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Title: **Role of Rhizofungus (Aspergillus terreus) in Improving Biochemical and Physiological Parameters Affected by Lead Stress in Allium sativum L.**

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Role of Rhizofungus (*Aspergillus terreus*) in Improving Biochemical and Physiological Parameters Affected by Lead Stress in *Allium sativum* L.

Abstract

Background. Lead (Pb) contamination in agricultural soils is a growing concern, particularly in South and Southeast Asia, where root vegetables such as garlic and ginger are dietary staples. The primary sources of Pb in these regions include industrial discharge, mining activities, the excessive use of phosphate fertilizers, and atmospheric deposition. Pb disrupts plants' physiological functions, that is, photosynthesis and nutrient uptake. It also enters the food chain, posing chronic health risks to human beings. Garlic (*Allium sativum* L.) is widely used for its culinary and medicinal value and remains especially susceptible to heavy metal accumulation in contaminated soils. This study investigates the potential of rhizospheric fungus (*Aspergillus terreus*) to mitigate Pb-induced stress in garlic, with a focus on enhancing agronomic traits and minimizing the health hazards associated with contaminated produce.

Method. Garlic plants were exposed to four treatment groups (control, rhizo-fungi alone, Pb stress (30 ppm), combined Pb stress (30 ppm) with rhizo-fungi inoculation). The experiment followed a randomized complete block design (RCBD) with three replicates per treatment.

Results. Pb exposure led to significant reductions in physiological parameters, including root and shoot length, fresh and dry weight, seed germination, and relative water content (RWC). Electrolyte leakage increased under Pb stress, indicating membrane damage. However, co-application of rhizo-fungi improved these physiological traits, that is, 18% increase in shoot length, 20% improvement in RWC, and 15% reduction in electrolyte leakage, as compared to Pb-treated plants. Biochemical analysis revealed a decline in cholorphyll and carotenoid levels under Pb stress, while rhizo-fungi inoculation enhanced the chlorophyll content by 25%, confirming its role in restoring photosynthetic efficiency.

Conclusion. This study highlights the potential of symbiotic rhizo-fungi to mitigate Pb stress in garlic, improving both growth and biochemical parameters. The findings suggest that rhizo-fungi is an effective bio-remediating agent, enhancing crop resilience in contaminated soils.

Keywords: *Allium sativum* L., bioremediation, chlorophyll, electrolyte leakage, garlic, heavy metal, lead stress, rhizo-fungi, sustainable agriculture.