



THEME TALK 8

Adding Far-red Radiation to Sole-source Lighting for Specialty Crops

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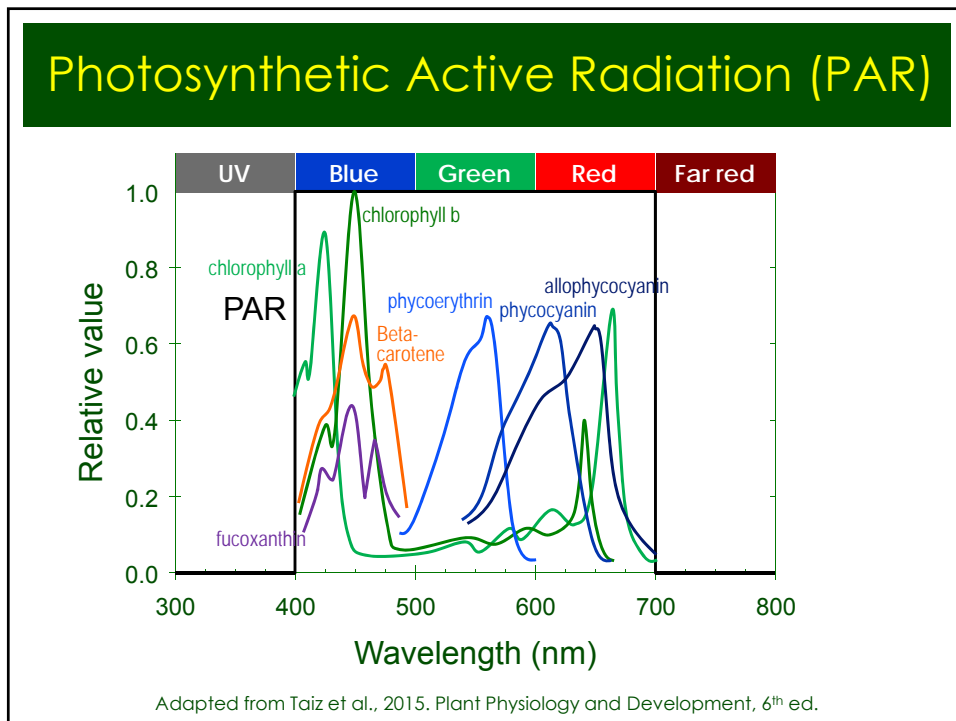
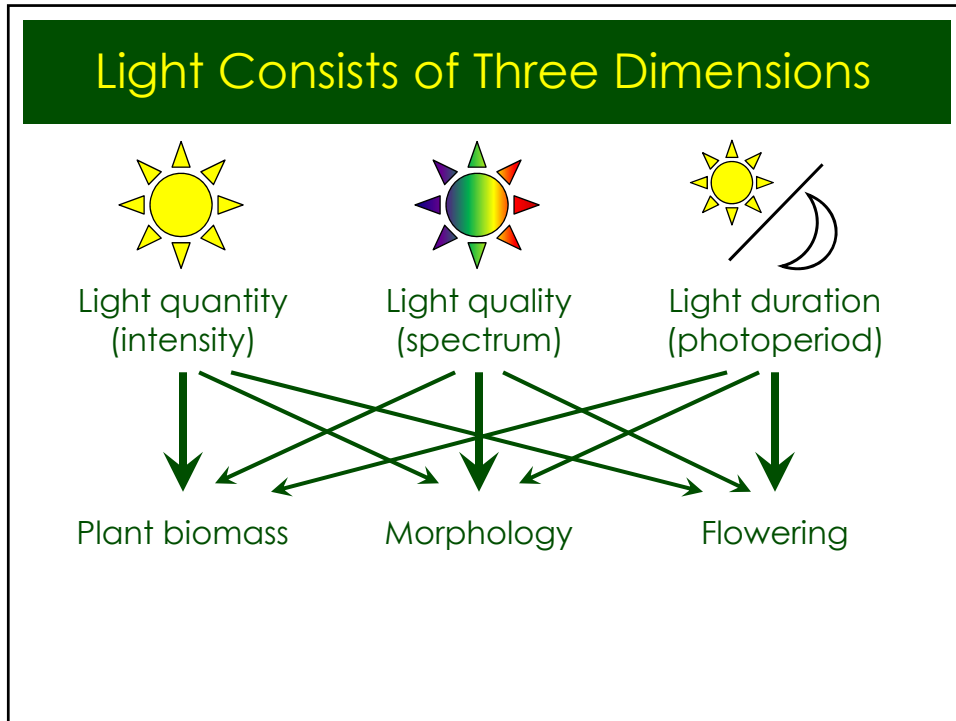
Adding Far-red Radiation to Sole-source Lighting for Specialty Crops

