Effects of White LEDs on Growth and Phytonutrients of ‘Outredgeous’ Romaine Lettuce When Supplemented with Various Monochromatic Wavelengths

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Kennedy Space Center

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Is Red and Blue Light Optimal?

ISS VEGGIE Chamber Flight Experiments

Kennedy Space Center Ground Experiments
Using WLEDs for Plant Growth

WLED Spectra

Spectral Effects of Three Types of White Light-emitting Diodes on Plant Growth and Development: Absolute versus Relative Amounts of Blue Light

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Objectives:

1. To use LEDs to determine the effects of enriched B, G, R, and FR light on growth of lettuce when supplemented with WLEDs as a background.

2. To identify optimal “light recipes” that could be used for ‘Outredgeous’ lettuce grown in the Advanced Plant Habitat (APH) and future growth chamber environments.

3. To determine the effects of the light treatments on secondary metabolites and nutrient content (ongoing).
Cultural Conditions

- Arcillite clay media (< 1 mm particle size)
- Nutricote controlled-release fertilizer (NPK=18:6:8, Type 70 day)
- Air Temperature: 23 °C
- CO₂: 1200 μmol·mol⁻¹
- RH: 70 %
- Pots rotated 3 times a week
- Photoperiod: 18 hr light/6 hr dark
AIBC Full Spectrum Super T Panel (Ithaca, NY)
Treatment 1 (Control)

W

Total PPF: ~180
B = 20%, G = 47%, R = 31%

Treatment 2

RB

Total PPF: ~180
B = 40%, G = 0%, R = 60%

Treatment 3

W+B

Total PPF: ~180
B = 43%, G = 34%, R = 23%

Treatment 4

W+G

Total PPF: ~180
B = 17%, G = 57%, R = 24%

Treatment 5

W+R

Total PPF: ~180
B = 16%, G = 38%, R = 46%

Treatment 6

W+FR

Total PPF: ~180
B=16%, G=39%, R=25%, FR=35 umol

Treatment 7

RGB+FR

Total PPF: ~180
B=15%, G=25%, R=60%, FR=35 umol
14 DAP

**Treatment 1**
- White (Control)

**Treatment 2**
- White + Blue (460 nm)

**Treatment 3**
- White + Green (525 nm)

**Treatment 4**
- White + Red (635 nm)
- White + Far Red (745 nm)

**Treatment 5**
- Indigo (425 nm) + Green (525 nm) + Deep Red (660 nm) + Far Red (733 nm)

**Treatment 6**
- RB

**Treatment 7**
- RGB + FR
21 DAP

Treatment 1: White (Control)

Treatment 2: White + Blue (460 nm)

Treatment 3: White + Green (525 nm)

Treatment 4: White + Far Red (745 nm)

Treatment 5: White + Red (635 nm)

Treatment 6: White + Indigo (425 nm) + Green (525 nm) + Deep Red (660 nm) + Far Red (733 nm)

Treatment 7: RGB + FR
Shoot Diameter (21 DAP)

- TMT 1 (W)
- TMT 2 (RB)
- TMT 3 (W+B)
- TMT 4 (W+G)
- TMT 5 (W+R)
- TMT 6 (W+FR)
- TMT 7 (RGB+FR)

Light Treatment

Shoot Length (mm)

- A
- B
- AB
- CD
- AC
- D
- D
28 DAP

Treatment 1: White (Control)

Treatment 2: White + Blue (460 nm)

Treatment 3: White + Blue (460 nm)

Treatment 4: White + Blue (460 nm)

Treatment 5: White + Red (635 nm)

Treatment 6: White + Far Red (745 nm)

Treatment 7: R (660 nm) + G (525 nm) + B (420 nm) + FR (733 nm)
Conclusion

Supplementing WLEDs with equal amounts of light from various monochromatic LEDs was dependent on plant age and cycle progression.

Overall, this study showed WLED performance to be more beneficial for growth than RB light alone, but also RGB + FR at certain ratios can be even more beneficial than WLEDs.
Future in LED light Recipes

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