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Elevated atmospheric CO_2 benefits rhizosphere microenvironment of black locust seedlings in Cd- and Pb-contaminated soils by altering plant physiology

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Elevated atmospheric CO_2 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 CO_2 (700 ppm) in combination with Cd- and Pb-contamination. Elevated CO_2 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 CO_2. Elevated CO_2 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 CO_2 + 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 CO_2. The increased removal of Cd and Pb in soils and the high rate of Cd and Pb uptake under elevated CO_2 indicated that black locust seedlings can be used for phytoremediation of contaminated soils under global change scenarios. Furthermore, our study also suggests that elevated CO_2 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 CO_2 benefits the soil microenvironment in the rhizosphere of black locust seedlings in Cd- and Pb-contaminated soils.

Biography

Xia Jia has her expertise in evaluation in the effect of global changes combined with heavy metal-polluted soils on ecosystems. Her research has been in the general field of interrelationships between plants and rhizosphere microenvironment under global changes combined with heavy metals. The long-term objective of her study is to have a better understanding of the response mechanism of ecosystems to the combination of global change and metal-contaminated soils, and eventually apply the knowledge gained in her study to assess the environmental risk of global change combined with heavy metal pollution to ecosystems.

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