The Effect of Single Wavelength Red and Blue Laser Lights on Growth of the Arabidopsis thaliana Plant

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Mankind is challenged to ensure sustainability in providing food and water at affordable prices. The problem becomes more complex with the growth in global population, especially in difficult natural environments, like Saudi Arabia. Indoor horticulture with artificial illumination is an effective solution. The purpose of this research is to develop a novel system of diffused single wavelength red and blue laser lights towards the use as an energy-efficient laser-based illumination system. The coherent laser lights were mixed and guided through specially designed optic modules comprising of dichroic mirrors, a beam expander, and collimators before being channeled via optical fibers through a diffuser that is installed at the roof of the chamber. The laser lights were tested on the model plant, Arabidopsis thaliana, for 42 samples over a sum of 3 trials, using a ratio of 90% red light (671 nm) to 10% blue light (435 nm). This plant species recorded 15% lower fresh and 30% dry weights than those grown under white fluorescent lights. In addition, laser-grown plants have distinct phenotypes including lighter shades of green, earlier inflorescence, longer petiole, broader, thinner, less sharp and less hairy leaf, and the absence of anthocyanin in comparison to those grown under white lights. The Red-Blue ratio achieved slightly lower chlorophyll and carotenoid contents than those grown under white light. Overall, results suggest that plants can grow under single wavelength laser lights, serving as a platform for future expansion of this technology to commercially important crops on larger scale production capacity.

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