Project: HS-PLNT-743
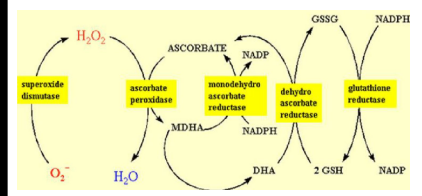# Using Monte Carlo Simulation to Optimize Vitamin C Production in *Lactuca sativa* by Varying Light Intensity and Wavelength, Year II

Quinn Hughes and Tyler Clair
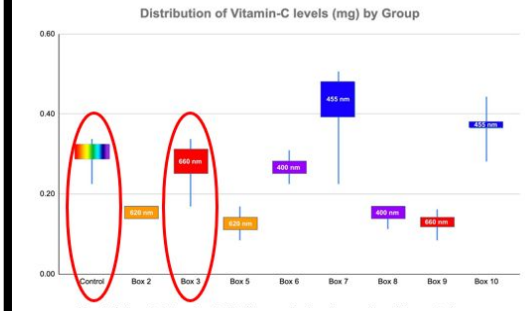**Grade 10, Minnetonka High School**
Minnetonka, MN USA

Q1: Research Question

Vertical Farming is revolutionizing agriculture. Unfortunately, its produce has been shown to be less nutritious - especially lacking in Vitamin C..

- Year 1: Research Question: Could it be that the lack of abiotic stress in the VF environment is contributing to the lack of Vitamin C?
- Year 2: Can a specific plant species with a given stress-tolerance level be manipulated by varying light wavelength and intensity alone to improve Vitamin C production?
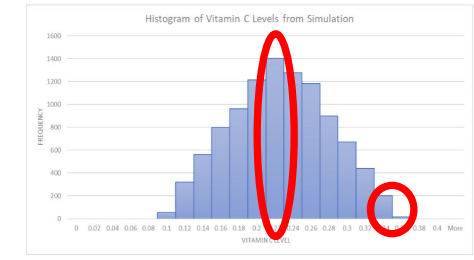
Q2: Methodology

- Grew, Harvested and Juiced Plants
- Application of Light Treatments: Various wavelengths and Intensities
- Vitamin C was measured by iodine titration
- An ANOVA and T-tests were performed to test for differences in treatment means. Regression equation fed the Monte Carlo Simulation.
- Monte Carlo Simulation with 10,000 iterations; results were graphed. The optimal point on the grid was found.

Combinations of Light Intensity and Wavelength of Treatment Groups

Q3: Data Analysis & Results

Distribution of Vitamin-C levels (mg) by Group

- Both null hypotheses were rejected: wavelength and light intensity both have an impact on the plant's Ascorbate-Glutathione cycle

- Shorter wavelength and higher intensity both correlated with Vitamin C production within the bounds of the experiment
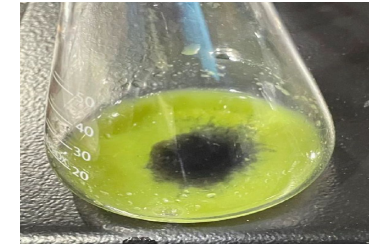

Histogram of Vitamin C Levels from Simulation

Q4: Interpretation & Conclusions

- Vitamin C increased 41% over the control with optimal light and wavelength combination
- This is very important because a lack of Vitamin C in the human diet can lead to iron deficiency anemia, the world's most common form of malnutrition

Simulation Surface: Vitamin C Levels