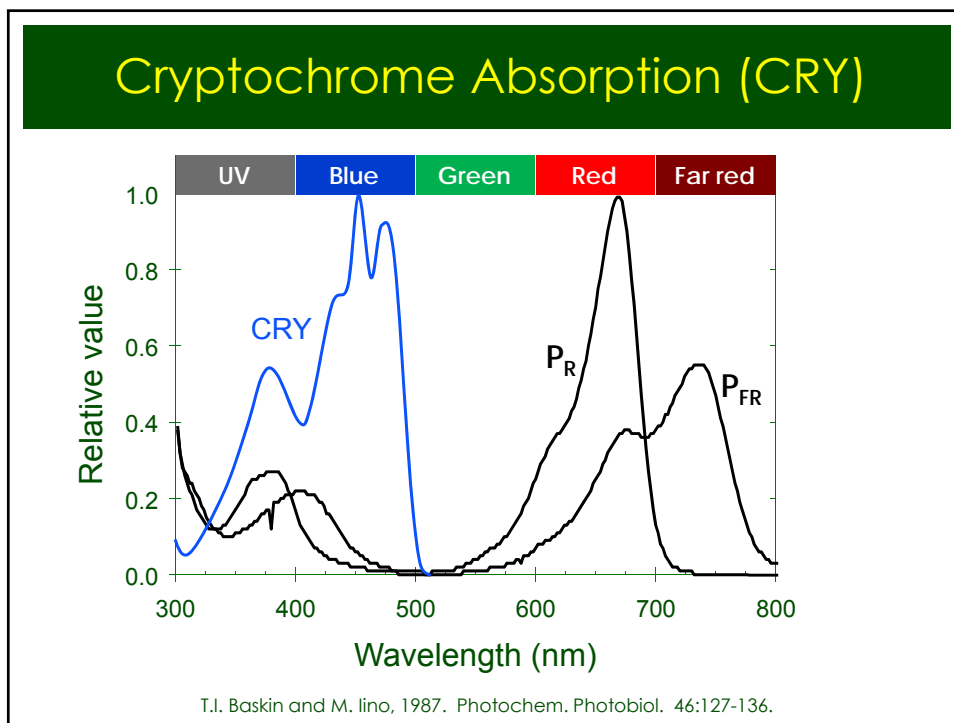
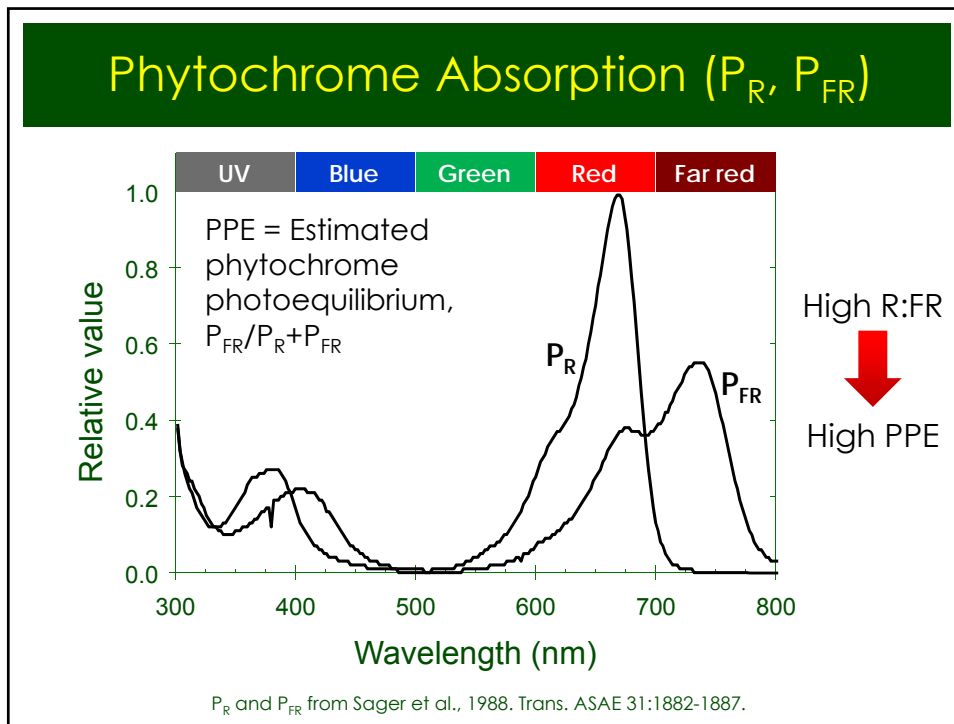


