ASSESSMENT OF HEAVY METAL CONCENTRATIONS IN SOME SOILS OF IKWUANO LGA ABIA STATE NIGERIA: IMPLICATION FOR COCOYAM PRODUCTION

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Abstract
Heavy metals status of agricultural soils were monitored in order to prevent soil-plant pollution. This study evaluates the effect of automobile emission, waste dump, and agricultural practices on the level of some heavy metals and with respect to cocoyam production. Analysis for Co, Cr, Cu, Fe, Pb and Zn was done on soils near road traffic, waste dump, and agricultural farms in some soils of Ikwuano in Abia state, south East Nigeria. The results show that the mean values (mg/kg) for the elements analyzed were as follows, site 1 Co=57.38, Cr =32.90, Cu = 60.90 Fe =137.26, Pb =112.19 Zn =55.82. Site 2, Co =82.93, Cr =21.15, Cu= 61.45 Fe =136.98, Pb= 113.43, Zn= 60.05. Site 3 Co= 115.79, Cr =25.73, Cu 57.16 Fe =133.15, Pb =117.40 Zn =60.05 The values were not up to the critical values and there was no significant difference between site 3, site 2 and control (site 1) from the statistical analysis (ANOVA) though automobile emission, waste dump sites, and agricultural activities increased the presence of the heavy metals in the soil. From the results of the soils analyzed, the soil will be suitable for cocoyam production since the concentration of the heavy metals are not yet toxic to the crop.

Index Terms— Heavy metals, soil pollution, waste dump, Automobile emmission, Agricultural practices, Cocoyam production, Agriccultural soils.

1. INTRODUCTION

Although heavy metals are naturally present in the soil, geologic and anthropogenic activities increase the concentration of these elements to amounts that are harmful to both plants and animals. Some of these activities include mining and smelting of metals, burning of fossil fuels, use of fertilizers and pesticides in agriculture, production of batteries and other metal products in industries, sewage sludge, and municipal waste disposal [2],.

Various methods of remediating metal polluted soils exist; they range from physical and chemical methods to biological methods. Most physical and chemical methods (such as encapsulation, solidification, stabilization, electro kinetics, vapour extraction, and soil washing and flushing) are expensive and do not make the soil suitable for plant growth. Biological approach (bioremediation) on the other hand encourages the establishment/reestablishment of plants on polluted soils[1]. It is an environmentally friendly approach because it is achieved via natural processes. Bioremediation is also an economical remediation technique compared with other remediation techniques.

2. Materials and Methods

2.1 Materials

2.1.1 Chemicals and Reagents

Chemicals and Solvents of Analytical grade were used for this experiment. The Chemical used for digestion is Perchloric acid

2.2 METHODS

2.2.1 Soil Collection and Preparation

a. Ten soil samples each were collected from the sample areas; using soil auger at 6 inch deep
b. The samples were thoroughly shaken and mixed for about 2 mins and sieved using 2mm sieve.
c. The soil samples were air dried for about 1 week

2.2.2 Sample Digestion

a. Using an analytical balance, 1g of each sample was weighed and placed in a digestion tube
b. 5ml of water was added in the digestion tube in each case.
c. 5ml of perchloric acid was added to the digestion tube
d. The digestion tube was put in the block digester and heated in a fume cupboard until a clear solution was formed.
e. The tube was allowed to cool
f. The sample was filtered and the filtrate collected in a 500ml volumetric flask and made up to the mark.

This procedure was repeated for each soil sample . The method used was as described by [3] .

