

# **Effect of Light Quality on Production of Bioprotective Compounds in Red Leaf Lettuce**

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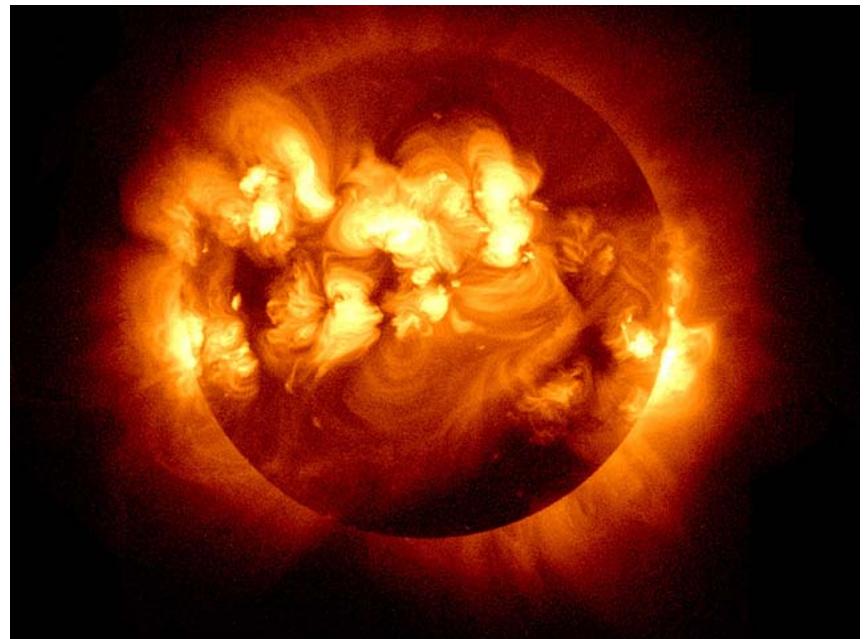
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# Background

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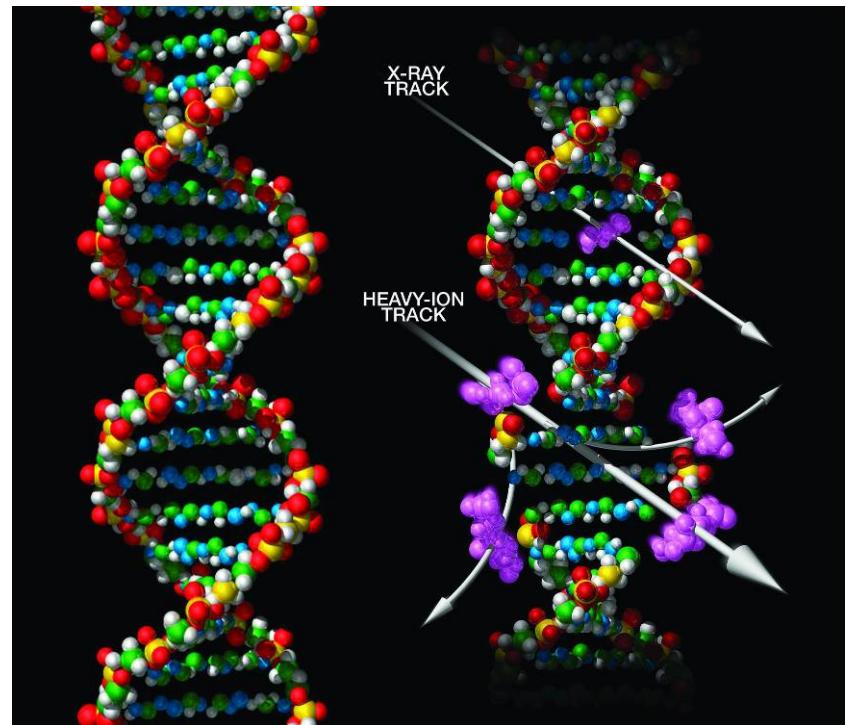
- Exposure to ionizing radiation during long-duration space missions increases risk for short term illness and long-term risk for cancer.



# Background

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- Radiation induces free-radical formation.
- Anti-oxidant defense mechanisms are over-ridden
- Damage at membrane, enzyme and chromosome level occurs



# Background

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- Increasing levels of anti-oxidants increases resistance to damage.
- Anthocyanins are pigments with anti-oxidative properties
- Red leaf lettuce is candidate salad crop and a relatively high source of anthocyanins.

