CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

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Project Number

38430

Project Title

The Growth of Basil in a Controlled Environment with Modulated Lighting Conditions

Abstract

Objectives/Goals

Incubator farming is an effective way to consistently grow plants year round in a controlled environment. However, the cost of lighting in an incubator is a big factor in the cost efficiency of an incubator farm. One way of reducing energy needs is to modulate light that is used to grow the plants. The objective of this experiment is to find the optimal light modulation for the growth of basil. The hypothesis is that the plants exposed to the 50% duty cycle light would sustain similar or less growth to the 100% duty cycle and the 75% duty cycle, but would still be superior to the 25% duty cycle. Moreover, the frequency of modulated lights should have an impact on the growth rate of basil plants as well.

Methods/Materials

The main materials used were LED growth lights, basil plants, a Raspberry Pi, an incubator, and a temperature/humidity sensor. Basil was chosen for our experiment because it grows best at room temperature and because it is a good proxy for semi-fragile, arable herbs. The plants were grown in four different incubators with four plants in each. Each of the four groups had a different modulation cycle, 25%, 50%, 75% and 100%. In our further research, we tested modulations at four frequencies at 0 (control sample, no modulation), 0.2, 1, and 5 hertz, all of which are at a 50% duty cycle. They were grown over three weeks and 12 hours on a day. A Raspberry Pi was used to regulate the light modulations, and a sensor was attached to the Raspberry Pi to measure the humidity and temperature in the incubator.

Results

By measuring the delta in weights of the plants, the total growth of the plants over a three week period was calculated. After comparing results, it was found that 50% modulation is optimal for plant growth with a total growth of 1.35 grams. The 25% light modulation had a total growth of 0.2 grams, while the 75% and 100% both had a total growth of 0.875 grams. It was also found that modulation frequency has an impact on the growth rate of basil plants.

Conclusions/Discussion

The experiment showed evidently that the optimal duty cycle needed to grow basil was 50%, which was discordant with our hypothesis of 100%. Moreover, the results uncover a novel approach to reducing the energy required to grow plants in a vertical farm. Further investigations of the effect of LED lights on plants in general is needed.

Summary Statement

The experiment tested for the optimal light modulation for growing basil plants, and it was found that the 50% duty cycle produced more total growth than the 25%, 75% and 100% modulations.

Help Received

We received advice from the CEO of a vertical farm, who recommended we use basil plants as the test subjects for the experiment.