Plant growth-promoting rhizobacteria as a sustainable method to enhance drought tolerance in tomato crop

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Context

PGPB – Plant Growth-Promotion Bacteria

Nature-based Solutions

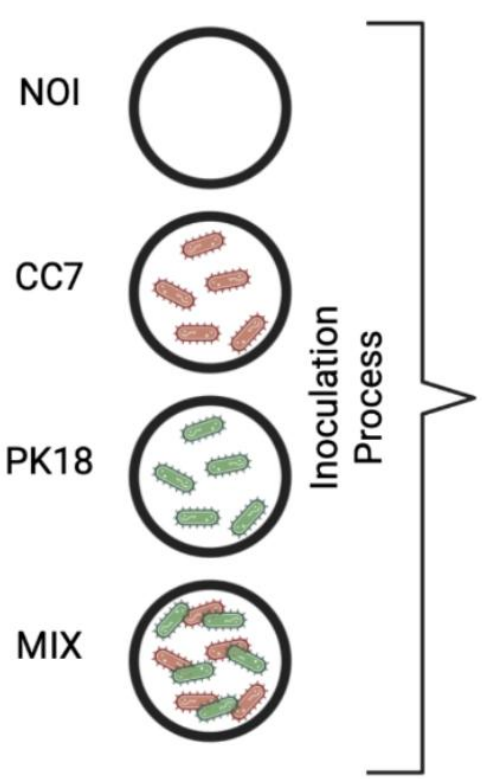
Sustainable Agriculture

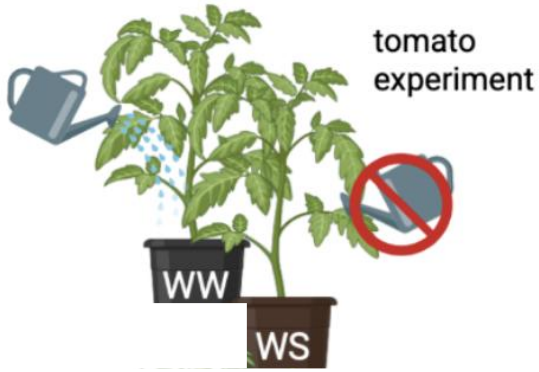
Growth and yield promotion

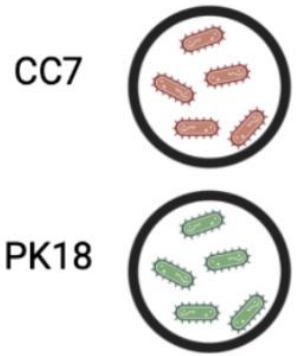
Bio-fertilizing and biocontrol activity

Providing a-/biotic resistance

Reference: del Carmen Orozco-Mosqueda et al., 2020; Background Reference: vecteezy, 2025.







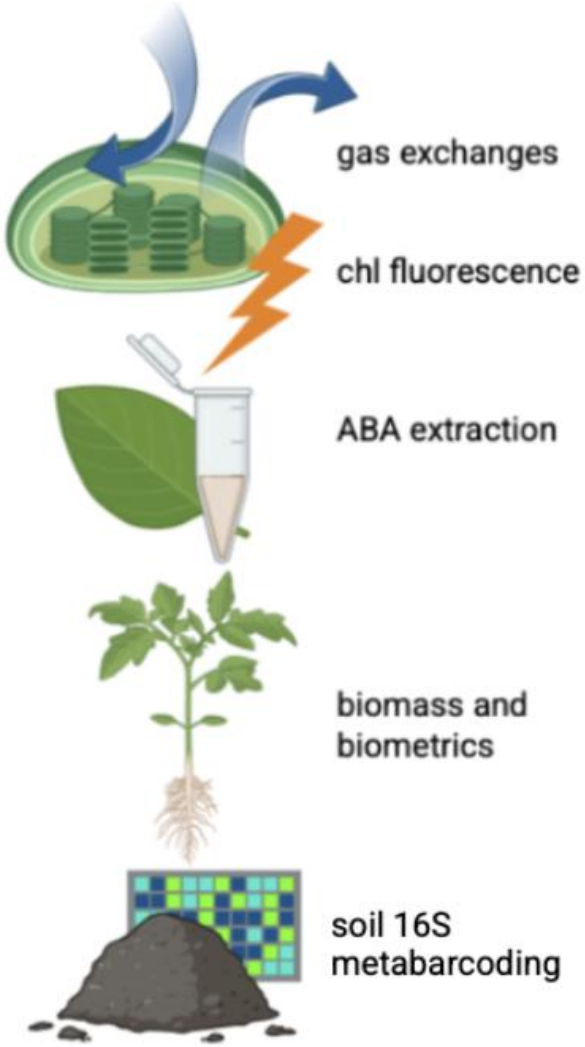
CC7 strain: selected for the production of ACC-deaminase, that lower ethylene levels

