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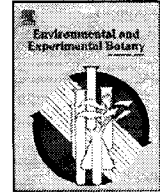
**25. © Functional traits related to seedling performance in the Mediterranean leguminous shrub *Retama sphaerocarpa*: insights from a provenance, fertilization, and rhizobial inoculation study.** Villar-Salvador, P., Valladares, F., Dominguez-Lerena, S., and Ruiz-Diez, B. Environmental and Experimental Botany 64:145-154. 2008.



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# Functional traits related to seedling performance in the Mediterranean leguminous shrub *Retama sphaerocarpa*: Insights from a provenance, fertilization, and rhizobial inoculation study

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### ABSTRACT

We studied functional traits related to survival and growth in seedlings of the Mediterranean leguminous shrub *Retama sphaerocarpa* (L.) Boiss. Plants from five provenances were grown at two contrasting fertilization rates. In one of the provenances, low-fertilized plants were also inoculated with a *Bradyrhizobium* strain to assess the influence of nodulation on seedling performance. Seedlings were transplanted onto an abandoned cropland and their growth and survival rates were measured for two years. Additionally, the persistence of the inoculated strain in the field was tracked using genetic methods. Fertilization produced two phenotypes of contrasting performance. High fertilization produced large plants with high nutrient concentration, photosynthetic rate, and root growth capacity. Plants with this phenotype had higher transplanting survival, growth, and water use efficiency than the plants of the low-fertilized phenotype, which were small and had low nutrient concentration, photosynthetic rate and root growth capacity. Provenances differed in relative growth rate (RGR) under optimal growing conditions and these differences were negatively related to the length of the growing season and positively related to the precipitation at the places of origin of seeds. Across provenances, transplanting survival and growth was positively related to the shoot carotenoid concentration. However, this relationship was only observed among low-fertilized seedlings. Among low-fertilized plants, nodulation did not increase either transplanting survival or growth significantly. The *Bradyrhizobium* strain used to inoculate seedlings survived at least two years in transplanted inoculated plants in spite of the presence of other native rhizobial strains in the field. In conclusion, high transplanting performance of *R. sphaerocarpa* seedlings is linked to a suite of attributes that promote fast seedling establishment during the wet season, which probably enhances drought avoidance during the dry season and helps avoid photoinhibition during the summer drought.

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### 1. Introduction

Water and nutrient stress are important constraints for plant life in Mediterranean ecosystems and seedlings represent the most vulnerable stage of a plant's life cycle (Castro et al., 2004). Many studies have assessed the physiological and structural adaptations

and acclimation mechanisms of plants to these factors (see Levitt, 1980; Chapin et al., 1993 and references therein). It is commonly accepted that certain functional attributes increase resistance to drought and nutrient stress. For instance, high allocation of biomass to roots at the expense of shoot growth (low shoot to root mass ratio) or the production of extensive and deep roots are mechanisms that enhance water acquisition and utilisation efficiency and therefore play an important role for plant survival in dry climates. However, few studies have analysed which functional attributes are related to seedling establishment in dry climates and results are frequently contradictory. In an interspecific comparison of Mediterranean chamaephytes and small shrubs in the field, species with seedlings that had low shoot to root mass ratio had greater survival than species with seedlings that had high shoot

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