

Exploring grass pea (*Lathyrus sativus* L.) breeding potential in Mediterranean changing climate conditions

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Grass pea (*Lathyrus sativus* L.) is an annual cool-season, stress-resilient grain legume, able to thrive in unfavourable growing conditions. It is cultivated worldwide, under different production systems, with two main ecotypes, one with dark and small seeds, from Asian countries, and another with light and large seeds, from Mediterranean countries. In particular, in the Mediterranean region, with climate change increasing weather instability on the otherwise mild wet winters and hot dry summers, there is a fundamental need for productive, more resilient plant varieties. With the present study, we aimed to identify, among a representative collection of grass pea worldwide genetic potential, new sources of interesting morpho-agronomic traits to breed for increased adaptation to unstable environments.

To fulfil this, we trialled a worldwide grass pea collection of 182 accessions, across four seasons in Alvaiázere, Portugal, a Mediterranean climate region, traditionally cultivating grass pea. We characterized the accessions using three plant growth-related, three inflorescence-related, five seed-related, four yield-related, and one *Bruchus* weevil resistance-related traits. Using linear mixed models, we accessed the diversity among accessions, as well as the genotype, the environment/growing season, and the genotype x environment variance effects. A principal component analysis was performed to summarize multivariate similarities among grass pea accessions and/or growing seasons. Additionally, we estimated the main ecotype clustering parameters, seed traits and geographical origin effects, on the measured traits.

Great diversity was observed among accessions for all measured traits. Moreover, and for the majority of the traits, the effect of the growing season was the most important, although significant genotype and genotype x environment interaction effects were also observed. The yield (as seed weight/plant), was highly influenced by the environment, decreasing significantly in cooler years. Yield was higher on large and light seed accessions, but no significant yield differences were detected across geographical origins. Mediterranean germplasm still conserve high diversity especially for seed related traits, conferring it high potential for breeding progress. However, South Asian accessions showed the highest number of seeds/plant, and plant height at first flower, two of the most important yield components in this study, whereas Sub-Saharan African accessions showed the earliest phenology and lower susceptibility to *Bruchus* pest. These last two traits, together with yield potential, are of great interest under the present Mediterranean climate change threats (increase terminal drought and increased frequency and intensity of pests' outbreaks), being their donor accessions valuable resources for present Mediterranean grass pea breeding.

Keywords: Germplasm evaluation, morpho-agronomic traits, pre-breeding.