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ELEVATED ATMOSPHERIC CO₂ BENEFITS RHIZOSPHERE MICROENVIRONMENT OF BLACK LOCUST SEEDLINGS IN CD AND PB CONTAMINATED SOILS BY ALTERING PLANT PHYSIOLOGY

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Elevated atmospheric CO₂ and contamination of soil with heavy metals co-occur in natural ecosystems and have important effects on the soil microenvironment by influencing plant physiology. We examined the response of the black locust rhizosphere microenvironment to elevated atmospheric CO₂ (700 ppm) in combination with Cd and Pb contamination. Elevated CO₂ led to an increase in organic compounds (total soluble sugars, soluble phenolic acids, free acids, and organic acids), microbial populations, biomass, and activity, and enzyme activity (urease, dehydrogenase, invertase, and β-glucosidase) and changes in microbial community in rhizosphere soils under Cd, Pb, or Cd + Pb treatments relative to ambient CO₂. Elevated CO₂ also corresponded to an increase in chlorophyll a and b in leaves, total sugars, and starch in leaves and stems of black locust seedlings under Cd and Pb stress relative to either metal alone, which indicated that changes in the rhizosphere microenvironment was affected by the response of seedlings physiology. The pH was lower under elevated CO₂ + Pb + Cd than under metals, which led to changes in Cd and Pb fractionation between soils and plants. Therefore, the removal of Cd and Pb in rhizosphere soils and the uptake of Cd and Pb by plants increased under elevated CO₂. The increased removal of Cd and Pb in soils and the high rate of Cd and Pb uptake under elevated CO₂ indicated that black locust seedlings can be used for phytoremediation of contaminated soils under global change scenarios. Furthermore, our study also suggests that elevated CO₂ alters the distribution of heavy metals in soil and plants and stimulates the uptake of plants, thereby probably affecting food quality and safety. Overall, elevated CO₂ benefits the soil microenvironment in the rhizosphere of black locust seedlings in Cd and Pb contaminated soils.

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