RESPONSE OF MAIZE (*ZEA MAYS L.*) TO DIFFERENT LEVELS OF DECOMPOSED REFUSE IN UYO MUNICIPALITY, NIGERIA

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ABSTRACT: A greenhouse experiment was conducted at the University of Uyo Teaching and Research Farm using polythene bags to study the effects of decomposed refuse from two dumpsites (A and B) on the growth of maize in Uyo, Southeastern Nigeria. Ten kilogrammes (10kg) of the decomposed refuse was mixed with soil at five (5) levels: 100, 75, 50, 25 and 0 (control) percent. The mixture of the soil and decomposed refuse in each polyethylene bag was wetted to field capacity before planting five seeds of maize on it. Completely randomized design (CRD) with four (4) replications was used to evaluate the response of the maize (Zea mays L.) to different levels of the decomposed refuse. Maize plant height, fresh and dry weights among the different treatments were significantly ($P<0.05$) different among the various levels of the applied refuse which contained N(0.19%), Avail. P(139.25 mg/kg), K(0.25 meq/100g), Ca(13.44 meq/100g), Mg(5.13 meq/100g) and 2.21 % organic matter. Mean values of plant height and weight obtained at 7, 21, 35 and 49 days after planting (DAP) showed variation with the nutritional status of this refuse. Maize plants grown on soil fertilized with refuse produced better fresh and dry matter yields than those on the experimental soil alone, indicating some improvements in the soil fertility with the application of these decomposed refuse.

INTRODUCTION

The usefulness of compost and farmyard manure has long been recognized in the maintenance of organic matter status, the amelioration of physical, chemical and biological properties of the soil (Stevenson, 1982; Swift and Sanchez, 1984). Agboola (1974); Lal and Kang (1982) showed that reduction in soil organic matter content leads to nutrient imbalances that consequently can affect growth and yield in crop plants. Soil fertility especially in the tropics can be maintained by using organic manure (compost) either alone or in combination with inorganic fertilizer (Agboola and Odeyemi, 1972; John *et. al,* 1996). This report is supported by the FAO (1976). Furthermore, Adepetu and Corey (1985) had earlier related organic matter level in the soil to the nitrogen requirement of maize.

Some other organic materials such as clam shells, periwinkle shells and horn/hoof meal from animal origin and also *Cassia siamea*, wood ash and burnt palm kernel shells from plant residues have already been analysed by John *et. al* (2003) to contain reasonable amount of essential nutrients and organic matter needed as organic amendments in crop production.

Various other compost treatments from different combinations of palm kernel cake, municipal solid waste, poultry manure, saw dust and cow dung have been prepared, and their effects tested on arable crops by John *et. al, (*2003); John and Udoinyang (2006) and John (2007).

This research on the effect of decomposed refuse on maize highlights the potentialities of the refuse to enhance improvements in the fertility and organic matter content of the soil towards sustainable growth and yield of the growing plant.

MATERIALS AND METHOD

A green house experiment was conducted at the University of Uyo Teaching and Research Farm to study the response of maize to different levels of two different decomposed refuse.

The decomposed refuse samples were taken from two locations in Uyo municipality. The first refuse designated A, was collected from Old Stadium Road, off Wellington Bassey Way. The second designated B, collected from Udosen Uko Lane. Two transects (A and B) measuring 100 cm and 120 cm, respectively, were made vertically on the heaps of the refuse. Each column was divided into two horizons (1 and 2) at each of the two dumpsites.

Refuse samples were taken from both horizons of both dumpsites, air-dried, ground and sieved through a 2 mm sieve. Each of the samples was analyzed for pH (1:2.5 refuse/water) using a glass electrode pH meter (Bates, 1934) and Available P by Bray P-1 method as described by Bray and Kurtz (1945). Total nitrogen was determined by micro Kjeldahl method (Bremier, 1965). Organic carbon was determined by using Walkley-Black wet oxidation method described by Nelson and Sommers (1982). Organic matter was estimated as organic carbon x1.729 (Odu *et. al*, 1986), while exchangeable cations; Mg and Ca were first extracted using 1m NH_4OAc. Thereafter, K was determined by using the flame analyzer, while Ca and Mg were determined using Ethylene diamine tetra acetic acid (EDTA) titration. Micronutrients such as Fe, Cu, and Zn were determined after extraction of the sample with 0.1M HCI and then read using an atomic absorption spectrophotometer (AAS) as described by Hunter (1972).

