Name(s)

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Project Number

S1811

Project Title

Comparing the Physiological Responses of C3, C4, and CAM Plants in Changeable Climates Using a Smart Plant Tracker

Abstract

Objectives

The objective of my study was to use a Smart Plant Tracker to research how C3, C4, and CAM plants would cope with Global Warming in order to understand the impact of rising temperatures on our future food sources.

Methods

In the first test group (the control group) I simulated the current avg. summer temperatures in the US. I placed 1 Lolium (C3), 1 Panicum virgatum (C4), and 1 Crassula ovata (CAM) in a circular formation. I suspended 1 Bulb 18in. above the center of the circular formation of plants, distributing 85F of heat onto the plants. For the 2nd test group, I suspended a Bulb 12in. above another set of Lolium, Panicum virgatum, and Crassula ovata plants, distributing 90F onto the plants. For the 3rd test group, I did the same, however I suspended the bulb 6in. above the plants, distributing 95F. I labeled each of the smartplant trackers, devices that measured the light, moisture, fertilizer levels, and temperature of the plants, with either C3, C4, or CAM. I inserted the trackers into the soil of their respective plants for test group 1 and measured the response after one week. Each week I placed the trackers in a different test group (following a pattern) and gathered data for 2 months using an app that correlated to the smart trackers.

Results

During the study, the vitals of the C3 plants were drastically lower than those of the C4/CAM plants. The smartplant app connected to the trackers conveyed the data on a scale of 1 to 10 (1 being deficient and 10 being in excess). A score of 5 meant the plant was in good health. Throughout the study, the C3 plants were deficient in moisture and in excess in light and temperature, while the C4/CAM plants were much more stable, with scores closer to 5.

Conclusions

At the end of the study, I discovered that there is a strong correlation between a plant's photorespiration pathway and how it will cope with the higher temperatures of the future. The C3 plants were more equipped to cope with lower temperatures and more moist conditions, rather than hotter, sunnier environments they were exposed to. This is largely due to their lack of photosynthetic adaptations to reduce photorespiration. The C4/CAM plants were more adapted to live in the hot, dry conditions than the C3 plants, because they have a pathway to minimize photorespiration. The conclusion of this study can be applied to real-world agriculture. As our global temperatures increase, the data from this experiment indicates that we should invest resources in planting C4 crops and figure out how to implement the C4/CAM pathway into C3 plants.

Summary Statement

By analyzing the physiological effects Global Warming will have on plants with varying adaptations to photorespiration, I discovered that C4/CAM plants are more able to cope with the future's rising temperatures than C3 plants.

Help Received

I received help from my science teacher Mr. Nat, who helped me understand the mechanics of the smartplant tracker. My parents also helped keep me on task.