

EVALUATION OF THE HEAVY METAL CONTENTS OF SOIL AND
CROPS ON A FIELD TREATED WITH OGUN ROCK PHOSPHATE AND
COWDUNG FERTILIZERS.

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ABSTRACT

Phosphate rock (PR) contains trace levels of Cadmium, Zinc, Arsenic and Lead, which could contaminate soil and plants following PR application alone and in combination with various levels of cowdung fertilizers. This study was designed with the aim to estimate the residual heavy metal contents of soil and crop following PR and cowdung fertilizer treatments. This was carried out with the view to determining the heavy metal contents of soil and plant samples in a field treated with PR fertilizer and to estimate the ideal PR and level of cowdung fertilizer combination with respect to Zn, Cu, Pb, Cd and As metal contamination of soil and crops.

The experiment was run for 4 years at the Institute of Agricultural Research and Training, Moor Plantation, Ibadan. The treatments consisted of PR; PR + 1.0 t ha⁻¹ of cowdung; PR + 2 t ha⁻¹ of cowdung; PR + 3 t ha⁻¹ of cowdung; PR + 4 t ha⁻¹ of cowdung. The control had no PR and cowdung treatments. All the treatments had a basal application rate of 100 kg ha⁻¹ of PR with the exception of the control. The treatments were given the basal nutrients of potassium and nitrogen supplied from muriate of potash and urea fertilizers. The experimental design used was the complete randomized block design which consisted of control, and phosphate rock applied to the soil singly and in combination with different levels of cowdung. All the treatments were replicated thrice. The treatments consisted of 18 subplots from which soil samples were randomly collected at depths of 0 – 15 cm and 15 – 30 cm in composite replicates. The subplots had *Zea mays* and *Abelmoschus esculentum* planted in them. At 10 weeks after planting, crops were harvested and soil samples were collected at random in a composite replicate using Dutch soil auger. A total of 72 samples consisting of 18 top and subsoil samples and 18 each of maize and okra leaves were collected in March, 2004. Both plant and soil samples were analysed for exchangeable Ca, Mg, K, Na, and heavy metal such as Pb, Zn, Cu, Cd and As using standard methods.

The results indicated that PR application in combination with various levels of cowdung increased the levels of Pb, Zn, Cu, Cd and P in soil solution in both topsoil and subsoil. Except for Cd the enrichment of both topsoil and subsoil with heavy

metal were not above the normal and critical value. Cadmium had a high value of $5.30\mu\text{g g}^{-1}$ which was above the critical value of $3\mu\text{g g}^{-1}$. The heavy metals content in the plant under different PR treatments showed that Pb, Zn, Cu and Cd were above the tolerable range recommended by FEPA and USEPA. The study further revealed a high transfer ratio (T/R) of heavy metal from soil to plants. For instance, the TR value for Pb in *Zea mays* ranged from (11.4-32.1) Zn (32.6-43.4), Cu (17.3-36.4), Cd (0.2-0.3) and As (0.1-0.9). The TR values for the various heavy metals in *Abelmoscus esculentum* ranged from Pb (12.6-25.0), Zn (35.7-44.4), Cu (14.8-29.8), Cd (0.2-.42) and As (0.9-2.1). The Cd concentration in *Ahelmoscus esculentuin* was negatively correlated ($r = -0.51$ $P < 0.05$) with soil pH. However, in *Zea mays* soil pH was negatively correlated with Cu ($r = -0.66$, $P < 0.01$) and As ($r = -0.70$, $P < 0.01$). This shows that pH adversely affected the bioaccumulation of Cd, Cu and As in all the plants respectively.

In conclusion the study showed that both PR and cowdung application to soil contributed significantly to soil contamination with heavy metals. This may be a significant source of the entrance of Cd into the food chain through arable crops grown on soils fertilized with rock phosphate and cowdung.