

CADMIUM, COPPER, NICKEL AND ZINC IN SOILS, LEAVES AND BEANS OF COCOA

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Introduction

There are several reports regarding the trace elements concentration in cocoa beans and its products of which Cd, Cu, As and Pb are of great concern (Lee and Low, 1985; Jinap et al. 1991; Denamany et al. 1991). Studies by Lee and Low (1985) and Denamany et al. (1991) showed no evidence of trace elements contamination during bean processing, transport and storage. It is likely that these elements are present due to their uptake by the cocoa plants from soils. A study was conducted to determine total Cd, Cu, Ni and Zn concentrations in selected cocoa soils from Perak and in the leaves and beans of cocoa.

Materials and Methods

Four soil profiles where cocoa is grown in the Bagan Datoh and Lumut area were sampled. Bulk samples were collected from all the major soil horizons. To relate soil properties and concentration of trace elements in plants, paired soil and foliar and beans sampling was performed. The soils were analysed for pH, organic-C, CEC, and trace elements. The aqua-regia digestion method was used for extracting trace elements from soil and the dry ashing method was used for the foliar samples. Cadmium was analysed using the graphite furnace atomic absorption spectrophotometry and Cu, Ni and Zn were analysed using the flame atomic absorption spectrophotometry.

Results and Discussion

The soils were classified as Jawa, Briah, Gong Chenak and Serok series. The Jawa and Briah series are developed on marine alluvium and dominated by montmorillonite, illite, kaolinite and quartz. The Gong Chenak and Serok series are developed on Sub-recent terrace alluvium and are dominated

by kaolinite and quartz (Zauyah et al. 1997). The ranges of trace elements concentration in the top 0-20 cm for all the four soil series are as follow: cadmium: 0.5-0.9 mg/kg; nickel: 3.5-15.8 mg/kg; copper: 1.5-6.2 mg/kg; and zinc: 6.7-20.1 mg/kg. The Jawa soil seemed to exhibit rather high concentration of Ni compared to the other soil series. Overall Cd, Cu, Ni and Zn were positively correlated with CEC ($p < 0.05$), while Ni, Cu, and Zn were positively correlated with organic C ($p < 0.05$). Ni concentration in the leaves of cocoa grown under Jawa soils was significantly higher than that in other soil series. The Serok and Briah soils exhibit significantly higher Cu in the foliar than that of the Gong Chenak and Jawa soils. The foliar Zn concentration of the Jawa was significantly higher than the Gong Chenak and Briah soils. There were no significant differences in the concentration of all these elements in the beans of cocoa grown on all soils with the exception of Ni. The concentration of Ni in the beans of the Jawa soil was significantly higher than Gong Chenak and Serok soils. There were no correlation between the foliar concentration of each trace element and the total concentrations in the top 0-20 cm of soils.

Conclusions

Relationship between total trace elements in the soil and concentration of trace elements in the leaves and beans of cocoa do not exist. A better predictor of bioavailability of trace elements such as 'available' or 'extractable' nutrients should be investigated.

References

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