Promotion of lettuce growth under an increasing DLI depends on the combination of the PPFD and photoperiod

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Objectives

1. To investigate how photoperiod and light intensity (PPFD) interact to affect growth of lettuce
2. To determine whether, at the same DLI, a lower PPFD delivered for a longer photoperiod would lead to greater growth than a higher PPFD delivered for a shorter photoperiod (in other words, are DLIs "equal"?)

Materials & Methods

- Lighting treatments were composed of different combinations of PPFD and photoperiod
- Red (peak=660 nm) and warm-white LEDs were used, 50% of each
- Lettuce 'Rex' and 'Rouxai' were grown on floating rafts in a deep flow hydroponics system

Materials & Methods

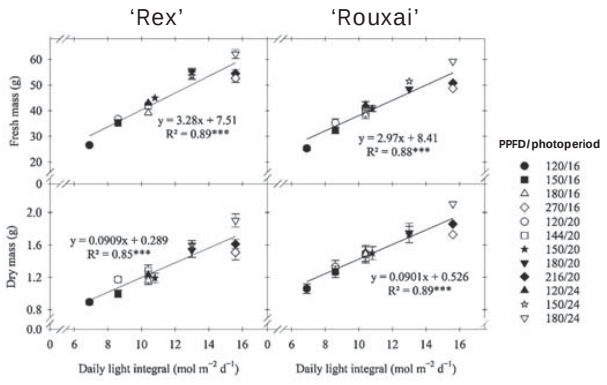
- Average temperature of 72 °F (22 °C)
- Ambient CO_2 concentration (380 ppm)
- pH and EC were maintained at 5.6 and 1.7 mS, respectively
- Plants harvested 27 or 28 days after seed sowing

Materials & Methods

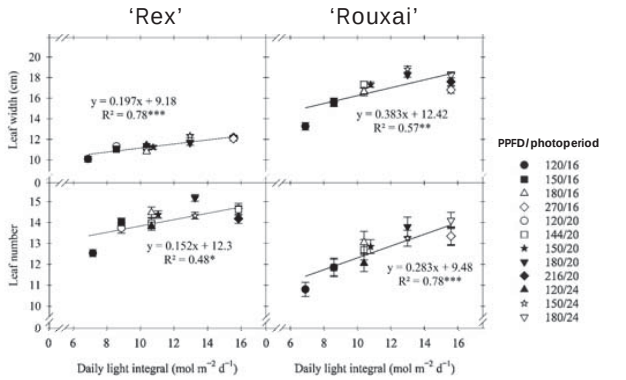
Radiation treatments were comprised of different combinations of photoperiod (h d^{-1}) and photosynthetic photon flux density (PPFD; µmol m^{-2} s^{-1}) to determine daily light integrals (DLI).

Radiation treatment (PPFD /photoperiod)	Actual PPFD [mean ± SD (µmol m^{-2} s^{-1})]	DLI (mol m^{-2} d^{-1})
120/16	119 ± 11	6.9
120/20	122 ± 8	8.6
120/24	123 ± 10	10.4
150/16	153 ± 15	8.6
150/20	149 ± 9	10.8
150/24	152 ± 13	13.0
180/16	181 ± 12	10.4
180/20	180 ± 11	13.0
180/24	181 ± 13	15.6
144/20	144 ± 14	10.4
270/16	271 ± 21	15.6
216/20	218 ± 17	15.6

