Proteomic and metabolic profiles of *Beta vulgaris* root tips: changes induced in response to iron deficiency and resupply

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Abstract

Root tips of sugar beet grown in hydroponics under Fe deficiency show marked morphological and metabolic changes that can be partially reverted after Fe resupply [1, 2]. In this work a comprehensive analysis of the metabolic and proteomic changes observed in sugar beet root tips with Fe deficiency and Fe resupply has been carried out. Root tip samples were taken from Fe-sufficient (grown with 45 µM Fe(III)-EDTA), Fe-deficient (grown with 0 µM Fe), and Fe-resupplied plants (24 and 72 hours after Fe resupply with 45 µM Fe(III)-EDTA). Proteome maps with approximately 150 spots were obtained by two-dimensional electrophoresis (IEF-SDS PAGE). Iron deficiency induced significant intensity changes in a large number of these polypeptides, many of them associated to carbohydrate catabolism. A protein identified as DMRL synthase was very abundant in root tips from Fe-deficient sugar beet and was not detectable in Fe-sufficient roots. This protein was found to be regulated transcriptionally by Fe status. Metabolites were analyzed in root tip extracts by GC-MS, following the recommendations described by the Metabolomics Standards Initiative [3]. Seventy-seven metabolites included in the Fiehn Library (http://fiehnlab.ucdavis.edu/Metabolite-Library-2007) were present in sugar beet root tip extracts. Multivariate statistical analyses, using unsupervised principal component analysis (PCA) and supervised partial least square (PLS), were performed. Score scatter plots using the first two components provided a good separation of the different treatments, with metabolites in the 72 hours after Fe resupply treatment being closer to those present in the initial Fe-sufficient conditions. Main metabolite changes were in agreement with previous results [1]. For example, an increase in the amounts of many TCA cycle intermediates was observed in the Fe-deficient root tips. Also, an increase in the amount of the raffinose series of oligosaccharides (RSOs), including raffinose, galactinol and *myo*-inositol was observed in Fe-deficient and 24 hours Fe-resupplied plant roots. This has never been described before in plants under Fe deficiency. Another 46 still unidentified metabolites showed significant concentration changes in root tips of Fe-deficient and Fe-resupplied plants when compared with Fe-sufficient plants.

[1] López-Millán *et al*. (2000) *Plant Physol.* **124:** 885
[2] López-Millán *et al*. (2001) *Australian J Plant Physiol.* **28:** 171.
[3] Fiehn *et al*. (2008) *Plant J.* **53:** 691.

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