








MICROALGAE-BASED BIOSTIMULANTS FOR ENHANCING TOMATO RESILIENCE UNDER CZECH CLIMATIC CONDITIONS

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Background: Sulfated polysaccharides (SPS) are biopolymers located on cell surfaces and in the extracellular matrix of microalgae and cyanobacteria. They are known for antioxidant, antiviral, and immunomodulatory properties. Due to their high sulphation and polyanionic nature, SPS interact with plant cells as natural elicitors and biostimulants. Their application can enhance seed germination, stimulate root and shoot growth, improve nutrient uptake, strengthen defense responses, and increase tolerance to abiotic stress. These effects are relevant for tomato seedlings in the Czech Republic, which are vulnerable to low spring temperatures and to summer heat and drought stress.

Aim of the study: The main objective of this study is to establish baseline methodologies and assess seed treatments with SPS biostimulants derived from *Arthrospira platensis* (spirulina), developed at IMB UTM, for enhancing tomato resilience to temperature extremes and water deficit, in relation to cumulative Growing Degree Days (GDD).

Materials and methods: For this purpose, SPS were extracted from spirulina biomass using distilled water at a ratio of 1:45 (w/v) at 90 °C for 2 h, followed by centrifugation to remove residual biomass. The resulting supernatant was subsequently treated with cetyltrimethylammonium bromide to precipitate the polysaccharide fraction, purified, and re-dissolved in distilled water. Tomato seeds were treated with obtained SPS before sowing.

Results: Under controlled greenhouse conditions, treated seeds exhibited faster, more synchronized emergence, with a reduction in mean germination time of approximately 2–3 days and a 25–35% increase in seedling vigor index compared to the untreated control. These responses were associated with enhanced root elongation and shoot growth. The most pronounced effects of the biostimulant application were observed at the seedling stage, where treated plants showed more vigorous and structurally balanced development, including a better-developed root system and improved physiological readiness for transplanting. Although the risk of late-spring frosts constrained transplanting dates, seedlings were successfully transplanted into open-field conditions in the Elbe Lowland region of the Czech Republic. Following transplanting, treated plants demonstrated faster field establishment, characterized by more rapid root anchorage and an earlier resumption of growth. Moreover, biostimulant-treated seedlings exhibited increased tolerance to early-season environmental variability, particularly spring temperature fluctuations, resulting in reduced transplanting stress and improved early field performance.

Conclusions: These findings highlight the relevance of SPS biostimulants for improving tomato development and adaptation to extreme temperature and water deficit.

Keywords: spirulina, sulphated polysaccharides, tomato, seed treatment, heat stress, drought

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