Synergistic Effects of Algal Biomass and Biochar with Actionobacteria on Lettuce Growth

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ABSTRACT

The widespread use of chemical fertilizers remains the primary method for enhancing agricultural productivity. However, their continuous application negatively impacts soil health, microbial diversity, and nutrient retention while increasing soil acidity and posing risks to both farmers and consumers. As a sustainable alternative, biofertilizers combined with plant growth-promoting bacteria offer a promising solution. This study investigates the effects of algal biomass and biochar, in combination with the actinomycete *Streptomyces sampsonii* MFA02, on lettuce growth.The experiment utilized four treatments: algal *Chlorella* biomass (AB), protein-extracted algal biomass (P-AB), algal biochar (ABC), and protein-extracted algal biochar (P-ABC), compared against a control group using regular planting soil without *S. sampsonii*. Lettuce growth was monitored over 30 days, and results showed that P-ABC combined with *S. sampsonii* significantly enhanced plant growth. Lettuce treated with P-ABC and *S. sampsonii* exhibited an average of 12.11±0.40 leaves, a fresh weight of 23.03±4.35 g, a dry weight of 3.27±0.71 g, a height of 14.44±1.43 cm, and a carotenoid content of 0.20±0.01 mg/L, all significantly higher than those in the control and other treatments ($P < 0.05$). These findings highlight the potential of biochar-based biofertilizers and actinomycetes as effective alternatives for enhancing crop yield while reducing reliance on chemical fertilizers.

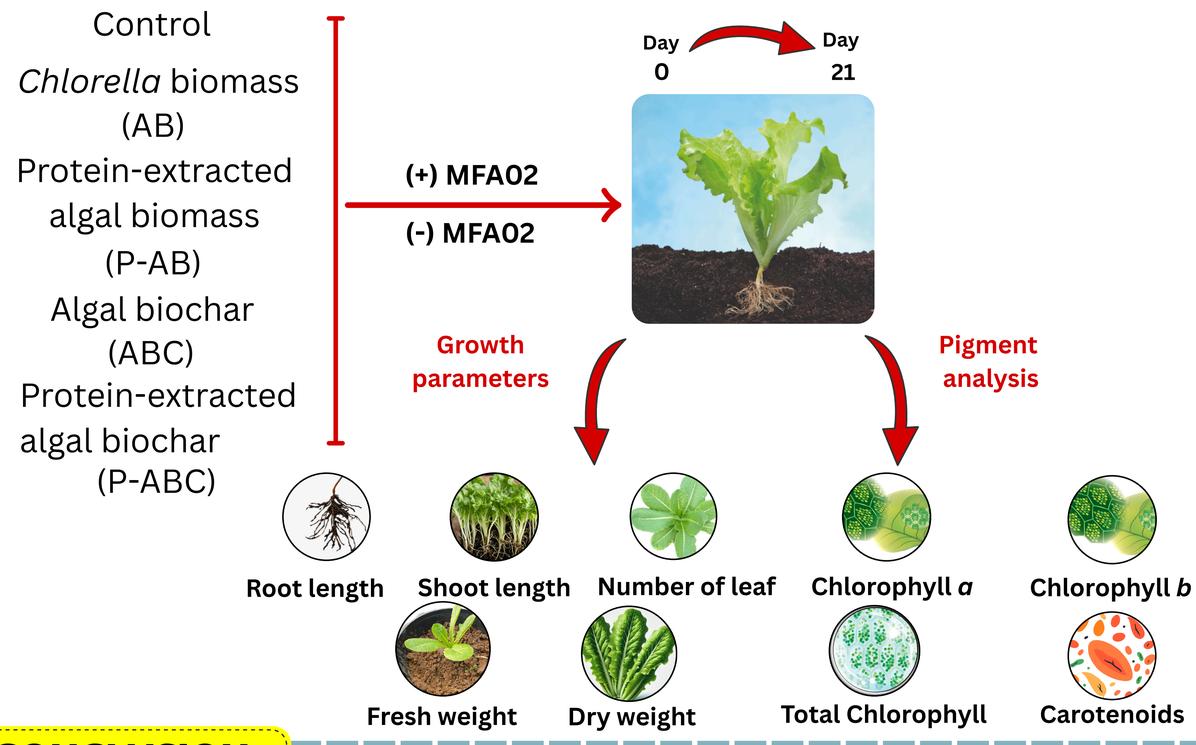
INTRODUCTION

Chemical fertilizers enhance agricultural productivity but have adverse effects on the environment and human health, leading to soil degradation and a decline in beneficial microbial diversity. Using biofertilizers derived from algal biomass and biochar offers a sustainable alternative. Algal biomass is rich in essential nutrients and plant hormones, promoting plant growth and increasing resilience to unfavorable environmental conditions. Meanwhile, biochar improves soil structure, enhances water and nutrient retention, and reduces nutrient leaching. Additionally, Actinobacteria play a crucial role in controlling plant pathogens, boosting plant immunity, and producing bioactive compounds that stimulate plant growth. This approach reduces the reliance on chemical fertilizers and pesticides, fostering environmentally friendly and sustainable agricultural practices.