Polyethylene bags containing 10 kg experimental soil mixed with decomposed refuse in different percentages of 0, 25, 50, 75 and 100 (decomposed refuse) and wetted to field capacity before planting three (3) maize seeds per bag. Planting was done at 2.5 cm depth and later thinned to two stands per bag at 7 days after planting (DAP). The mean plant heights, fresh and dry weights collected from the test crop were subjected to statistical analysis. Analysis of variance was used in evaluating the significance of treatment effects of the refuse on the maize. Means that showed significant differences were further separated using the least significant difference.

RESULTS AND DISCUSSION

The macronutrient, heavy metal and organic matter contents of the decomposed refuse and experimental soil were generally low (Table 1). However, the organic matter, Ca, Mg, Zn and Cu contents of the experimental soil were much lower than their contents in both refuse dumps. The levels of N, available P, K and Fe were not widely different in both experimental soil and the two decomposed refuse dumps. Macronutrients in horizon 2 in both refuse dumps were higher in content than same elements in horizon 1. However, contents of the micronutrients (Fe, Zn and Cu) were higher in the upper horizon (1) than in the lower horizon (2). The low content of essential elements and organic matter in the decomposed refuse may be responsible for the significantly ($P<0.05$) lower plant height, fresh and dry weights of the maize under soil only (control) as shown on Tables 1 and 2 and Figure 1.

Table 1: Some chemical properties of decomposed refuse from the two dumpsites and experimental soil.

Element	Refuse A		Refuse B		Experimental Soil
	Horizon 1 (0-49.5cm)	Horizon 2 (49.5-100cm)	Horizon 1 (0-60cm)	Horizon 2 (60-120cm)	Mean
Nitrogen (%)	0.17	0.20	0.19	0.21	0.23
Avail. Phosphorus (mg/kg)	120.33	159.99	133.33	143.33	139.34
Potassium (meq/100g)	0.16	0.18	0.34	0.33	0.26
Calcium (meq/100g)	8.96	12.80	12.80	19.20	3.20
Magnesium (meq/100g)	3.20	6.10	4.40	6.80	1.60
Organic carbon (%)	1.91	2.34	2.24	2.34	1.48
Micronutrients:					
Iron (ppm)	573.38	500.40	489.98	364.88	583.80
Zinc (ppm)	164.00	105.00	102.50	98.00	86.80
Copper (ppm)	14.85	11.98	20.67	18.20	3.88

