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Isolation and Characterization of PGPR from Date Palm Rhizospheres in the Algerian Sahara: Insights into Soil Fertility and Stress Tolerance

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INTRODUCTION & AIMS

The date palm (*Phoenix dactylifera* L.) is vital for agriculture and livelihoods in the Algerian Sahara but faces challenges from poor soil fertility, salinity, and pathogens. Plant Growth-Promoting Rhizobacteria (PGPR) associated with its roots can enhance nutrient availability, stimulate plant growth, and protect against diseases. This work focuses on isolating and characterizing native PGPR from date palm rhizospheres to identify strains adapted to arid and saline soils[1], [2].

Objectives

- Isolate rhizospheric bacteria from date palm soils.
- Evaluate biofertilization traits (Indole-3- acetic acid (IAA), Biofilm production).
- Assess stress tolerance (NaCl, temperature).
- Test biocontrol potential against *Fusarium oxysporum*.

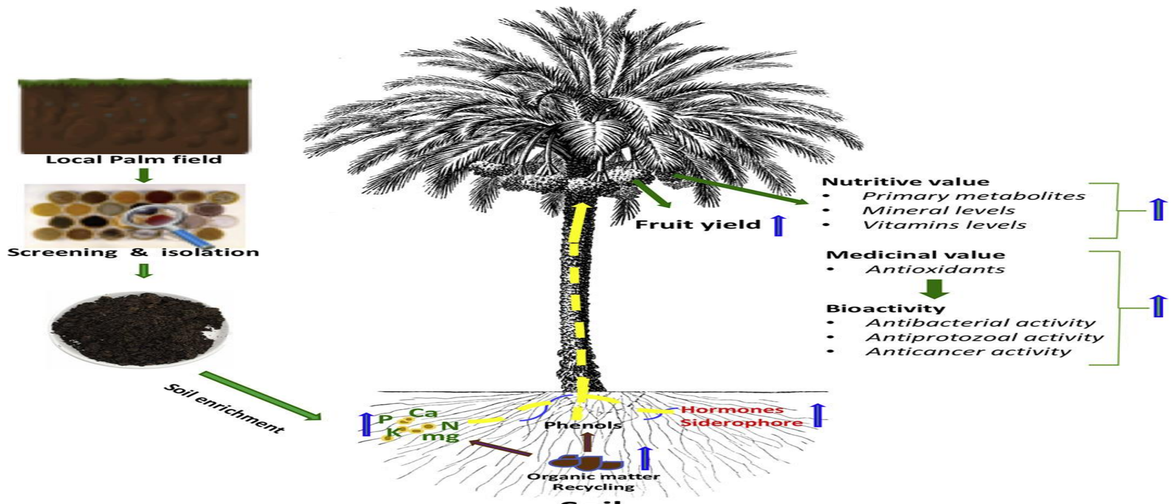
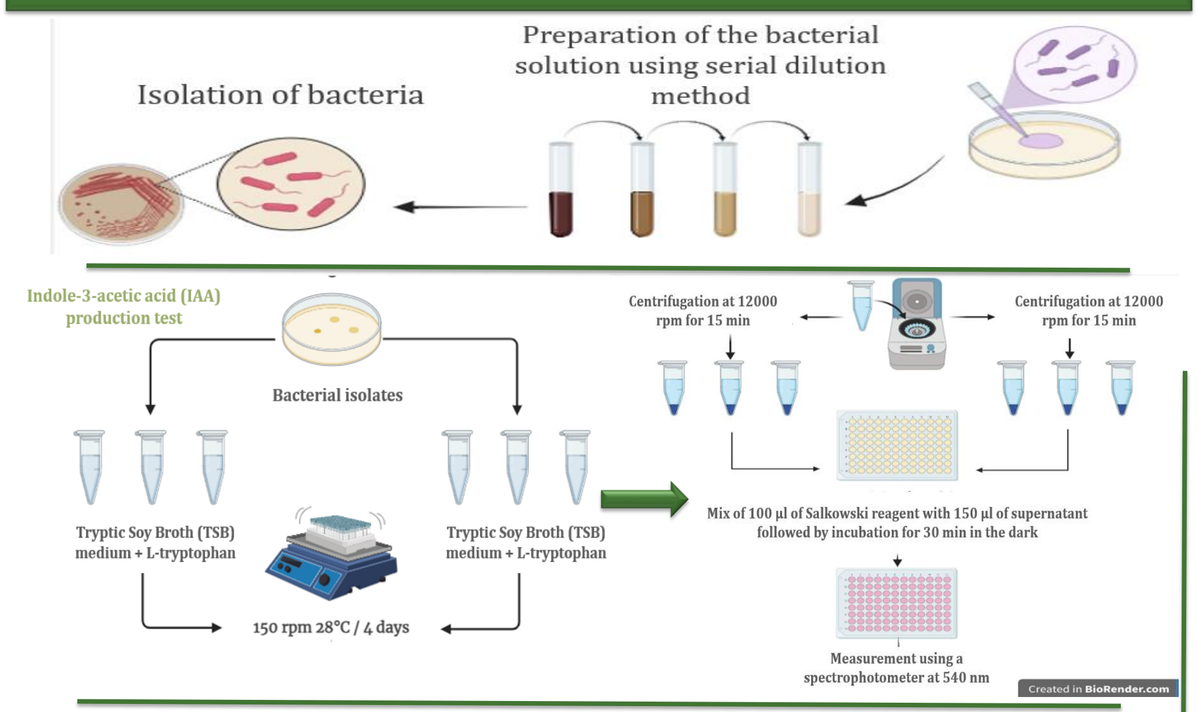
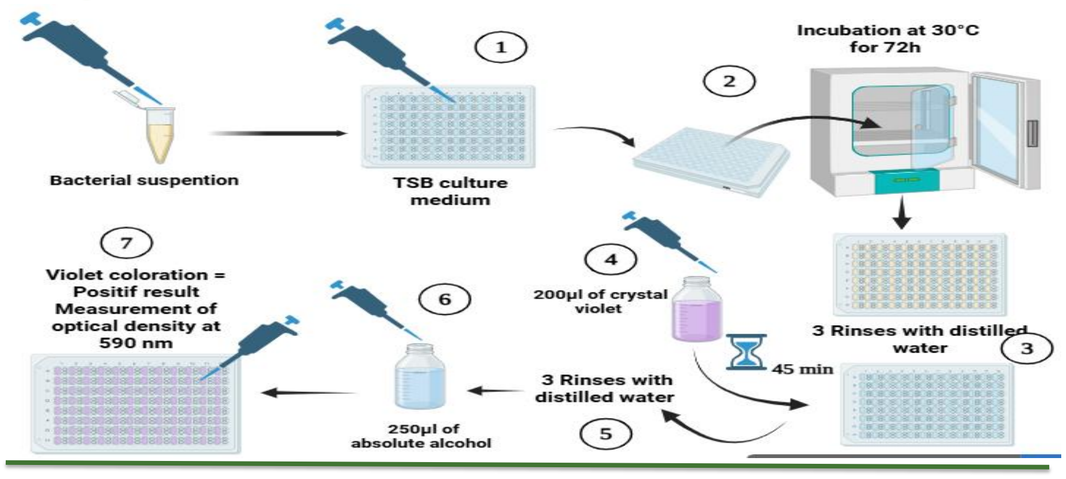


