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Response of Rice to Changes in the Green and Far-Red Light Ratio

Marc Schmierer, Ezequiel Bruguera, Folkard Asch

University of Hohenheim, Institute of Plant Production and Agroecology in the Tropics and Subtropics, Germany

Abstract

Plant production in artificial or semi-artificial environments such as greenhouses, growth chambers or the newly emerging "vertical farms" typically requires high levels of artificial light and calculations show that energy costs for illumination are generally the greatest cost factor for such installations. Due to their increasing electric efficiency, LED light-panels have become the standard for plant lighting in the last years. Light emission from LEDs typically covers light in a narrow 20–30 nm range of the waveband, but full spectrum white LEDs are also available. Research has shown that these white LEDs have certain benefits for plant growth compared to grow light that is composed from narrow bandwidth single colour LEDs. Although white LEDs cover the full range of the photosynthetic spectrum, the absolute levels of far red light in their spectrum is low and hence, the ratio of red to far red light (R/FR-ratio) is much higher as compared to that of sunlight. Since the R/FR-ratio is an important parameter in photobiology as it is part of plants' shade-detection mechanism, we were interested, if a manipulation of the R/FR ratio under illumination of white light LEDs has an effect on growth and morphology of plants. As current research also indicates that the ratio of green light in the spectrum could also play a role in shade-detection, we conducted an experiment including 3 morphologically contrasting rice genotypes (a dwarf, a full-dwarf and a super-dwarf line). We equipped 12 ventilated tubes (15 cm diameter, 48 cm height) with a white LED (8 Watt). The R/FR-ratio and the level of green radiation in the spectrum were increased by adding a far red or green LED respectively to each 4 of the tubes. Plants were harvested after 4 to 6 weeks and biomass production and allocation, morphological features and gas exchange parameters were accessed. Results indicate no clear effect of the manipulated light qualities on plants and differences in biomass production found in one variety did not establish in the others. Results will be presented in more detail and a technical explanation of the experimental setup will be given.

Keywords: Green light, LED, R/FR-ratio, rice, superdwarf rice

Contact Address: Marc Schmierer, University of Hohenheim, Inst. of Plant Production and Agroecology in the Tropics and Subtropics, Stuttgart, Germany, e-mail: marc.schmierer@gmail.com