ECM 2025 Conference
The 3rd International Electronic Conference on Microbiology
01–03 April 2025 | Online
MDPI

Exploring Cellulose Fibers as Support for a Microbial Inoculant Immobilitation

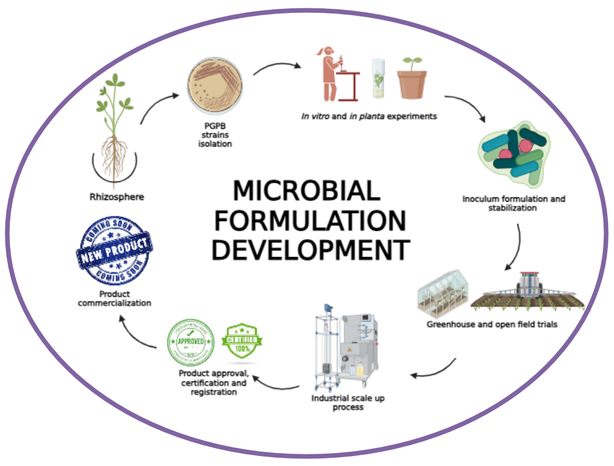
Beatrice Farda[1]*, Amedeo Mignini [2], Fabrizia Pasquarelli [3], Luz de-Bashan [4], Iris Beatriz Vega Erramuspe [5], Rihab Djebaili [1], Marika Pellegrini[1–2]

[1] Department of Life, Health and Environmental Sciences, University of L'Aquila, Via Vetoio 40, L'Aquila, 67100 AQ, Italy
[2] Agroqualis Srl, Academic Spin off of University of L'Aquila, L'Aquila, Italy
[3] SPAA s.r.l., Via delle Industrie 11-13, Città Sant'Angelo, 65013 PE, Italy
[4] The Bashan Institute of Science, 1730 Post Oak Court, Auburn, 36830 AL, USA
[5] Forest Products Development Center, College of Forestry, Wildlife & Environment, Auburn University, 520 Devall Drive, Auburn, 36849 AL, USA

INTRODUCTION & AIM

Creating robust and long-lasting storage solutions presents a major challenge in developing microbial inoculants for eco-friendly farming.

Well-developed techniques for anchoring bacteria onto solid supports are available, and growing interest is focusing on the implementation of sustainable carrier materials.



This work aims to examine the utilization of cellulose functional fibers, chemically altered by the integration of natural polymers derived from the pulp industry.

METHODS

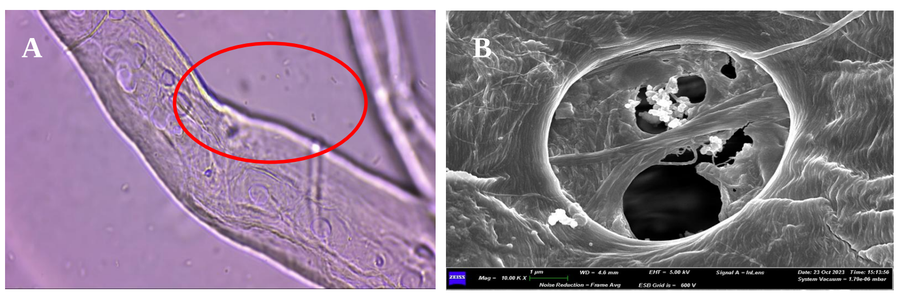
The fibers were assessed as a carrier for a consortium of plant growth-promoting bacteria. The consortium was immobilized on fibers culturing the strains in a combined fermentation with the addition of fibers (1% w/v) to allow microbial self-adhesion to the surface. The fibers were added at three specific stages of the bioreaction (0, 24 hours, and 48 hours), utilizing two separate culture mediums. Desiccation was executed using freeze-drying and heat-drying techniques. Cell viability was assessed in never-dried functional fibers and dried fibers until one month from inoculation, after drying. Immobilized bacteria were also assessed for plant growth-promoting (PGP) traits, encompassing indoles, ammonia production, and phosphate solubilization.

