

Title : Application of Algal Biomass and Biochar in Combination with Actinobacteria to Promote the Growth of Lettuce

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ABSTRACT

The widespread use of chemical fertilizers remains a key strategy for improving agricultural productivity. However, their long-term and intensive application can degrade soil quality, reduce microbial diversity, impair nutrient retention, and increase soil acidification, posing potential risks to farmers and consumers. This study investigated the effects of *Spirulina* biomass and biochar derived from *Spirulina* biomass, applied with or without the actinomycete *Streptomyces sampsonii* MFA02, on lettuce growth during a 28-day cultivation period. The experiment consisted of two main groups based on the presence or absence of *S. sampsonii* MFA02 inoculation. Each group included six treatments: *Spirulina* biomass (B), *Spirulina* biochar (Bc), chemical fertilizer (Ch), half-strength *Spirulina* biomass plus chemical fertilizer (B50+Ch50), half-strength *Spirulina* biochar plus chemical fertilizer (Bc50+Ch50), and half-strength *Spirulina* biomass plus *Spirulina* biochar (B50+Bc50), along with a control (no B, Bc, or Ch addition). Among all treatments, Bc50+Ch50 with actinomycete inoculation produced the greatest growth enhancement. Compared with the control, plant height, root length, leaf number, fresh weight, and dry weight increased by 1.30-, 1.06-, 2.00-, 6.70-, and 4.03-fold, respectively. Photosynthetic pigment contents also increased by 1.20–1.50-fold, indicating improved photosynthetic capacity. Higher soil carbon dioxide emissions were observed, suggesting enhanced microbial activity and nutrient cycling in the rhizosphere. Correlation analysis revealed strong positive relationships among growth parameters and close associations among pigment groups. Overall, the combined application of *Spirulina* biochar and *S. sampsonii* MFA02 achieved performance comparable to or exceeding that of chemical fertilizer alone. These findings highlight its potential as a sustainable strategy to reduce synthetic fertilizer inputs and support long-term agricultural sustainability.

Keywords: Actinomycete; Biochar; Lettuce; *Spirulina* biomass; Fertilizer

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