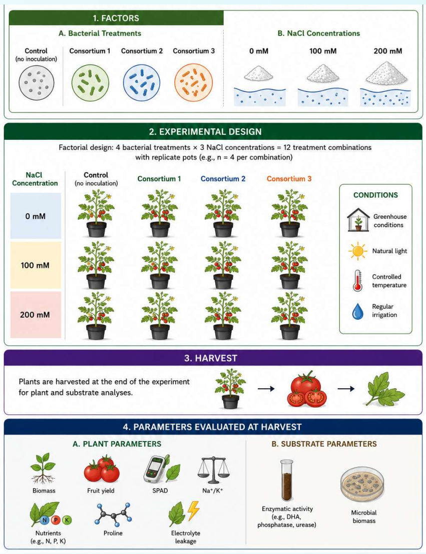
1. *B. cereus* LS3-1, *B. pumilus* IZ2, *P. fluorescens* S3X
2. *A. nicotinovorans* EAPAA, *B. megaterium* 3AP1, *B. cereus* LS3-1
3. *B. subtilis* IZP2, *P. graminis* LR1-9, *P. fluorescens* S3X

2. Evaluation of increasing NaCl concentrations on tomato growth and development

✓ The application of salt stress via nutrient solution after plantlet transplantation severely impaired plant growth, resulting in plant death

✓ A new experiment was established using the same NaCl concentrations, but with NaCl incorporated directly into the substrate to obtain the desired salinity levels

3. Evaluation of the beneficial effects of PGPB consortia on tomato growth and development under salt stress conditions



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