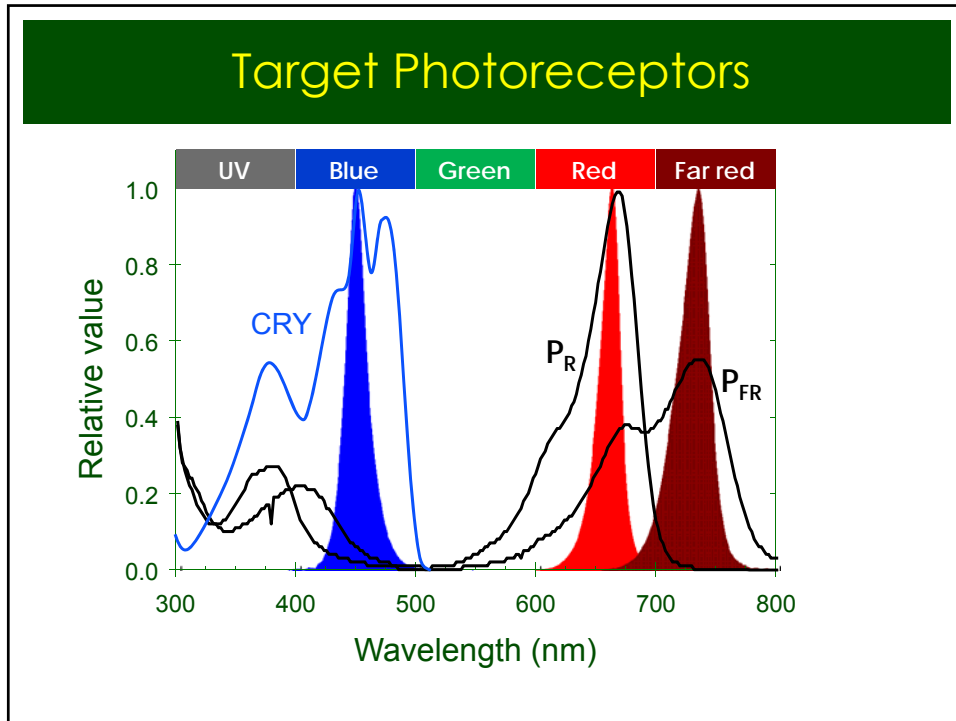
Yujin Park



Qingwu Meng

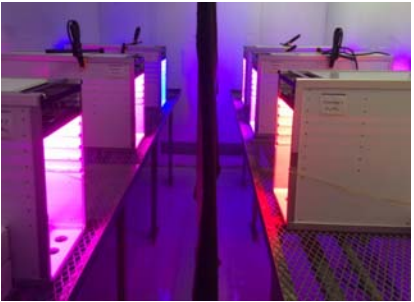







Narrow-Band (LED) Lighting


- Growth attributes
 - Extension growth
 - Leaf area and thickness
 - Fresh/dry weight
 - Rooting
- Regulation of flowering
- Phytonutrient content
- Organoleptic attributes
 - Taste
 - Texture
 - Coloration

B, G, and R on Salvia 'Vista Red'

Seedlings grown at 20 °C for 4 weeks under LEDs for 18 h·d⁻¹ at PPFD=160 μmol·m⁻²·s⁻¹ consisting of (%):

B ₀ G ₀ R ₅₀ HR ₅₀	B ₀ G ₅₀ R ₂₅ HR ₂₅	B ₂₅ G ₂₅ R ₂₅ HR ₂₅	B ₅₀ G ₅₀ R ₀ HR ₀	B ₅₀ G ₀ R ₂₅ HR ₂₅	B ₁₀₀ G ₀ R ₀ HR ₀
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B=blue, 446 nm; G=green, 516 nm; R=red, 634 nm; HR=hyper red, 664 nm

W, R, R+B on Petunia 'Wave Blue'

Seedlings grown at 20 °C for 19 days under LEDs (31 days after sow) 18-hour photoperiod with PPFD = 160 μmol·m⁻²·s⁻¹

MW ₁₀₀	MW ₇₅ +R ₂₅	MW ₄₅ +R ₅₅	MW ₂₅ +R ₇₅	R ₈₅ +B ₁₅	R ₄₀ +G ₄₀ +B ₂₀
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Leaf area (cm ²)					
22.7 a	23.2 a	23.7 a	21.9 a	20.4 a	21.9 a

B=blue, 451 nm; G=green, 521 nm; R=hyper red, 660 nm; MW=mint white, 552 nm

Phytochrome-Mediated Responses

- Seed germination and de-etiolation
- Shade-avoidance responses
 - Stem, leaf, and petiole extension
 - Branching
 - Flowering
- Flowering of photoperiodic crops

+FR in a Radiation Spectrum





Objective: To investigate the effects adding FR radiation to B+R radiation provided by LEDs on growth and subsequent flowering of ornamental seedlings

Hypothesis 1: Leaf size will increase as the R:FR decreases (as the PPE decreases), increasing light interception and potentially increasing biomass accumulation

Hypothesis 2: Subsequent flowering of long-day plants will be promoted with an FR addition (a PPE decrease)


+FR in a Radiation Spectrum

Plant materials


<p>Snapdragon (<i>Antirrhinum majus</i>) 'Trailing Candy Showers Yellow'</p>	<p>Petunia (<i>Petunia</i> <i>× hybrida</i>) 'Wave Blue'</p>	<p>Geranium (<i>Pelargonium</i> <i>× hortorum</i>) 'Pinto Premium Orange Bicolor'</p>	<p>Impatiens (<i>Impatiens</i> <i>walleriana</i>) 'Super Elfin XP Red'</p>
			
