

# Acute and chronic effect of copper on levels of reduced and oxidized glutathione and nutrient uptake of tomato plants

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Phytotoxicity due to copper (Cu) is generally associated with visible symptoms such as a decrease in plant shoot and root growth and chlorosis. The application of low levels of Cu or plant exposure to the metal for short periods can affect several cell processes, involving changes in the levels of metabolites related to the plant antioxidative response. The purpose of this study was to compare the response of the reduced and oxidized glutathione system and Cu uptake in tomato plants exposed to phytotoxic levels of Cu in hydroponic culture. Attention was centered on establishing whether determination of the levels of both peptides in plants exposed for a short period of time (acute treatment) compared with exposure for an extended period (chronic treatment) could be used as an early indicator of Cu stress in tomato plants. For the acute treatment, the plants were exposed to 0.4, 9, and 36  $\mu\text{M}$  Cu for 48 h, and for the chronic treatment to 0.4, 3, and 12  $\mu\text{M}$  Cu for 28 d.

Results indicate th