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SIAM WEED *(Chromolaena odorata)* AND COWDUNG COMPOST EFFECTS ON PHYSICOCHEMICAL PROPERTIES, YIELD and MINERAL NUTRITION OF TOMATOES(*Lycopersicon esculentum* L)

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ABSTRACT

Greenhouse trials were conducted to evaluate the effects of siam weed *(chromolaena odorata*) and cowdung compost on physicochemical properties, yield and mineral nutrition of tomatoes (*lycopersicon esculentum* l). The nutritional value of tomato makes it one of the crop that is a daily household consumption by every family.Compost was prepared in this study from Siam weed (*Chromolaena odorata*) and cowdung. Three compost samples were prepared from Cowdung and siam weed at ratio 100g: 100g (sample A), 200g chopped siam weed (sample B) and 200g cowdung (sample C). These three samples were composted in plastic drums perforated for aeration and each sample was replicated three times. The content in the drums were regularly turned and monitored at 1, 10, 30 and 60 days for physicochemical properties. The physicochemical and mineral element analyses of the compost were carried out using standard procedures.The pH of the composted samples ranged between 5.8 to 6.9. Nitrogen, phosphorus and potassium contents increased with days of composting while those of heavy metals decreased. The result of plant height for the two varieties ranges between 5.31-119.8, number of fruits is between 11-21 and the yield (kg) parameter ranges between 0.76-1.91. Treatment. A gave higher mineral element over other treatment applied. The order of mineral elements contributed to the fruits were as follows treatments A>C>B>D

Keywords: Tomato, Siam weed, cowdung and compost

INTRODUCTION

In recent years the application of organic wastes to amelorate soil has been demonstrated as an effective environmental and agricultural practices. Organic wastes have been used for maintaining soil organic matter, reclaiming degraded soils and supplying plant nutrients. Sources of organic wastes include animal manure (Haynes and Naidu, 1998), sewage sludge (Ahiachi *et al*., 2001) and compost (Tejada and Gonzalez, 2003a). Composting is a process in which waste materials are subjected to natural decomposition, facilitated by microbial activities under aerobic or anaerobic conditions. It is a relatively humus-like substances obtained from

biochemical conversion of various components of organic waste that can be used as soil amendment (Switzenbaum *et al.*, 1994). Microorganisms decompose the organic matter into stable amendment product for improving soil quality and fertility (Tiqua, 2005).

A number of biological waste can be used for composting which include municipal, animal, plant and human waste. Aerobic composting process involves oxidation of relatively complex organic compounds by microorganism resulting in simpler organic compounds. Compost improve stability of soil aggregate and used as mulch to reduce erosion risk (Pinamonti and Zorzi., 1996), releases nutrients to plants (Chodak et al., 2001) and have positive effects on plant growth and health (Pinamonti and Zorzi, 1996)

Siam weed is a tropical species of flowering shrub in the sunflower family. It is used as a fallow species and as soil amendment to improve plant growth and also play important role in rotation system of agriculture in Nigeria in their ability to rejuvenate soil nutrient system. However, it is most problematic invasive species within protected rainforest in Africa because it grows luxuriantly. Cowdung is undigested residue of plant matter which has passed through animal's gut. It is a waste of bovine which traditionally has been used as fertilizer. Today cowdung is collected and used as soil amendment and also to produce biogas.

The aim of this study was to know the effect of compost prepared from cowdung and siam weed on the physicochemical properties of compost samples, yield and mineral elements of two varieties of Tomato Roma and Beske.

MATERIALS AND METHODS

The materials used in this experiment are siam weeds collected from fallow land and cowdung all collected from the Teaching and Research Farm of the Federal University of Agriculture, Abeokuta, Nigeria.

Preparation of compost from siam weed and cow dung

Three sets of plastic drums (1.0x0.8m) perforated and with lid were used in this experiment. Drum (A) contained mixture of cowdung and chopped siam weed in ratio 100 : 100, drum (B) 200g of cowdung alone and drum (C) 200g of chopped siam weed alone. To each bucket one Litre of water was added, the mixture were thoroughly mixed and the set of buckets were replicated three times. The mixture in each bucket was allowed to decompose for 60 days with regular turning to allow for aeration. Samples from each bucket was taken at 1, 10, 30 and 60 days for physicochemical analysis.

Physicochemical properties of the composted samples at 1, 10, 30 and 60 days of composting andsoil physicochemical propertiesbefore planting.