Shade-avoiding		Shade-tolerant	
Long-day		Day-neutral	

+FR in a Radiation Spectrum


Experimental protocol




Sow



Germination





128-cell plug



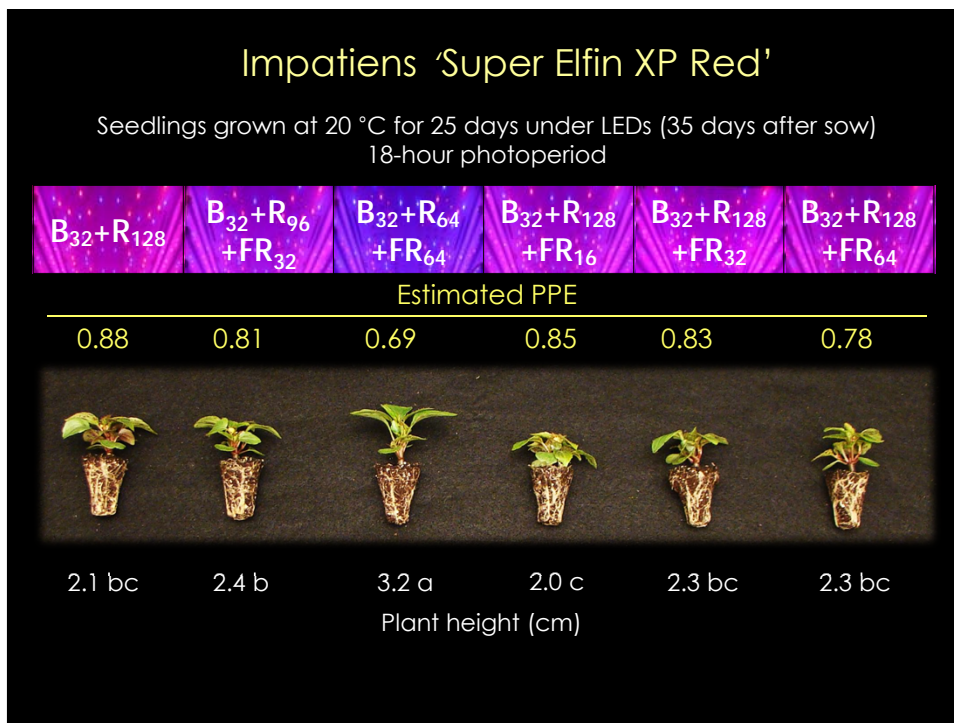
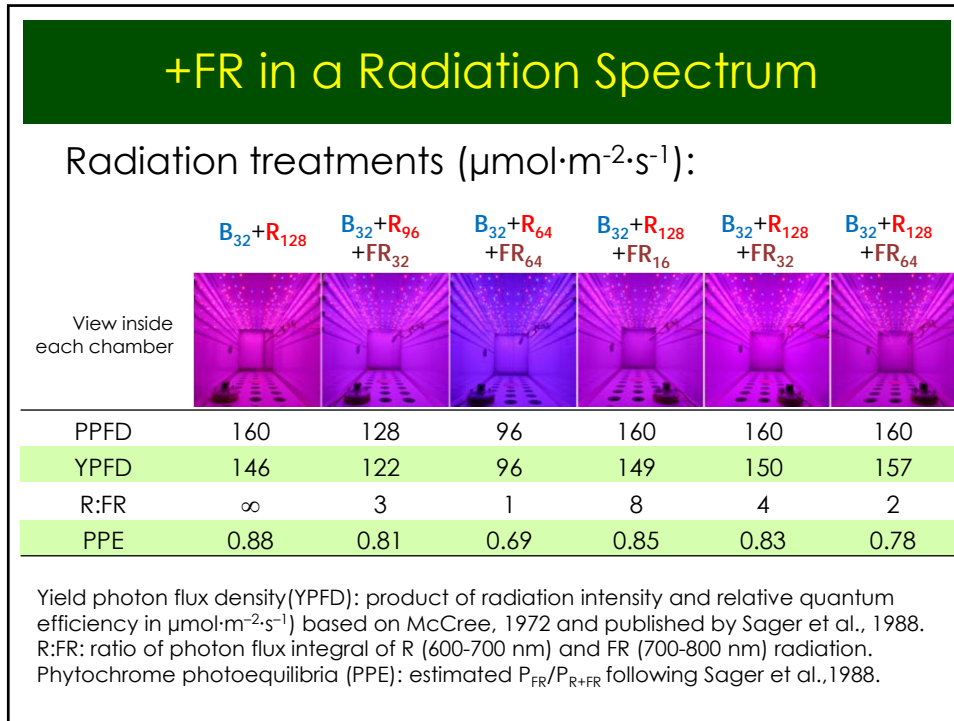
Flower