	<u>Compound</u>	<u>Structure</u>
Phenolic acids		
Flavonols		
Anthocyanins		
Flavonols		

# Research Objective

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- To determine whether the production of bioprotective compounds in candidate salad crops can be increased by regulating the morphology, growth, and biochemistry of the plants with though spectral quality using light emitting diodes.

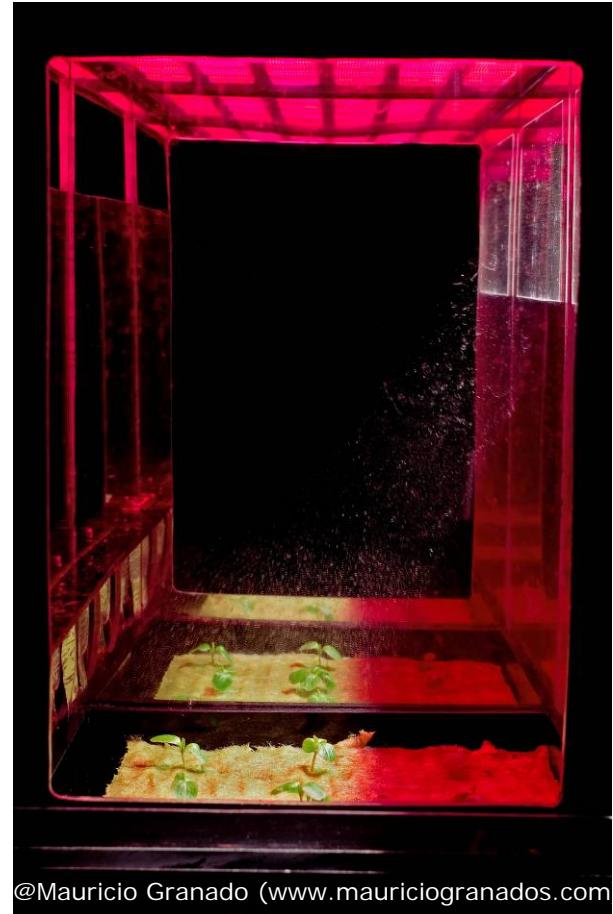


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# Research Approach

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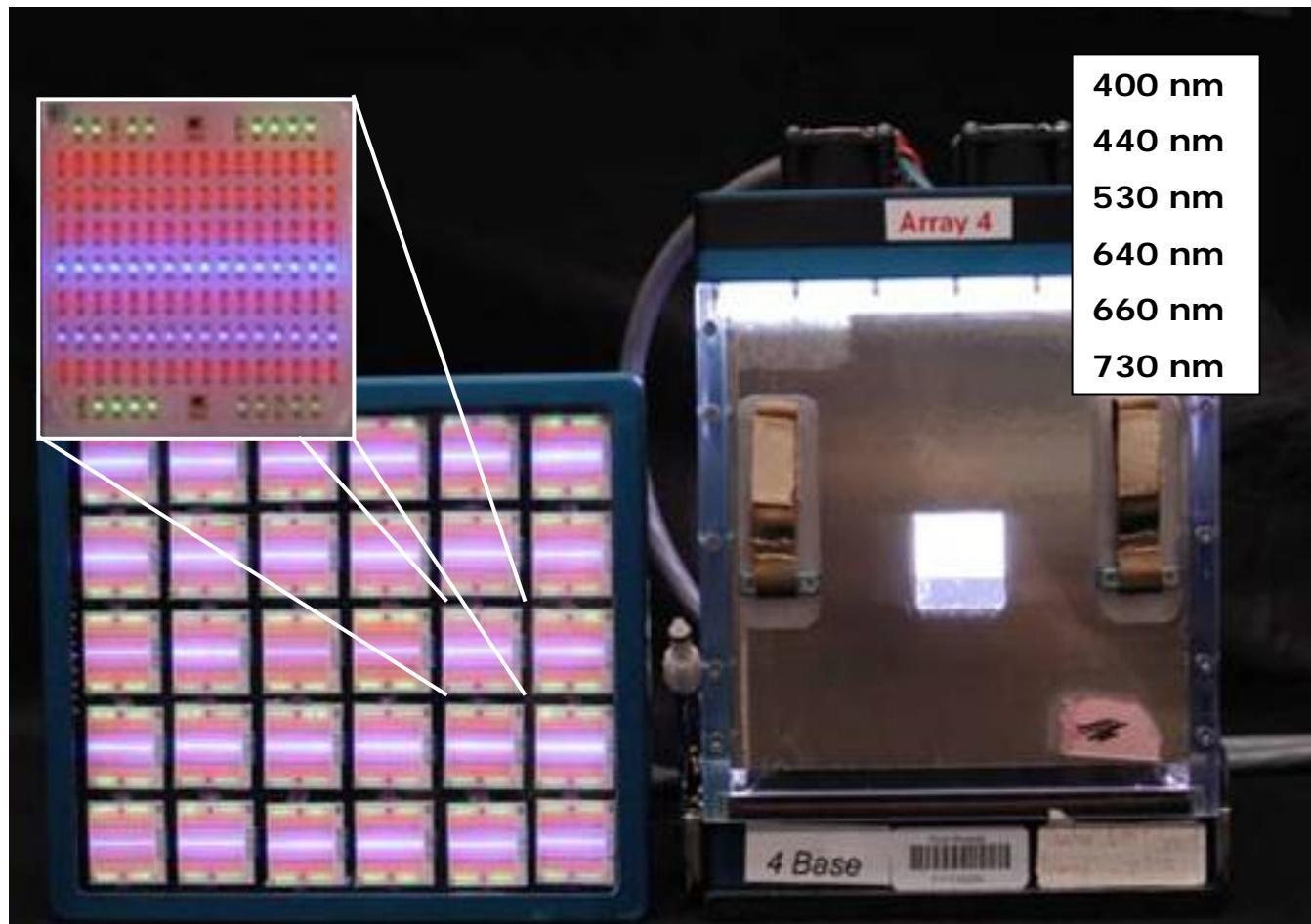
- *Lactuca sativa* cv. Outredgeous seedlings were grown in Rockwool under in small (16 x 19 x 24 cm) chambers at  $300 \mu\text{mol m}^{-2} \text{s}^{-1}$  PPF with 18/6 photoperiod.
- Environment conditions were 23°C, 65% RH and  $1200 \mu\text{mol mol CO}_2$ .
- Total anthocyanin production in leaves was determined using spectrophotometer
- Anti-oxidant potential determined using the ORAC methodology



