Title : Synergistic Effects of Algal Biomass and Biochar with Actinobacteria 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*, 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.