

Teaching Plant Propagation with Microgreens in Secondary Agriscience Classrooms

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HORT 6050 Plant Propagation Laboratory Clemson University

Research Team:

- 5 Agricultural Education Graduate Students
- 1 PES Professor
- 1 AGED Assistant Professor



Funding Generations of Progress Through Research and Scholarships

Introduction

MICROGREEN PRODUCTION

- Popular/novel idea especially among restaurants and health food groups due to the convenience and nutritional value.
- Easy to produce, fast growing, and have desirable shelf-life.
- Harvested within seven days after sown
- High harvest volume allows for ease of use in a classroom.



Research Objectives:

- Determine how teachers can utilize microgreens as a science, technology, engineering, and mathematics (STEM) lesson within the agriscience plant science curriculum.
- Contrast light-emitting diode (LED) and fluorescent light and its effects for producing nutrient dense microgreens and growth.
- Examine if microgreens grown in a classroom setting are a safe food product with an acceptable shelf-life.



Agriscience Teachers

Professional Development Conference

- Clemson University
- Collaboration: Agricultural Education Program and Plant and Environmental Science Department
- Winter and Summer
- N = 23

How do you currently teach sexual plant propagation in your agriscience course? (include resources you use)

- What do participants know?
- Pretest/Posttest Administered
 - Goal: to gain knowledge about seed-based propagation and microgreens



SCAAE Summer Conference- Microgreens Professional Development
Workshop Evaluation

PRE- Workshop Evaluation

1. Why did you chose to participant in this professional development workshop?
2. What career pathway(s) do you teach? (select all that apply)
 - o Horticulture
 - o Environmental and Natural Resource Management
 - o Plant and Animal Systems
 - o Agricultural Mechanics
 - o Bio-Systems Engineering Technology
 - o Other _____
3. How do you currently teach sexual plant propagation in your agriscience course? (include resources you use)
4. On average, how many instructional days do you dedicate to teaching sexual plant propagation?
5. How would you define microgreens?
6. Please rate your personal level of perceived knowledge about microgreens.
 - 1 =No knowledge
 - 2 = Little knowledge
 - 3 = Some knowledge
 - 4 = Moderate knowledge
 - 5 = Extensive knowledge
7. Do you currently incorporate microgreens activities into your classroom?
 - 1 = Yes
 - 2 = No
 - 3 = I don't know

SCAAE Summer Conference- Microgreens Professional Development
Workshop Evaluation

POST- Workshop Evaluation

1. Please rate your new personal level of perceived knowledge about microgreens.
 - 1 = No knowledge
 - 2 = Little knowledge
 - 3 = Some knowledge
 - 4 = Moderate knowledge
 - 5 = Extensive knowledge
2. Please describe how your knowledge about microgreens has been expanded through this professional development/laboratory experience.
3. Please rate how likely you would be to incorporate microgreens activities into your sexual plant propagation unit or other unit of instruction in the curricula you teach.
 - 1 = Not likely
 - 2 = Somewhat likely
 - 3 = Neutral
 - 4 = Likely
 - 5 =Very likely
4. What supporting educational materials would improve this microgreens lab for your use?
5. If a microgreens laboratory investigation kit that included supplies and materials and supplemental instructions were available, would you purchase this kit? Please circle yes or no and explain why.

YES or NO
6. Please provide additional comments, questions, or suggestions to assist us with developing this unit of instruction for you to teach.

Methods

Used six different Crucifer species:

Broccoli

Mustard

Daikon Radish

Red Cabbage

Kogane Cabbage

Red Rambo



Aseptic Culture Clean Room Technique



Aseptic Culture Tabletop Technique



Preparation Seed Cleaning



Seed Preparation

Place 6 scoops of each seed into different mesh bags (label them!)



