



University of Zabol

Graduate school

Faculty of Basic Sciences

Department of biology

The Thesis Submitted for the Degree of M.Sc (in the field of
plant physiology)

**Effect of different concentrations of copper nanoparticles, copper complex and
copper oxide on some physiological parameters of tomato (*Solanum
lycopersicum*)**

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Abstract

Copper is an essential nutrient element for the growth of plants. Fertilizers containing copper are effective in controlling many diseases and improving growth indicators. Tomato (*Solanum lycopersicum L.*) is the second most important crop in the world. In this research, the effect of different concentrations of CuO NPs, CuSO₄ and Cu Complex on growth and physiological properties of tomato plants was investigated. The experiments were conducted in a factorial manner based on a completely randomized design with 10 treatment levels and in triplicate. Cultivation was done in plastic pots with a soil mixture of peat moss: soil: perlite (1:1:1). The plants were sprayed three times with different concentrations (10, 25 and 50 mg/l) of the mentioned treatments at the four-leaf stage (21 days after cultivation). Thirty-one days after cultivation, morphological traits such as shoot length and weight, biochemical traits such as content of photosynthetic pigments, proline, protein, phenol, flavonoid, antioxidant activity (DPPH), lipid peroxidation (MDA) as well as activity of antioxidant enzymes (guaiacol peroxidase and polyphenoloxidase) were measured by spectrophotometry and recorded, and statistical analysis was performed using SPSS 27. The results showed that copper nanoparticles at a concentration of 10 and 25 mg/l increased the length and weight of roots and shoots, the level of chlorophyll a, b, and total chlorophyll, carotenoid, total phenol, flavonoid, antioxidant activity (DPPH) and antioxidant enzyme activity compared to the control. Proline and malondialdehyde (MDA) levels decreased compared to the control. Based on the results of this research, the treatment of CuO NPs in the optimal concentration compared to other treatments is suggested as a suitable stimulus to improve the physiological traits of tomatoes.

Keywords: Phenolic Compounds, Tomato, CuO NPs, CuSO₄, Cu Complex