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# LED arrays with multiple wavelengths were used to alter spectral quality

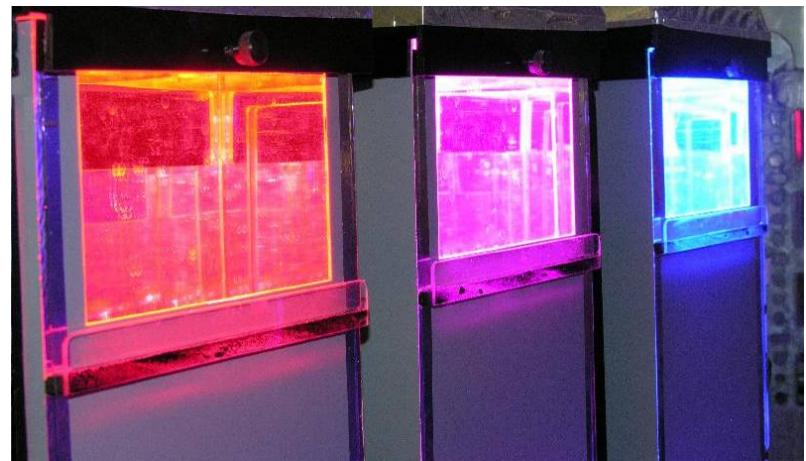
