Deciphering the hidden potentials of bacterial communities isolated from root nodules of native legumes growing in Tunisian arid regions

Ben Gaied, R.[1,2*], Sbissi, I.[1], Tarhouni, M.[1], Brígido, C.[3]

[1] Laboratory of Pastoral Ecosystems and Promotion of Spontaneous Plants and Associated Micro-Organisms, Institute of Arid Lands, University of Gabes, Medenine 4119, Tunisia,
[2] MED – Mediterranean Institute for Agriculture, Environment and Development, Universidade de Évora, Pólo da Mitra, Ap. 94, Évora, 7006-554, Portugal,
[3] MED-Mediterranean Institute for Agriculture, Environment and Development & CHANGE-Global Change and Sustainability Institute, Institute for Advanced Studies and Research, Universidade de Évora, Pólo da Mitra, Ap. 94, Évora, 7006-554, Portugal.

*roukaya.bengaied@gmail.com

In an Era where climate change imposes difficult challenges for agricultural sustainability, there's a growing urgency for the development of novel strategies to guarantee both plant productivity and soil fertility. In this context, particular attention was given to plant growth promoting bacteria (PGPB) associated with native legumes in arid habitats due to their natural adaptability to extreme environments. Despite the large number of identified species, the potential application of this microbial community in food legumes wasn't thoroughly explored in current research endeavours. In this context, we proceeded for the isolation and characterization of root nodules endophytes from 15 wild legumes, originating from Tunisian drylands. In a collection of 210 strains, phylogenetic analysis revealed the presence of a large diversity of rhizobial and non-rhizobial isolates belonging to α-, β-, and Gamma-proteobacteria, Firmicutes and Actinobacteria, among which the strain IRAMC:0171 was introduced as a new species in the *Mesorhizobium* genus. Furthermore, genomic characterization of the Saharan isolate *Sinorhizobium meliloti* IRAM:0087 showed the presence of some unique genetic features, conferring to the strain an outstanding capacity to tolerate a variety of abiotic stressors such as heat, drought, salinity, and heavy metals. Interestingly, the same isolate was able to nodulate *Acacia tortilis* var *raddiana*, a plant-tree well adapted to harsh environments. Moreover, the evaluation of the impacts of heat and salt stress on *Pisum-Rhizobium* and *chickpea-Mesorhizobium* symbiosis respectively, showed not only a decrease in the growth and plant nodulation of both legume species, but also a substantial change in the composition of phenolic compounds in root exudates, which negatively affected the early molecular signalling in legume-rhizobium symbiosis. Nevertheless, these detrimental impacts were successfully mitigated by the co-inoculation with non-rhizobial endophytic consortium from our collection, proving the promising potential of nodules microbiome from wild legumes in boosting the survival and productivity of food legumes in drylands.

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