Enhancing salt stress tolerance in tomato (*Solanum lycopersicum*) through foliar silicon application

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Soil salinization is a significant threat to agricultural productivity, necessitating innovative agronomic strategies to mitigate its impact. This study focuses on improving salt stress resistance in tomato plants through the foliar application of silicon (Si) in the form of Na_2SiO_3 solution. The greenhouse experiment was carried out with six treatment groups: three under normal conditions (control with distilled H_2O, 1- and 2- mM Si), and three under salinity stress (control with distilled H_2O, 1- and 2- mM Si), with 50 mM NaCl in the nutritional solution. These treatments were regularly applied via foliar pulverization. Various parameters, including fresh and dry weight, chlorophyll content, macro and micronutrient concentrations, catalase activity, total soluble sugars, malondialdehyde levels, and proline content, were analyzed in leaves and roots. Under normal conditions, tomato plants grown in non-saline conditions exhibited some toxicity when exposed to Na_2SiO_3. Specifically, an increase from 0.18 to 1.8% in Na uptake, an increase from 0.09 to 0.65 mg proline/g dry weight and a 60% decrease in catalase activity were observed. In all cases, the lower dose produced better results under normal conditions than the 2 mM dose. As for the experiments under salt stress conditions, Si mitigated oxidative damage, preserving root cell membrane integrity. Na uptake was reduced by 42% with respect to the control, malondialdehyde concentration was reduced by 15% and there was a 58% increase in catalase activity. Again, 1mM Si showed improved results compared to 2mM Si. In summary, this research offers a promising strategy for enhancing salt tolerance in tomato plants, primarily through foliar Si application. The results underscore the importance of optimizing Si dosage to achieve the desired effect. Furthermore, this study provides a potential application of Si in non-fertigated crop systems, emphasizing its importance in addressing the challenges posed by soil salinization in agriculture.