

# Relationship between Changes in Ion Content of Leaves and Chlorophyll-Protein Composition in Cucumber under Cd and Pb Stress

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Hydroponically cultured cucumber plants supplied with 4  $\mu\text{M}$  Fe chelated either with EDTA or citrate and treated with Cd (10  $\mu\text{M}$ ) and Pb (10, 50  $\mu\text{M}$ ) from their one- or four-leaf stage were grown up to five-week-old age. The decrease in the chlorophyll content was the most pronounced in plants treated with Cd from a younger age, and in the case of Fe-citrate. The chlorophyll *a/b* ratio of Cd stressed plants was also significantly lowered. In later treated plants the accumulation of chlorophyll was inhibited and the chlorophyll *a/b* ratio decreased only in the vigorously growing young leaves. Pb treatment had only a slight effect on both parameters. The changes in the chlorophyll-protein pattern of thylakoids were strongly related to their chlorophyll content but the response of each complex was different. Cd reduced the amount of chlorophyll containing complexes in the order of photosystem I > light-harvesting complex II > photosystem II-core, while light-harvesting complex II appeared somewhat more sensitive than photosystem I in Pb treated plants. In accordance, a decline or blue shift of the long wavelength fluorescence emission band of chloroplasts was observed referring to disturbances also in photosystem I antenna assembly. The accumulation of chlorophyll and chlorophyll-proteins did not show close relationship to the heavy metal content of leaves which was the highest in the first of the intensively expanding leaves in the time of the treatment. The extraordinary sensitivity of photosystem I, and the relative stability of photosystem II under Cd treatment were similar to the case found in iron deficient plants. However, the pattern of chlorophyll content of leaf storeys of Cd treated plants rather followed the changes in their Mn content.