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Changes in Root Morphology and Organic Acids Extrusion Related to Differential P Acquisition by *Brassica* Cultivars

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Abstract

Wide spread P deficiency around the globe and its low use efficiency in agriculture impels to exploit genetic variation among crop species/varieties to increase P use efficiency. Sixteen *Brassica* cultivars were studied for evaluating genetic differences for P acquisition from sparingly soluble phosphate rock (PR) and soluble mono ammonium phosphate (MAP). Plant biomass production and P content were significantly ($p < 0.01$) different among cultivars. Four cultivars (Rainbow, Peela Raya, CON⁻¹ and Dunkeld) were studied to identify traits responsible for such contrasting differences. These cultivars were grown low P soil for 40 d under control conditions. Cultivars supplied with two types of P sources differed significantly for biomass production, total root length, specific root length, P and Ca contents both in shoots and roots, and ash alkalinity. Cultivars, Rainbow and Dunkeld, accumulated higher biomass as well as P contents with either P source. To study differences in organic acids extrusion under P deficiency, these cultivars were grown in nutrient solution and after 40 d organic acids were collected. Cultivars varied significantly for total as well as different organic acids when grown with either deficient or adequate P levels. Longer roots and higher quantities of exuded citric acid, malic acid and butaric acid were measured for Rainbow and Dunkeld. Shoot dry matter production had a significant positive correlation with root dry matter ($r=0.85$, $n=32$, $p < 0.01$), root length ($r=0.59$, $n=32$, $p < 0.05$) and root P uptake ($r=0.95$, $n=32$, $p < 0.01$). Efficient P immobilisation in PR by the two cultivars was associated with their longer roots and more exudation of citric acid.

Keywords: citric acid exudation, phosphorus