

Foliar spray or soil drench: Microalgae application impacts on soil microbiology, morpho-physiological and biochemical responses, oil and fatty acid profiles of chia plants under alkaline stress

Alkaline soil inhibits the growth and productivity of chia plants (*Salvia hispanica* L.). Microalgae as biofertilizers have been reported to induce alkalinity tolerance and enhance yield and quality. However, limited information is known concerning the influence of microalgae application on medical plants, including chia. Our experiments were performed to evaluate the effect of microalgae strains of *Arthrospira platensis*, *Chlorella vulgaris*, *Nostoc muscorum*, and *Anabaena azollae* with two application methods, foliar spray and soil drench, on morpho-physiological and biochemical parameters, yield, seed and oil quality, and fatty acid profiles of chia plants cultivated under alkaline soil conditions, as well as the on soil microbial activity. The results obtained reveal that both application methods positively influenced the growth and productivity of chia plants. However, the foliar application showed significant differences in the herb's fresh and dry weights and leaf pigments, whereas the drenching application caused more effect than the foliar spray application at the reproductive stage. Untreated chia plants showed a slight decline in the growth, productivity, and antioxidant level with an increase in Na content. However, microalgae applications significantly ameliorated these impacts as they induced an enhancement in the growth, leaf pigments, total protein and carbohydrate contents, nutrient content, seed and oil yields, as well as an increase in linolenic and linoleic fatty acids, with a reduction in saturated fatty acids, namely, palmitic and lauric acid. Soil drenching generated an improvement in the soil microbial activity and caused a reduction in the pH. The treatment of *A. platensis* with drenching application resulted in higher seed and oil yield, with an increase of 124 and 263.3% in seed and oil yield, respectively.