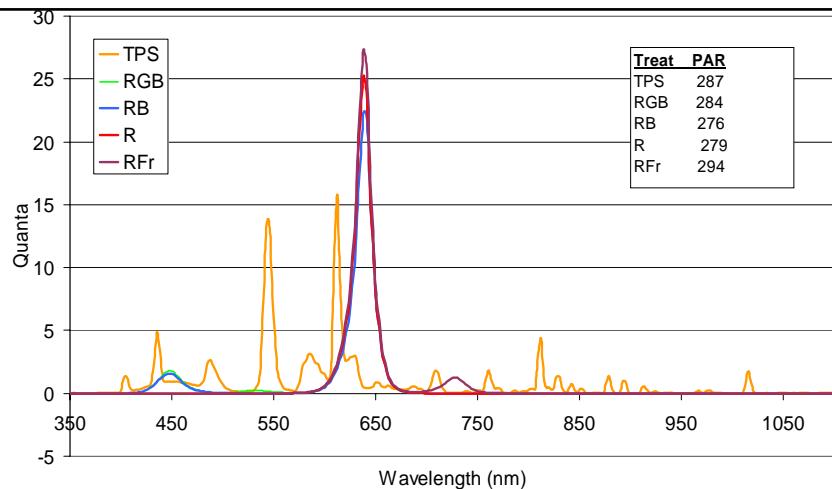
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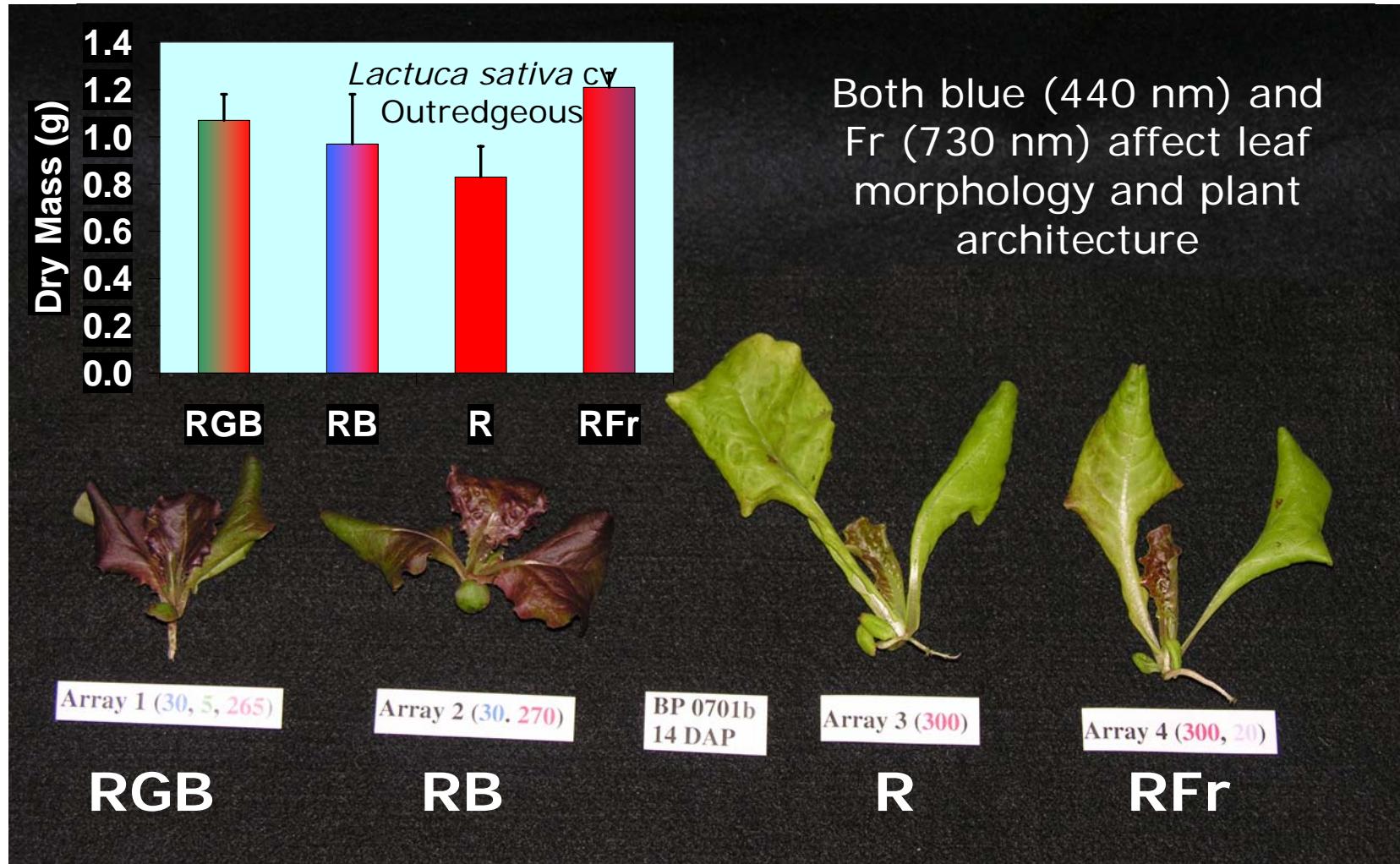
LED arrays designed and built by Orbitec using Norlux LED engines

