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Root morphology comparison between maize recombinant inbred lines population per se and crossed with a common tester under low phosphorus condition

(submitted by Sylvia Morais de Sousa <sylvia.sousa@embrapa.br>)
Full Author List: Negri, Barbara F[1 2]; Azevedo, Gabriel C[1 3]; Matos, Fabiano M[1]; Guimaraes, Claudia T[1]; de Sousa, Sylvia M[1]
[1] Embrapa Maize and Sorghum; Sete Lagoas, MG, Brazil, 35701-970
[2] Federal University of São João Del-Rei, São João Del Rey, MG, Brazil, 36307-352
[3] Federal University of Minas Gerais, Belo Horizonte, MG, Brazil, 31270-901

Phosphorus (P) is highly immobile in soil, therefore difficult to be acquired by plants. Low P is one of main constrains to increase maize yield in Brazil. Root traits that enhance topsoil foraging are important for P acquisition and since they are controlled by multiple genes, one useful tool for this analysis is recombinant inbred lines (RILs). Most studies regarding root traits have been done in RILs per se, but for breeders it is important to know how lines perform in crosses. We know that heterosis is of paramount importance in maize breeding and is manifested during the early stages of root development. Hence, we phenotyped a population of 145 RILs, derived from a cross between maize contrasting lines for P efficiency (L3 – efficient and L22 – inefficient), and the same RIL population crossed with a common tester (L53 - inefficient), for root traits. We used a paper pouch system with Magnavaca´s nutrient solution (low P - 2.5 uM) under a controlled environment to evaluate four root traits (length, volume, diameter and volume of fine roots) and shoot and root dry weight. High heritability and low coefficient of variation were detected for all analyzed traits for both populations after 13 days of treatment. As expected, the hybrids showed higher values for all traits. Interestingly, all traits correlated significantly between RILs per se and crossed. Based on the correlation between root traits and dry weight, we could observe that plant investment in root turned into shoot biomass. Thus the metabolic cost seems to be advantageous in this case. Additionally, Principal Component Analysis (PCA) enabled us to differentiate contrasting maize populations based on the selected traits. PC1 had positive eigenvector coefficients for all variables, except for root diameter. PC1 was explained most by all traits, except root diameter and PC2 was explained mostly by root diameter. These phenotypic results will be used in the discovery of root morphology quantitative trait loci (QTLs) that are also involved on P acquisition efficiency in maize and also help to develop cultivars that use less fertilizer.

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