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Adaptive Responses of Soybean and Cotton to Water Stress II. Changes in CO_2 Assimilation Rate, Chlorophyll Fluorescence and Photochemical Reflectance Index in Relation to Leaf Temperature

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Abstract: Adaptive changes were studied comparatively in soybean and cotton grown in pots under four irrigation conditions i.e. normal irrigation (equal to the evapotranspiration of the crop), and 50%, 25% and 10% of the normal irrigation. In soybean, the maximum quantum yield of PSII (Fv/Fm) was generally higher while the actual quantum yield of PSII ($\Delta F/Fm'$) and CO_2 assimilation rate (A_N) were lower than in cotton. The intensity of the decrease in Fv/Fm, $\Delta F/Fm'$ and A_N by water-stress treatments was larger in soybean than in cotton. The decrease in $\Delta F/Fm'$ in soybean under water stress was accompanied by a significant increase in non-photochemical quenching (NPQ) and significant decrease in photochemical reflectance index (PRI). Chlorophyll content decreased significantly under severe water stress only in soybean. The increase in leaf temperature (T_L) in response to water stress was significantly larger in soybean than in cotton. T_L was highly and negatively correlated with Fv/Fm, A_N, PRI and $\Delta F/Fm'$ while it was highly and positively correlated with NPQ of both crops. Especially in soybean, the correlations of T_L with A_N, Fv/Fm and PRI were significant. It was concluded that soybean adapted to water stress by dissipating the excess excitation energy thermally with the down-regulation of PSII activity to protect its photosynthetic apparatus from the photodamaging effect of water stress and high T_L. This photoprotective mechanism might be supported by the paraheliotropic leaf movement of the

crop. Cotton adapted to water stress by keeping T_L lower to protect the photosynthetic apparatus from photodamage. Probably higher transpiration kept T_L of the crop lower under drought stress.

Keywords: Chlorophyll fluorescence, *Glycine max* (L.) Merr., *Gossypium hirsutum* L., Leaf movement, Photoinhibition, Photosystem II

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