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Iron Concentrations in Roots and Edible Organs of African Indigenous Vegetable Species

Ulrich Eckhardt[1], Julius Beer[1], Holger Bessler[1], Godfrey N. Nambafu[2,1], Enos Onyuka[1,4], Samuel Mwonga[3], Darius O. Andika[4], Joseph Patrick Gweyi-Onyango[2], Christof Engels[1]

[1]*Humboldt-Universität zu Berlin, Albrecht Daniel Thaer-Institute of Agricultural and Horticultural Sciences (ADTI), Germany*

[2]*Kenyatta University, Dept. of Agricultural Science and Technology, Kenya*

[3]*Egerton University, Dept. of Crops, Horticulture and Soils, Kenya*

[4]*Jaramogi Oginga Odinga University of Science and Technology, Dept. of Plant, Animal and Food Sciences, Kenya*

Abstract

Iron (Fe) deficiency is among the 10 leading human health risks causing "hidden hunger" in sub-Saharan Africa. Iron concentrations and bioavailability are often higher in leafy vegetables than in staple crops like maize and sorghum. Therefore, increasing food diversity through vegetable production and consumption is an option to mitigate Fe deficiency.

The aim was to quantify Fe uptake and distribution between roots, stems and leaves in selected African indigenous vegetable (AIV) species, and to compare species responses to different rates of Fe supply.

Plants of five leafy AIV species (African night shade *Solanum scabrum*, amaranth *Amaranthus cruentus*, cowpea *Vigna unguiculata*, spider plant *Cleome gynandra*, Ethiopian kale *Brassica carinata*) and a standard species commonly grown in Kenya (kale *Brassica oleracea acephala* group) were grown in nutrient solution at three rates of Fe supply (sub-optimal to induce Fe deficiency responses, optimal for growth, supra-optimal to test if Fe density in edible organs can be enhanced by additional Fe fertiliser application). Leaf chlorophyll content (SPAD-meter) and pH of the nutrient solution were measured at regular intervals to quantify shoot and root responses to Fe deficiency. At harvest, biomass and mineral nutrient concentrations were measured separately for roots, stems and leaves.

The species markedly differed in their early root responses to Fe deficiency. Whereas in amaranth, proton extrusion from roots was significantly increased at low Fe supply compared to medium and high Fe supply, in spider plant and kale proton extrusion was not influenced by Fe supply. Fe concentrations in the plant dry mass strongly varied among plant organs and decreased in the order roots >> leaves > stems. In all organs, Fe concentrations were significantly affected by species. Concentrations in shoots varied from 17 (Ethiopian kale) to 39 mg Fe kg^{-1} dry mass (amaranth) at low Fe supply, and from 42 (Ethiopian kale) to 127 mg Fe kg^{-1} dry mass (cowpea) at high supply respectively

Responses of Fe density in edible plant organs indicate that the potential for increasing the nutritional value of leafy vegetables by Fe fertilisation (biofortification) is largest in cowpea and spider plant.

Keywords: Biofortification, hidden hunger, iron deficiency responses, rhizosphere

Contact Address: Christof Engels, Humboldt-Universität zu Berlin, Albrecht Daniel Thaer-Institute of Agricultural and Horticultural Sciences (ADTI), Berlin, Germany, e-mail: christof.engels@agrar.hu-berlin.de