# Spectral Quality Established by Altering Power to the LED arrays.

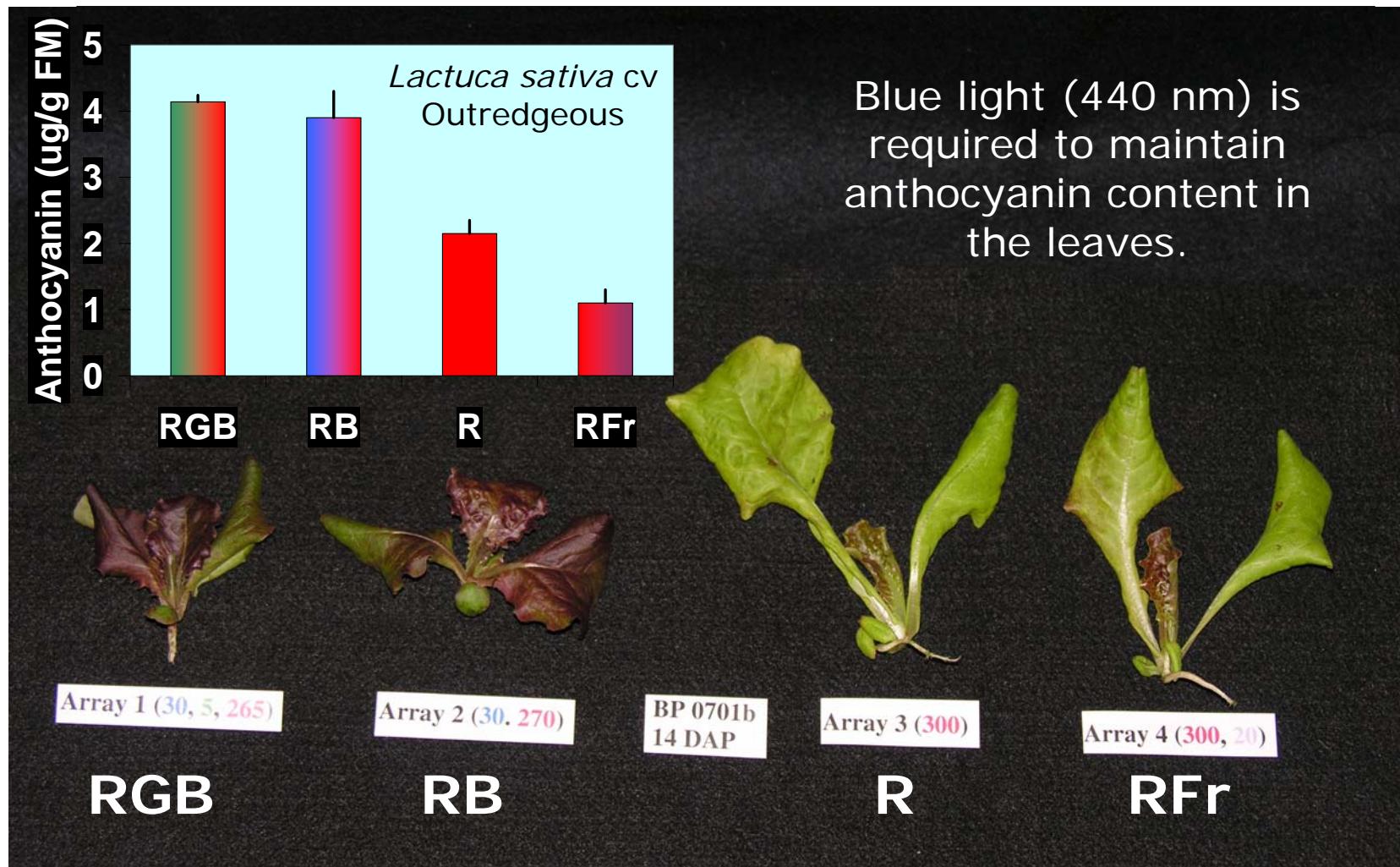
- Light treatments are established using blue (440 nm), green (530 nm), red (640 nm), and far red (730 nm) LED's.
- Spectral quality and quantity determined with using spectroradiometer.
- $300 \mu\text{mol m}^{-2} \text{s}^{-1}$  PPF from triphosphor fluorescent lamps (TPF; Pentron T-5) was used as the control treatment.