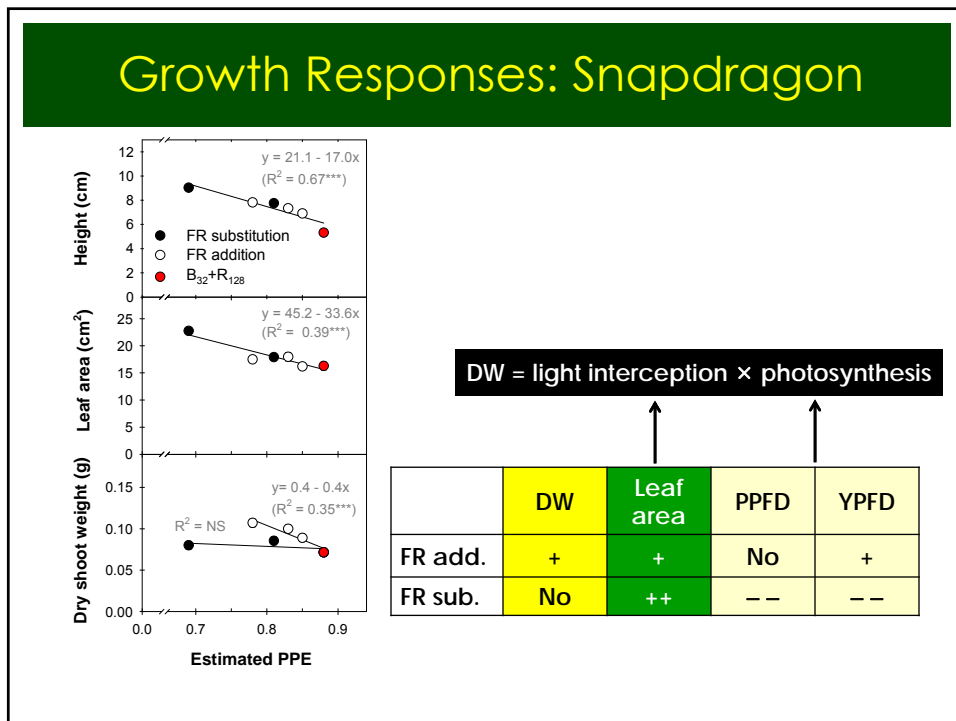
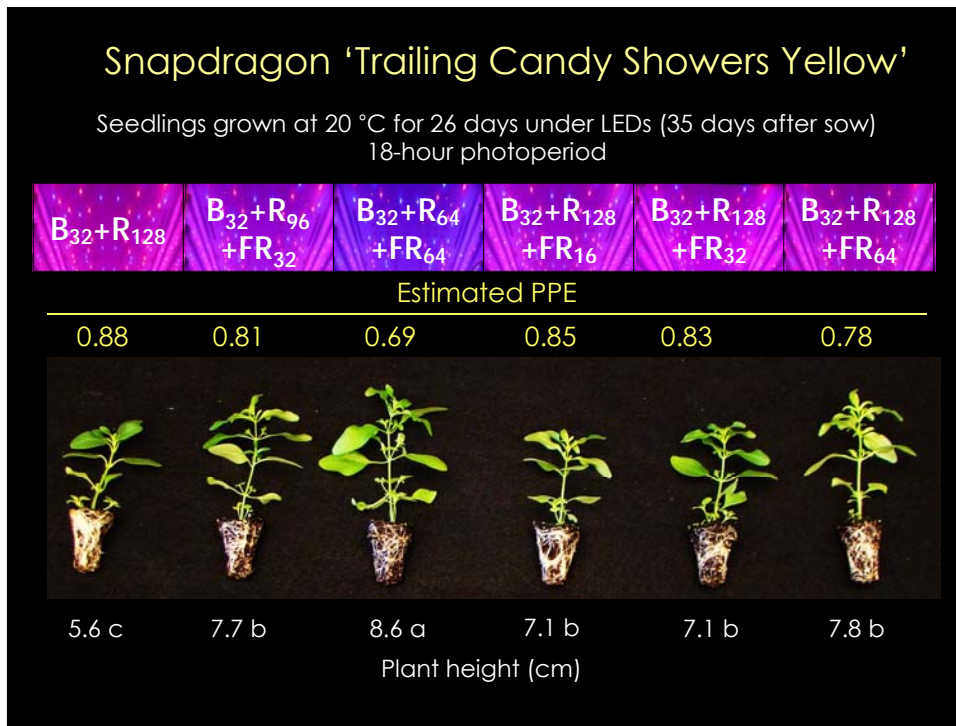
Transplant (3-4 weeks)

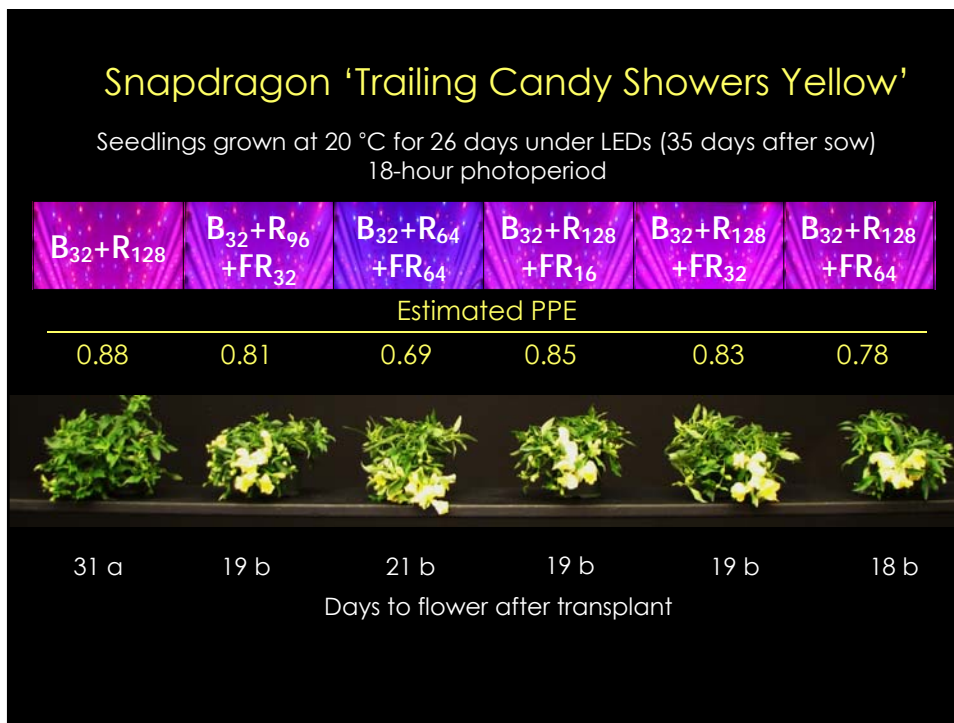
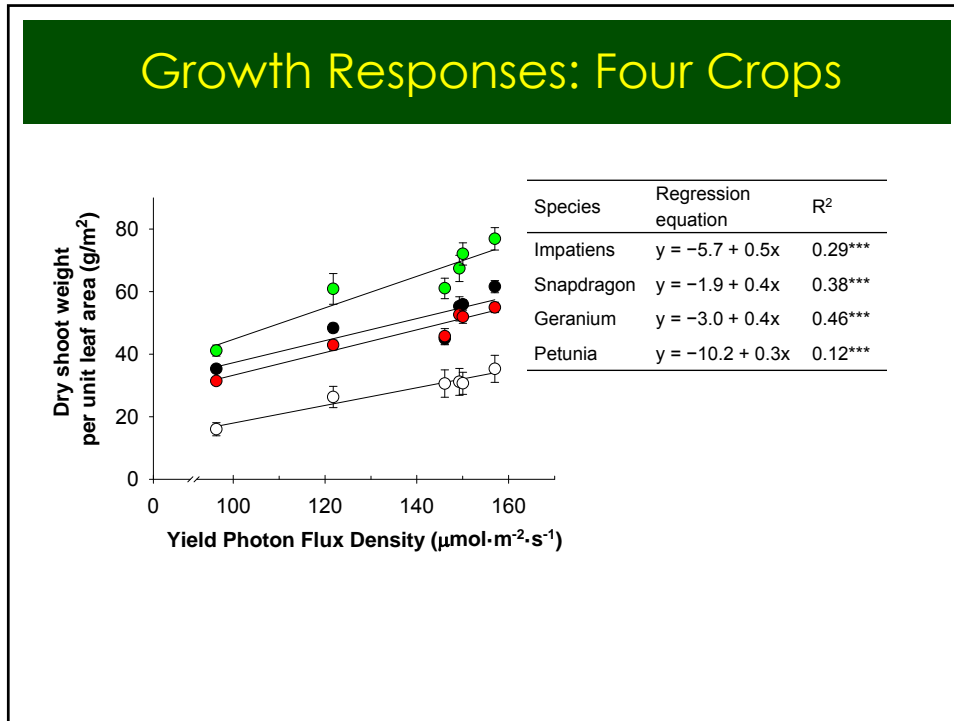
Finishing (3-8 weeks)

