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Enhanced Stimulation of Plant Root Growth in Hydroponic Systems Using Blue and Red Fluorescent Light

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Project Title: Enhanced Stimulation of Plant Root Growth in Hydroponic Systems Using Blue and Red Fluorescent Light

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Project Description:
Hydroponic gardening uses a mineral rich solution to feed plants without soil. Competition for nutrient acquisition becomes a growth limiting factor in many hydroponic systems in which slower germinating seeds cannot compete with more mature root systems leading to both low yields and high cost in agricultural production. The ability to stimulate germination and development of initial, strong root systems would enable a hydroponic crop to achieve maximum yield whether in a large, commercial hydroponic system planting, a home hydroponic system or even in a commercial spaceflight system.

It is known that blue light in the range of 400-500 nm promotes root growth and stimulates rates of photosynthesis whereas red light in the range of 640-720 nm stimulates stem growth, flowering and chlorophyll production. The primary objective of the current project is to set up a standard hydroponic system in the UAH Greenhouse that would allow timed exposure to cycles of blue and red fluorescent lighting that would produce a maximum ratio resulting in development of strong root systems, stem growth and maximum germination rate. Dry weight of root biomass and the numbers of seeds germinated would be measured versus the individual exposure times to the blue and red-light ratios. The hydroponic system would be organized and the selection of key plants made in Spring, 2019. Fluorescent lights in both the red and blue wavelengths have already been purchased (Fall, 2018).

Student Specific Duties, Contributions and Outcomes:
Specific Duties: The student selected would be specifically responsible for: (1) maintaining and preparing the hydroponic system in the Greenhouse using commercially available hydroponic solutions, (2) establishing the experimental design of the project i.e. numbers of repetitions and seeds to plant for statistically significant analysis (3) maintaining the exposure times for each wavelength of blue and red light and (4) collecting and analyzing data in the form of a laboratory
Tangible Contributions: Tangible contributions made by the student will include: (1) technical report to be submitted to Perpetua (2) poster presentation at the annual UAH Undergraduate Research Poster Event (3) interacting with a professional in the field of hydroponics. A long-term goal is attendance and poster presentation at the regional meeting of the Association of Southeastern Biologists (April 3-6th 2019 in Memphis, Tennessee).

Specific Outcomes: Skill-based outcomes for the student will include: (1) maintenance of a hydroponics system (2) preparation of nutrient solutions (commercial mix) for hydroponic systems involving serial dilutions (3) experimental design of an experiment (4) statistical analysis of data to include: ANOVA, linear regression analysis (5) use of Excel spreadsheets (6) dry weight determination of root systems via desiccation. Knowledge-based outcomes for the student will include: (1) understanding of the effects of red and blue wavelengths on root growth and germination rates and (2) nutritional requirements of plants.

Faculty Requirements and Mentorship:

Faculty Requirements:

(1) Student with a minimum of junior level standing
(2) Student background to include BYS 119 or BYS 120 and BYS 302

Faculty Preferred Requirements:

(1) Student with senior level standing at the onset of the Summer semester
(2) BYS 491 Special Topics in Plant Physiology in addition to BYS 119 or 120 is preferred

Faculty Mentorship: The student will interact with the primary mentor a minimum of two times weekly at a prearranged time. Discussions will include issues and concerns developing with the project as well as a review of major factors affecting plant root growth. Basics in hydroponic systems will be reviewed with the student interacting a minimum of two times for a professional review of the Greenhouse hydroponic system by an agent (adjunct mentor) Mrs. Rhonda Conn Britton, from the Alabama Cooperative Extension Agency. The mentor will also accompany the student to the regional meeting of the Association of Southeastern Biologists (April 3-6th 2019 in Memphis, Tennessee).