



# Comparing the Pathogen Reduction Potential of UV Water Treatment with Competition from Beneficial Bacteria

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## Introduction

- Hydroponic cultivation presents a safe, sustainable way to grow a variety of crops, including nutrient-dense microgreens
- However, the same recirculation that enhances water use efficiency in hydroponic systems can also spread human and plant pathogens throughout an indoor farm or greenhouse
- UV-C treatment of hydroponic nutrient solution provides one effective way to combat these pathogens (Moore et al, 2025)
- However, UV-C treatments target all microorganisms indiscriminately, including those in the hydroponic microbiome which may be beneficial to crop growth
- Products containing Plant Growth-Promoting Bacteria (PGPB) are commercially available to hydroponic growers, advertising a wide range of benefits including reduction of plant pathogens through microbial competition
- It is possible that if PGPB products are effective against plant pathogens in terms of biocontrol through competition, they may have a similar impact on human pathogens

## Objectives

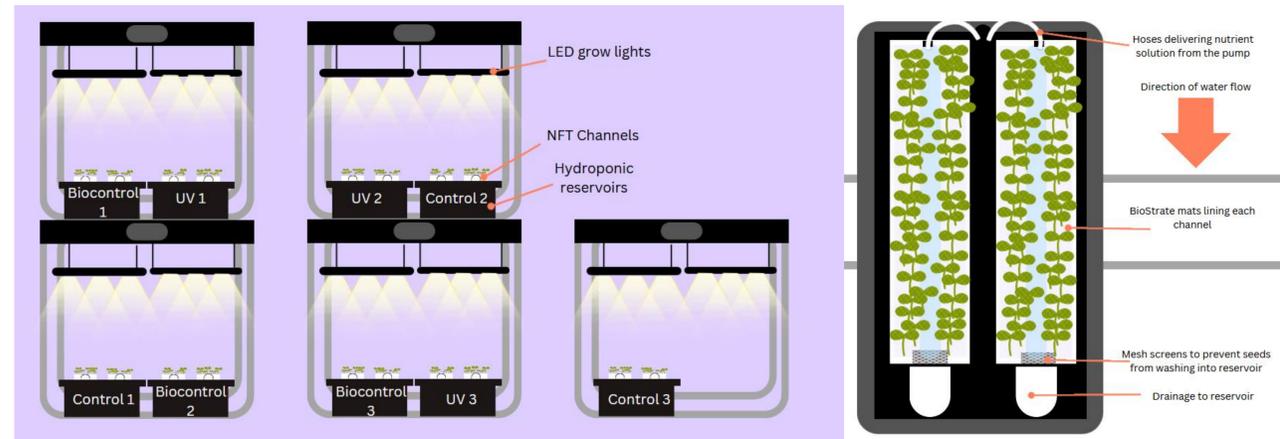
The project's overall goal was to compare the application of ultraviolet water treatment of hydroponic nutrient solution in small-scale Nutrient Film Technique (NFT) hydroponic systems to the addition of a PGPB product, in terms of reduction of *E. coli* within the system. The specific objectives are to compare differences among treatment groups and control groups by:

- Evaluating microgreen height and log CFU/ml of *E. coli* in nutrient solution over time
- Evaluating fresh weight and log CFU/ml of *E. coli* in BioStrate mats upon harvest

## Materials and Methods

The hydroponic system used was desktop Nutrient Film Technique (CropKing, Inc.) and the lighting and frame were from Aero Garden farm 24+ hydroponic towers; the crop grown was kale microgreens (Red Russian, sourced from Johnny's Seeds). Nutrients used in the system were CropKing's Hydro-Gro Leafy and Calcium Nitrate stock solutions. The pH and electrical conductivity (EC) were tested using a Hach H9813-51 pH and EC meter. The UV treatment was performed using a MiniPure MIN-1. Nutrient solution samples were diluted using 0.1% buffered peptone water, and plated on tryptic soy agar (Remel, Inc.) with 80 µg/ml of rifampicin.

## Materials and Methods



- Seeds, nutrients, and water were added on the first day of the experiment, after which *E. coli* was inoculated into the nutrient solution
- On the same day, after inoculation, the UV treatment was performed for systems in the UV treatment group, and the PGPB was added to systems in the biocontrol group
- pH was adjusted using 1% KOH and 1% H<sub>2</sub>SO<sub>4</sub> and maintained between 5.5 – 6.0 and EC from 1.2-1.6 mS/cm during the growth period.
- Nutrient solution samples were collected for bacterial enumeration before and after the treatments on day 1, and then six additional times throughout the growth period
- Three trials were conducted at different times, with microgreens harvested after 11 days

## Major Findings

- The UV treatment was more effective than the PGPB product in terms of reducing the *E. coli* that is detectable in recirculating hydroponic nutrient solution
- However, the UV treatment was no more effective than the biocontrol intervention in terms of reducing the *E. coli* detectable on the BioStrate mat upon harvest
- Neither treatment significantly impacted the height or fresh weight of Kale microgreens

## Future Studies

The study compared the reduction potential of a UV treatment to a PGPB product being used in a novel capacity for biocontrol of a surrogate human foodborne pathogen in NFT hydroponic systems growing kale microgreens. However, further studies are needed to investigate additional benefits of each kind of intervention, including:

- More in-depth analyses of crop physiology parameters (photosynthetic pigments, phytochemicals, SPAD, etc.) in order to determine if the PGPB product is providing any other benefits to the crop in comparison to UV treatments

## Acknowledgments

Kansas State University, Olathe Campus, for providing research facilities support.