2.2.3 Sample Analysis using atomic absorption spectrometer (AAWin Pro model)

a. The computer and spectrometer were turned on
b. The parameters on the instrument were set. The acelylene pressure were set to > 700 kpa (100psi) the acelylene valve set to 11psi and the air valve 45 psi
c. The spectra AA software was used
d. A new worksheet was opened for each sample.
e. "add method" was chosen and the metal to be analyzed for Clicked, for example to do copper analysis you click on copper
f. Type/mode parameters were set to the following
    1. Type = flame
    2. Element = element to be analyzed e.g lead for lead analysis
    3. Sampling mode = manual
    4. Instrument mode = Absorbance
    5. Flame type = Air/Acetylene
    6. Air flow = 13.5
    7. Acetylene flow = 2.0
    8. Online diluter type = sips
g. The measurement parameters were set to the following:
    1. Measurement mode = prompt
    2. Calibration mode = concentration
    3. Times: measurement = 10
    4. Times: read delay = 10
    5. Replicates: standard = 3
    6. Replicates: sample = 3
    7. Precision (%): standard = 1.0
    8. Precision (%): sample = 1.0
h. Optical parameters were set to the following
    1. Lamp position = 4
    2. Lamp current (MA) = 10.0ma
    3. Wavelength = 217.0nm (depending on the metal being an alysed)
    4. Slit = 1.0nm
    5. Background: BC off
i. The SIPS parameters were set to the following:
    1. Mebulazer uptake rate = 5.0ml/min
    2. Right pump = none
    3. Standard additions = unselect
    4. Calibration mode = auto set std concentrations
    5. Dual pump calibration = unselect
j. Under the standards tab, a list of standards automatically populates for the particular test
    A 1000ppm Pb standard for atomic absorption spectrometry purchased from a chemical supply company is used and automatically diluted by the instrument. A new calibration curve is generated each time a new set of samples is run.
k. Menu and the "Labels" tab clicked. The information regarding sample names and number of samples were inputted.
l. Using the "analysis" tab, the "select" button was used to highlight the samples to be analyzed.
m. The flame was turned on by pressing the ignite button on the instrument.
n. The instrument was zeroed by aspirating a blank and pressing the "act" and "read" keys simultaneously.
o. The pump tubing was placed in the blank solution and "start" button pressed. After the calibration was performed, the pump tubing was placed in the sample and the "Read" key pressed. This was done for all samples.
p. The instrument was turned off by pressing the red power off button on the instrument.

All gas tanks were turned off and samples removed.

3. Result and Discussion

The soil samples were analyzed using atomic absorption spectrometer to determine the amount of the heavy metals (Co, Cr, Cu. Fe, Pb, Zn) they contained.

The results are presented both graphically and in table format. See appendix for the full results and graphical statistical analysis.

The results showed that there is no significant difference in the heavy metal concentrations of the soils of the three sites sampled. This implies that cocoyam will do well on the two sites tested.

The group mean of the Heavy Metal concentration of the three sites in site 1 (control), site 2 and site 3 are in the table below. See appendix for full table and graphical/statistical analysis.