Sterilized seeds
in 5% bleach @ 50
C for 5 minutes



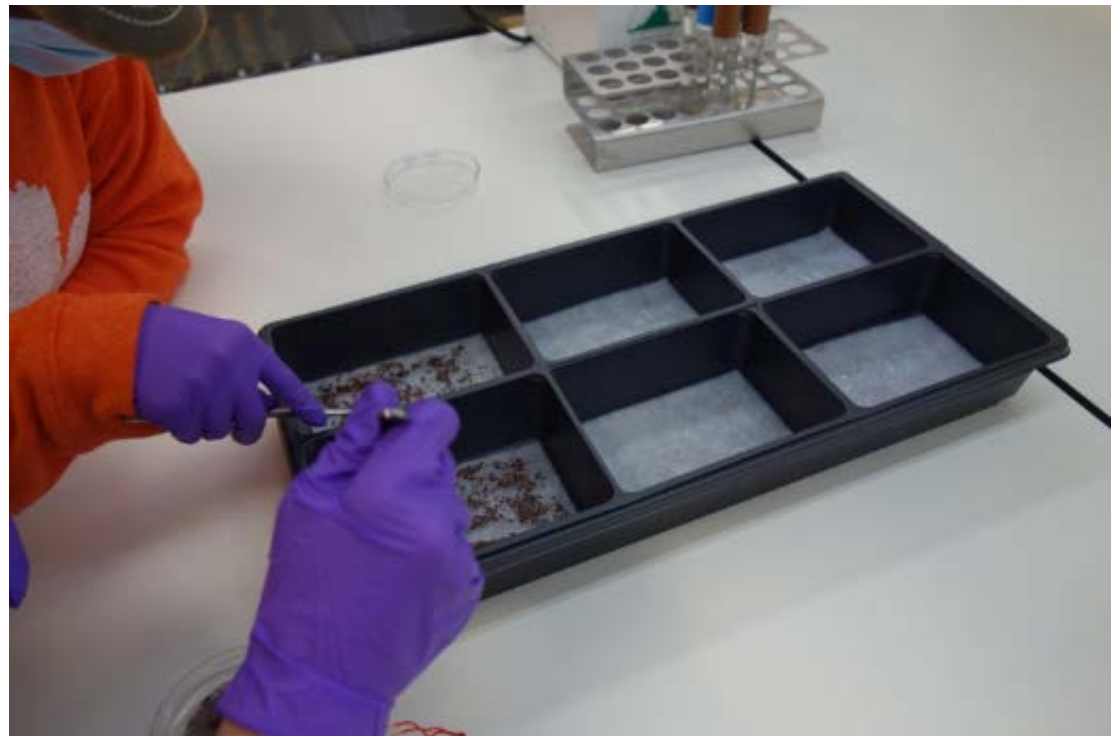
Water bath 20 minutes

Process continued...



