A-5 Effects of Enhanced UV-B Radiation on Terrestrial and Marine Vegetation and Zooplankton (Final Report)

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The objective of this project was to test whether a possible enhanced UV-B affects growth or yield of agricultural crops, forest tree species and marine algae and haching success and survival of ocean zooplankton, and to clarify primary mechanisms of the UV-B damage and their repair, the defence and/or acclimation mechanisms in above various plants.

Enhanced UV-B irradiation experiments to rice plants in a paddy field were carried out using a UV-B radiation system with modulated lamp output for the three years 1993 - 1995 at Tsukuba. The UV-B enhancement was up to 1.7 times ambient $UV\text{-}B_{BE}$ (biologically effective UV-B) or up to 6.8 kJ m^{-2} d^{-1} for seasonal daily integral $UV\text{-}B_{BE}$. The UV-B irradiation caused no big changes in rice growth traits including plant height, number of tillers and plant biomass, but reduced yield by up to 7%, which can be translated into a 1% yield loss by a 10% $UV\text{-}B_{BE}$ increase.

Impaired products of DNA caused by UV-B, cyclobutane pyrimidine dimers (CPD) and pyrimidine (6-4) pyrimidinone photoproducts (6-4PP), were formed in several plants, and increased with increasing UV-B fluence. Both photoproducts were repaired even in the dark, while repaired very fast under white light containing UV-A. Activity of ascorbate peroxidase, an enzyme involved in detoxication of active oxygen, in the first leaves of cucumber, was increased by UV-B irradiation, suggesting active oxygen species were induced due to UV-B stress and then may bring about cellular injury and growth reduction.

The red alga *Chrysymenia. Wrightii* body, which inhabits 5 to 8 m in depth, grown in the habitat contained UV-absorbing compounds higher concentrations at the apical portion than those at the basal portion.

The hatching success of the boreal vertical migrator of copepods, which float on surface layer during nighttime and migrates to deep layer during the daytime, decreased anti-sigmoidally with UV-B dose. On the other hand, no influence of solar UV-B radiation on hatching success and survival of the temperate and subtropical neustons of copepods, which inhabits surface layer throughout a day, was observed. UV-absorbing compounds of temperate neustones were 4 to 17 times higher than those of the temperate vertical migrator. These indicate that neustons can escape from lethal damages of UV-B by accumulation of UV-absorbing compounds.

High UV-B levels eg. 2 to 3 times solar $UV\text{-}B_{BE}$ induced morphological changes and severe growth reduction at germination stage of Glehn's spruce and Seibold's beech seedlings. The growth of young seedlings of Glehn's spruce, White fir and Seibold's beech was inhibited during the continuous UV-B irradiation over a year.