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Photosynthesis, Dark Respiration and Protein Synthesis of Rice Leaves at Low Temperature : Analysis of Ribulose-1, 5-Bisphosphate Carboxylase

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Abstract:
The effects of low temperature on photosynthesis, dark respiration and protein synthesis in developing fourth-leaf blades of rice (Oryza sativa L.) seedlings were investigated. Photosynthesis and respiration were measured with an oxygen electrode system, and protein synthesis was analyzed by SDS-polyacrylamide gel electrophoresis, fluorography and immunoprecipitation of ribulose-1, 5-bisphosphate carboxylase (RuBPC) after in vivo labeling of leaf proteins with [^{35}S]methionine. When the rice seedlings were grown at a low temperature of 15°C for 10 days, the photosynthetic rate was severely inhibited, whereas the dark respiration rate of the stressed plants was even higher than the control plants grown at 25°C. The de novo synthesis of total proteins was also inhibited by low temperature, and the distribution of synthesized proteins drastically changed with growth and incubation temperatures, especially in the proteins related to photosynthesis. An immunological analysis of RuBPC revealed that synthesis of the RuBPC proteins was suppressed more severely than the other soluble proteins at low temperature, and that the synthesis of large subunits of RuBPC was more sensitive to the temperature treatments than that of small subunits. These results indicate that the synthesis of RuBPC proteins, especially in the part associated with chloroplasts, is specifically susceptible to low temperature, and that this may be one of the causes of retarded photosynthesis and the poor development of leaves on rice plants grown at low temperatures.

Keywords:
Dark respiration, Oryza sativa L., Photosynthesis, Protein synthesis, Ribulose-1,5-bisphosphate carboxylase, Rice

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