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Chlorophyll fluorescence and Antioxidative Enzyme Activity of *Crinum* Leaves Exposed to Winter Stress

Soonja Oh*, Kook Lhim Chin and Seok Chan Koh
Department of Life Science & Research Institute for Basic Sciences, Cheju National University

1. Introduction

Low temperature is the major factor limiting the productivity and geographical distribution of plant species, and it can inhibit several metabolic processes seriously and thus can be stressful to plants. This stress is particularly severe in plants with a tropical or subtropical evolutionary background. In the present study we investigated chlorophyll fluorescence and antioxidative enzyme activity in leaves of subtropical plants, *Crinum asiaticum* var. *japonicum,* growing under the natural habitat.

2. Material and Methods

Chl a fluorescence transient was measured by the Plant Efficiency Analyzer (PEA, Hansatech Ltd., UK) with an actinic light of 1,500mole/m^2/s and analysed according to the JIP-test (Strasser and Strasser, 1995). Chl a fluorescence imaging was performed using a commercial imaging fluorometer (Fluorcam 700MF, P.S. Instrument, Czech Repblic) described in Nedbal *et al.*(2000). The isoenzyme patterns and activities of catalase, superoxide dismutase, ascorbate peroxidase and peroxidase were determined as described by Oh and Koh (2004).

3. Results and Conclusions

Chl a fluorescence transient followed a typical polyphasic rise in summer, while in winter it was transformed to a J-I-P drop with the main effect being a time-dependent decrease in the fluorescence yield at P-step. Analysis of the JIP test developed from the O-J-I-P transient showed that winter stress led to the decrease of Fm and Fv/Fo and the increase of Sm and N. Of the structural parameters obtained from J-I-P test, the maximum quantum efficiency of PS II photochemistry (Φpo) was significantly low in late winter, while the efficiency that a trapped exciton can move an electron into the electron transport chain (Ψo) was high during the period of winter. And the quantum yield of

electron transport chain (Φeo) maintained higher in winter than in summer. However, the density of the active reaction center per excited cross section (RC/CS) decreased significantly in winter. Furthermore, the maximum yield of excitation energy trapping by PS II (Φpo) decreased irreversibly in winter in contrary to its diurnally reversible change in summer. These phenomena as described above were observed when the leaf disks of *Crinum* plants were exposed to low temperature and probed by chlorophyll fluorescence imaging analysis. On the other hand, the catalase activity decreased significantly depending on temperature drop when *Crinum* leaves were exposed to winter stress. However, the activities of superoxide dismutase, ascorbate peroxidase and peroxidase increased slightly with appearance of some isoenzymes in winter. These results, with the remarkable decrease of Φpo in winter, represent that *Crinum* leaves are exposed to oxidative stress and irreversibly damaged leading to cell death.

Reference

Strasser, B. J. and Strasser, R. J., 1995, Measuring fast fluorescence transients to address environmental questions: the JIP test. In: Mathis P, Ed. Photosynthesis: from Light to Biosphere, V. Dordrecht : Kluwer Academic Publishers, pp. 977-980.

Nedbal, L, Soukupova, J, Kaftan, D, Whitmarsh, J and Trtílek, M., 2000, Kinetic imaging of chlorophyll fluorescence using modulated light. Photosynth. Res., 66, 3-12.

Oh, S. J., Koh, S. C., 2004, Chlorophyll fluorescence and antioxidative enzyme activity of *Crinum* leaves exposed to natural environmental stress in winter, Korean J. Environ. Biol., 22(1), 233-241