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THE EFFECTS OF SEWAGE SLUDGE, COWDUNG AND POULTRY DROPPING IN BIOREMEDIATION OF SOIL AND CULTIVATION OF HERBAGE VEGETABLE (AMARANTHUS VIRIDIS)

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ABSTRACT

Farmers generally ignore the value of organic fertilisers and most of the time supplement with chemicals and minerals (the inorganics). In consequence, we suffer a great loss of valuable materials while mountains of animal wastes overload barnyards. Lagoons and streams are overloaded with plant nutrients draining from farmyards. The thrust of this work presents the effects of the use of Sewage Sludge (SS), Cow Dung (CD), and Poultry Droppings (PD) farmyard manures in soil renovation and cultivation of Amaranthus viridis (Green vegetable). This study unfolded the morphological and phenological events, elements uptake with due environmental considerations. The trace metals were determined. The treatment consisting of 10cm of manure mixed to the surface (30cm) of control (soil) and about 5kg to 1250cm^2 area. The initial increase in lead concentration of the control in association with the combined PDCDSS treatment featured a sharp decline in lead (Pb) concentration by 70% suggesting a possible bioremediation effect. The other single treatments fell below those of the control. Amaranth from the randomly sampled soil beds with treatments were analyzed for lead (Pb), (12504 – 98314.2 ?g/g) Zinc (Zn) (59.42 – 282.24 ?g/g), and Cadmium (Cd), (0.036 – 0.123 ?g/g) and the PDCDSS treatment was seen to contain the least toxic metals tested in comparison with the grossly polluted control. At the end of the fourth week of the study, randomly selected Amaranth from the treatments were weighed for moisture content and PDCDSS treatment featured the most weight.

INTRODUCTION

In the process of interacting with nature man inevitably has been consistently disturbing the abundance and purity of natural resources in his environment. Every person on the planet depends on agricultural produce for foods and a terrible pressure is unleashed on soils and its environment with concomitant increase in the rate of deterioration. Soil fertility is measured by its capacity to produce crops and this depends on the ability of the soil to supply essential nutrients to the plants both in forms and amounts. Over-cropping leads to reduction in soil fertility (Wood, 1989). To obtain maximum yield, soil fertility must be continuously maintained through such practices or bush fallowing and shifting cultivation, crop rotation and manuring involving the use of organic fertilisers.

Organic manure refers to any material prepared from plants or animals which when added to the soil improves its fertility. Manure may include, the green manure, farmyard manure (FYM), compost and sewage sludge. Farmyard manure is the mixture of animal dung, droppings and the bedding. Poultry manure (guard) is the richest of all livestock manures because of its high concentration of nitrogen and little percentage of indigestible fibres, followed by that of goats, pigs and cattle (Arie 1995). Farmyard manures contain three main nutrients – nitrogen, phosphorus and potassium needed by plants for their growth and production. Sewage sludge is a world-wide phenomenon constituting environmental hazard especially in the developing world through the pollution associated with it. However sludge with its nitrogen and phosphorous contents provides a valuable fertiliser (Ayejuyo 1997). Application of sludge could impact heavy metals into the soil despite its advantage of resource recovery. It has been asserted that a large number of micro-organisms could be introduced into the soil when animal dung was applied to the land (Wood, 1989).

Farmers generally ignore the value of organic fertilisers probably because of the high cost of labour and equipment resulting in a great loss of valuable materials. At the world scene, advances are being made to get valuable urban wastes back into the soil. While the present work examines the effects of farmyard manure and sewage sludge on the cultivation of Amaranths, the possible reduction of toxic metals present along side sewage sludge when combined with micro-organisms-rich manures would be assessed towards a build up to soil bioremediation.

MATERIALS AND METHODS

SEED AND PREPARATION

Existing vegetation was cleared and stumps removed right from the base. The farm was laid out, ploughed (hoe) about 20 cm deep and harrowed. Nursery beds were 50 x 50 cm to a height of 15 cm and interspaced 65 cm respectively. The beds were treated with 5kg each of organic manure. The seeds of the Amaranthus viridis were selected and spread evenly on the soil beds and watered to a field capacity. After two weeks of raising the nursery, the seedlings were transplanted on soil beds 25 cm x 50 cm with seedlings inter spacing of 15 cm and beds inter spacing of 30 cm and inter – spaced of 60 cm. Soil beds were treated randomly. The beds were continuously weeded throughout the phases to avoid any competition for nutrient with the undesired and watered twice daily. The herbage vegetables were observed for their morphological and phenological events and periods.

