



Conference Abstract

Isolation of beneficial soil microbes with stress tolerance traits and establishment of microbial consortia to improve legume productivity and adaptation to harsh environments

Mariangela Fotelli[‡], Constantinos Ehaliotis[§], Myrto Tsiknia[§], Petros Efstathopoulos[§], Rodica Efrose[‡], Emmanouil Zoanos[‡], Daniela Tsikou[¶], Polyxeni Gorgia[¶], Fotios Xystrakis[‡], Ilias Karmiris[#], Christos Damianidis[‡], Athina Papatheodoulou[□], Emmanouil Fletmetakis[‡]

[‡] Forest Research Institute, Hellenic Agricultural Organization Dimitra, Thessaloniki, Greece

[§] Department of Natural Resources Development and Agricultural Engineering, Agricultural University of Athens, Athens, Greece

[¶] Department of Biotechnology, Agricultural University of Athens, Agricultural University of Athens, Athens, Greece

[¶] Department of Biochemistry and Biotechnology, University of Thessaly, Larisa, Greece

[#] Hellenic Agricultural Organization Dimitra, Thessaloniki, Greece

[□] Nature Conservation Unit, Frederick University, Nicosia, Cyprus

Corresponding author: Mariangela Fotelli (fotelli@elgo.gr)

Received: 07 Apr 2025 | Published: 28 May 2025

Citation: Fotelli M, Ehaliotis C, Tsiknia M, Efstathopoulos P, Efrose R, Zoanos E, Tsikou D, Gorgia P, Xystrakis F, Karmiris I, Damianidis C, Papatheodoulou A, Fletmetakis E (2025) Isolation of beneficial soil microbes with stress tolerance traits and establishment of microbial consortia to improve legume productivity and adaptation to harsh environments. ARPHA Conference Abstracts 8: e155144. <https://doi.org/10.3897/aca.8.e155144>

Abstract

Legumes produce highly nutritious seeds, making them a valuable resource of nutrients for both humans and livestock. In addition to contributing to global food security, they can also provide an ecologically sustainable and cost-effective means of soil fertilization by initiating nutrient cycling in nutrient-limited soils through symbiotic associations with beneficial microbes such as nitrogen-fixing rhizobia and arbuscular mycorrhizal fungi (AMF). However, climate change-induced xerothermic conditions and soil salinity may threaten these beneficial associations between symbionts. Changing environmental conditions and increasing earth's population require the development of new sustainable products that will support not only plant nutrition but also plant growth and productivity

under extreme conditions. This challenge can be addressed by isolating natural beneficial microbes from extreme environments and applying optimized combinations of selected strains that carry interesting and compatible traits to legume crops.

To achieve this objective, rhizobial and AMF strains were isolated from wild legumes grown in extreme environments throughout Greece and Cyprus and are currently being evaluated for their application as microbial consortia in pasture legumes for increased rangeland production under climate change. Compatibility between symbiotic partners, functionality of symbiotic relationships and performance of symbiotic plants are investigated at the ecophysiological, molecular and microbial community levels.

Furthermore, in order to overcome the lack of knowledge about the molecular mechanisms regulating the interactions between symbiotic partners and to test the efficacy of different rhizobia-AMF co-inoculation strategies, studies are also being conducted in the model legume *Lotus japonicus*.

Roots of 45 different species of wild legumes and their rhizosphere were collected from 22 locations in Greece and Cyprus, and functional nodules were obtained from 12 species. A total of 324 pure rhizobia strains were isolated and the most valuable strains were selected based on their tolerance to abiotic stress (tested *in vitro*) and their ability to nodulate the legumes *Trifolium resupinatum* and *Medicago sativa* under salinity and drought conditions. In parallel, trap cultures were established to enrich AMF spores from the sampled rhizospheres, and more than 20 AMF spore morphotypes were isolated and re-inoculated to trap cultures for a second reproduction cycle. To optimize the composition of beneficial microbial consortia, legume plants were co-inoculated with different combinations of selected rhizobia and AMF strains and subjected to salinity or drought stress with the aim of achieving compatibility between symbiotic partners and improved plant fitness.

Application of microbial consortia is expected to improve the survival, productivity, and nutritive value of pasture plants and promote grazing livestock nutrition and carbon sequestration in pasture soils. This study will contribute to the development of innovative bio-based products, creating new opportunities for sustainable agriculture and investment.

Keywords

microbial consortia, rhizobia, arbuscular mycorrhizal fungi, climate change, pasture legumes, rangeland production

Presenting author

Mariangela Fotelli

Presented at

POSTER

Acknowledgements

The project entitled “Synergetic beneficial microbial consortia for improving plant productivity and adaptation in challenging environments (EICONA)” is conducted in the framework of the National Recovery and Resilience Plan “Greece 2.0”, funded by the European Union - NextGenerationEU (Implementing Body: H.F.R.I.; Project ID: 16231).

Conflicts of interest

The authors have declared that no competing interests exist.