Physicochemical parameters were determined at 1, 10, 30 and 60 days. The pH was measured using a pH meter Unicam 9450, Orion model according to Sarangi et. al (2001). Organic C was determined as described by Walkley and Black (1934), total nitrogen as described by Bremner (1960), total phosphorus was analysed by the Vanado-Molibdo phosphoric acid method using colorimeter, total K, Ca, and Na were determined using flame photometer (AOAC, 1984) and total Mg, Fe, Cd, Zn, Pb, Cu, Cr and Mn were done using Buck 200 absorption spectrophotometer AAS (AOAC,1984).

Green house experiment

Federal University of Agriculture, Abeokuta, Nigeria is in latitude 6.5-7.50E and longitude 3-40N.

Five (Kg) of sieved soil was placed plastic buckets perforated at the bottom. The soil type used was Ultisol (Iwo series) that was derived from Igneous / Metamorphic mateirals. The test crop used was tomato (*Lycopersicon esculentum* (L) Mill) (two varieties Roma VF and Beske). The experiment was 2X4 factorial arranged in a completely randomised design (CRV) with three replicates. Experiment consisted of eight treatments as follows:

TRSC--------- Tomato Roma + Siam weed + Cowdung
TRS----------Tomato Roma + Siam weed
TRC----------Tomato Roma + Cowdung
TR----------Tomato Roma (Control)
TBSC----------Tomato + Siam weed + Cowdung
TBS----------Tomato + Siam weed
TBC----------Tomato + Cowdung
TB----------Tomato (Control)

The rate of application were cowdung 8 ton/ha, Siam weed 8 ton/ha and cowdung + Siamweed (1:1) = 8 ton/ha.
Tomato seeds were raised for 21 days before transplanting into bucketss in the greenhouse. Prio to transplanting of the seedlings into the buckets, the soil was amended with the above treatments. Weeding was carried out as the need arose. Data were collected on plant height, number of fruits and yield (Kg). Analysis of variance (ANOVA) was carried out and means compared by least significant difference (LSD) at 5% probability level.

Mineral element.

Determination of mineral element in the tomato fruit (AOAC, 2005). The following mineral elements were determined in the fruits of tomato, Phosphorus, Potassium, Magnesium, Zinc and Manganese
Potassium determination

The ash of each sample obtained was digested by adding 5ml of 2M Hcl to the ash in the crucible and heated to dryness on a heating mantle. Five ml of 2M Hcl was added, heated to boil, and filtered through a Whatman No. 1 filter paper into a 100ml volumetric flask. The filterate was made up to mark with distilled water stoppered and made ready for reading of concentration of Potassium on the Jenway Digital Flame Photometer(PFP7 Model) using the filter corresponding to each mineral element.
The concentration of each of the element was calculated using the formula:

$$\%K = \frac{\text{Meter Reading(MR) x Slope x Dilution factor}}{1000}$$

NB: MR x slope x dilution factor will give you the concentration in part per million (ppm or mg/kg).You get concentration in % when you divide by 10000.

Phosphorus Determination

Phosphorus was determined by the vanadomolybdate colorimetric or spectrophotometric method.

The ash of each sample obtained was treated 2M Hcl solution as described for Potassium determination above. Ten ml of the filterate solution was pipetted into 50ml standard flask and 10ml of vanadate yellow solution was added and the flask was made up to mark with distilled water, stoppered and left for 10 minutes for full yellow development. The concentration of phosphorus was ob-

tained by taking the optical density (OD) or absorbance of the solution on a Spectronic 20 spectrophotometer or colorimeter at a wavelength of 470nm.

The percentage phosphorus was calculated from using the formula:

$$\%\text{Phosphorus} = \text{Absorbance} \times \text{Slope} \times \frac{\text{Dilution factor}}{1000}$$

DETERMINATION OF Mg, Mn, Zn

The digest of the ash of each sample above as obtained in potassium determination was washed into 100ml volumetric flask with deionised or distilled water and made up to mark. This diluent was aspirated into the Buck 200 Atomic Absorption Spectrophotometer(AAS) through the suction tube. Each of the trace mineral elements was read at their respective wavelengths with their respective hollow cathode lamps using appropriate fuel and oxidant combination.

RESULTS AND DISCUSSION

The physicochemical properties of the soil before treatment is shown in Table 1. The soil was alkaline in nature with low level of organic carbon, nitrogen.