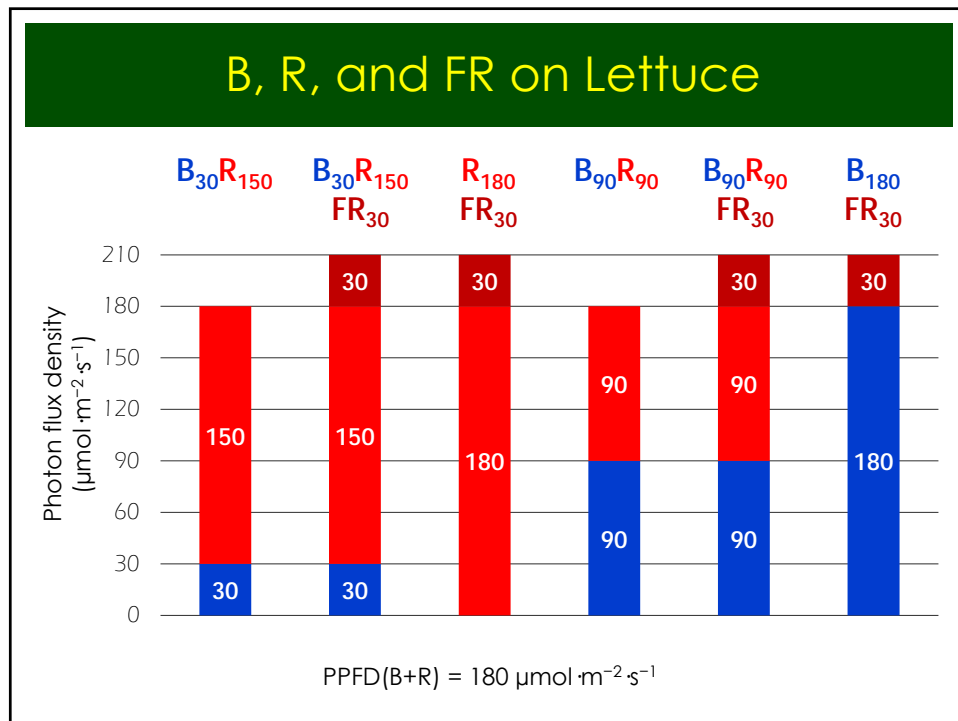
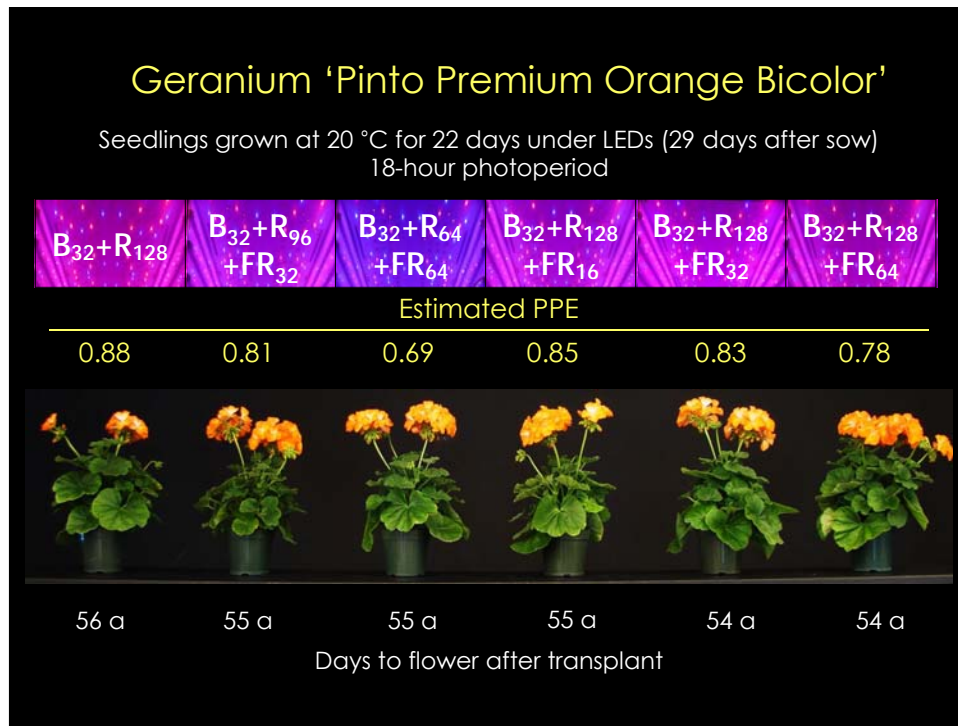



