

Synergistic effect between different plant growth promoting bacteria and various nitrogen rates on production and quality of fennel grown in open field

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Fennel [*Foeniculum vulgare* Miller var. *azoricum* (Mill.) Thell.] is a typically Mediterranean biennial herbaceous plant belonging to the *Apiaceae* family. Nitrogen (N) fertilisation is a conventional agricultural practice to increase yield and yield components of vegetables. However, synthetic nitrogen fertilisers, commonly adopted by farmers, have several negative effects on the environment and humans. Against this backdrop and in line with the European Green Deal strategies, biostimulants, including plant growth promoting bacteria (PGPBs), are considered eco-friendly tools to enhance growth, development and quality of vegetable crops. Based on the above considerations, the aim of the present study was to evaluate the interactive effect between four different N levels (0, 45, 90 and 180 kg ha⁻¹) and three PGPBs (*Azospirillum Brasiliense* DSM 2298, *Bacillus subtilis* DSM 10 and *Streptomyces violaceoruber*) on the quanti-qualitative traits of 'Leonardo' F₁ fennel grown in open field. The results showed that sub-optimal levels of N (45 and 90 kg ha⁻¹) in combination with PGPBs improved growth traits (plant height, stem diameter and number of leaves) and the production of fennel plants. In non-inoculated plants, N concentration in plant tissues increased as N dose supply increased. However, the use of PGPBs, especially *A. brasilense*, resulted in a reduction of N concentration in plant tissues compared to the non-inoculated plants. Furthermore, the use of PGPBs significantly increased the sugar content, as well as the content of functional compounds such as, ascorbic acid and polyphenols. Our results suggest that the tested PGPBs can be considered an eco-friendly tool to improve fennel productivity and quality, particularly when combined with sub-optimal N doses (45 or 90 kg ha⁻¹).

Keywords: *Foeniculum vulgare* Mill.; biostimulants; *Azospirillum brasilense*; *Bacillus subtilis*; *Streptomyces violaceoruber*