SAMPLING AND SAMPLE PREPARTION

Soil and manure, and plants were collected and analysed for trace metals. Soil surface of the respective beds was sampled using a non-metal trowel while wearing a non-powdered disposable polyethylene gloves; dried and sieved prior to acid digestion analysis.

Leaves of the plant were randomly collected. Aerial parts of which were obtained by cutting with acetone-distilled deionised water pre-cleaned secateur at least 3 cm above soil level. Samples were stored in polythene bags, then freeze dried, milled before using wet oxidation involving perchloric acid. Atomic Absorption spectrophotometer (Cathodeon) was used to determine zinc, lead and cadmium in the samples. (AOAC 1990).

RESULTS AND DISSCUSION

The phenological events available were obtained through visual observations. The timing of the recurring natural phenomena of Amaranthus viridis in relation to the environmental factors is presented in Table 1. The levels of heavy metals in the soil and the manure are shown in Table 2. Preliminary investigation has shown that the soil contained high amount of lead, cadmium and zinc and could be said to be polluted with respect to these metals. The nature soil for instance contained 19159.2 ?g/g as against the mean recommended value of less than 40 ?g/g (Nriagu and stevenson, 1991).

At the end of the fourth week of study randomly selected Amaranth from the treatments were weighed and PDCDSS treatment featured the most weight of 0.3 kg followed by the poultry dropping (PD) single treatment with 0.2 kg in compassion with 0.5 kg recorded by the control. Factors which commonly prevent or retard germination, establishment or growth development of plants include metal toxicity, macronutrient deficiency or water stress (Goodman *et al.;* 1975). Many unidentified deficiency and toxicity symptoms were observed. The leaves developed yellowing of the new growth and some matured growth in PD and CD indicating probable deficiency and the cause was not apparent but similar to those of manganese.

Successful applications of sewage sludge have also been carried out. In addition to providing an economical means of sludge disposal, land application of sludge generally increases the organic content of the soil, improves the holding capacity of certain soils (Pudolph 1955).

In continuous cropping, plants suffer depletion of essential elements and the soil continues to accumulate none essential elements such as lead, cadmium, arsenic and mercury. High soil pH and organic contents influence both the solubility and mobility of lead. Normal surface soil lead levels are typically less than 40 mg/kg but with increased values following contamination by motorway soil (460 – 3600 mg/kg).

Application of treated and processed sewage sludge on agricultural land has the advantage of resource recovery and provision of valuable fertiliser. The combination of the farmyard manures PDCDSS seemed to have soil bioremediation properties which could reduce elemental uptake of toxic materials in a polluted soil and a possible best performance in non-contaminated soil. There was a drastic reduction in the soil content of lead when the soil was treated with PDCDSS as shown in table II. Mild exposure to lead may result in behavioural and educational abnormalities and even mental retardation (Ward 1995).

A 430 mg lead intake per day has been recommended for an adult (WDP 1992) contaminated and polluted landsites should be remedied or cleaned up before usage for further agricultural purposes. A periodic check of the elemental uptake of available foodstuffs sold in market places and farmyards is necessary in order to identify and reduce these sources of food poisoning.

Table 1 **CROP DATA OF AMARANTHUS VIRIDIS**

Manure	PD	CD	SS	PDCDSS	NS
Germination	2 days	1 day	1 day	2 days	3 days
% (No germinated)	50%	100%	80%	50%	20%
Height after WK 1 (cm)	3.2	3.2	2.4	3.2	1.0
Leaf count "	5	5	4	6	2
Leaf spread	1	1.2	0.5	1.2	0.2
...after week two					
Plant height	11	6.5	3.0	20	0.7
Leaf count	10	6	5	12	4
Leaf spread	3	2.5	2	4.4	0.5
...after week 4					
Plant height	111	13.5	10	154	2
Leaf count	17	10	11	19	5
Leaf spread	7.5	3	4	8	1

TABLE II MEAN CONCENTRATION OF METALS IN THE SOIL/MANURE SAMPLES (? g/g.)

Type	Pb	Zn	Cd
Natural (NS) soil (control)	19159.2	18.07	0.009
Sewage Sludge (SS)	8209.9	17.20	0.010
Poultry Droppings (PD)	8622.0	16.19	0.010
Cow dung (CD)	13768.6	18.18	0.009
SS Manure + NS	10659.0	18.25	0.010
PD " + NS	7590.2	16.43	0.010
CD " + NS	7562.7	15.19	0.009
PDCDSS + NS	5995.8	15.18	0.006

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