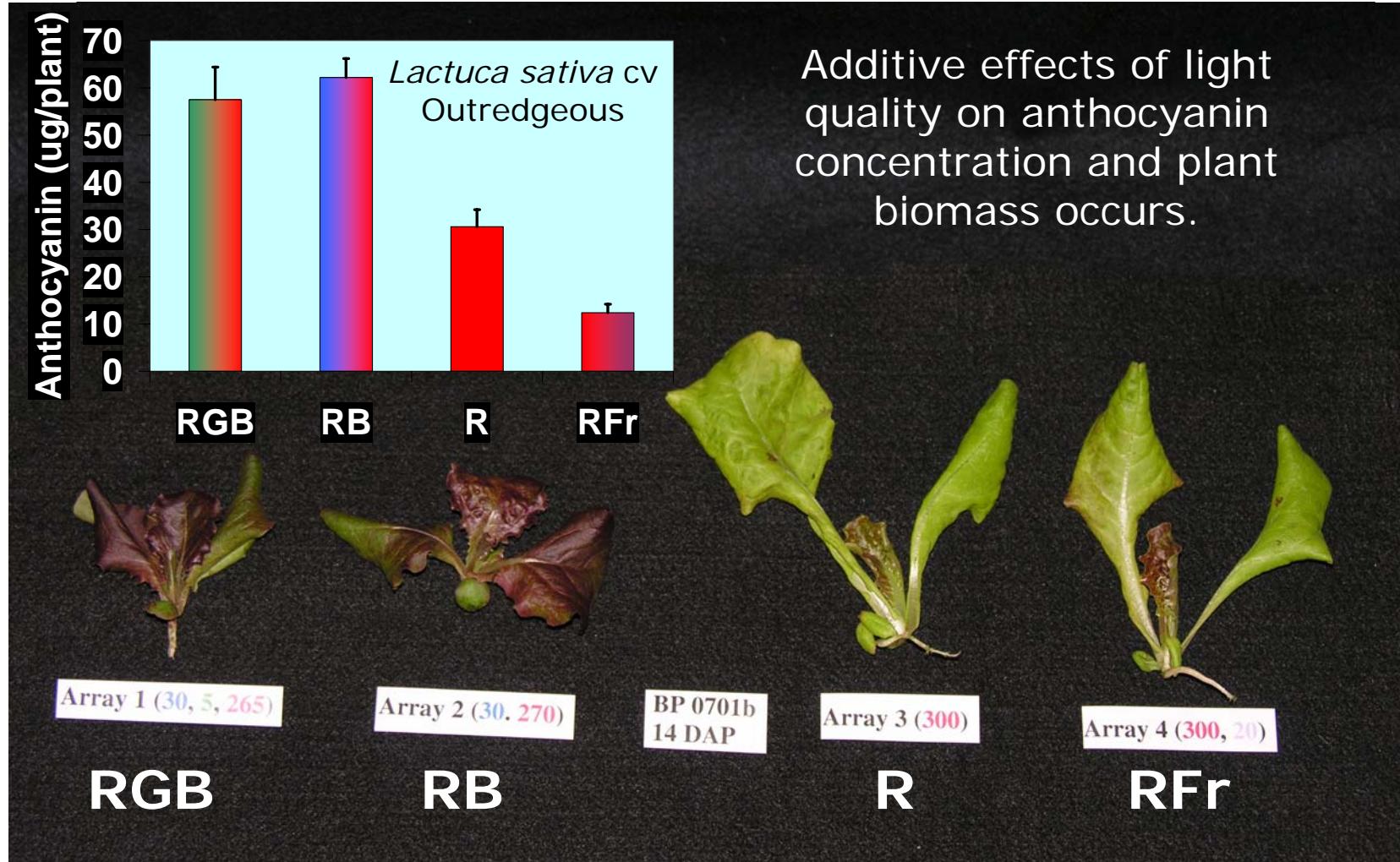
# Light quality affected plant morphology alter efficiency of light interception



