A high throughput early screening platform for selection of phosphorus efficient maize genotypes

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Abstract:
Phosphorus (P) is an essential nutrient to the plants and is acquired from the rhizosphere solution as inorganic phosphate (Pi), primarily in the form of H2PO-4. In tropical soils, Pi concentration in the soil solution is often low and its diffusion strongly limited by fixation to aluminum and iron oxides in the clay fraction. Hence, P is one of the least available mineral particularly in highly weathered, tropical soils, limiting substantially plant growth. An interesting approach to circumvent P deficiency in tropical areas is to explore the genetic diversity available in plants to breed cultivars more efficient in P acquisition. This study aimed to standardize the growth conditions in nutrient solution and to define phenotypic traits for a high throughput early screening platform in order to select maize genotypes more efficient in P acquisition. Field phenotyping results under low and high P conditions showed that genotype L3 has a higher P acquisition efficiency than L22. These two contrasting genotypes were used for nutrient solution phenotyping standardization. These results indicated that morphological characteristics as P content in shoots, root:shoot dry weight, root volume and fine roots (1-2 mm) after 12 days of growth under 2.5 µM P in Magnavaca´s solution seemed to be the best parameter for early selection of maize genotypes under P deficiency. Also an imaging system was improved, permitting a faster quantification of the entire root system. Expression profile suggested that Rtcs, Rth3 and Bk2 would be good candidate genes for additional screening criteria of P efficient maize genotypes. The genetic studies showed that most of the root characteristics had a high heritability and a low coefficient of variation. Moreover, a high correlation was found among root morphology traits, whereas no correlation was detected between hybrids and inbred lines for those traits. Thus, these results are essential to proceed an early selection for P efficiency in maize and to support advanced molecular and physiological studies, culminating on the generation of maize cultivars more efficient in fertilizers use.

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