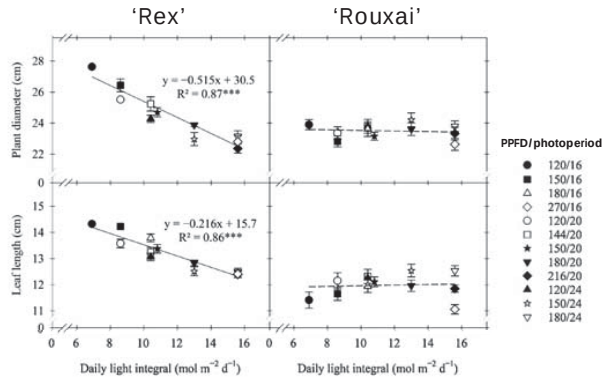
Results



Results



Results



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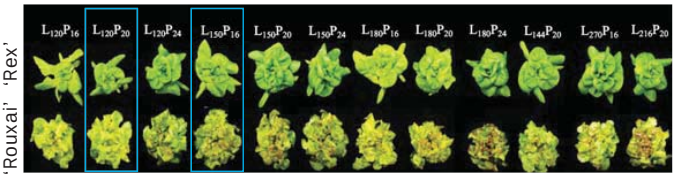
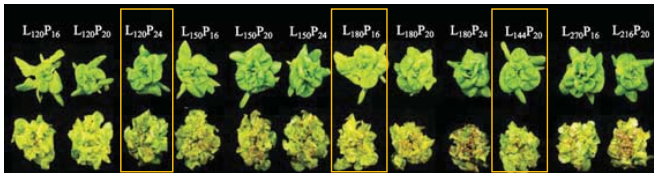


DLI = 8.6 mol·m⁻²·d⁻¹

L= light intensity/PPFD (µmol·m⁻²·s⁻¹); P= photoperiod (hours/day)

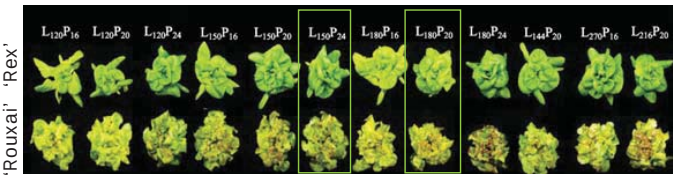
Results



DLI = 10.4 mol·m⁻²·d⁻¹

L= light intensity/PPFD (µmol·m⁻²·s⁻¹); P= photoperiod (hours/day)

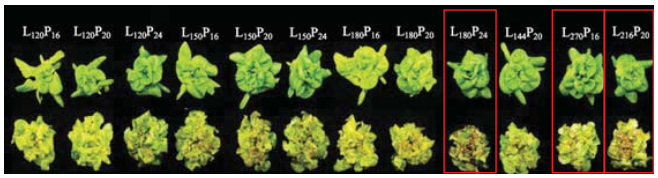
Results



DLI = 13.0 mol·m⁻²·d⁻¹

L= light intensity/PPFD (µmol·m⁻²·s⁻¹); P= photoperiod (hours/day)

Results



DLI = 15.6 mol·m⁻²·d⁻¹

- For 'Rouxai', leaves were darker, redder, and bluer as the DLI increased, in a linear manner

L= light intensity/PPFD (µmol·m⁻²·s⁻¹); P= photoperiod (hours/day)

Results

- Increasing the DLI increased fresh weight, dry weight, leaf width, leaf number, chlorophyll concentration, and leaf coloration
- Increasing the DLI decreased plant diameter and leaf length of 'Rex'
- Under the highest DLI, the lower PPFD delivered for a longer time had greater mass than a higher PPFD delivered for a shorter time

Kelly, N., D. Choe, Q. Meng, and E.S. Runkle. 2020. Sci. Hort. (article 109565).

Research in progress: Quantifying the effects of supplemental UV-A or blue light on lettuce growth, coloration, and bioactive compounds

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UV-A and/or Blue Light

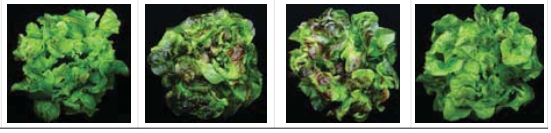
- Suppresses extension growth
- Can enhance quality attributes such as leaf coloration and nutritional quality by increasing phenolic compounds and antioxidant capacity
- Little research has been published comparing lettuce grown indoors under supplemental blue or UV-A lighting
- Initial focus is on end-of-production lighting

Materials and Methods

- 'Rouxai' chosen for study
- Photoperiod of 20 hours/day and air temperature of 72 °F (22 °C)
- PPFD of 180 $\mu mol \cdot m^{-2} \cdot s^{-1}$ from 55% red (peak=665 nm) and 45% warm white LEDs
- Six days of end-of-production lighting from UV-A (peak= 385 nm) and/or blue (peak=450 nm) LEDs, with two controls (no additional lighting, or with red and green light

Preliminary Observations

Photon flux density ($\mu mol \cdot m^{-2} \cdot s^{-1}$)	Control	+ UV-A	+ Blue	+ Green & Red
UV-A		30		
Blue			30	
Green				20
Red	100	100	100	140
Warm white	80	80	80	80
Total				



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