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## Strategies to improve tolerance to abiotic stress in legumes

Legumes play a key role in sustainable agriculture. Mineral nitrogen deficiency is an important limiting factor for plant growth in arid and semi-arid regions, and rhizobia-legume symbioses are the primary source of fixed nitrogen in such areas. The introduction of legumes and their nodulating rhizobia may have an important effect on the reclamation of degraded, polluted, saline, marginal soils for sustainable agriculture. Such recovery is becoming an urgent matter due to climate change, the increasing extension of salinized land and the ever-rising requirements for food and feed. In general, both rhizobia and legumes have a low or moderate tolerance to abiotic stress. Moreover, symbiosis and nodule functions are very sensitive to abiotic stress, more so than the host legume or the rhizobia. Thus, it is of interest to obtain bacterial inocula and legume varieties with enhanced tolerance to abiotic stress for use in soil reclamation, which can be achieved by traditional trait selection or by biotechnological procedures. We will present our results on the selection of tolerant legume cultivars and rhizobial strains, as well as our biotechnological approaches to obtain legumes and rhizobia with improved tolerance to abiotic stress. Omics analyses and genome-wide association studies (GWAS) appear as optimal tools for elucidating the physiological and molecular mechanisms that determine sensitivity or tolerance to abiotic stress in the symbiotic system, which might help define strategies to obtain nodulated legumes with enhanced tolerance to environmental stresses that act efficiently in reclaiming and exploiting marginal soils.

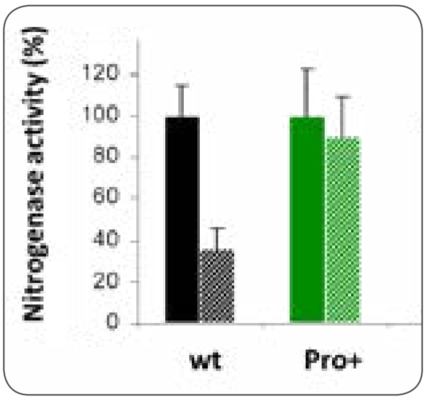


**Figure 1:** Nitrogenase activity of wild-type (black) and transgenic Medicago truncatula plants that accumulate proline (green), under control (solid) and salt stress conditions (stripes).

### Recent Publications

1. Chinnaswamy A et al. (2018) A endophytic *Bacillus megaterium* strain isolated from *t* root nodules enhances growth, promotes nodulation by *Ensifer medicae* and alleviates salt stress in different alfalfa plants. Annals of Applied Biology 172(3):295-308.

2. Lucas M M et al. (2015) The future of lupin as a protein crop in Europe. Frontiers in Plant Science. 6:705.
3. Garcia de la Torre V S et al. (2013) Rapid screening of *Medicago truncatula* germplasm for mercury tolerance at the seedling stage. Environmental and Experimental Botany. 91:90-96.
4. Coba de la Pena T and Pueyo J J (2012) Legumes in the reclamation of marginal soils, from cultivar and inoculant selection to transgenic approaches. Agronomy for Sustainable Development. 32(1):65-91.
5. Coba de la Pena T, Redondo FJ, Manrique E, Lucas MM, Pueyo JJ (2010) Nitrogen fixation persists under conditions of salt stress in transgenic *Medicago truncatula* plants expressing a cyanobacterial flavodoxin. Plant Biotechnology. J. 8(9):954-965.

## Biography

Jose J Pueyo is a Full Professor and Research Group Leader at the Institute of Agricultural Sciences, Spanish National Research Council (CSIC) in Madrid, Spain. His scientific interests include the biotechnological improvement of legume crops and the study of beneficial plant-microbe interactions under environmental constraints. After obtaining his PhD, he worked as a Research Assistant at University College Dublin, Republic of Ireland, as a Fulbright Postdoctoral Fellow at the University of California, San Diego, and at The Scripps Research Institute, La Jolla, USA as a Research Associate. He then joined the Centre for Environmental Sciences, CSIC, where he was later appointed Director. He has been a Member of CSIC Committee on Agricultural Sciences, Vice-Chair of CYTED (Latin-American Programme on Cooperation in Science and Technology) Committee on Sustainable Development and Chair of COST (European Cooperation in Science and Technology) Committee on Food and Agriculture. He also works as a Scientific Advisor for the State Research Agency, where he manages several agri-food ERA-Nets.

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