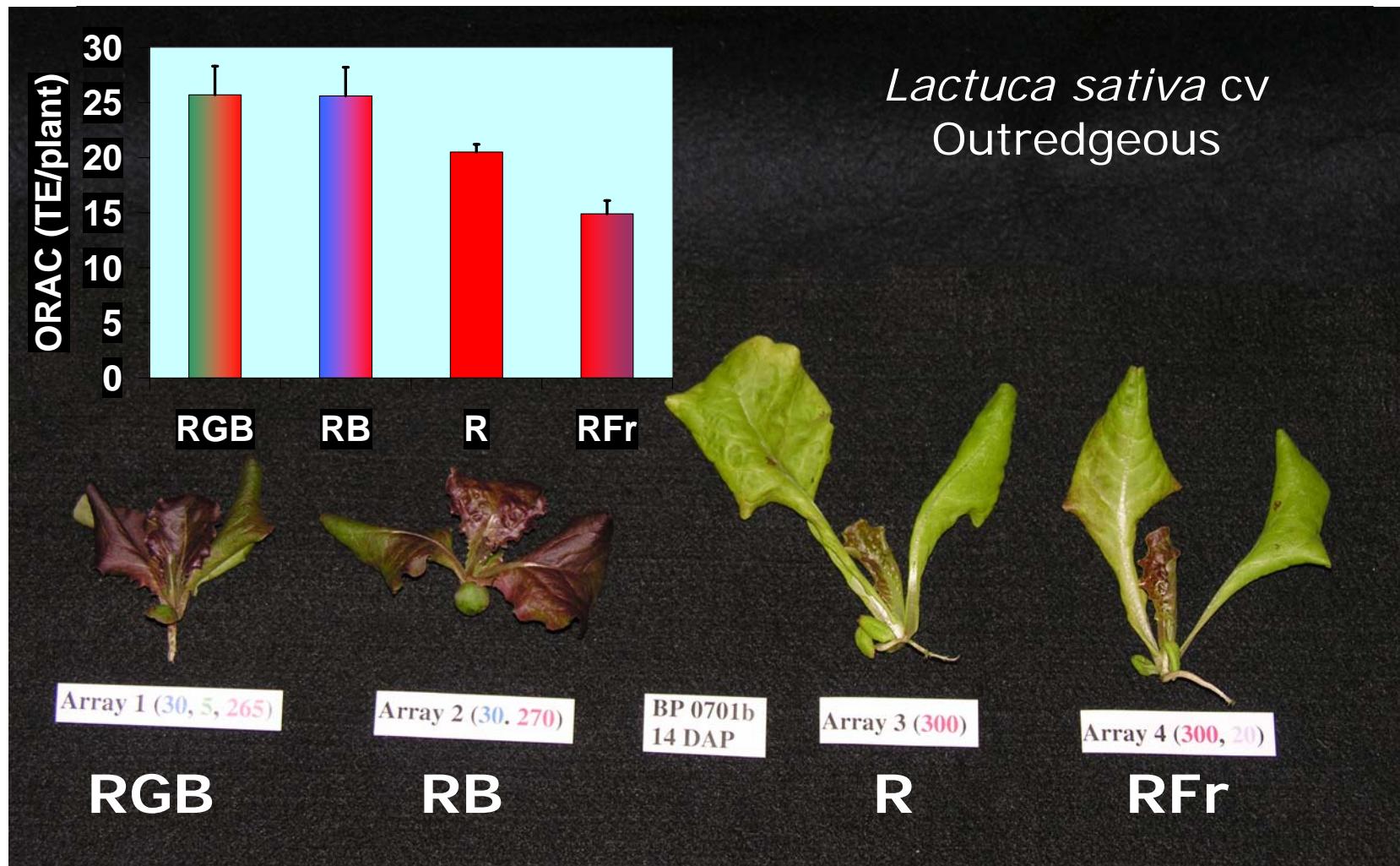
# Light quality has significant effect on anthocyanin concentration in leaves.