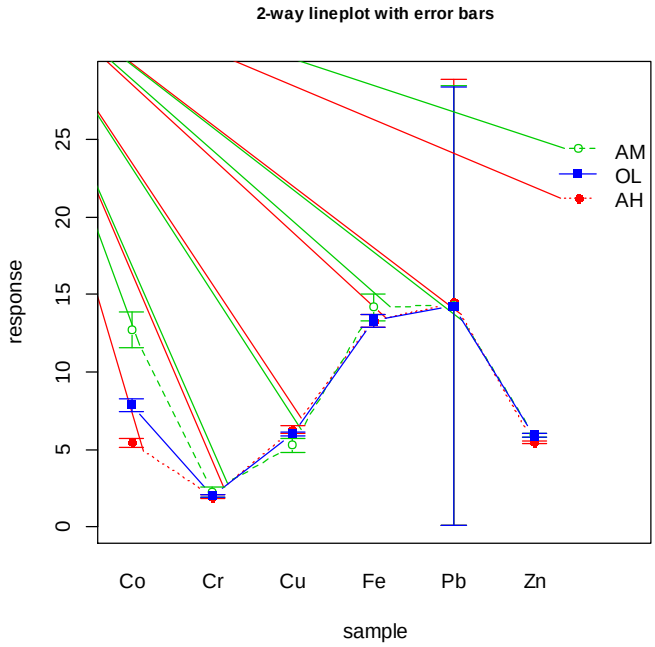
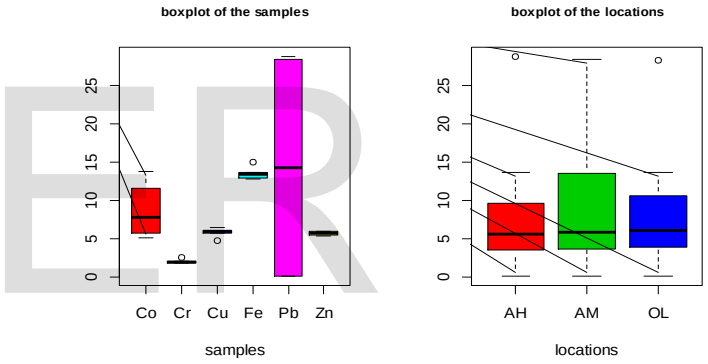
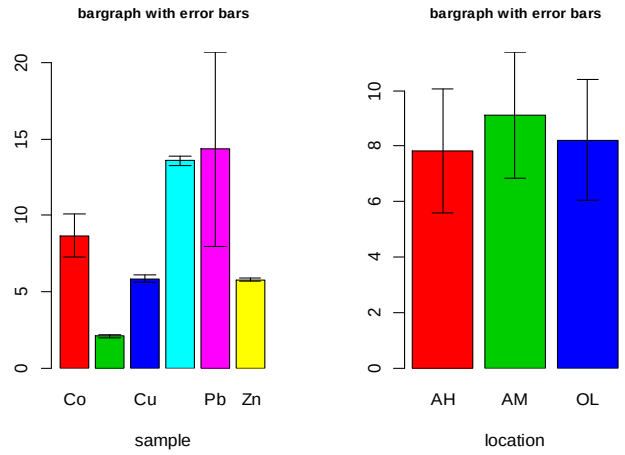


Table 3.1 Mean of the Heavy Metal concentration

	Site 1(control) mg/kg	Site2 (mg/kg)	Site3 (mg/kg)
Co	57.38	82.93	115.79
Cr	32.90	21.15	25.73
Cu	60.03	61.45	57.16
Fe	137.26	136.98	133.15
Pb	112.19	113.43	117.40
Zn	55.82	60.05	60.05