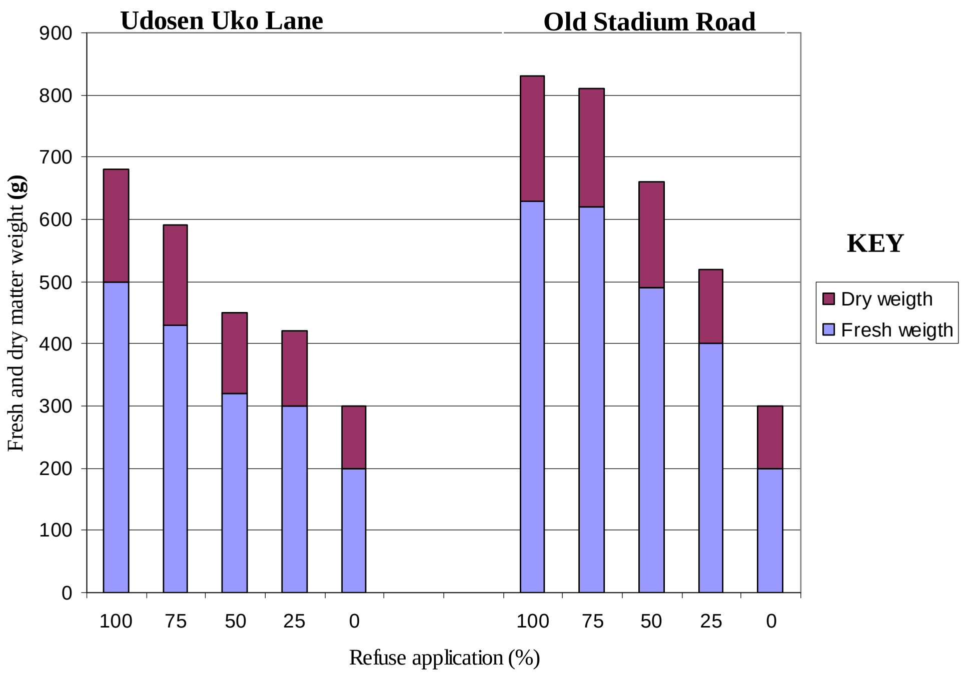

Figure 1: Fresh and dry weights of maize plant fertilized with different levels of decomposed refuse at 49 days after planting.

Table 2: Mean plant height (cm) of maize plant fertilized with decomposed refuse A collected from Old Stadium Road, Uyo.

Percent mixture of refuse applied	Days after planting 7	21	35	49
100	10.0b	63.5c	93.1b	110.2a
75	18.0a	75.5a	104.9a	110.7a
50	17.6a	69.8b	97.7b	110.8a
25	16.9a	63.3c	87.8c	103.9b
0 (Soil only)	15.8a	52.8d	80.5d	97.1c

The mean plant height (cm) of maize plants fertilized with refuse A and B taken at 7, 21, 35 and 49 days after planting (DAP) were significantly ($P<0.05$) different among the various refuse treatments. The applications of refuse A treatments produced plants with the highest height when 75% refuse + 25% soil treatment was used (Table 3). Similar, result was obtained from refuse B with the application of 50% refuse + 50% soil treatment at 7, 21, and 35 DAP. This indicates that the application of large amounts of decomposed refuse measuring about 50 – 75% to the soil could give significant growth to the growing plant. However, the lowest mean height of maize was recorded under soil alone as shown on Tables 2 and 3. Between 21 and 49 DAP, there was a significant ($P<0.05$) increase in the rate of growth of plants fertilized with compost B than that of A. This increase in growth might be attributed to the high content of macronutrient elements especially N in refuse B than A (Table 1).

The low amount of these elements in experimental soil correlates with the low organic matter content of the soil as reported by Titiloye (1982). This culminated in the poor performance of maize grown on soil alone. Similar results were obtained by John and Udoinyang (2006) and John (2007) with the use of other organic fertilizers in crop production.

Table 3: Mean height (cm) of maize plant fertilized with decomposed refuse B collected from Udosen Uko Lane, Uyo.

Percent mixture of refuse applied	Days after planting			
	7	21	35	49
100	20.4b	65.0a	111.2a	138.6a
75	20.9b	67.8a	113.8a	116.8d
50	22.2a	68.8a	114.8a	131.6c
25	19.0b	67.5a	108.6b	127.3b
0 (Soil only)	15.8c	52.8b	80.5c	97.1c

The fresh and dry weights of maize plants from each of the treatments at 49 DAP indicated that there were significant differences ($P<0.05$) among the various refuse plus soil treatments as shown on Figure 1. Decomposed refuse A and B applied to the maize recorded significantly ($P<0.05$) higher fresh and dry weights than plants on the soil alone. However, fresh and dry matter yields of maize fertilized with decomposed refuse B showed relatively better performance than those fertilized with refuse A, especially between 7 and 49 DAP.

CONCLUSION

Organic materials, which constitute a greater portion of the waste in various dumpsites around our environment, contain varying levels of both macro and micronutrients needed by growing plants for sustainable growth and optimum yield. This is due to the fact that refuse is rich in organic matter and essential nutrients needed for the improvement of the soil texture and structure. However, both the organic matter and essential nutrients contained in these refuse are only released and become readily available to plants when they are decomposed. Though the level of plant nutrients in the refuse is generally low, this research has revealed that the application of large amounts of decomposed refuse (50 % and above) could significantly improve the growth and yield of crops. Also, there are differences in the plant nutrient and organic matter contents of the refuse depending on its location in the city.

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