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High phosphorus rapidly increase squash root magnesium, sodium and calcium concentration

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Previous studies in our laboratory have shown a significant impact of phosphorus nutrition on mineral element dynamics in plant roots and shoots (Reinbott and Blevins 1991, 1994, 1999). We hypothesize that increased P availability increases ATP concentration, driving rapid increases in root concentration of several cations by stimulating the proton pump and opening gated ion channels. Considering the rapid turnover of ATP in plant tissues, P-induced changes in root mineral element concentrations should be observed in a relatively short time. Therefore, experiments were designed to evaluate the effect of P on root tissue cation concentrations over the time course of 30 min to 8 hrs. Squash plants were grown hydroponically in a complete nutrient solution (500 μM P) for six days, following by four days with 50 μM P. Treatments of 50 and 500 μM P were started on day 10 and roots were harvested after 0, 0.5, 1, 2, 4, and 8 hours. Roots were rinsed in DI H_2O , blotted, frozen in liquid nitrogen, and freeze-dried. Freeze-dried samples were ground, digested in nitric acid using a closed-vessel microwave system, and macro- and micronutrient concentrations were determined using ICP-OES. As expected, higher P in nutrient solution resulted in higher P concentrations in squash roots. This increase was first observed after 2 hrs. As for other cations, high P increased leaf magnesium, sodium, and calcium concentrations, and decreased zinc and potassium concentrations. Interestingly, the change in concentration of all these elements was observed within 30 min. This is, to our knowledge, the first study showing a short-time impact of P nutrition on root cation composition. It supports the hypothesis of the role of P in cation uptake.