FIBERS' INOCULATION

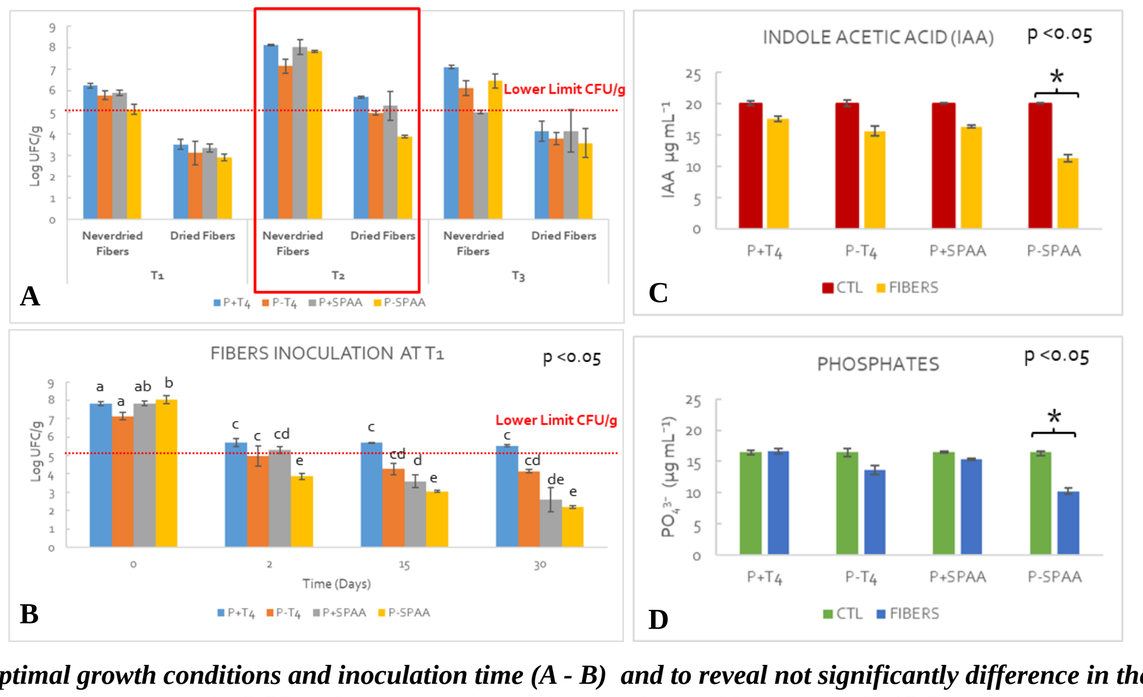
FIBERS' ESSICATION

RESULTS & DISCUSSION

Never-dried fibers demonstrated a favorable microbial load (between 6.78 and 8.22 Log CFU g-1), although the cell viability after drying diminished more than 1 Log CFU g-1 relative to the never-dried matter. Notable findings were achieved when comparing the two distinct growth conditions and the timing of functional fiber inoculation. Post-drying disparities between unmodified fibers and functional fibers were observed, underscoring the possible role of natural polymers in enhancing cellular protection.



Inoculated fibers at optical microscope view (A) and scanning electron microscope (B)



Optimal growth conditions and inoculation time (A - B) and to reveal not significantly difference in the main PGP traits between free-living and immobilized bacteria (C-D)

CONCLUSION AND FUTURE WORK

The conducted tests on the plant growth-promoting properties demonstrated positive results compared to non-immobilized consortia. These findings provide a solid foundation for further research, focusing on shelf-life evaluation and practical applications in crop cultivation and greenhouse studies.

ACKNOWLEDGMENTS

We extend our sincere gratitude to SPAA Srl and the University of L'Aquila for funding the PhD program focused on developing innovative microbial-based biostimulants. We also wish to thank the AGRIMAQ Microbiology Laboratory, the Academic Spin-off AGROQUALIS, the Bashan Institute of Science, and Auburn University for their invaluable support in the research activities.