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Effects of light quality on carbon assimilation/emission and growth of lettuce: use of an upgraded prototype-platform to unravel mechanisms of photosynthesis/respiration control.

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Responses of plant performances to light quality are focus of research to optimize plant indoor cultivation with artificial light. In a comparative study of lettuce grown with different light spectra, photosynthesis, root and shoot respiration, and growth traits through chlorophyll fluorimetry essays, biochemical and molecular characterization of photosystems, and plant-to-atmosphere gas exchange assessment have been measured. To answer physiological questions at the whole-plant level we tested two phenotyping platforms, one based on 3D and multispectral imaging technology and a prototype based on whole plant gas exchange analyses, capable of differentiating root from canopy gas exchange. Red and blue (RB) light maximized photosynthetic activity, but this advantage did not lead to greater biomass accumulation, which was greater in plants under red, green and blue (RGB) and further under full spectrum (FS) light. Plants subjected to the RB light regime invest less carbon in leaf blade extension and incorporate less carbon than what has been assimilated. RB leaves have a smaller PSII antenna size and the cyclic electron transport around PSI is higher, implying a lower NADPH / ATP ratio. Exposure to RB light affects plant overall metabolic biosynthetic pathways at the expense of growth, while RGB and especially FS light, by not triggering this acclimation, are more suited to constant low light growing conditions, as those usually provided by indoor growing technologies.

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