Figure 1. Utilization of actinobacteria to enhance the production and quality of date palm (*Phoenix dactylifera* L.) fruits in a semi-arid environment [1].

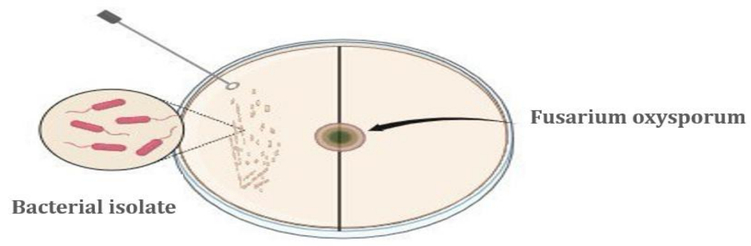
METHODS



Biofilm production test

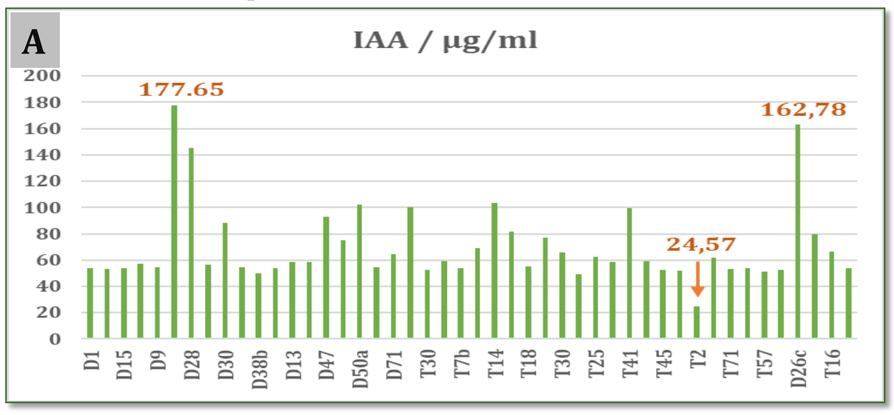


Direct confrontation assay on PDA (Potato Dextrose Agar) medium



RESULTS & DISCUSSION

46 bacterial isolates from the date palm rhizosphere showed **high tolerance to salinity (1.2% NaCl) and temperature (42 °C)**. These stress-resistant strains displayed multiple plant growth-promoting and antagonistic traits, highlighting their potential for improving crop resilience in arid environments.



