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ROOT ARCHITECTURE CHARACTERIZATION OF A LENTIL CORE COLLECTION TO BOOST THE BREEDING IN MEDITERRANEAN AREA

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Lentil (*Lens culinaris* subsp. *culinaris*) is a globally cultivated legume valued for its protein content, agronomic versatility and role in sustainable cropping systems. In 2023 it was grown on more than 5.68 million hectares with a global production of 7.01 million tonnes confirming its strategic importance. However future projections highlight an increased risk of drought stress especially in regions dependent on rainfall. In this context root system traits emerge as critical determinants of crop performance as they govern water and nutrient acquisition under limiting conditions. The aim of this study was to characterize the diversity in root architecture across a panel of 64 lentil genotypes developed via single seed descent and selected from the INCREASE project core collection. Selection was based on passport genotypic and phenotypic data to ensure a wide range of genetic backgrounds and environmental origins. The experiment was conducted under controlled conditions at Forschungszentrum Jülich (Germany), in soil-filled rhizotrons. Plants were cultivated for 26 days and monitored using the *GrowScreen Rhizo3* phenotyping platform which allowed daily automated imaging of root and

shoot growth. A randomized block design was used with three replicates per genotype. We measured several traits related to belowground and aboveground development including primary and total root length, root system width, convex hull area and biomass accumulation. Statistical analyses showed significant genotypic effects across most of the measured traits, confirming extensive phenotypic variability within the panel. These results highlight the presence of genotypes with contrasting root profiles ranging from compact to highly exploratory systems. Such variation can be directly exploited to improve drought tolerance in breeding pipelines. In particular deep rooting and efficient lateral expansion represent promising strategies to access water from different soil layers depending on the target environment. This research contributes to a better understanding of lentil root system diversity and provides a foundation for selecting genotypes adapted to stress prone conditions. The approach used here demonstrates the power of automated phenotyping platforms to support genetic improvement by enabling precise and high-throughput trait measurement. Ultimately these results reinforce the importance of root traits in crop resilience and yield stability and provide valuable knowledge for future breeding strategies in lentil for the Mediterranean area.

Keywords: legume crops, high-throughput phenotyping, root architecture traits, drought stress, genetic diversity