Hoagland's solution is made using 1.63 g of Hoagland's basal salt solution

Spread the seeds as uniformly as possible



Sowing the Seed



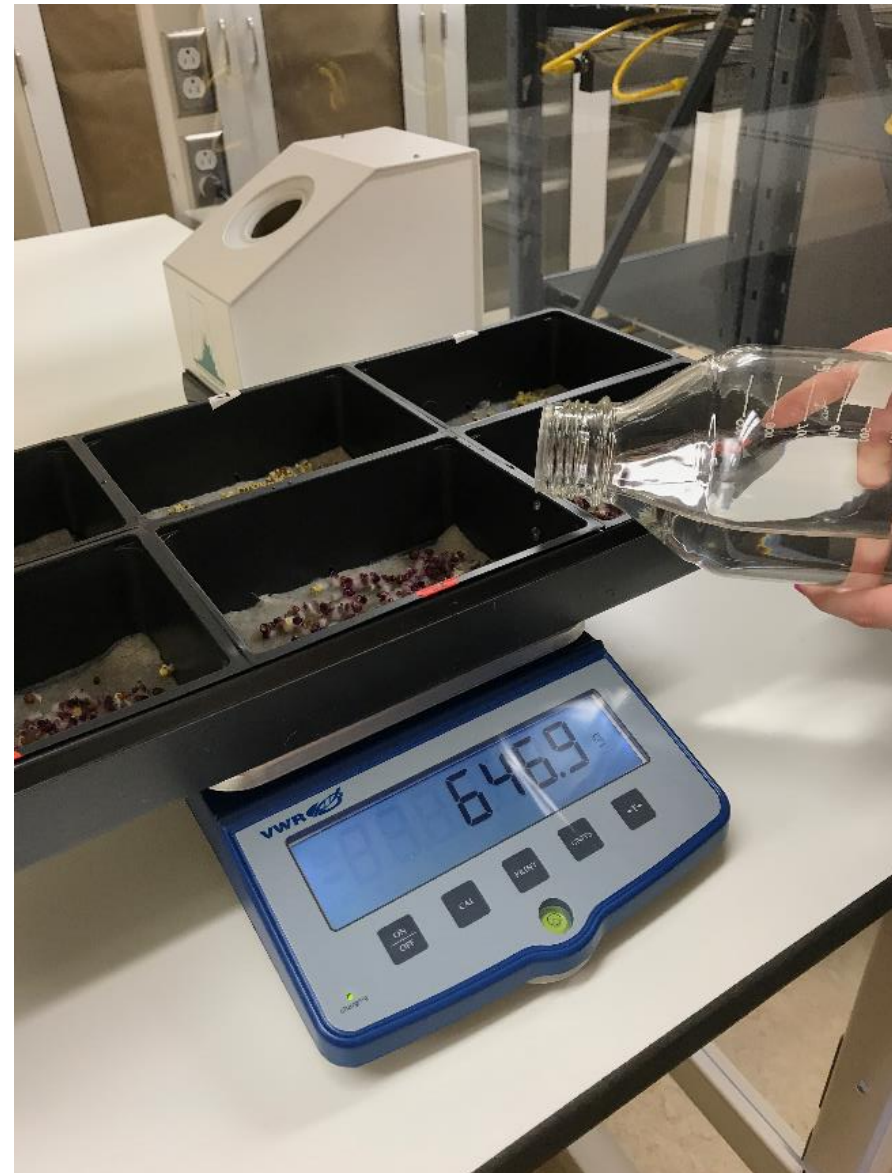
DARK STORAGE

Place seeds into dark storage area for 2 days.



After the 2 days of darkness.

Add Hoagland's fertilizer mixture each day to the flats. When added, the flat should weigh 1050 g.



LIGHT TREATMENTS

After 2 days in dark storage, seeds are now ready to be placed under desired lighting.



Light-emitting Diode (LED)

Fluorescent



TRANSFER TO LIGHT TREATMENTS

After 7 days under lighting, the microgreens are ready to be harvested.



ANALYZE GROWTH

Measure heights of each microgreen cell in three different places.
Calculate the average height of plants in each cell.



FERTILIZE AND WEIGH



HARVEST

Using scissors, cut each cell of microgreens at the same height. Weigh out 20g of fresh microgreens to place in plastic bags and place in refrigerator.



WEIGH, PACKAGE & LABEL

Weigh out 20g of fresh microgreens to place in plastic bags and place in refrigerator.



