UNIVERSITÄT HOHENHEIM

Nutrient and heavy metal levels in leaves of selected crops in the Mt. Cameroon area and their possible use for biomonitoring of air pollution.

By

Mbaka Ebechue, George

Matriculation number: 598871

A Master Thesis Submitted to the Institute for Landscape and Plant Ecology (320) - Plant Ecology and Ecotoxicology of the Faculty of Agricultural Sciences (300) in Partial Fulfilment of the Requirements for the Award of a Master of Science Degree (MSc.) in Environmental Protection and Agricultural Food Production.

Supervisors

Prof. Dr. Andreas Fangmeier
Chair Plant Ecology and Ecotoxicology (320b)
Institute for Landscape and Plant Ecology (320)
Universität Hohenheim

PD Dr. Frank Rasche
Chair Agroecology in the Tropics and Subtropics (490f)
Institute of Agricultural Sciences in the Tropics (490)
Universität Hohenheim

Fiat Panis Foundation financially supported this work

Stiftung fiat panis

September 2016

Projektförderung
2016/02

ABSTRACT

The widespread and often severe air pollution in many developing countries causes yield losses in crops and poses risks to food safety as pollutants may enter the food chain and the food web. In March 2016, we collected 126 leaf samples of cassava, maize, new cocoyam and plantain from 28 georeferenced locations at the southern flank of Mt. Cameroon. The leaf samples were investigated for the concentrations of N, P, K, S, Mg, Fe, Cu, Zn, Mn, Cr, Ni, Nb, Cd, Pb, V, Ce, Sb, Sn, Ta and Hg. N concentrations were determined by elemental analyser, Cd, Cu, Ni, Pb, Ce, Cr, Nb, Sb, Sn, Ta and V concentrations were determined by ICP-MS, Fe, K, P, S, Mg, Mn and Zn were determined by ICP-OES and Hg was analysed using CV-AAS. The reference materials were poplar leaves (GBW07604) for N and pine needles (NIST 1575a) for the ICP-MS/OES and CV-AAS analyses. While there was high variation in the leaf levels of most of the elements, Sb, Sn, Ta and Hg were below detection limit (<0.02 ppm). The concentrations of N, P, K, Cr and Mg were well above the concentrations identified by Markert (1992) for a reference plant. While Cu, Nb, V, Ni, Fe and Ce levels were on average just within the reference plant concentrations range, S, Cd, Zn, Pb and Mn fell below the concentrations. Surprisingly, cassava leaves had low levels of K but accumulated Zn three fold higher than other crop species. Leaves of cassava had higher levels in most cases, followed by new cocoyam and maize leaves while plantain generally appeared to have much lower element concentrations. Special enrichment of metals was seen from samples collected south of Mukunda village. Furthermore, Pb and Cr levels in present study were on average greater than the International standard limits based on Codex Alimentarius Commission of FAO/WHO and European Commission, and thus they may pose potential food safety risks. We concluded that despite potential sources of air pollution such as biomass and waste burning, most enrichment pointed to geogenic sources rather than hypothesized anthropogenic sources. We recommend that further studies on element concentrations in plants and soils in relation to pH and organic content be performed to clarify whether toxic elements are available to plants. Furthermore, active biomonitoring study using pre-grown plants on standard substrate would enable a clear differentiation between geogenic backgrounds and the contribution of air pollution to element concentrations.

Key words: air pollutants, biomonitoring, nutrients, heavy metals, Mt. Cameroon, food crops and food safety.