Oxidative Stress in Cucumber (*Cucumis sativus* L.) Seedlings Treated with Acifluorfen

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Illumination of acifluorfen-sprayed and 14 h-dark-incubated cucumber seedlings with cool-white fluorescent light caused overaccumulation of protoporphyrin IX and severe oxidative stress which resulted in seedling death within 72 h. The ratio of variable fluorescence (F_v)/ maximum fluorescence (F_m), a measure of the functional status of PSII, declined by 30%, 58% and 85% after 24 h, 48 h and 72 h respectively. When 24 h-light-treated plants were transferred to dark for 24 h the F_v/F_m ratio was restored to near control levels suggesting a dark recovery from photodynamic damage. The intracellular distribution of protoporphyrin IX that accumulated in the cotyledons of acifluorfen-treated and 1 h-light-exposed plants was 22% within and 78% outside chloroplasts suggesting migration of protoporphyrin IX within one hour of exposure of plants to light. When thylakoid membranes, treated with exogenous protoporphyrin IX, were illuminated there was a reduction in photosystem II activity. Addition of L-histidine, scavenger of singlet oxygen, to illuminated thylakoid+ protoporphyrin IX mixture resulted in substantial protection of photosystem II activity suggesting the involvement of singlet oxygen in protoporphyrin IX-mediated photodynamic damage. In illuminated thylakoid+protoporphyrin IX mixture no indication was found for production of superoxide radicals via type I reaction. In cucumber seedlings acifluorfen-induced synthesis of protoporphyrin IX caused severe photodynamic damage mediated by singlet oxygen generated due to type II photosensitization reaction.