

Zinc (Zn) alleviates copper (Cu) toxicity and rescues quality of lettuce grown in metal contaminated simulated wastewater

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Abstract

Wastewater (WW) contains heavy metals (HM) like copper (Cu) and zinc (Zn) which are beneficial at their lower concentrations but toxic at their higher concentration (Ullah et al., 2023). Shortage of freshwater compels farmers to use WW as a source of irrigation. Besides, WW has substantial amount of nutrients and organic matter necessary for plant growth. In this study it was hypothesized that Zn could ameliorate the hazardous impacts of Cu on lettuce when irrigated with highly Cu and Zn contaminated WW. Thereby, lettuce plants were grown in pots containing field soil irrigated with following treatments (i) Control or uncontaminated WW, (ii) Cu contaminated WW (Cu 20 mg L⁻¹), (iii) Zn contaminated WW (Zn 100 mg L⁻¹), and (iv) Cu+Zn contaminated WW (Cu 20 mg L⁻¹+ Zn 100 mg L⁻¹). Each treatment replicated thrice following a completely randomized design. Plants were grown in controlled condition of growth chambers and harvested at maturity. In results, irrigation with Cu contaminated WW caused a substantial reduction in growth and quality attributes of lettuce. In contrast, irrigation with Zn contaminated WW either alone or in combination with Cu left positive influence on lettuce growth and quality attributes. Addition of Zn to Cu contaminated WW retrieves the hazardous influence of Cu toxicity, hence, improved root dry matter, shoot dry matters and root length by 13.5%, 46% and 19%, respectively. Moreover, Zn addition improved lettuce quality with increased concentrations of Mg (30%), P (15%), Ca (41%), Mn (24%) and Fe (23%) as compared to control. Thereby, these findings intimate that high levels of Zn in HM contaminated WW could alleviate the hazardous influences of HM on crop growth and quality.

Keywords: Zinc · Copper · Lettuce · Minerals · Phytotoxicity · Leaf quality

References

Ullah, S., A. Naeem, I. Calkaite, A. Hosney, N. Depar and K. Barcauskaite. 2023. Zinc (Zn) mitigates copper (Cu) toxicity and retrieves yield and quality of lettuce irrigated with Cu and Zn-contaminated simulated wastewater. Environmental Science and Pollution Research. <https://doi.org/10.1007/s11356-023-26250-8>. IF-5.19.

Acknowledgments: These results are the part of our published work in Environmental Science and Pollution Research with given reference.

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