OBJECTIVE

To study the synergistic effects of algal biomass (*Chlorella* biomass, protein-extracted algal biomass, algal biochar, protein-extracted algal biochar) with or without actinobacteria on promoting the growth of lettuce.

METHODOLOGY



CONCLUSION

The P-ABC+Acti (protein-extracted algal biochar + actinobacteria) treatment was the most effective in promoting lettuce growth. It had positive effects in several aspects, including increased root length, higher fresh and dry weight, and the highest number of leaves.

REFERENCES

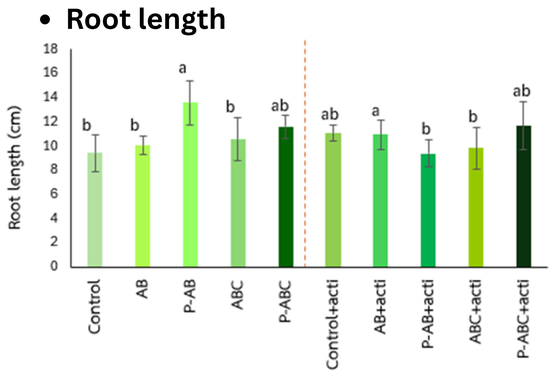
Chalatchaliao, T., Chumsang, C., & Sangmanee, P. (2022). Effect of biochar as amendment of potting soil on growth and yield of three leaf vegetables grown in raised garden beds. *Journal of Energy and Environment Technology*, 9(1), 46-55.

Chumchai, R., Chutimanukul, P., & Thepsilviisut, O. (2025). Effect of compost and biochar on lettuce production under San Sai series with low fertility. Khon Kaen Agriculture Journal, 53(1), 166-180

