Non-Invasive Monitoring of the Light-Induced Cyclic Photosynthetic Electron Flow during Cold Hardening in Wheat Leaves

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The effect of irradiance during low temperature hardening was studied in a winter wheat variety. Ten-day-old winter wheat plants were cold-hardened at 5 °C for 11 days under light (250 μmol m^{-2} s^{-1}) or dark (20 μmol m^{-2} s^{-1}) conditions. The effectiveness of hardening was significantly lower in the dark, in spite of a slight decrease in the F_v/F_m chlorophyll fluorescence induction parameter, indicating the occurrence of photoinhibition during the hardening period in the light. Hardening in the light caused a downshift in the far-red induced AG (afterglow) thermoluminescence band. The faster dark re-reduction of $P700^+$, monitored by 820-nm absorbance, could also be observed in these plants. These results suggest that the induction of cyclic photosynthetic electron flow may also contribute to the advantage of frost hardening under light conditions in wheat plants.

Key words: Frost Tolerance, Photosynthesis, *Triticum aestivum* L.