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Salinity Induces Granal Development in Bundle Sheath Chloroplasts of NADP-Malic Enzyme Type C₄ Plants

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Abstract: In NADP-malic enzyme (NADP-ME) type C₄ plants, MC chloroplasts have well-developed grana, whereas BSC chloroplasts are generally characterized by highly reduced grana. In the previous study, salt treatment induced granal development in BSC chloroplasts of *Zea mays*, an NADP-ME type C₄ plant. Therefore, we examined the effects of salinity stress on the granal structure of BSC chloroplasts in seven other C₄ species belonging to the NADP-ME type. The plants were grown in soil and after a certain period of time, they were treated with 3% NaCl for 5 d. Ultrastructure and quantitative properties of chloroplasts at the middle part of leaf tissues were investigated. In BSC chloroplasts of all the C₄ species, almost no structural damage was observed, but the development of granal stacking was induced under salinity condition. Granal indices and appressed thylakoid density of BSC chloroplasts in the salt-treated plants were higher than those in the control plants. In all the species, the structure of MC chloroplasts was more or less damaged by salt stress; thylakoids were swollen and chloroplast envelope was disorganized. These results suggest that the granal development in BSC chloroplasts and the high damage of MC chloroplasts are common features of NADP-ME type C₄ plants under salinity stress.

Keywords: [Bundle sheath](#), [C₄ plants](#), [Chloroplast](#), [Grana](#), [Mesophyll](#), [Salinity](#)

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