PK18: produces IAA (cell division, elongation, differentiation, root, xylem development), solubilize P

AIM OF THE EXPERIMENT

- to assess if **PGPR inoculation affected growth** by measuring plants' biomass and height
- to investigate **plants responses to water deficit** exposure **and PGPR inoculation** by measuring physiological parameters (*i.e.*, gas exchange, chlorophyll fluorescence and leaves ABA content)
- to elucidate the impact of inoculation and its duration on the **soil microbiome**

ANALYSES



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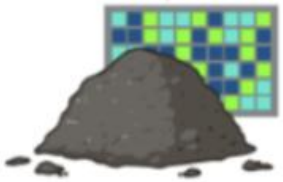
ANALYSES

gas exchanges

chl fluorescence

ABA extraction

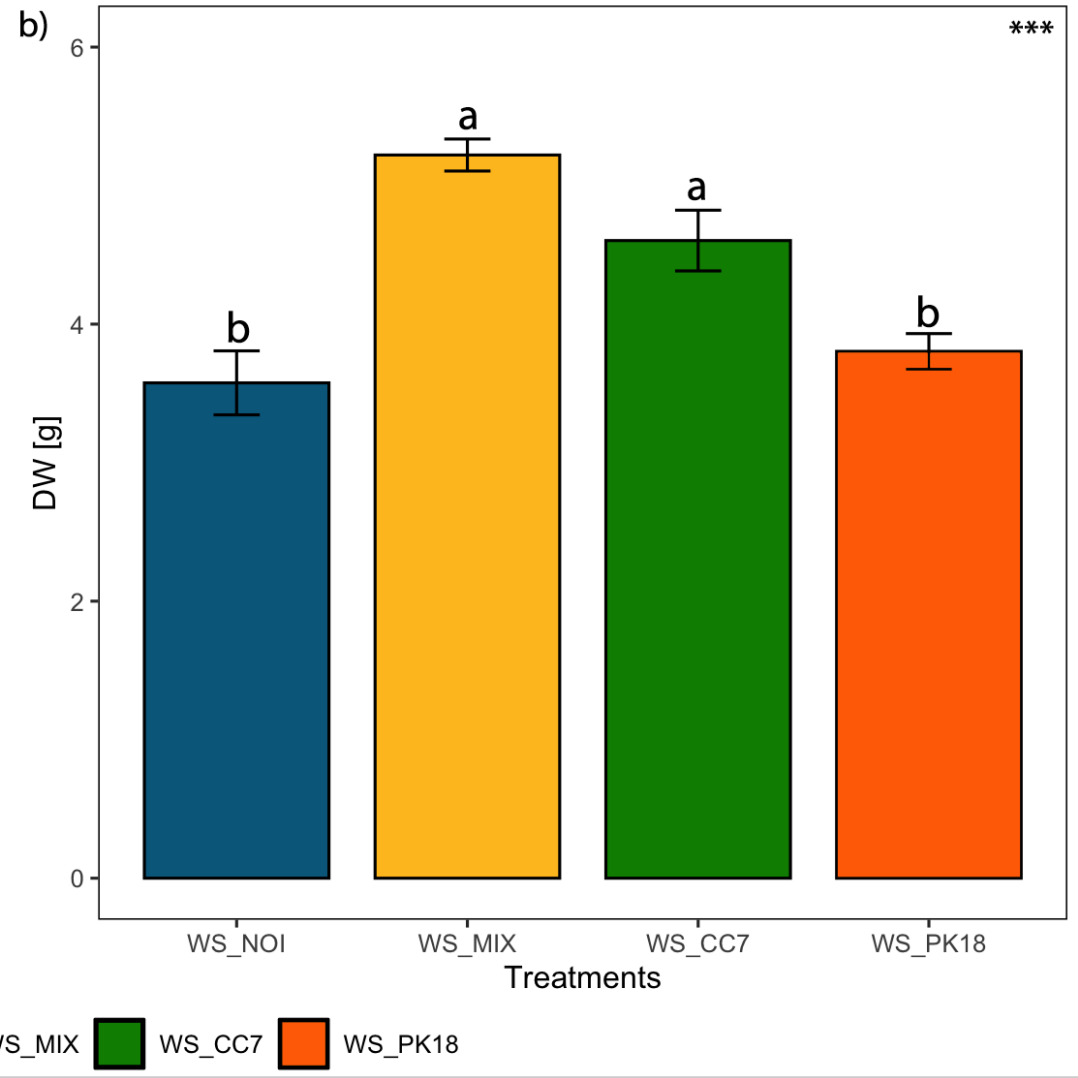
biomass and biometrics

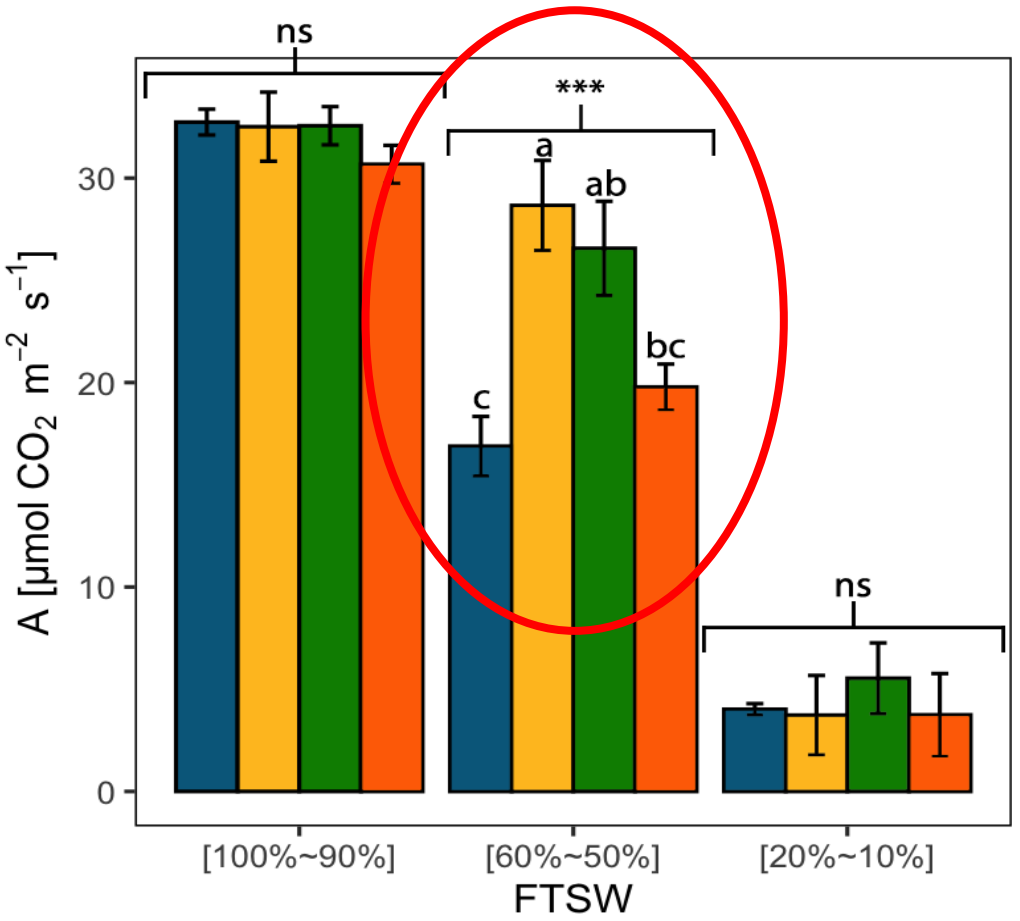


