

## Introduction

In vertical farms, light quality of sole-source lighting can be optimized to promote crop yield and quality. Addition of far-red light (700-800 nm) can promote flowering in some long-day plants and induce photomorphogenic effects, including leaf expansion and stem elongation.

## Objective

To investigate the effects of addition of far-red light to blue and red lighting on plant growth and flowering in ever-bearing strawberries

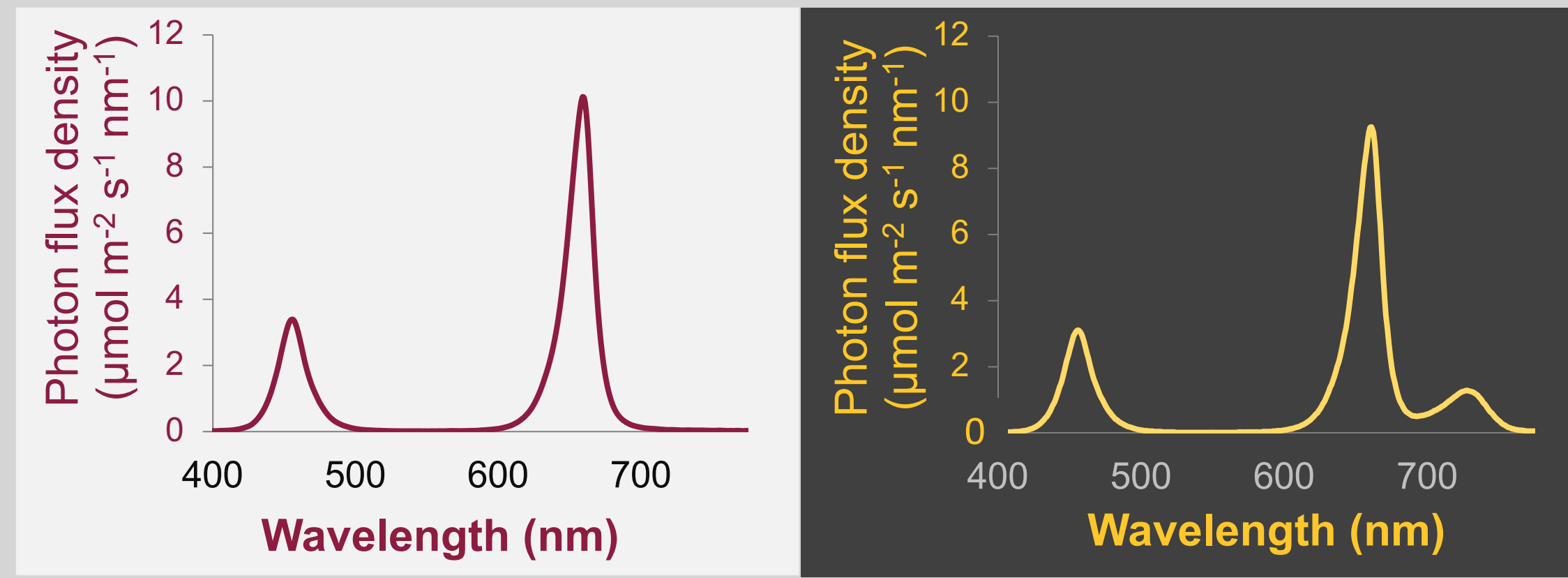
## Materials and Methods

- Plant Materials:**  
Strawberry (*Fragaria x ananassa*) 'Albion', 'Monterey', and 'San Andreas'
- Growth Conditions:**
- Indoor vertical farm
  - Deep water culture hydroponic systems
  - Air temperature set point: 22°C
  - Nutrient solution: Yamazaki formula (N = 77 ppm)
- Lighting Treatments:**
- Blue+red (B+R) or blue+red+far red (B+R+FR)
  - Photoperiod: 18-hour

**Table 1.** Photon flux density (PFD) of lighting treatments delivered from LEDs (B = Blue, R = Red, FR = Far-red).

Lighting treatments	PFD ( $\mu\text{mol m}^{-2} \text{s}^{-1}$ )		
	B (400-500 nm)	R (600-700 nm)	FR (700-800 nm)
B+R	90	250	0
B+R+FR	90	250	50

## Materials and Methods



**Fig 1.** Spectral distribution of blue+red (B+R) (left) or blue+red+far-red (B+R+FR) (right) lighting treatment delivered from LEDs.



**Fig 2.** Experimental set up for blue+red (B+R) (left) or blue+red+far-red (B+R+FR) (right) lighting treatment delivered from LEDs.

## Results



**Fig 3.** Strawberry plants grown for 5 weeks under blue+red (B+R) or blue+red+far-red (B+R+FR) lighting treatment.

## Results

**Table 2.** Growth characteristics of strawberry plants grown for 5 weeks under blue+red (B+R) or blue+red+far-red (B+R+FR) lighting treatment. Data represents the mean of two replications.

Cultivar	Treatment	Leaf number	Leaf area (cm <sup>2</sup> )	Shoot FW (g)	Root FW (g)
Albion	B+R	3.6	237.2	18.2	25.0
	B+R+FR	3.7	242.8	18.7	23.4
Monterey	B+R	3.2	119.3	10.8	14.5
	B+R+FR	4.0	214.5	17.6	23.5
San Andreas	B+R	2.9	163.2	12.3	17.8
	B+R+FR	2.6	120.6	9.2	14.9
Significance		NS	NS	NS	NS

NS, Nonsignificant at  $P < 0.05$

**Table 3.** Days to flower (after transplanting) of strawberry plants grown under blue+red (B+R) or blue+red+far-red (B+R+FR) lighting treatment. Data represents the mean of two replications.

Cultivar	Treatment	Days to flower
Albion	B+R	50
	B+R+FR	51
Monterey	B+R	49
	B+R+FR	49
San Andreas	B+R	53
	B+R+FR	54
Significance		NS

NS, Nonsignificant at  $P < 0.05$

## Conclusions

Upon comparison of the two lighting treatments, there was not a significant effect on plant growth or time to flower with the addition of far-red light.

**Acknowledgement:** The authors thank Tristan Lewis, Tyler Forgacs, Nicklas McClintic, and Zhenling Zhang for experimental assistance and Lassen Canyon Nursery for strawberry plant materials.