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Synergistic effects of biofilm-producing PGPR strains on wheat plant colonization and growth under drought stress

Iqbal Ahmad* and **Firoz Ahmad Ansari**
Aligarh Muslim University, India

Statement of the problem: Drought stress severely hampers crop productivity in many parts of the globe. Microbial strategies have been considered a promising option and are under scrutiny. It is hypothesized that indigenous bacterial strains exhibiting multiple plant growth promoting traits and interacting positively in planktonic and biofilm mode will effectively provide enhanced plant growth under a stress environment. Based on our previous screening study two distinct and novel biofilm-producing strains of PGPR, *Bacillus subtilis* (FAB1) and *Pseudomonas azotoformans* (FAP3) are included in this study. Biofilms provide bacteria to withstand stressful conditions in the soil system which may support the mitigation of crop stress in a sustainable manner. Limited studies have shown that biofilm-forming rhizobacteria support plants in alleviating water scarcity stress.

The purpose of this study is to understand the role of individual and combined inoculation effects of strains on wheat plant growth under a water-stress environment.

Methodology & theoretical orientation: Bacterial isolates biofilms development on a microtiter plate, glass coverslip surface and seedling roots were evaluated and characterized by microscopic and scanning electron microscopy. The effect of water stress was studied on bacterial production of biofilms, EPC production and other traits. Rhizosphere and rhizoplane colonization by the FAB1 and FAP3 isolates, individually and mixed, was evaluated under ten-day water stress Selected bacterial isolates were inoculated on wheat plants in a soil pot system individually and in combination and evaluated for their performance under water stress conditions. Plant growth vegetative parameters, seed attributes, straw yield, and physiological parameters, and stress markers (CAT, SOD, GR, MDA, proline content) were analyzed.

Findings: *In vitro* interaction, two test bacterial strains showed synergy in both planktonic and biofilm modes of growth. The FAB1 and FAP3 strains exhibited specific and multifunctional PGP traits as well as better roots and rhizosphere colonization, which could provide sustained plant growth during drought. Moderate tolerance to ten-day drought conditions was noted when the individual strain was inoculated with wheat plants; however, the FAB1+FAP3 combined treatment significantly enhanced wheat survival during drought stress. The FAB1 and FAP3-induced modifications cooperatively conferred enhanced plant drought tolerance by regulating antioxidative systems.

Conclusion: The findings of the present investigation support further efforts to improve plant drought tolerance by engineering the biofilms and associated traits of rhizobacterial communities which needs in-depth investigation and exploiting promising indigenous strains for local application.

Keywords: PGPR, Mixed biofilms, Drought stress, Synergistic interaction, Plant growth, Root colonization.

Biography

Iqbal Ahmad is a senior professor of Agricultural microbiology at AMU, Aligarh, India. He has more than 27 years of extensive teaching and research experience. His major works are in the area of Applied Microbiology, Environmental and Agricultural aspects of Microbial diversity and bio-prospection. He has significantly contributed in exploring the use of traditionally used Indian medicinal plants as a source of anti-infective/ anti biofilms against drug-resistant microbial pathogens. His current research thrust area includes Microbial Ecology, AMR, Quorum sensing, Biofilms based PGPR, Mixed biofilms and the use of natural and synthetic products including nanoparticles as anti-infective agents. He has guided 15 PhDs and more than 60 MSc dissertations, completed five Research Projects, edited 12 books and published more than 250 original research papers/book Chapters. The research work published has been fairly cited by the International scientific community.

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