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GAS EXCHANGE AND LEAF ANATOMY OF LETTUCE IN RESPONSE TO BLUE AND RED LEDS AS A SOLE-SOURCE LIGHTING

Abstract

The sustainability of long-duration manned missions in space relies on plant-based Bioregenerative Life Support Systems (BLSSs). Providing optimal light conditions in closed environments is crucial for proper design and optimization of space-based plant growth chambers. Light-emitting diodes (LEDs) are a promising electric light source for BLSSs research because of their inherent capability to provide accurate spectral control as a function of specific crop requirements. In addition, the capability they offer to modulate light quality allows for plant photoreceptors to perceive light cues that can improve yield and nutritional attributes of food crops. The objective of this study was to quantify the effects of blue light on growth and morphology, photosynthesis (A), stomatal conductance (gs), transpiration (E), chlorophyll estimation (SPAD readings), and anatomical features of 'Waldmann's Green' and 'Outredgeous' lettuce (Lactuca sativa) grown under different red-to-blue-light ratios. Five treatments were evaluated in the study: 100% red; 7% blue + 93% red; 26% blue + 74% red; 66% blue + 34% red; 100% blue. All treatments provided an average daily light integral (DLI) of 11.5 mol·m2·d1 (200 2 mol·m2·s1 over a 16-h photoperiod). The effect of light treatments on leaf structure was measured comparing anatomical traits by using light and fluorescence microscopes equipped with camera and software for digital image analysis. The experiment was replicated four times; each experimental replication was terminated 22 d after treatment initiation. Preliminary findings suggest that regardless of treatment, A, gs, E, SPAD, and biomass production were higher for 'Waldmann's Green' compared to 'Outredgeous' plants. Treatment comparisons indicate that except for 100% blue, the increasing percentages of blue light increased A, gs, E, and SPAD, but resulted in decreased leaf area and edible biomass production. Final results from this experiment, including a discussion on the function of leaf anatomy in response to light-quality, will be presented.