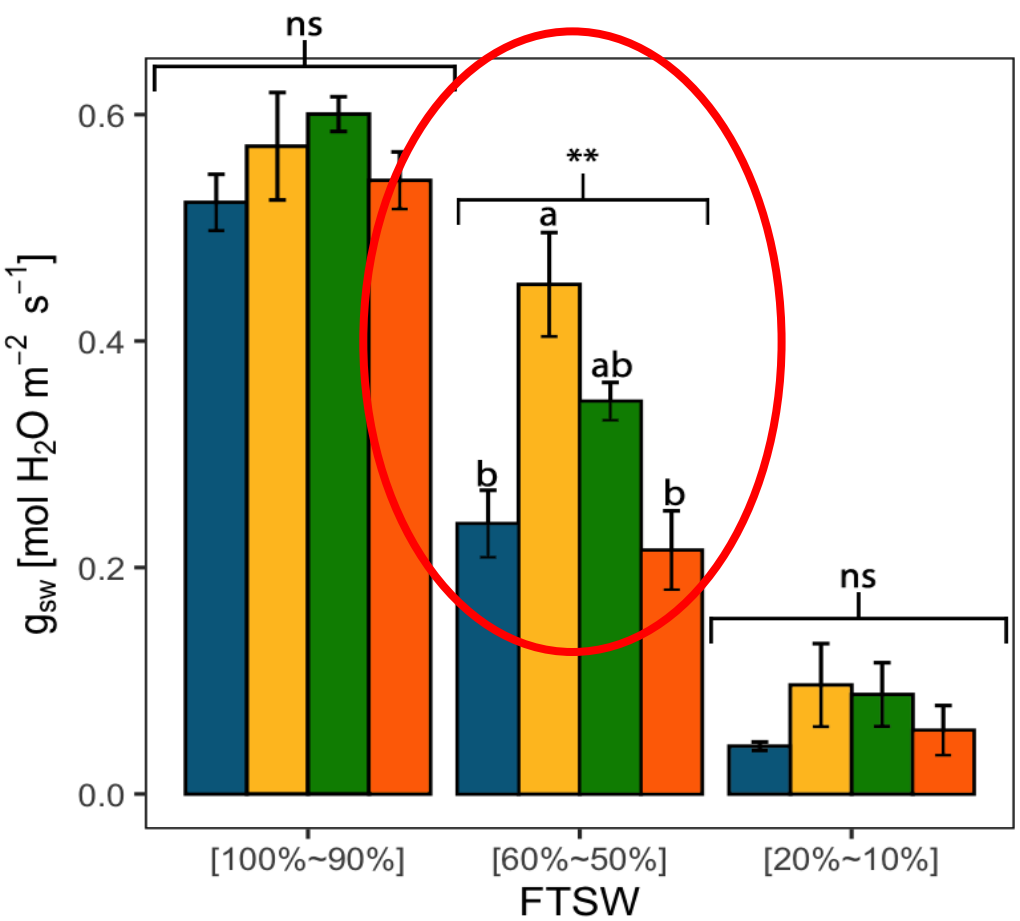
soil 16S metabarcoding

RESULTS

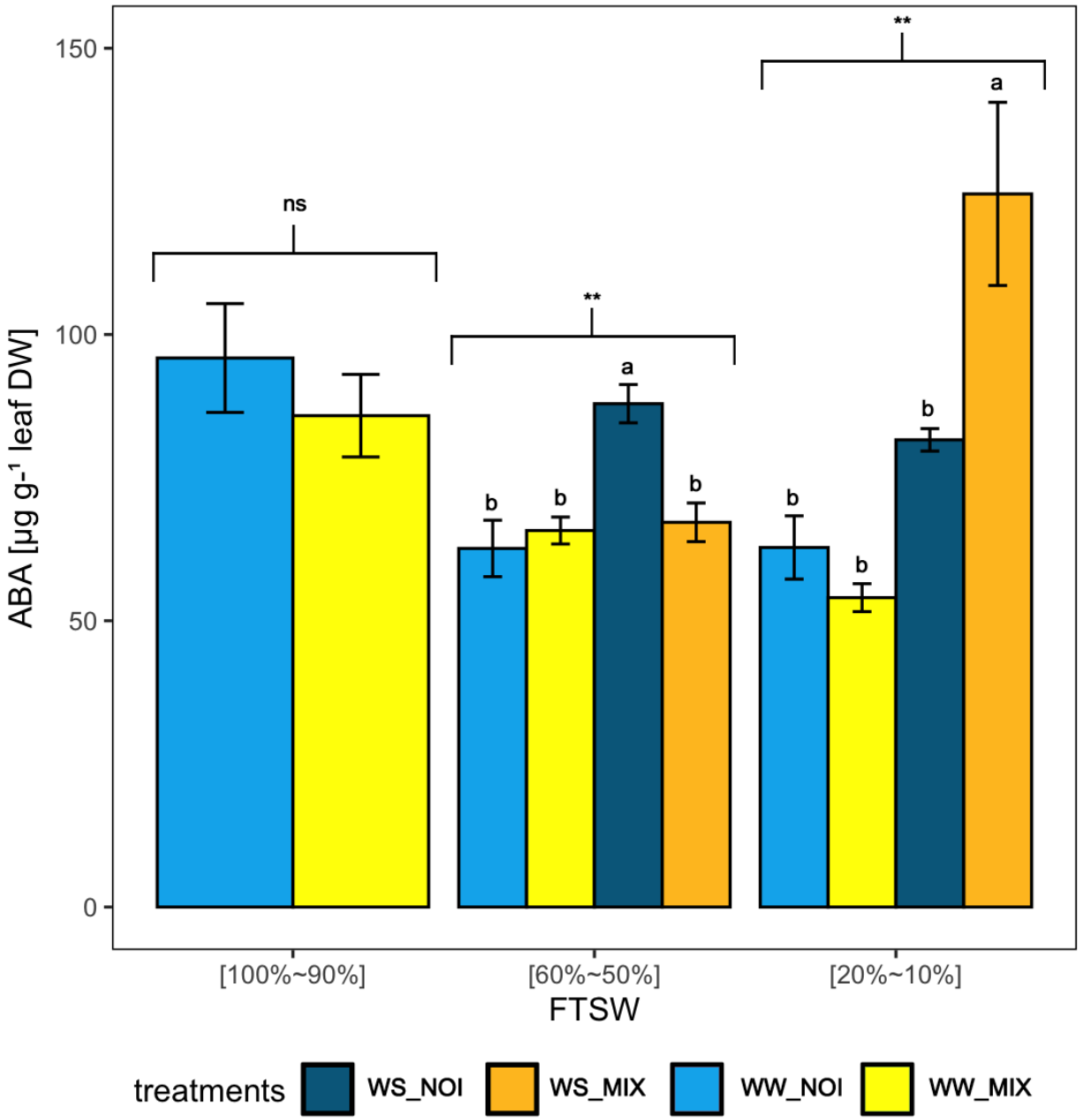
- Increased biomass production in MIX- and in CC7-inoculated plants
- Increased height and dry weight in MIX-treated plants in well-watered and water stress regimes
- ACC-deaminase activity of CC7 leading to ethylene decrease







- At the moderate water stress point, MIX consortium positively impacted tomato photosynthetic response and stomatal conductance



- In NOI plants, ABA did not change in time
- In MIX plants ABA increased at severe water stress
- Hypotesis:

  MIX: stomatal diffusive limitation as main driver of photosynthetic decline under progressive water deficit

  NOI: biochemical limitations (since leaf ABA content did not change between moderate and severe water stress)

