soil systems

MDPI

Article

Unravelling the Combined Use of Soil and Microbial Technologies to Optimize Cultivation of Halophyte *Limonium algarvense* (Plumbaginaceae) Using Saline Soils and Water

Amaia Nogales [1,2,†], Salvadora Navarro-Torre [1,3,†], Maria Manuela Abreu [1], Erika S. Santos [1], Ana Cortinhas [1], Rosalba Fors [1], Marion Bailly [1], Ana Sofia Róis [1,4] and Ana Delaunay Caperta [1,*]

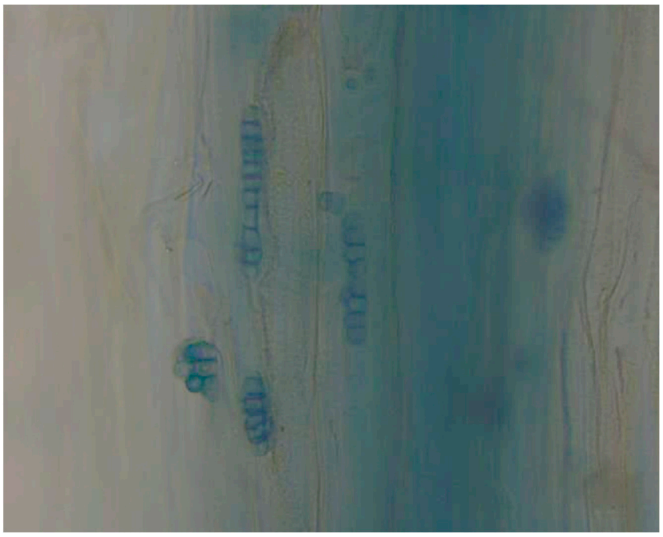
[1] LEAF—Linking Landscape, Environment, Agriculture and Food Research Center, Associate Laboratory TERRA, Instituto Superior de Agronomia, Universidade de Lisboa, Tapada da Ajuda, 1349-017 Lisboa, Portugal; anogales@isa.ulisboa.pt (A.N.); snavarro1@us.es (S.N.-T.); manuelaabreu@isa.ulisboa.pt (M.M.A.); erikasantos@isa.ulisboa.pt (E.S.S.); anacortinhas@isa.ulisboa.pt (A.C.); rosalbafors@isa.ulisboa.pt (R.F.); marion.bailly0105@gmail.com (M.B.); ana.rois@ulusofona.pt (A.S.R.)

[2] Sustainable Plant Protection, Centre de Cabrils, IRTA—Institute of Agrifood Research and Technology, Ctra. Cabrils Km 2, 08348 Cabrils, Spain

[3] Departamento de Microbiología y Parasitología, Facultad de Farmacia, Universidad de Sevilla, C. Tramontana, 2, 41012 Sevilla, Spain

Abstract Salt-affected soils have detrimental effects on agriculture and ecosystems. However, these soils can still be used for halophyte (salt tolerant plants) cultivation using brackish and/or saline water. In this study, we employed soil technologies and mutualistic microorganisms as a sustainable strategy to improve the growth and reproduction of the halophyte *Limonium algarvense* Erben growth and reproduction under saline conditions. A microcosm assay was conducted under controlled greenhouse conditions to cultivate *L. algarvense* using a saline Fluvisol (FLU) amended or not with a Technosol (TEC). Plants were inoculated with the arbuscular mycorrhizal fungus (AMF) *Rhizoglomus irregulare* and/or a consortium of plant growth promoting bacteria (PGPB) and irrigated with estuarine water. Soil enzyme analysis and physicochemical characterization of the soils, collected at the beginning and at the end of the assay, were carried out. The physiological status of non-inoculated and inoculated plants was monitored during the assay for four months and AMF root colonization was evaluated. In FLU, only plants inoculated with the AMF survived. These plants had lower vegetative indices (NDVI and PRI), number of leaves, and shoot and root dry biomass than the ones grown in the TEC by the end of the assay. In the TEC, PGPB-inoculation led to higher NDVI values and AMF-inoculation promoted higher reproductive development but not pollen fertility. The findings show that the combined use of soil and microbial technologies can successfully be applied to cultivate *L. algarvense*, suggesting their generalized use to other *Limonium* species with economic interest, while contributing to the sustainable use of marginal lands.

Keywords: Arbuscular mycorrhizal fungus (AMF); estuarine water; Fluvisols; plant growth promoting bacteria (PGPB); reproduction; Technosols.



Supplementary Figure S1. Esclerotia of dark septated endophyte in a *Limonium algarvense* root stained with Trypan blue**.** The image was taken using optical microscopy (LEICA).