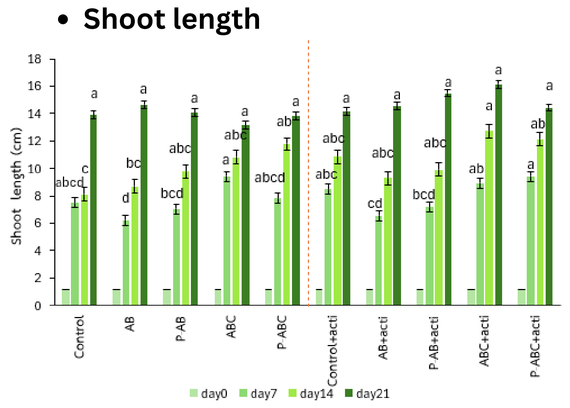
RESULTS AND DISCUSSION

Growth parameter

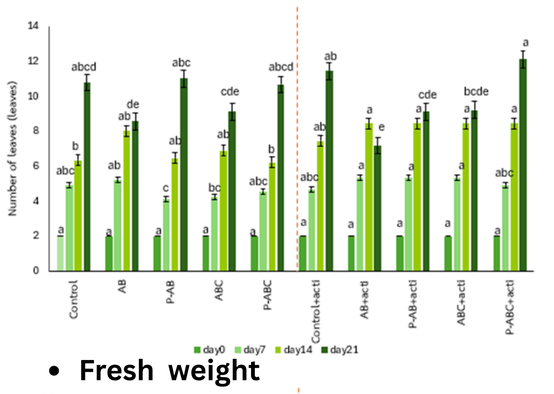
- **Root length**



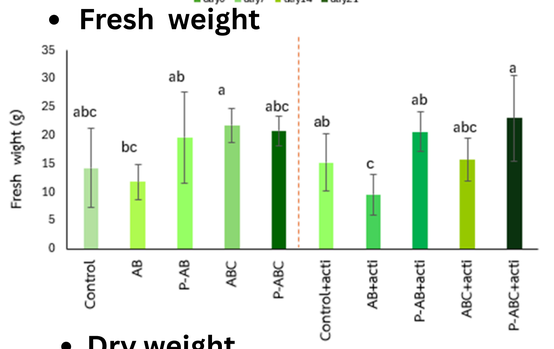
- **Shoot length**



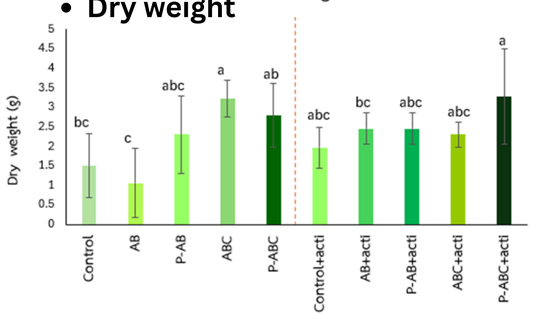
- **Number of leaves**



- **Fresh weight**

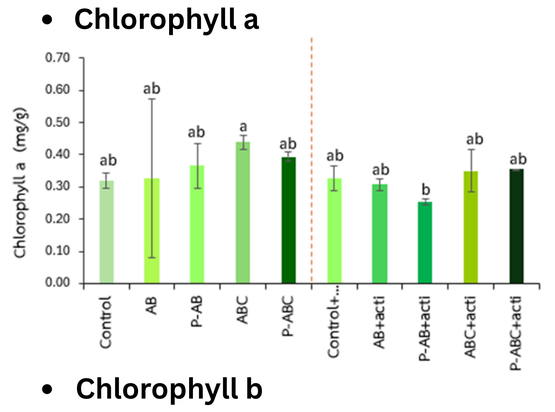


- **Dry weight**

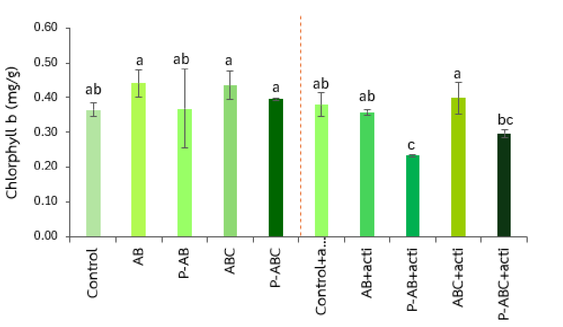


Pigment analysis

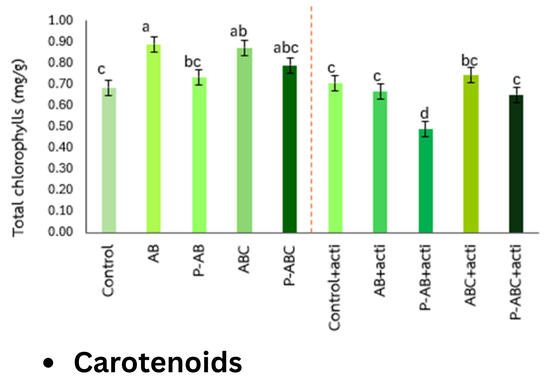
- **Chlorophyll a**



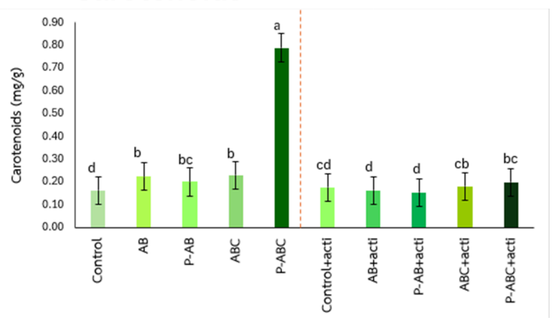
- **Chlorophyll b**



- **Total Chlorophyll**



- **Carotenoids**



AB= *Chlorella* Biomass
P-AB= protein-extracted algal biomass
ABC= algal biochar
P-ABC= protein-extracted algal biochar
AB+acti= *Chlorella* Biomass+actinobacteria
P-AB+acti=protein-extracted algal biomass+ actinobacteria
ABC+acti=algal biochar+actinomybacteria
P-ABC+acti=protein-extracted agal biochar+ actinobacteria

ACKNOWLEDGEMENTS

This project was successfully completed with the support and guidance of Assoc.Prof.Dr. Wasu Pathom-aree, Dr. Sirisit Srinuanpan and Mr. Apivit Khamngoen, as well as the members of Lab SCB2710, Department of Microbiology, and my friends who provided encouragement throughout the research. I would also like to express my gratitude to the Faculty of Agriculture for providing the necessary laboratory facilities for this experiment.