

**Alleviation of Low-temperature Photoinhibition in Gamma-irradiated
Red Pepper (*Capsicum annuum* L.) Plants**

Advanced Radiation Technology Institute, KAERI : Jin-Hong Kim, Byung Yeoup Chung*,
Jae-Sung Kim, Seung Gon Wi, Hyo Seok Chae, Don Sun Im

Objectives

This study aims to investigate effects of gamma-radiation pre-treatment on the photoinhibition of red pepper leaves when exposed to a low temperature.

Materials and Methods

- *Plant materials and gamma-irradiation*: Red pepper (*Capsicum annuum* L. cv. Taeyang) plants were irradiated with low doses of gamma-radiation (4, 8, or 16 Gy) at 25 d after sowing (DAS). Radiation was generated by a gamma irradiator [⁶⁰Co, ca. 150 TBq of capacity; Atomic Energy of Canada Limited (AECL)] at the Korea Atomic Energy Research Institute. Plants were grown in a growth chamber with photosynthetic photon flux density (PPFD) at pot level of 330 $\mu\text{mol m}^{-2} \text{s}^{-1}$ supplied by two sodium lamps in combination with six fluorescence lamps. The growth chamber was maintained at 28/20°C (day/night) with a 14 h photoperiod.
- *Low temperature treatment*: To induce low temperature photoinhibition, leaf discs 2 cm in diameter were prepared from the first leaves at 2 h after the irradiation, the second at 1 day after the irradiation (DAI), or the third at 3 DAI, and floated on distilled water under a PPFD of 100 $\mu\text{mol m}^{-2} \text{s}^{-1}$ at 4°C for 3, 6, or 12 h, respectively.
- *Chlorophyll fluorescence analysis*: Chlorophyll (Chl) fluorescence was measured using a Chl fluorometer (IMAGING-PAM, Walz, Effeltrich, Germany) as described in the operation manual. Readings were taken after the leaf discs 5 mm in diameter were dark-adapted for 15 min at room temperature.

Results and Discussion

- The decrease in the maximal photochemical efficiency (Fv/Fm) during low temperature photoinhibition was significantly alleviated in the gamma-irradiated groups. And such an alleviatory effect was dose-dependent in the range of 4-16 Gy.
- The irradiation groups had higher values in the parameter for photochemical quenching (qP) and the apparent rate of the photosynthetic electron transport (ETR) than did the control. In contrast, the parameter for non-photochemical quenching (NPQ) was lower in the irradiation groups than in the control until 6 h of low temperature photoinhibition.
- Taken together with our previous data, the present results suggest that gamma-irradiation contributes to the increased resistance against low temperature photoinhibition through the elevated antioxidative capacity.

*Corresponding author: (Phone) 063-570-3331 (E-mail) bychung@kaeri.re.kr

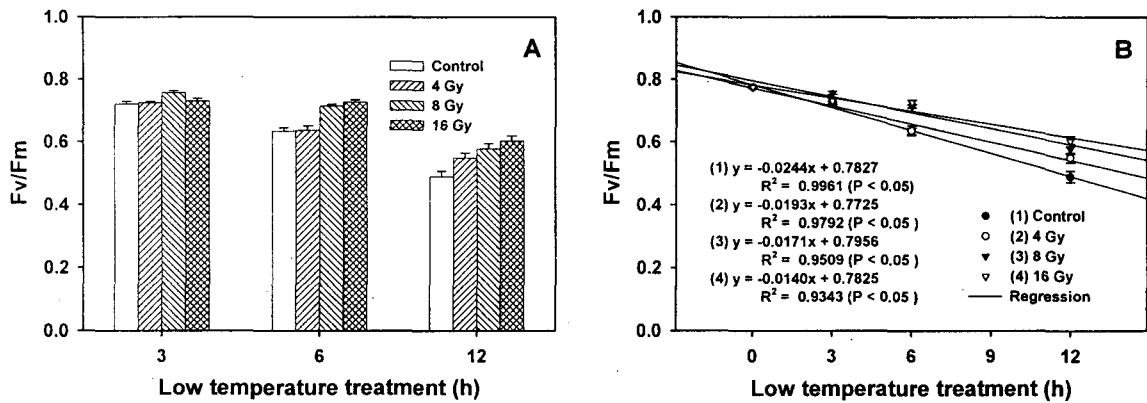


Fig. 1. Changes in the maximal photochemical efficiency (Fv/Fm) in the control and irradiated red pepper leaves during low temperature photoinhibition. All values are means \pm SE (n = 6). Regression analysis of the data was performed using SigmaPlot 2002 for Windows Version 8.02 (SPSS Inc., Illinois, USA).

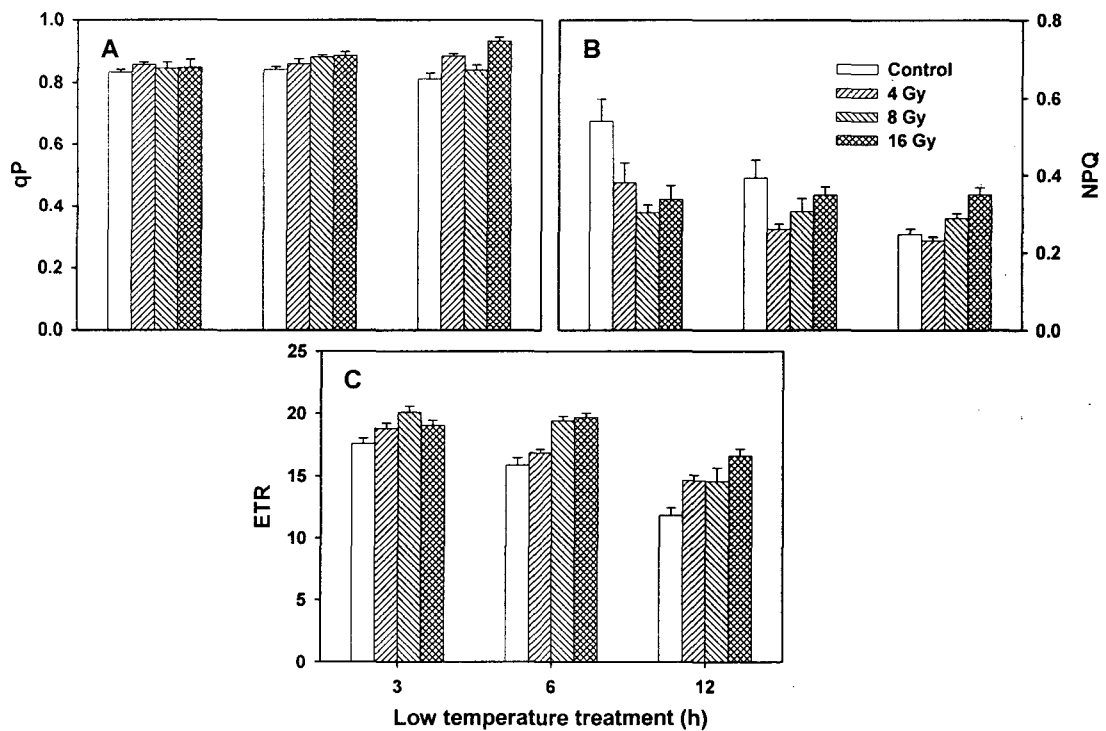


Fig. 2. Effects of gamma-irradiation on the Chl fluorescence parameters of red pepper leaves during low temperature photoinhibition. qP, NPQ, and ETR are the parameters for photochemical and non-photochemical quenching, and the apparent rate of the photosynthetic electron transport, respectively. All values are means \pm SE (3 \leq n \leq 6).