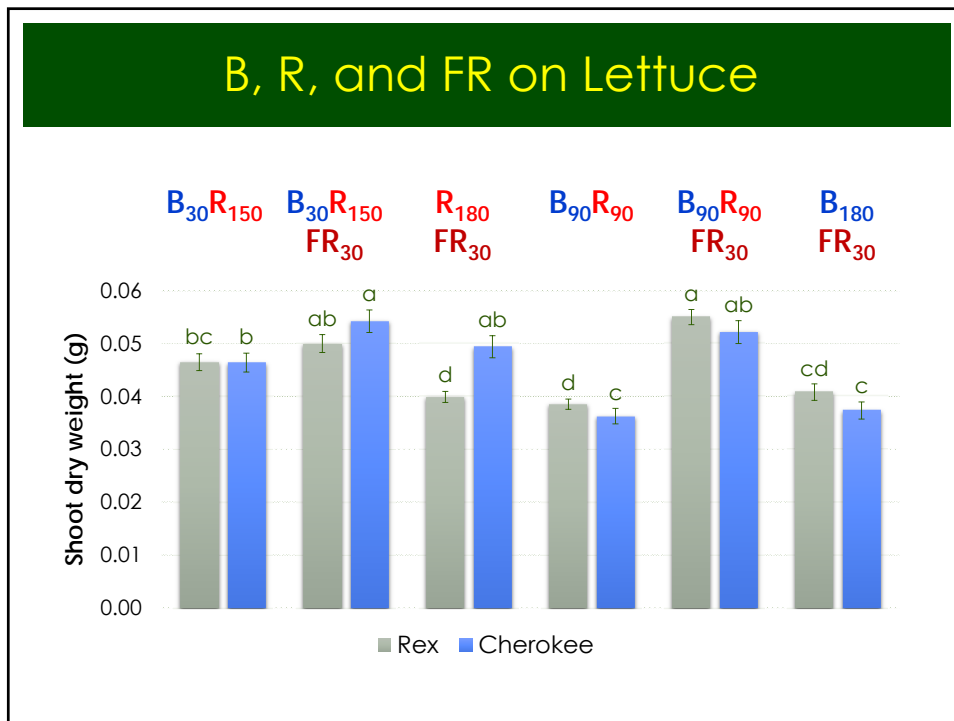
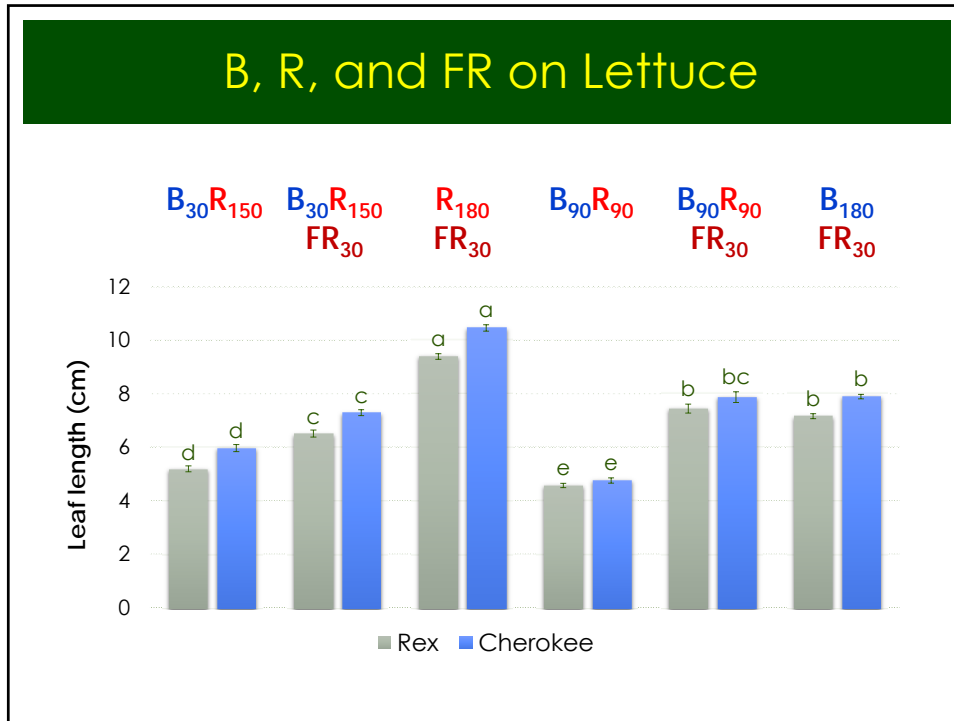
- Refrigerated growth chamber
 - Temperature: 20 °C
 - Photoperiod: 18 hours
- Greenhouse
 - Temperature: 20 °C
 - Photoperiod: 16 hours