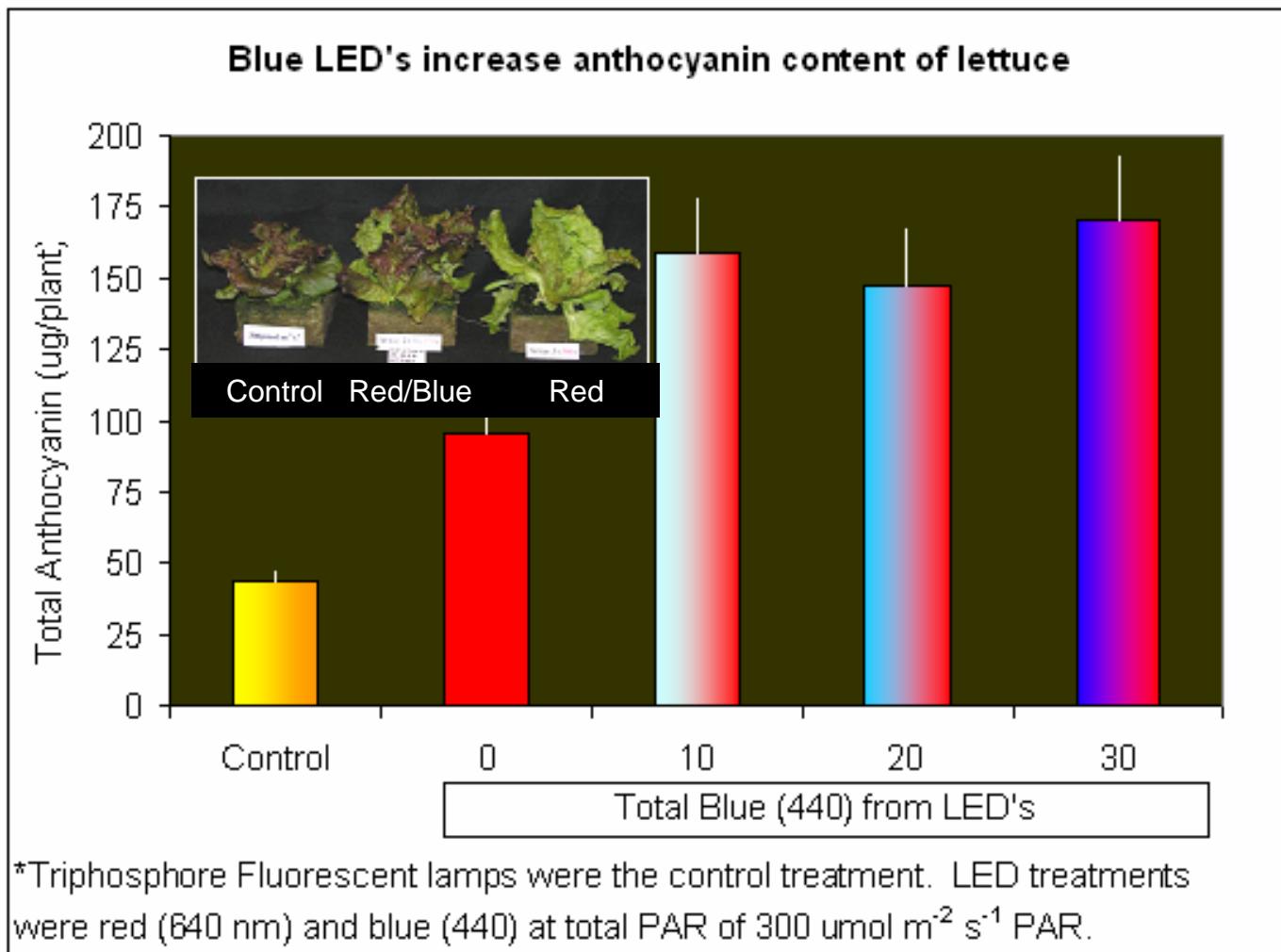
# Blue (440 nm) light increases total anthocyanin content of plant.



Blue (440 nm) light increases total anti-oxidant potential (ORAC) value of plant.

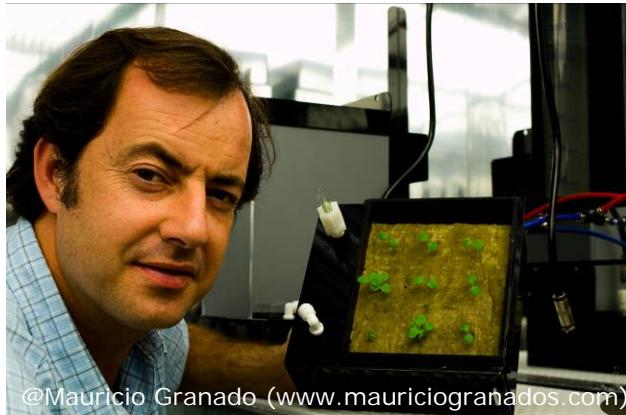


# Threshold for blue (440 nm) was <5% of total PAR for anthocyanin production



# Conclusions

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- LED's can be used optimize spectral quality in plant chambers for long duration missions in order to increase yields by increasing light interception and increased efficiency of light conversion.
- Photoregulation of secondary metabolisms has potential to significantly increase the bioprotectant and nutraceutical value candidate salad crops
- A significant amount of research is required to understand the photo regulation of bioprotectant metabolism in plants.

# Acknowledgments

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