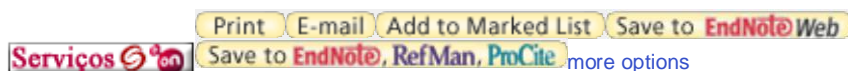


Survey of Chickpea Rhizobia Diversity in Portugal Reveals the Predominance of Species Distinct from *Mesorhizobium ciceri* and *Mesorhizobium mediterraneum*



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Source: MICROBIAL ECOLOGY **Volume:** 58 **Issue:** 4 **Pages:** 930-941 **Published:** NOV 2009

Times Cited: 0 **References:** 52  [Citation Map](#)

Abstract: Several *Mesorhizobium* species are able to induce effective nodules in chickpea, one of the most important legumes worldwide. Our aims were to examine the biogeography of chickpea rhizobia, to search for a predominant species, and to identify the most efficient microsymbiont, considering Portugal as a case study. One hundred and ten isolates were obtained from continental Portugal and Madeira Island. The 16S ribosomal RNA gene phylogeny revealed that isolates are highly diverse, grouping with most *Mesorhizobium* type strains, in four main clusters (A-D). Interestingly, only 33% of the isolates grouped with *Mesorhizobium ciceri* (cluster B) or *Mesorhizobium mediterraneum* (cluster D), the formerly described specific chickpea microsymbionts. Most isolates belong to cluster A, showing higher sequence similarity with *Mesorhizobium huakuii* and *Mesorhizobium amorphae*. The association found between the province of origin and species cluster of the isolates suggests biogeography patterns: most isolates from the north, center, and south belong to clusters B, A, and D, respectively. Most of the highly efficient isolates (symbiotic effectiveness > 75%) belong to cluster B. A correlation was found between species cluster and origin soil pH of the isolates, suggesting that pH is a key environmental factor, which influences the species geographic distribution. To our knowledge, this is one of the few surveys on chickpea rhizobia and the first systematic assessment of indigenous rhizobia in Portugal.

Document Type: Article

Language: English

KeyWords Plus: RIBOSOMAL-RNA GENE; ARIETINUM-L; SP-NOV; MOLECULAR CHARACTERIZATION; NATURAL-POPULATIONS; SEQUENCE-ANALYSIS; SYMBIOTIC GENES; DIFFERENT AREAS; STRAINS; TIANSHANENSE

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