Mobility and Uptake of Zn, Cd, Ni and Pb in Sludge-amended Soils Planted to Dryland Maize and Irrigated Maize-Oat rotation

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ZM Ogbazghi[1], EH Tesfamariam[1], JG Annandale[1], PC De Jager[1], and I Mbakwe[1]
[1]University of Pretoria, Department of Plant Production and Soil Science, P.Box: X20, Hatfield 0028, Pretoria, South Africa,
E-mail: zekariasogbazghi@gmail.com

INTRODUCTION

Sludge application to agricultural lands is often limited, mainly because of concerns about metal accumulation in soils and uptake by crops.

OBJECTIVES

The objective of the study was to test the hypotheses that in the short to medium term (5-10 years) the application of good quality sludge according to crop nitrogen requirements: i) will not lead to significant accumulation of water soluble metal fractions in soil, ii) mobility and uptake of metals is higher under irrigated than dryland systems, and iii) metal concentrations in plant tissue could reach phytotoxic levels before the soil reaches environmental threshold levels.

MATERIALS AND METHODS

Field plots were arranged in a randomized complete block design comprising four replications of three treatments (0, 8, and 16 Mg ha^{-1} yr^{-1} anaerobically digested municipal sludge) planted to dryland maize and irrigated maize-oat rotation (Fig. 1). Soil and plant samples were collected following 7 years of treatment application for selected metal analyses.

Fig.1. Dryland maize and irrigated-maize oat rotation cropping systems.

RESULTS AND DISCUSSION

A large fraction of the Zn, Ni, and Pb in the soil profile was EDTA extractable (46 to 79%). Metal concentrations in the soil remained far below total maximum threshold levels (Fig. 2). Concentrations of the metals considered in plant tissue of both cropping systems remained well below phytotoxic levels, except for Zn under dryland maize that received 16 Mg sludge ha^{-1} yr^{-1} (Fig. 3).

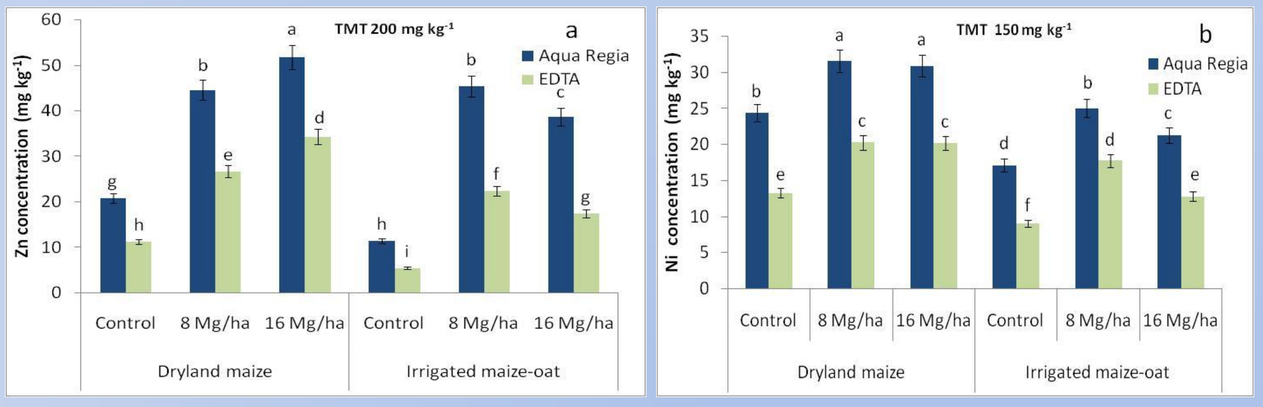

Fig.2. Aqua Regia extractable and plant available concentrations of zinc (a), and nickel (b) in the soil.

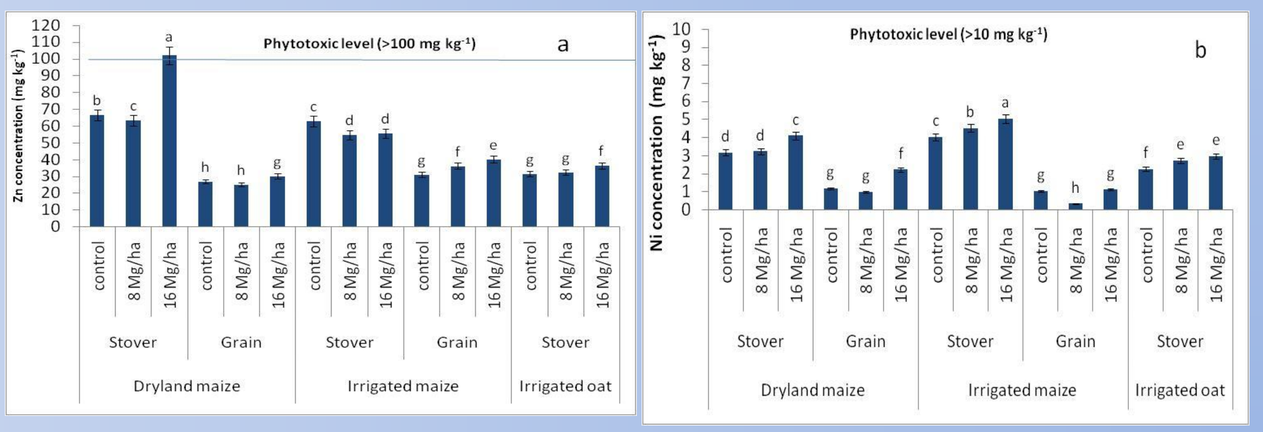

Fig.3. Concentration of zinc (a) and nickel (b) in stover and grain of dryland maize and irrigated maize-oat rotation.

CONCLUSIONS

Monitoring the upper 0.3 m plough layer for potential heavy metal accumulation based on the soil threshold levels set in the current sludge guidelines may not necessarily indicate low heavy metal uptake by plants and negligible potential heavy metal leaching.

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