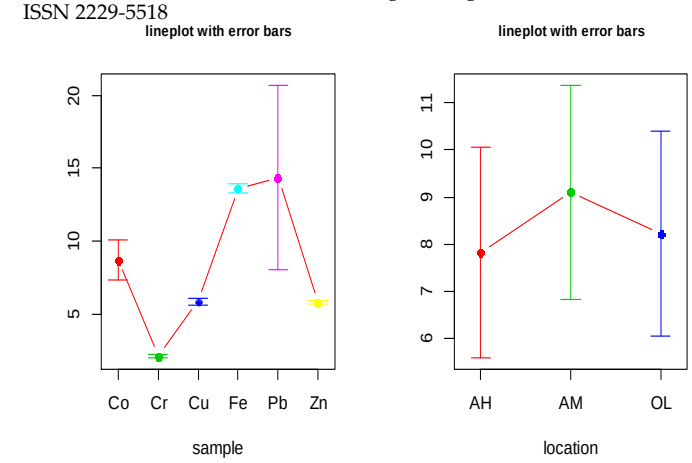


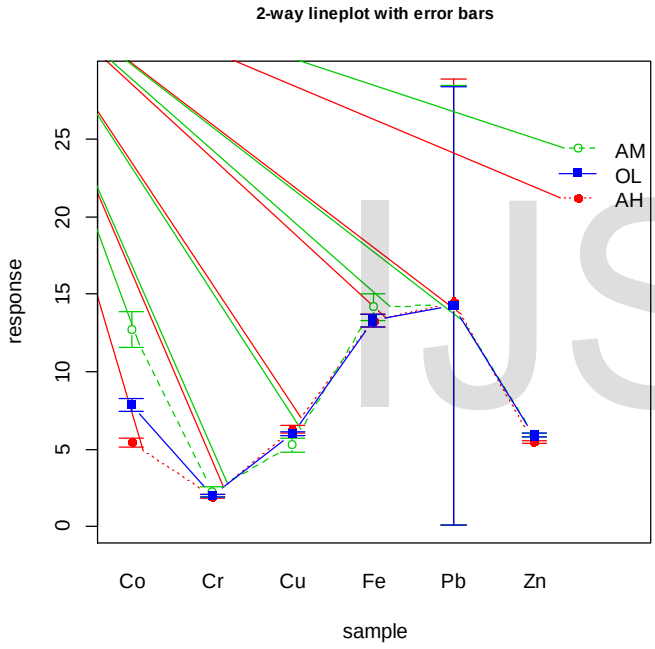


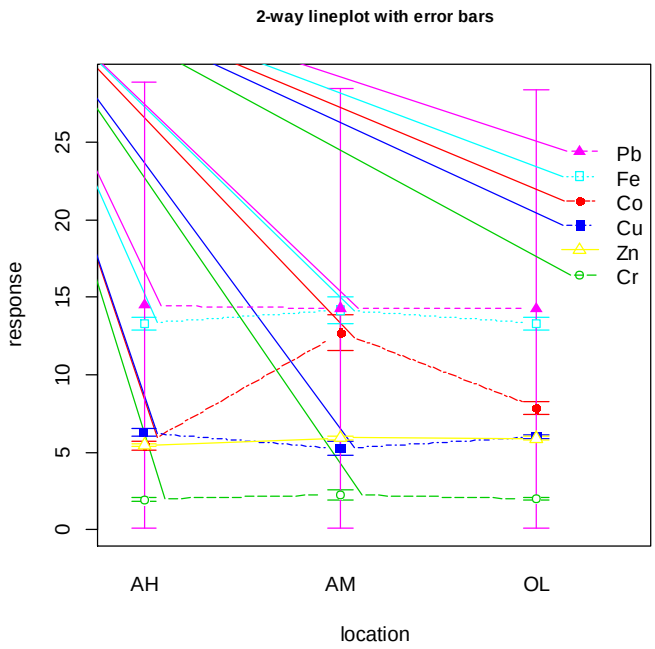
From the result, the Heavy metal concentration of the site 2 and site 3 have not reached the toxic level.

For site 3 and control, the t= 1.008 and P value = 0.3597. Thus, there is no significant difference between site 3 and Site 1(control)at 5% Sl.

For site 2 and Site 1(control) t = 1.0345 and P value = 0.3483. Hence, no significant difference between site 2 and control. This validates the ANOVA result.







4. Conclusion

The results of this research study showed that when the concentration of the heavy metals from sites 1-AH (soil near major road with vehicular movement) 2-Am (soil near dump sites), where compared with site 1- OL , where cocoyam was already being planted and is known to do well, there was no significant difference in the heavy metal concentrations when the group means were compared statistically. Cocoyam can still do well when planted in site 2 (AH) and site 3 (AM).

Soil contamination by heavy metals can be increased by vehicular emissions and waste sites, however in this study the results of the samples taken revealed that auto mobile emission and waste site have not significantly contaminated the surrounding soil. Cocoyam can still do very well on these soils.

Although there was no significant difference, the heavy metal concentrations in AH and AM were higher than the concentration in OL (control), which means that the vehicular movement and waste dump close to those farm had effect on the soild and therefore should be monitored regularly before it gets to a very toxic level where it becomes detrimental to the crops and human.

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