MAIN FINDINGS

- In the pot experiment, the CC7 and PK18 strains acted synergistically in the MIX treatment promoting the growth of tomato under water deficit
- Given the similarities between MIX and CC7 treatments, we hypothesize a key role of CC7 in the overall effect of the MIX consortium

- In field conditions, the PGPR effect was less evident
- Mix-treated plants performed better under full water regime, but water availability remained the primary determinant of physiological and productivity responses
- Ongoing second year of field trial with repeated PGPR applications

CONCLUSIONS

- Biostimulants are emerging as sustainable strategies to improve crop tolerance to drought
- Differences in the results obtained in semi-controlled versus field conditions
- Complexity of translating PGPB efficacy to field conditions, with environmental variability and microbial fitness strongly determining outcomes

Starting in 2022, a series of state-of-the-art research infrastructures, advanced platforms for digital agriculture and high-throughput phenotyping (HTP), have been assembled by a dedicated team of researchers from the Italian National Research Centre Institute for the Sustainable Protection of Plants (CNR - IPSP), primarily based in Sesto Fiorentino (Florence) & Metaponto (Basilicata)

DEMETRIS Hub
Digital Ecosystems for MEtabolomics, plant Traits Research, and Imaging Systems Hub

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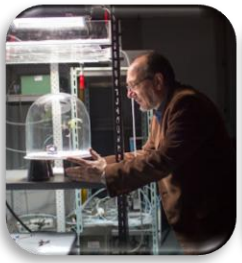
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