Applying blue LED light overnight improves the growth and quality of indoor and greenhouse grown arugula and mustard microgreens

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Introduction

Microgreens are edible seedlings harvested with cotyledons fully expanded, with or without the appearance of true leaves depending on species. They are gaining increasing popularity due to their various colors and flavors, tender textures, and high nutritional contents. Commercial productions of microgreens have been increasingly switching from hand- to machine-harvesting to reduce labour cost. Microgreens with hypocotyls less than 5 cm are not feasible to be harvested by machine. To promote stem elongation without compromising yield or other growth metrics, overnight supplemental blue (B) or far-red (FR) light was examined in growth chamber and greenhouse.

Methods

Growth chamber

Daytime (16 h)	Nighttime (8 h)

Photosynthetic photon flux density (PPFD): 300 $\mu mol \cdot m^{-2} \cdot s^{-1}$
Blue (B) and red (R) ratio: B20:R80
Temperature: 21 °C (day)/ 17 °C (night)
Relative humidity: 80%

Nighttime 2am-10am:
Treatments:
D (dark)
40 $\mu mol \cdot m^{-2} \cdot s^{-1}$ B (4h)+D (4h)
D (4h)+ 40 $\mu mol \cdot m^{-2} \cdot s^{-1}$ B (4h)
20 $\mu mol \cdot m^{-2} \cdot s^{-1}$ B (8h)
20 $\mu mol \cdot m^{-2} \cdot s^{-1}$ B+FR (8h)
20 $\mu mol \cdot m^{-2} \cdot s^{-1}$ FR (8h)

Greenhouse

The experiment was performed in research greenhouse at Guelph, ON during January of 2019, where the daily light integral was only around 2.2 $mol \cdot m^{-2} \cdot d^{-1}$ measured at canopy level in the greenhouse.

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Supplemental light
5:30 pm-6:30 am
・ Treatments:
D (dark)
14 $\mu mol \cdot m^{-2} \cdot s^{-1}$ B
14 $\mu mol \cdot m^{-2} \cdot s^{-1}$ FR
・Black-out curtains were closed during supplemental light period
Temperature: 21/19 °C
Relative humidity: 70%

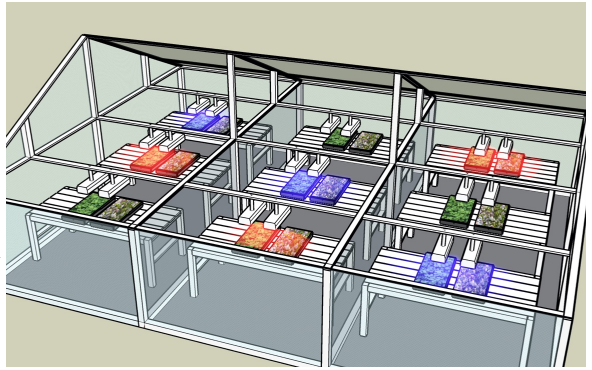


Figure 1. Schematic of the experimental greenhouse.

Results

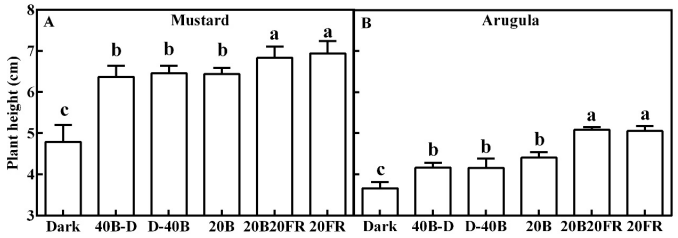


Figure 2. Effect of nighttime light treatments on height of mustard (A) and arugula (B) microgreens in the growth chamber.

In the growth chamber, nighttime supplemental B light promoted stem elongation by 34% and 18% in mustard and arugula microgreens, respectively, compared to no supplemental light. The combination of B and FR light further increased plant height by 6% and 15% for mustard and arugula, respectively, compared to supplemental B light alone. Depending on species, supplemental FR light alone decreased chlorophyll content index, dry matter content and leaf thickness compared to other treatments.

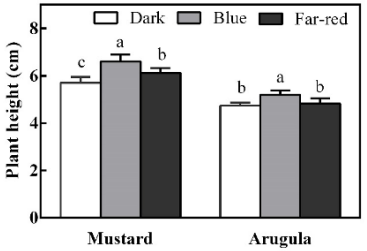
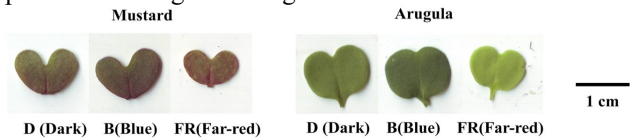


Figure 3. Effect of overnight light treatments on height of mustard and arugula microgreens in the greenhouse.

In the greenhouse, supplemental B light increased plant height by 16% and 10%, and fresh weight by 36% and 28% in mustard and arugula compared to no supplemental light, respectively. B light also increased cotyledon area in mustard, leaf mass per area in arugula, and stem diameter in both species compared to supplemental FR. Microgreens grown under different supplemental light qualities also showed changes in cotyledon color. However, supplemental B light did not affect total chlorophyll, carotenoid or phenolic concentration compared to D, while supplemental FR light had negative effects.



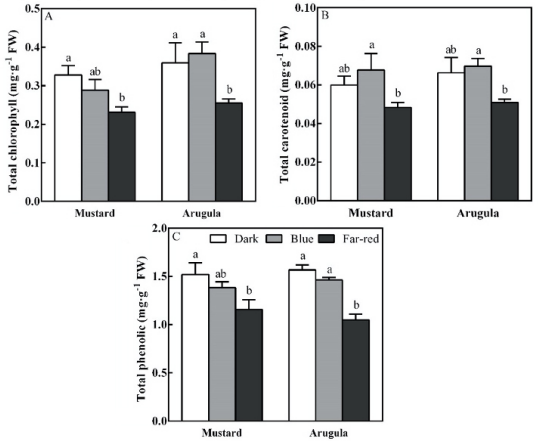


Figure 4. Effect of overnight light treatments on cotyledon color (up) and phytochemical concentrations (right) of mustard and arugula microgreens in the greenhouse.

Conclusion

In summary, low-intensity monochromatic B light could be applied during nighttime in both indoor plant factories and greenhouse, as an effective way to promote stem elongation, without compromising other growth metrics or phytochemical concentrations.