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## Results and Discussion

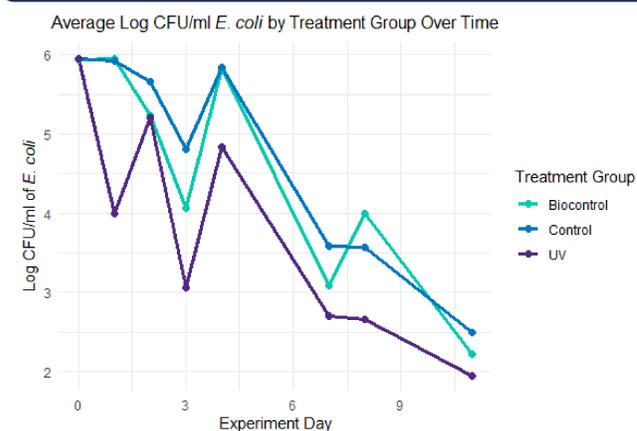


Figure 1: Log CFU/ml of *E. coli* in nutrient solution samples declined over time for all treatment groups and the control. Levels were found to be significantly lower in nutrient solution samples from systems receiving the UV treatment compared to those from control systems, while the samples from biocontrol systems were not significantly different from those in control or UV-treated systems.

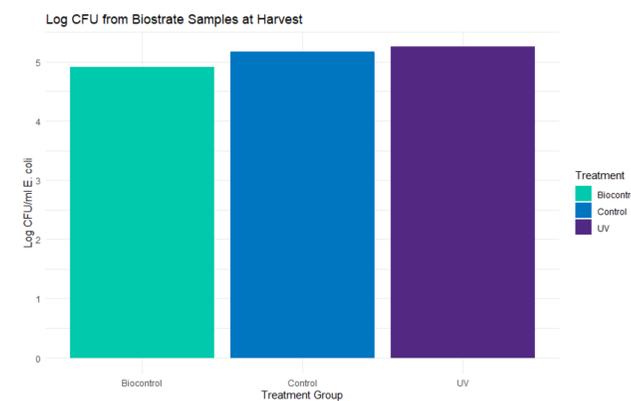


Figure 2: At harvest, log CFU/ml of *E. coli* was much higher than levels seen in the nutrient solution at the same time. There were no significant differences between the groups in terms of log CFU/ml of *E. coli* on the biostrate.

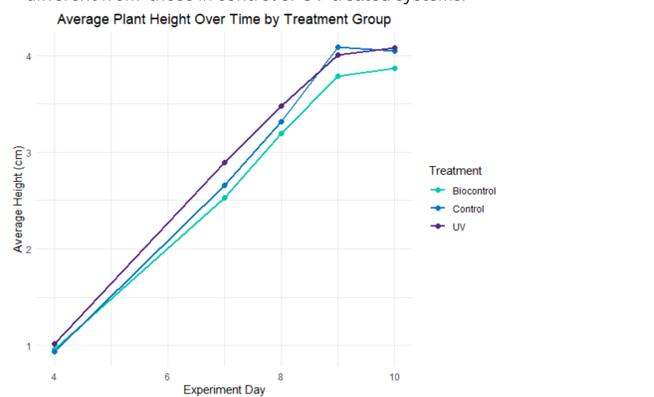


Figure 3: There were no significant differences in height between plants from any of the three groups

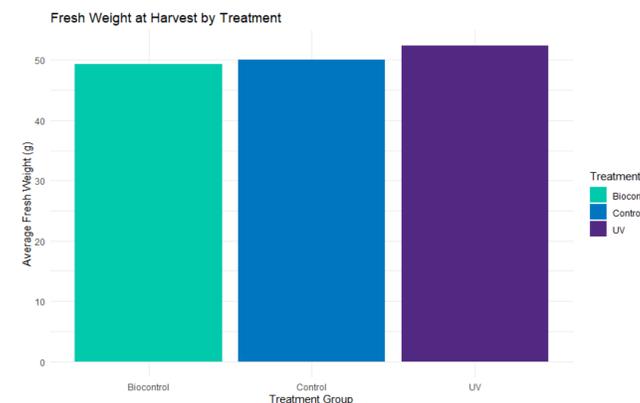


Figure 4: There were no significant differences in fresh weight upon harvest