Effect of potassium and calcium application on water use and fruit yield of tomato in a hydroponic system with dynamic and non-uniform distribution of salts

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Abstract

One of the problems for unequal distribution of salts in the root media is toxicity of sodium (Na) and reduced uptake of some nutrients, particularly calcium (Ca) and potassium (K), by the roots growing in the saline section. There is a hypothesis that addition of Ca and K to these systems might alleviate salt-induced damages to plants. This study was carried out to evaluate the effect of Ca and K application on fruit yield, water use and crop per drop (CPD) of tomato (*Lycopersicon esculentum* var. Falcato F1) plants grown in a hydroponic system with unequal distribution of salts in the root media. Tomato roots were divided into two equal splits and one half was immersed in the full Johnson nutrient solution. In the other root half, 40 mM NaCl solution, alone or in combination with KCl (6 mM), $CaCl_2$ (4 mM), K+Ca (3+2 mM) or half-strength Johnson nutrient solution, was applied. A control treatment was also used in which both root splits were immersed in the Johnson nutrient solution (C). The root splits were exchanged every 7 days. Results showed that addition of 40 mM NaCl in one side of the root media resulted in reduction of fresh and dry weight of root and shoot, stem diameter, shoot height, number of leaves and fruit yield of tomato in comparison with the control treatment. Addition of Ca, K+Ca and half-strength Johnson nutrient solution to the saline part of the root media increased significantly the root and shoot growth and fruit yield of tomato compared with the sole application of saline solution. In contrast, addition of K could not alleviate the adverse effects of salinity and even reduced the fruit yield. Application of 40 mM NaCl in one side of the root media reduced significantly the plant water use. Addition of Ca, K+Ca and half-strength Johnson nutrient solution to the saline part of the root media resulted in significant increase in CPD. Addition of Ca, K+Ca and half-strength Johnson nutrient solution caused replacement of 48, 43 and 43% of nutrient solution with saline water, respectively. According to the results of this study, in case of dynamic and non-uniform distribution of salts in the root media, by addition of Ca to the saline solution, it would be possible to replace about half of the crop water demand with saline water, with no significant fruit yield reduction.

Keywords: Local salinity, Tomato, Hydroponic, Calcium, Potassium.

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