

Presence of cadmium in cocoa soils of Ecuador and mitigation alternatives

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Siembra 13 (3) (2026): Special Edition
PROCEEDINGS OF FIRST INTERNACIONAL
SYMPOSIUM ON SOIL HEALTH

DOI: [10.29166/siembra.v13i3\(Especial\).9612](https://doi.org/10.29166/siembra.v13i3(Especial).9612)



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Abstract

Cadmium [Cd] is a naturally occurring element found in soil in small quantities; however, natural and anthropogenic factors can contribute to its enrichment and increase its concentration in the soil, making it a contaminant. Cd has no defined function in plants, but it can be transferred from the soil and bioaccumulate in vegetative organs. Such is the case of the cocoa crop, which has an affinity for absorbing Cd and concentrating it in its beans, putting the health of consumers of cocoa products at risk, since this metal causes severe diseases. For this reason, the European Union, in 2019, put into effect regulation 438/2014, which regulates the levels of Cd in chocolate and its derivatives. The presence of Cd in soil and cocoa beans in Ecuador was cited before 2000 by several researchers, who found Cd values higher than those regulated by the Codex Alimentarius. Subsequently, in a study conducted in 2019, they found that 40% of cocoa seed samples from 560 sites exceeded the value of 0.6 mg kg⁻¹. In order to address this problem, studies have been conducted on the application of mineral and organic amendments and microorganisms that reduce the mobility of Cd, by increasing the exchange sites in the soil and the formation of stable complexes, the soil pH can also be increased causing less availability of Cd in the soil solution and thereby reducing its concentration in cocoa seeds. The use of amendments is feasible, profitable, environmentally friendly and quick to implement. Thus, in a study conducted from 2019 to 2021 in four cocoa farms in the province of Manabí, zeolite, vermicompost, calcite, activated carbon and biochar were evaluated. The results obtained were favorable, all amendments decreased the presence of Cd in the soil, leaf tissues and cocoa cotyledon. In general, zeolite was presented as the best alternative for reducing the concentration of Cd in cocoa, finding reductions in the concentrations in the foliar tissues and cotyledons. In the case of the area under study (average of the farms), vermicompost, calcite and biocarbon amendments were effective in reducing the concentration of Cd in the soil, while zeolite and vermicompost were the amendments that caused the greatest reduction in the concentration of Cd in the cotyledon.

Keywords: Absorption, Concentration, Availability, Amendments

SIEMBRA
<https://revistadigital.uce.edu.ec/index.php/SIEMBRA>
ISSN-e: 2477-8850
Frequency: half-yearly
vol. 13, issue 3 Special, 2026
siembra.fag@uce.edu.ec



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