DIFFERENCES IN THE PROTECTION MECHANISMS AGAINST CHILLING-INDUCED PHOTOINHIBITION AMONG TWO RICE AND A BARLEY CULTIVARS

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The mechanistic basis for differential sensitivities to chilling-induced photoinhibition among two rice (*Oryza sativa* L.) cultivars (an Indica type and a Japonica type) and a barley (*Hordeum vulgare* L. cv. Albori) was examined. When leaf segments were exposed to moderate illumination at 4℃, a sustained decrease in the photochemical efficiency of photosystem (PS) II measured as the ratio of variable to maximal fluorescence (Fv/Fm) was observed within several hours. An analysis of fluorescence quenching revealed a sudden drop in PSII-driven electron transport rate (ETR) and a rapid rise in the reduction state of the primary electron acceptor Q_A upon exposure to chilling in moderate light. There was no appreciable difference in the level of non-photochemical quenching (NPQ) nor in the xanthophyll cycle activity between Japonica rice and barley. However, barley was capable of sustaining a higher ETR thereby keeping a lower reduction state of Q_A throughout the chilling for 6 h. The Indica rice was characterized by the lowest ability to develop the xanthophyll cycle-associated NPQ, particularly the fast relaxing NPQ component, accompanying the highest reduction state of Q_A and photoinhibitory quenching (qI). It is concluded that the lower susceptibility of barley to chilling-induced photoinhibition than Japonica rice is attributable to its higher potential to dissipate excess light energy via a photochemical mechanism, whereas Indica rice is more sensitive to photoinhibition at a chilling temperature than Japonica rice due primarily to its lower capacity to develop an efficient non-photochemical quenching pathway.