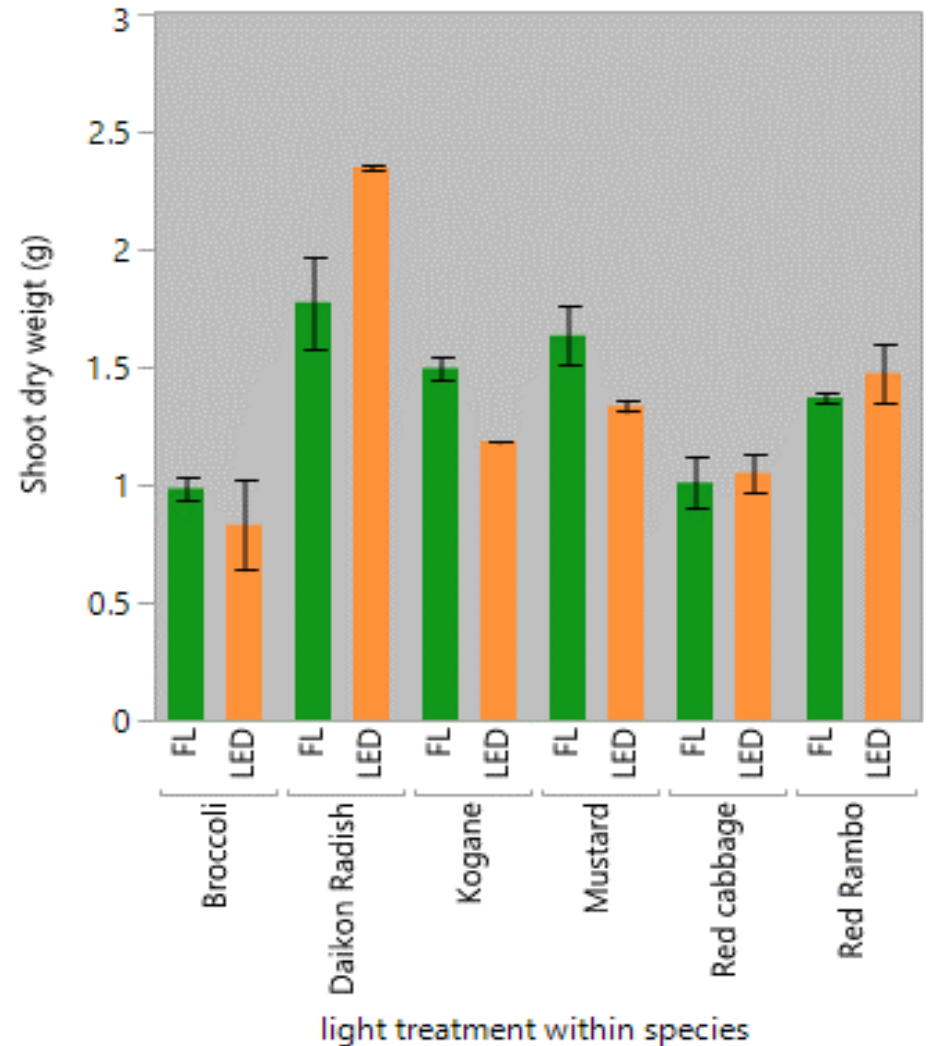
REFRIGERATE AND CALCULATE SHELF-LIFE



Effects of Contrast Light Emitting Diode (LED) and fluorescent light for producing nutrient dense microgreens

GROWTH

- Increase in dry weight reported for all six species of Crucifers under different light treatments.
- Greatest increase in shoot mass was Daikon Radish under LED.
- Kogane and mustard showed greatest increase under florescent lighting.



γ FL LED

Each error bar is constructed using 1 standard error from the mean.

Results- NUTRITION

Phosphorus, Calcium, Magnesium, Potassium

- Content of mineral nutrients in each 10 g fresh serving shows these plants are nutrient dense.
- Through nutrient analysis, Broccoli was the most responsive to increase nutrient uptake by LED light for all nutritional categories.
- In most varieties, calcium was the one nutrient that was significantly increased by LED.
- Kogane, florescent light increased Phosphorous and Magnesium



Results: Shelf-life

- Fairly consistent results with shelf-life and the differences in the clean room versus table top technique
- Confirms this could be implemented into a classroom setting

SPECIES	TREATMENT	LONGEVITY
Broccoli	Tabletop	5 weeks
Broccoli	Aseptic Clean Room	5 weeks
Daikon radish	Tabletop	4-5 weeks
Daikon radish	Aseptic Clean Room	4-5 weeks
Kogane Cabbage	Tabletop	3 weeks
Kogane Cabbage	Aseptic Clean Room	3 weeks
Mustard	Tabletop	7 weeks
Mustard	Aseptic Clean Room	7 weeks
Red Cabbage	Tabletop	7 weeks
Red Cabbage	Aseptic Clean Room	7 weeks
Red Rambo	Tabletop	6 weeks
Red Rambo	Aseptic Clean Room	3 weeks

Conclusions

MINERAL NUTRITION

- All of the crucifers we used contain significant nutritional value. Both genetics and the environment determine the nutritional quality.

GROWTH

- Due to the microgreens rapid growth (7 days) they make a powerful teaching tool to highlight STEM concepts. Similar to nutrition, genetics and environment interact when determining the optimal growth conditions.

SHELF-LIFE

- School-based agricultural education students can learn about cleanliness and hygiene in food preparation through a STEM microgreen production laboratory.



Agriscience Teachers

What do participants know?

- Majority rated themselves

PRE:

- Little to some knowledge of microgreen production

POST:

- Positive self-efficacy of their ability to implement microgreens into horticulture program
- Indicated willingness to incorporate microgreens STEM laboratory investigation into plant science curricula



Teacher Perspective

- Demonstrated the skills derived in the experimental study conducted by the AGED graduate students
- Teachers who participated were overwhelmingly interested with the idea of incorporating microgreens into their SBAE programs
- All teachers (N = 23) “likely” or “very likely” to utilize the curricula in their SBAE program
- Unanimously agreed a lab kit would be beneficial for teaching



“A ‘kit’ would be amazing. I find it's easier for my school to agree to order if I can purchase a ‘kit’ from one vendor.”

Conclusions – Teacher Perspective

- Microgreens workshop presented in a hands-on demonstration to SC Agriscience teachers proved to be an effective learning experience for all.
- Microgreens can be grown and utilized as an effective learning tool for plant propagation.
- Positive response to implementing microgreen STEM curricula into school-based agriculture education curricula.
- Students can easily be taught STEM concepts in a plant propagation unit of instruction using microgreens.



Future Implications

- Create instructional materials to match teacher needs.
- Based on popular demand, additional PD sessions are being explored.
- Current plan is for the microgreens kit to be available for agriscience teachers at the June 2019 “STEM it UP” conference at Clemson University.
- In the future, this curricular unit of instruction may be available to agriscience teachers across the nation.
- Expansion of this idea to create other STEM laboratory investigations will allow for collaboration between multiple departments at Clemson University.



Questions?



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