PLANT GROWTH AND MORPHOLOGY UNDER A SKY COLOR LIGHT PROGRAM. B. Moyer[1] and J. Haqq-Misra[1,2], [1]GreenSpace (PO Box 5881, Newark DE 19714; brian@growgreenspace.org), [2]Blue Marble Space Institute of Science (1200 Westlake Ave N Suite 1006, Seattle WA 98109; jacob@bmsis.org).

Light is the primary energy source for nearly all life on Earth. Photosynthetic organisms rely on light-harvesting pigments to absorb this energy and convert it to chemical energy that can be stored for later use. Early research into plant photosynthesis has shown that plant morphology and growth characteristics are directly influenced by the spectral quality of the light source illuminating the plants [1]. Further studies have revealed that while individual pigments typically have narrow peak-efficiency ranges, competition for light has led to the evolutionary development of numerous pigments, which allow greater light energy to be collected across the broad radiation spectrum of the Sun [2]. This insight, and the desire to attain the maximum growth, have been the basis for the development of more efficient plant grow light systems.

Conventional grow lamps such as high-pressure sodium, metal halide, or compact fluorescent output “full-spectrum” light, as well as heat, over a large area. By contrast, light emitting diodes (LEDs) produce a discrete band of visible light and minimal heat from a surface that is only a few millimeters across. Prior to the availability of LED technology, it was highly impractical to make fine adjustments to transmitted light over small fluctuations in time. However, computer controlled, wavelength-specific LEDs have given researchers precise control over the lighting environment. Red, Green, Blue (RGB) LEDs combine each color diode into a single package that can provide “white” light when all three of its diodes are lit. Additionally, the intensity of each color can be adjusted independently to provide any color in between. The greater availability, decreasing cost, and improved efficiency has increased the popularity of LEDs as an artificial lighting source.

The purpose of this study is to observe the developmental characteristics of plants grown under a LED light regime that mimics the daily sky color cycle. Previous research has investigated sequential treatments of darkness, blue light, green light, red light, and infrared light to significantly alter final product quality [3, 4]. Therefore, we hypothesize that there will be a quantifiable difference in growth habits and characteristics between plants grown with LEDs under a sky-mimicking light pattern and plants grown with LEDs under a constant light schedule. An Arduino© microprocessor board will be used to control the light arrays. Arduino© is an open-source prototyping board based on the C++ programming language. The code will utilize data from a real time clock (RTC) and the sun’s position based on physical longitude and latitude to calculate a matching RGB value. This serves as a realistic daily light cycle that transitions from a pre-dawn to dusk, which provides a realistic color profile for plant growth. These ongoing efforts seek to investigate growth characteristics for a variety of agricultural plants, which will provide insight into improving cultivation techniques on Earth as well as in artificial environments such as space stations. Future work will extend this analysis to examine the dependence of plant growth on the stellar spectrum by examining solar (G-type) and non-solar (F/K/M-type) spectral energy distributions.

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