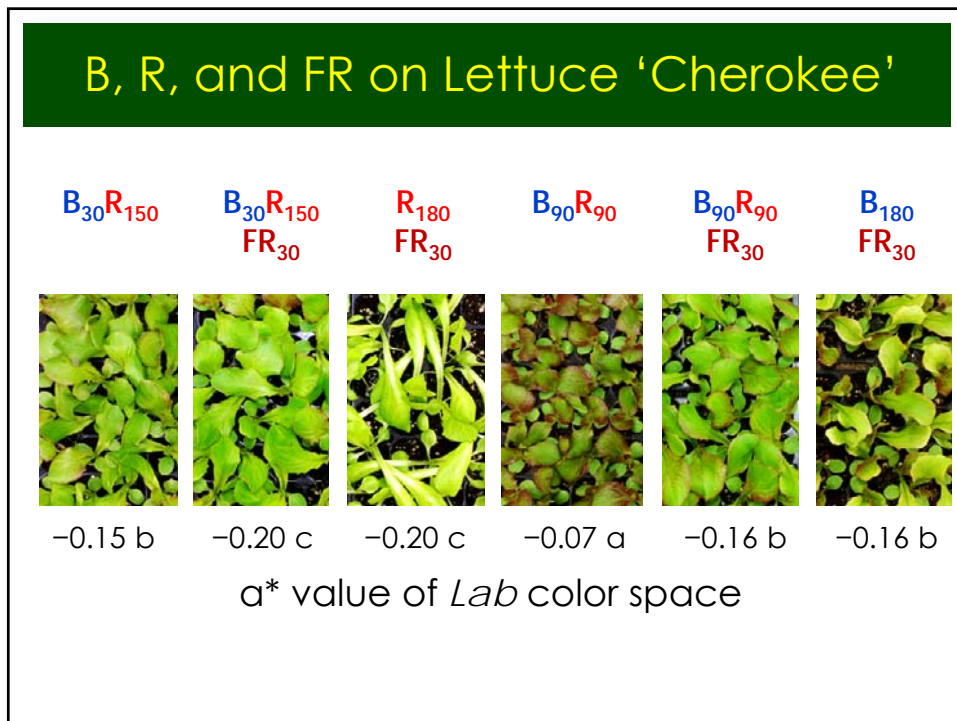
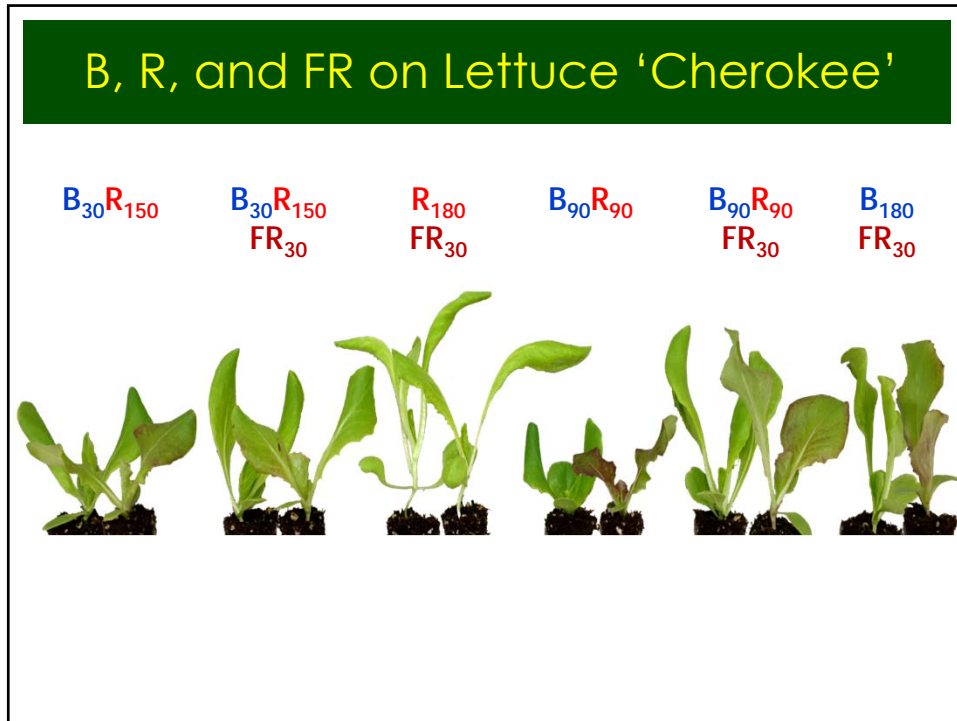












General Conclusions & Future Studies

- Light quality can regulate plant growth and quality characteristics, a valuable attribute of LEDs
 - Sole source lighting, much more potential (costs/benefits)
 - Little to no effect of light quality when supplementing sunlight (exceptions: end of day or intra-canopy lighting)

General Conclusions & Future Studies

- FR radiation directly and indirectly promotes whole-plant photosynthesis, partly by increasing leaf area and thus, radiation capture
- Linear relationship with yield photon flux density and whole-plant photosynthesis
- When considering R:FR, need to also consider B radiation
- Current projects
 - Interaction of B and R:FR responses
 - Interaction of PPFD and R:FR responses