Phosphorus–induced zinc deficiency in vegetable grown in weak acid soils in typical vegetable growing areas of Dianchi catchment

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Zinc (Zn) deficiency not only affects the growth of vegetables, but has also an impact on the nutritional quality as Zn is an essential mineral nutrient for both, plants and humans. Zn deficiency in vegetables is more common on calcareous soils, but may also occur on acidic soils because of a phosphorus (P)-zinc antagonism induced by excessive P enrichment, for example after excessive P fertilization and on bio-geochemical basis. In total, 28 sites within an area of 7.46 km^2 was selected for taking samples of rhizosphere soil, fine root, and leaves of vegetables (*Pisum sativum, Broccoli, Cucurbita pepa, Zea Mays*) at each site in order to to examine the P-Zn relationship in the rhizosphere soil, fine roots, and vegetable leaves. There was a linear positive relationship between the Zn content in fine roots and the Zn content in leaves (R^2=0.96, p< 0.001). A power function existed for the relationships between the P content in fine roots (x) and the Zn content in fine roots and/or leaves (y), and the P content in the rhizosphere soil (x) and and the Zn content in fine roots and leaves(y), respectively (Figure 1, and Figure 2). The P-induced Zn deficiency threshold value was 2.65 mg/g P in the soil based on a critical nutrient value for Zn that characterizes Zn deficiency of 35 mg/kg Zn in vegetable leaves. In 43% of all samples the soil P status was higher than the threshold value of 2.65 mg/g P and the Zn concentrations in the vegetable leaf material below 35 mg/kg Zn. Soil P enrichment could be contributed to biogeochemical P enrichment (phosphorus ore) and excessive P fertilization. Thus it is important to correct Zn deficiency in vegetables in order to improve the nutritional quality and to prevent a Zn deficiency induced decline of nitrogen use efficiency which in return will increase nitrogen losses into water bodies.

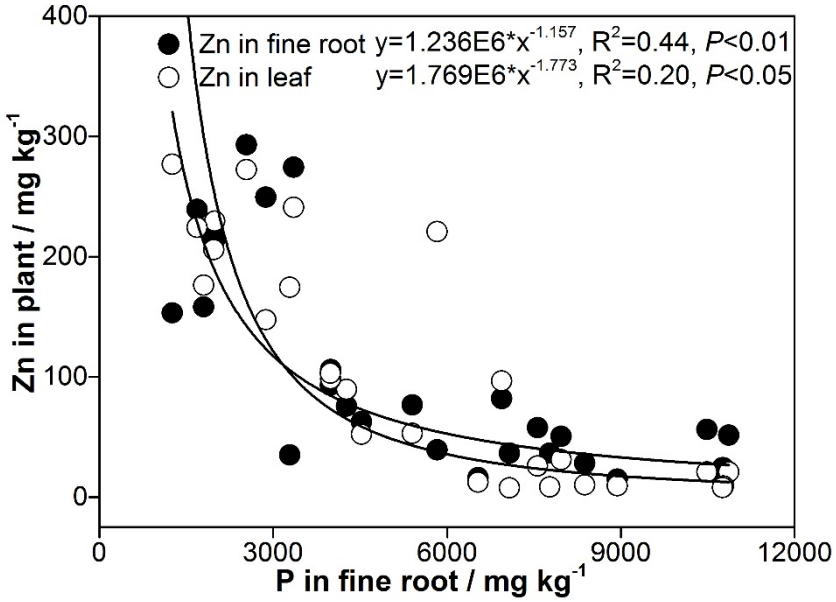

Figure 1. Relationship between the P content in fine roots and the P and Zn content in fine roots and leaves of vegetables.

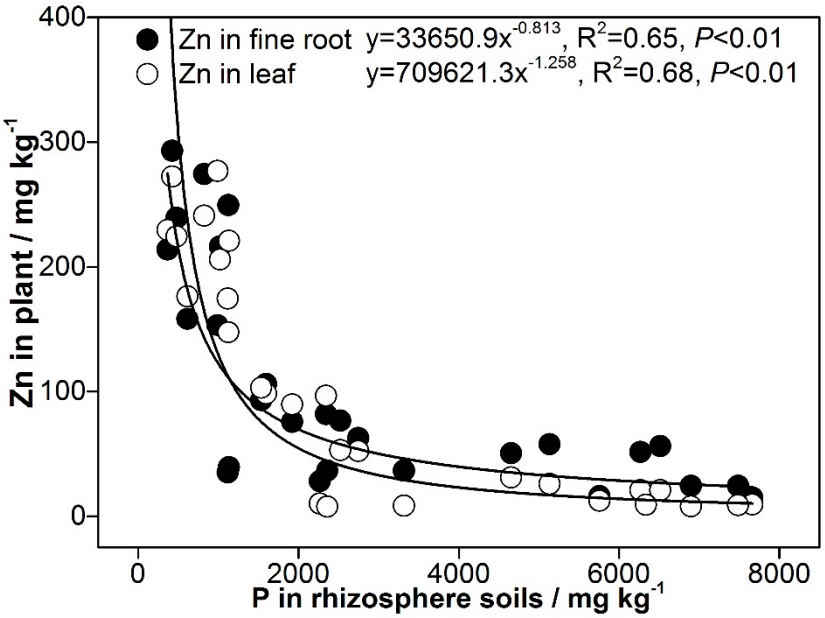

Figure 2. Relationship between the P content in the rhizosphere soil and the Zn content in fine roots and leaves of vegetables.