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S4-OR-01 MECHANISM AND REGULATION OF CHLOROPLAST IRON UPTAKE

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Chloroplasts are primary targets of iron accumulation in the plant shoot. If the availability of Fe is limited, the development and function of the photosynthetic apparatus is also retarded resulting in Fe chlorosis symptoms. Though some chloroplast Fe uptake and metabolism related genes and chloroplast envelope membrane proteins were identified in the past ten years, mostly in *Arabidopsis*, the mechanism and regulation of Fe uptake into chloroplasts is still not understood completely. The Fe content of chloroplasts strongly decreased under both Fe deficiency and Cd induced shoot Fe deficiency, whereas only a slight increase was found in the chloroplast Fe content under Fe surplus. The Fe uptake capacity of isolated chloroplasts decreased under Fe deficiency but remained nearly unchanged under Fe surplus, thus the higher external Fe concentration did not inhibit the Fe uptake of chloroplasts. Cd induced Fe deficiency in the shoot could be regenerated by elevated Fe supply of the plants. Fe enriched nutrient solution induced an intensive Fe uptake and translocation to the shoot that finally led to the accumulation of Fe in the chloroplasts and recovery of photosynthetic structures and activity. The Fe uptake of chloroplasts directly proportional to the Fe translocation to leaves referred to the dependence of chloroplast Fe uptake on the amount of available Fe in the cytoplasm. Cd itself did not have any inhibitory effect on chloroplast Fe uptake *in vivo*. Even more, Cd and other divalent transition metal cations enhanced the Fe uptake capacity of isolated chloroplasts, while oxoanions inhibited it. These latter effects are likely related to outer envelope-associated processes. Thus, a voltage-dependent step is proposed to play a role in the Fe transport through the chloroplast outer envelope. Among others, a ferric chelate oxidoreductase family protein (AtFRO7 in *Arabidopsis*) localized in the chloroplasts inner envelope membrane proved to have an important role in chloroplast Fe uptake. Chloroplast FRO uses photosynthetically produced NADPH to reduce ferric chelates before Fe uptake, thus serves as a direct link between photosynthesis and Fe acquisition of the chloroplasts. In our recent studies, Fe deficiency decreased and Fe surplus slightly increased the expression of *Brassica napus Fro7* (close relative to *Arabidopsis*). Nevertheless, the treatments also caused alterations in the detailed expression kinetics during leaf development. The direction and level of alterations in the expression of *BnFro7* under the treatments were comparable to the changes of the ferric chelate reductase activity of chloroplast inner envelope membranes referring to transcriptional regulation.

Keywords: chloroplast, envelope membranes, ferric-chelate oxidoreductase, iron uptake

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