INTRACANOPY LIGHTING AS A SOLE SOURCE OF PAR AND PHAR FOR PLANOPHILE CROP CANOPIES IN CONTROLLED ENVIRONMENTS

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Mutual shading attenuates PPF below the light-compensation point within closed canopies of overhead-lighted crop stands, causing loss of productivity and premature senescence of lower leaves in dense stands of planophile crops (leaves aligned perpendicular to the plane of incident light) growing in controlled environments. Deployment of low-intensity light sources within foliar canopies permits developing leaves to adapt physiologically for more efficient conversion of photon energy to the energy content of photosynthate. The usual attenuation of blue and red wavelengths in the understorey of overhead-lighted canopies is absent in intracanopy-lighted canopies. A significant delay in senescence of lower leaves occurred within cowpea (*Vigna unquiculata* L. Walp) crop stands lighted by 15-W fluorescent lamps arrayed within the canopy remote from their ballasts and switches. Lamina and petioles re-oriented so that adaxial leaf surfaces faced the nearest tubular lamp. Intracanopy lighting with low-PPF PAR yielded half as much crop biomass as did overhead lighting with high-PPF PAR, but did so consuming only 10% as much electrical energy for lighting. The heat load associated with low-irradiance intracanopy lighting raised leaf temperature no more than 2°C above ambient air temperature without activating the air-conditioning/heat-rejection system, which ran constantly with high-irradiance overhead lighting. Intracanopy lighting with relatively cool light sources that are low in mass, volume, and power requirement and which have an emission spectrum that matches absorption maxima of major pigment systems have a promising future for controlled environment agriculture on Earth and in space.