

Quantitative analysis of phosphorus, iron, and arsenic in the roots or root apoplast of barley grown on water medium with arsenic and iron

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Abstract

An experiment with arsenic (As) and barley (*Hordeum vulgare* L. cv. Minorimugi) grown hydroponically was conducted to observe the effects of phosphorus (P) status on the formation of iron (Fe)-plaque. Plants were grown for 16 days treated with 10 μM As in presence or in absence of P. A set of treatment was without As and P. Phosphorus was used as ammonium phosphate ($\text{NH}_4\text{H}_2\text{PO}_4$) and As was used as sodium meta-arsenite (NaAsO_2). The 1/2-strength nutrient solution was used at pH 5.5. Plants were treated with 10 μM As + 500 μM P, 10 μM As + 250 μM P, 10 μM As + 50 μM P, 10 μM As + 0 μM P and 0 μM As + 0 μM P for 16 days. Iron-plaque with root reddish color was clearly visible in barley roots grown in As-treated and P-depleted condition. However, Fe-plaque with reddish color was not found in P-depleted and As containing medium, suggesting that As played a vital role in the formation of Fe-plaque in P-depleted condition. Intensity of reddish color intensity increased with decreasing P concentration in the medium. Apoplastic-Fe together with other elements were extracted by the method of Bienfait et al.. Contents of macro and microelements occurred as Fe^{3+} -complex in apoplast and in roots were determined. Particular emphasis was given on the concentration of P, Fe and As. Arsenic decreased root dry weight (DW) with decreasing P concentration in the medium. Detectable amount of P was not found in apoplastic portion in all treatments, indicating that P might not be complexed with apoplastic-Fe. Phosphorus may be present inside of roots as organic or inorganic phosphate. Iron was mostly concentrated in apoplast. However, As was mostly concentrated in roots and a little portion was found to be complexed with Fe^{3+} in the apoplast. Our result suggested that P might repress the formation of As-Fe complex in the apoplast, somehow.