

Soil and Water Science Department Seminar

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Title: Enrichment of Cadmium in Cacao
Growing Soils in Southern Ecuador:
Chemical Characterization and Soil
Amendments as Remediation Alternatives



Date: Monday, November 23rd

Time: 3:00 pm

Location: McCarty Hall B, Room G086

Cadmium (Cd) is probably the most troublesome soil pollutant due to its high availability to living organisms. Excessive Cd content was reported in cacao (*Theobroma cacao* L.) beans from southern Ecuador. Moreover, soil-Cd has not been monitored in cacao-growing areas. Biogeochemistry of Cd in cacao farms in southern Ecuador was studied. Furthermore, the potential of soil amendments in reducing plant-available Cd was evaluated. Soil and bean samples were collected from representative cacao farms whereas the potential of amendments in reducing plant-available Cd was evaluated in three cacao-growing soils. In addition, Cd absorption and partitioning in cacao seedlings were evaluated in hydroponics. According to US standards, all soils had Cd concentrations above critical levels for agricultural land ($> 0.43 \text{ mg kg}^{-1}$). Cadmium was substantially accumulated in surface layer ($< 15 \text{ cm}$) and significantly decreased depth wise, indicating that soil contamination might have been mainly resulted from anthropogenic activities. Bean-Cd was significantly correlated to Mehlich 3- and 0.01 M HCl-extractable Cd ($r > 0.78$, $P < 0.01$) in soils. Therefore, Cd enrichment in cacao beans was strongly linked to soil-Cd. Soil fractionation analysis indicated that acid-soluble phase was significantly correlated with both bean-Cd and extractable-Cd ($r > 0.80$, $P < 0.01$). In cacao trees, more Cd was accumulated in beans than in leaves or stems. 12 out of 19 sites registered bean-Cd content higher than European Union standards ($> 0.06 \text{ mg kg}^{-1}$). The incorporation of vermicompost at 2% in three contaminated soils significantly reduced ($P < 0.01$) plant-available Cd. Additionally, vermicompost significantly increased soil pH ($P < 0.01$) in all studied soils; thereby, plant-available Cd was reduced due to the raise in soil pH. Vermicompost may have potential in reducing Cd uptake by cacao trees in the contaminated soils, nevertheless it must be confirmed in further studies. Increasing supply of Cd increased plant-Cd content under hydroponic conditions, Cd was equally distributed among plant parts. Biomass, nutrients uptake, and root morphology were not affected by the addition of Cd, indicating the high tolerance of cacao to soluble Cd.

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