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Drought, salinity, and their combination affect the growth and secondary metabolites of tomato (*Solanum lycopersicum* L.)

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Abstract

Climate change and global warming pose significant challenges to biodiversity and agricultural practices. These factors negatively affect agricultural productivity by introducing environmental stresses, such as salinity and drought. An experiment was conducted to investigate the effects of drought, salinity, and their combination on the growth of tomatoes (*Solanum lycopersicum* L.) and their secondary plant metabolites. The irrigation levels were defined as Control (C): 25 % of soil weight, D1: 12.5 % of soil weight, and D2: 6.25 % of soil weight. The salinity treatments included S1: 0.5 % NaCl and S2: 1.0 % NaCl, in addition to various combinations of these factors. Growth parameters such as height, stem diameter, fruit weight, yield, and the number of leaves and fruits were measured. Secondary plant metabolites, including phenolics (chlorogenic acid, quercetin-3-rutinoside, and naringenin chalcone), carotenoids (lycopene, β-carotene, and lutein), and antioxidant activity (TEAC, DPPH, and TPC) were also assessed.

Severe drought conditions, accounting for 6.25 % of soil weight, reduced plant height, fruit number, and yield, while concentration of lutein, chlorogenic acid, and naringenin chalcone increased under these conditions, as well as antioxidant activity (DPPH). Severe salt conditions (1.0 % NaCl) increased antioxidant activity (DPPH) and total phenolic compounds, but did not affect plant morphology, specific phenolic compounds, lycopene, and β-carotene. Additionally, a significant interaction was observed between drought and salinity affecting β-carotene, total phenolic compounds (TPC), and antioxidant activity (TEAC). Moreover, there was no interaction between drought and salinity regarding plant morphological characteristics and specific phenolic compounds in tomato fruit. In contrast, a combination of severe conditions (6.25% soil weight and 1.0% NaCl) and moderate conditions (12.5 % soil weight and 0.5 % NaCl) resulted in higher β-carotene concentrations and antioxidant activity (TEAC). The increase in the concentration of health-beneficial compounds is encouraging for human nutrition, especially given the challenges posed by climate change. Under severe drought conditions, the yield of tomato plants was reduced by approximately 30%, whereas it remained unaffected under severe salinity.

Keywords: Antioxidant activities, carotenoids, drought, growth, phenolics, salinity, tomato

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