

Heavy metals content in soils of Peninsular Malaysia grown with cocoa and in cocoa tissues

ABSTRACT

In a study of heavy metal distribution in soils grown with cocoa in Peninsular Malaysia, soil samples from 10 soil types were analyzed for Cd, Cu, Ni, Pb and Zn, cation exchange capacity (CEC), organic C, pH, electrical conductivity (EC), available P and clay content. The soils developed over intermediate volcanic parent material (andesite) showed higher concentration of heavy metals compared to the alluvial soils at a depth of 0-20 cm. Total soil Ni and Zn are correlated with pH ($P < 0.01$, $r = 0.27$ and $r = 0.33$, respectively), total soil Cd and Zn with EC ($P < 0.05$, $r = 0.18$ and $P < 0.01$, $r = 0.38$, respectively), total soil Cu and Zn with CEC ($P < 0.05$, $r = 0.18$ and $P < 0.01$, $r = 0.37$ respectively), total soil Cd with organic C ($P < 0.05$, $r = 0.17$), and total soil Cd, Cu, Ni and Zn with clay content ($P < 0.01$, $r = 0.65$; $P < 0.01$, $r = 0.54$; $P < 0.005$, $r = 0.16$; and, $P < 0.05$, $r = 0.48$, respectively). The concentrations of Cd, Cu and Ni in cocoa beans grown on soils developed from andesite was higher compared to those grown on alluvium. Meanwhile, for Cu and Zn concentration in cocoa beans, there was no significant difference between soils developed from andesite and alluvium. The concentration of heavy metals in soils tends to influence the concentration of heavy metals in cocoa tissues. Influence of P fertilization was exhibited by the significant correlations of Cd and Zn with extractable P ($P < 0.01$, $r = 0.25$ and $P < 0.01$, $r = 0.40$, respectively). For the Benta Series only, cadmium concentration in cocoa beans had reached the maximum permitted concentration (MPC) as defined by the Malaysian Food Act of 1983 and Food Regulations 1985. Zinc in cocoa beans, for some other soils, was either above or reached the MPC level.

Keyword: Cocoa beans; Heavy metals; Correlation study; Transfer coefficient; Maximum permitted concentrations