Light Intensity and Quality from Sole-source Light-emitting Diodes Impact Growth, Morphology, and Nutrient Content of Brassica Microgreens

Microgreens are new specialty crops of vegetables and herbs that are harvested at the base of the hypocotyl when the first set of true leaves start to emerge. These crops are used by chefs to enhance dishes, and also for the high concentrations of health-promoting phytochemicals. Due to their high market value, commercial greenhouse growers have recently become interested in producing microgreens. Crops from the genus *Brassica* are a popular choice due to ease of germination, short production time, flavors, and colors. Microgreens can be produced in greenhouses or with sole-source (SS) lighting in multilayer vertical growing systems. The traditional SS lighting used with multilayer vertical production systems can consume large amounts of electrical energy. Light-emitting diodes (LEDs) offer many advantages over conventional light sources, including high photoelectric conversion efficiencies, narrowband spectral light quality, low thermal output, and adjustable light intensities. Another potential advantage of using LEDs is the ability to select light qualities and intensities. The objective of this study was to quantify the effects of SS LEDs of different light qualities and intensities on growth, morphology, and nutrient content of Brassica microgreens.

Purple kohlrabi (*Brassica oleracea* L. var. *gongylodes* L.), mizuna (*Brassica rapa* L. var. *japonica*), and mustard [*Brassica juncea* (L.) Czern. 'Garnet Giant'] were grown in hydroponic tray systems placed on multilayer shelves in a walk-in growth chamber. A daily light integral (DLI) of 6, 12, or 18 $mol \cdot m^{-2} \cdot d^{-1}$ was achieved from commercially available SS LED arrays with light ratios (%) of red:green:blue 74:18:8, red:blue 87:13, or red:far-red:blue 84:7:9, with a total photon flux (TPF) from 400 to 800 nm of 105, 210, or 315 $\mu mol \cdot m^{-2} \cdot s^{-1}$ for 16 hours.

Regardless of light quality, as the light intensity increased from 105 to 315 $\mu mol \cdot m^{-2} \cdot s^{-1}$, hypocotyl length decreased and percent dry weight increased for kohlrabi, mizuna, and mustard microgreens (Fig 1). With increasing light intensity, leaf area of kohlrabi generally decreased and relative chlorophyll content increased. In addition, nutrient content increased under low light intensities regardless of light quality. The results from this study can help growers to select light intensities and light qualities from commercially available SS LEDs to achieve preferred growth and nutrient characteristics of Brassica microgreens.

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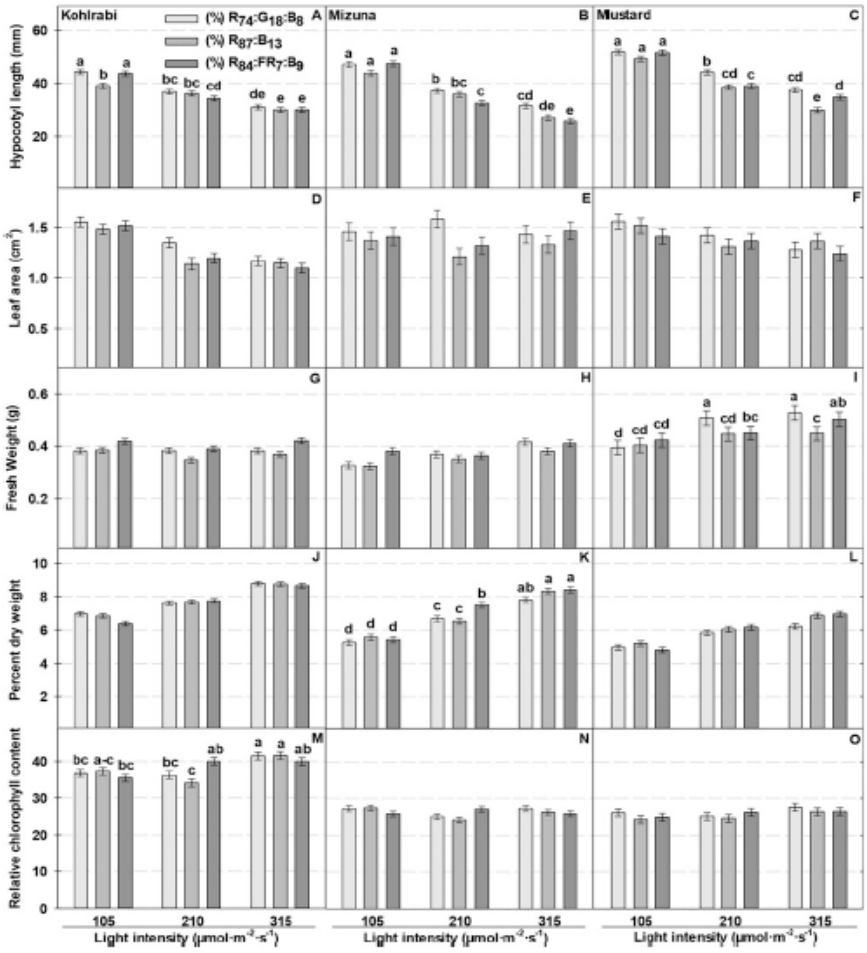

Fig. 1. Hypocotyl length (A–C), leaf area (D–F), fresh weight (G–I), percent dry weight (J–L), and relative chlorophyll content (M–O) of kohlrabi (*Brassica oleracea* L. var. *gongylodes* L.), mizuna (B. *rapa* L. var. *japonica*), and mustard [B. *juncea* (L.) Czern. 'Garnet Giant'] microgreens placed under light intensities of 105, 210, or 315 $\mu mol \cdot m^{-2} \cdot s^{-1}$ delivered from sole-source light-emitting diodes with light ratios (%) of red:green:blue 74:18:8, red:blue 87:13, or red:far-red:blue 84:7:9. Error bars indicate ±SE. Means sharing a letter are not statistically different by Tukey's honestly significant difference test at $P \leq 0.05$. Figures with no letter were found to have no significant interaction between light intensity and light quality.

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