THE RELATIONSHIP BETWEEN CHLOROPHYLL METER READINGS AND OPTICAL PROPERTIES OF LEAVES IN FOUR COMMERCIAL COTTON CULTIVARS

H. J. Earl
Department of Crop and Soil Sciences
University of Georgia
Athens, GA

Abstract

Simultaneous measurements of leaf gas exchange and chlorophyll fluorescence can provide information about leaf photosynthetic activity which is not obtainable using gas exchange techniques alone. For instance, thylakoid electron transport rates can be measured in sunlit leaves using fluorometry. In combination with gas exchange data, this information can be used to calculate rates of photorespiration, as well as mesophyll resistance to CO_2 diffusion from the substomatal cavity to the carboxylation site in the chloroplast stroma. In field experiments, these techniques can be used to identify specific restrictions to leaf photosynthesis occurring under stress conditions. With currently available instrumentation, gas exchange and fluorescence measurements can be made rapidly in the field. However, calculation of electron transport rates also requires knowledge of leaf absorptance of incident photosynthetically-active radiation. Measurement of leaf absorptance using an integrating sphere and spectroradiometer is often impractical in the field. The objectives of the present work were 1) to quantify the variability in leaf absorptance of greenhouse- and field-grown cotton, and 2) to determine if cotton leaf absorptance could be rapidly estimated using a hand-held chlorophyll meter (SPAD 502, Minolta). Three normal-leaf cultivars (ST 474, PM 1560 BG, DP 5690) and one okra-leaf cultivar (FM 832) were examined, at two (greenhouse) or five (field) dates over the season. In the greenhouse, leaf absorptance ranged from approximately 0.70 to 0.91, and was highly correlated with SPAD readings ($r = 0.91$). In contrast, leaf absorptance in the field varied over a much smaller range (0.85 to 0.91), and was poorly correlated with SPAD readings ($r = 0.55$). In both the greenhouse and the field experiments, the relationship between leaf absorptance and SPAD readings did not differ among the four cultivars examined. Overall, SPAD readings were found to provide a useful estimate of leaf absorptance only when leaf transmittance was greater than leaf reflectance. In cases were reflectance dominates leaf optical properties, alternate techniques such as reflectance spectroscopy should be used to estimate leaf absorptance.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:591-592 (1999)
National Cotton Council, Memphis TN