All isolates produced indole-3-acetic acid (IAA). Strains **D25 (177.65 µg/mL), D28, and D50a showed the highest production**, indicating strong potential to stimulate root growth and nutrient uptake. In contrast, strain **T2** exhibited low IAA levels. IAA production remains a key criterion for selecting efficient PGPR from both cultivars.

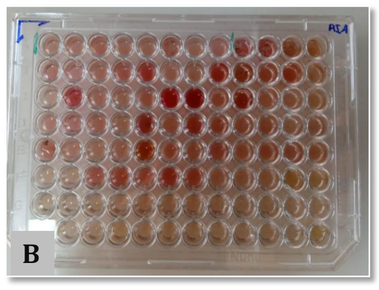
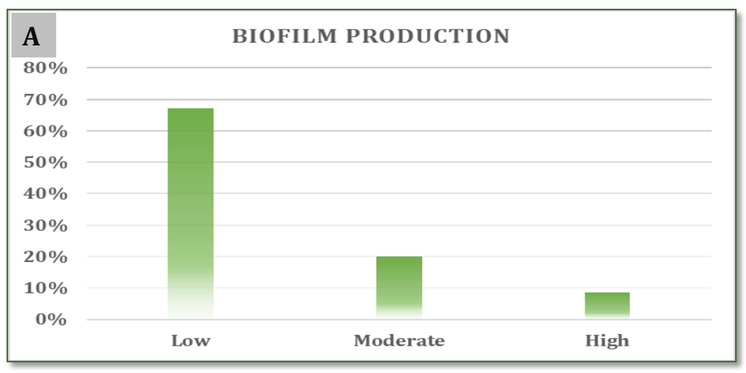


Figure 2. Indole-3-Acetic Acid (IAA) Production by Bacterial Isolates: A. Quantitative IAA production (µg/mL) by individual isolates. B. Colorimetric reaction in microplate assay indicating IAA production

Approximately 67% of the isolates formed weak biofilms, whereas only 8.5% (**D50a, D63, and T16**) showed strong adhesion capacity. This ability enhances their rhizosphere colonization and resilience under biotic and abiotic stress conditions.



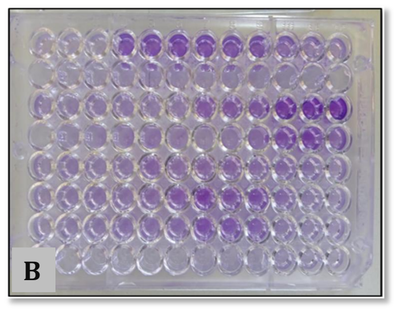


Figure 3. Biofilm Formation by Bacterial Isolates. A. Percentage distribution of biofilm-forming isolates (low, moderate, high producers) B. Colorimetric microplate assay showing biofilm formation.

Dual confrontation assays revealed strong inhibition of *Fusarium oxysporum* f. sp. *albedinis* (Bayoud disease agent) by **the halotolerant and thermotolerant isolates *Bacillus* sp. T51 (67.44%) and T61 (69.76%)**. Their antagonistic effect is likely linked to the combined action of siderophores, hydrolytic enzymes, and antimicrobial metabolites.

A. Control plate: *Fusarium oxysporum* f. sp. Albedinis.

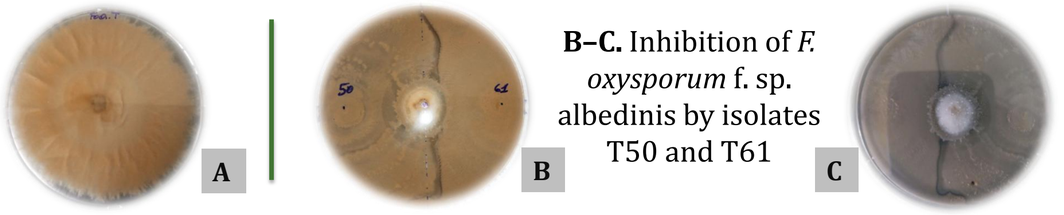


Figure 4. Dual culture assay of halotolerant bacterial isolates against fungal phytopathogen *Fusarium oxysporum* f. sp. Albedinis.

CONCLUSION

Some isolates combined strong biofertilization traits (IAA production and biofilm formation), while others showed potent biocontrol potential through enzyme secretion and antifungal activity. Notably, *Bacillus* sp. T51 and T61—both halotolerant (1.2% NaCl) and thermotolerant (42 °C)—exhibited dual functions, making them promising bioinoculants for enhancing plant resilience under stress. Along with D25 and D50a, these strains offer potential for sustainable cultivation of date palms and other crops in saline or arid soils.

Future perspectives include **molecular identification** of these isolates and **characterization of their biofungicidal metabolites** to better understand their mechanisms of action and optimize their agricultural application.

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