Physicochemical parameters of the composting materials and at different days of composting is shown in Table 2. The pH ranged between 5.8 to 6.9. The pH of composting materials tended towards acidity which was favorable to the growth of bacteria. The C:N ratio decreased in all composting materials upto the 10th day, increased upto the 30th day and decreased at the 60th day. The C:N ratio observed in this study is suitable for agriculture The organic matter increased upto the 10th day and decreased upto the 60th day of decomposition. Nitrogen content increased throughout the days of composting. Phosphorus, Potassium, Calcium, Magnesium and Sodium increased upto the 30th day of composting and decline at the 60th day of composting. The heavy metals Iron, Manganese, Zinc, Lead, Cupper, Chronium, and Cadmium deceased with days of composting. The reduction in heavy metals after 60 days of composting falls within the accepted limit for compost as reported by Adekunle et al (2010).

The result of plant height on the two varieties of tomato Roma and Beske showed that only treatment A had significant effect of treatment when compared with control but treatment B and C did not have significant effect (Table 3). The result of number of leaves followed the pattern of plant height. For the two varieties only treatment A had significant effects but treatment B and C does not have significant effect. The reason why treatment A had significant effect may be because of the synergistic effect of combination of siam weed and cowdung. On the yield parameter treatments A and C had significant effect and treatment B did not have significant effect both on Roma and Beske varieties. The additive effect of treatment A gave higher yield in all parameters determined. This finding supports the work of Adenawoola and Adejoro (2005) who reported that compost from poultry increased both the organic matter and soil nutrient due to presence of mineral element that support the growth and yield of arable crops.

Table 1 : Physicochemical properties of the soil before planting, siam weed and cowdung.

Parameters	Values
pH	6.71
Sand (%)	92.9
Silt (%)	4.30
Clay (%)	2.80
Organic C (%)	0.58
Organic matter (%)	0.99
Nitrogen (%)	0.07
Phosphorus (Mg/kg)	4.91
Calcium (c mol/kg)	2.52
Magnesium (c mol/kg)	0.74
Sodium (c mol/kg)	0.26
Potassium (c mol/kg)	0.44
Lead (mg/kg)	0.08
Manganese (mg/kg)	8.09
Copper (mg/kg)	0.21
Zinc (mg/kg)	1.51

Table 2: Physicochemical parameters of composted materials at different days of composting

DAYS	1			10			30			60		
Parameters	A	B	C	A	B	C	A	B	C	A	B	C
pH	6.9	6.8	6.9	6.7	6.8	6.6	6.6	6.7	6.4	6.4	6.7	5.8
C:N	35.55	27.75	46.09	17.79	16.92	15.99	63.12	63.98	66.22	14.62	13.85	13.00
Org Matter (%)	61.15	62.52	72.15	64.24	66.01	68.20	16.03	15.12	14.47	61.06	63.14	62.01
N g kg-1	0.99	1.31	0.91	2.10	2.27	2.48	2.29	2.46	2.66	2.42	2.65	2.80
P g kg-1	5.04	5.35	15.72	6.32	7.20	16.92	5.92	6.66	6.74	5.24	5.84	1.82
K g kg-1	0.60	0.71	1.36	0.71	1.40	1.24	0.61	1.26	1.19	0.50	1.00	1.04
Ca g kg-1	0.91	0.81	0.91	1.05	1.26	1.36	0.92	1.15	1.28	0.75	0.95	1.22
Mg g kg-1	0.74	0.83	0.96	0.98	1.28	1.44	0.84	1.20	1.33	0.71	1.12	0.69
Na g kg-1	0.37	0.46	0.60	0.50	0.73	0.62	0.40	0.64	0.74	0.35	0.43	0.69
Fe mgkg-1	1027.25	1137.60	184.40	1019.35	1135.35	96.45	1004.65	1123.40	92.4	1021.00	1121.10	90.83
Mnmgkg-1	525.45	612.55	213.65	524.65	527.71	168.55	612.65	513.40	248.60	600.05	510.05	215.13
Zn mgkg-1	384.65	382.65	167.35	380.50	374.70	152.25	379.80	363.35	169.40	360.20	361.15	153.10
Pb mgkg-1	19.45	21.40	0.66	18.75	17.40	0.37	15.35	16.60	0.22	10.12	16.60	0.94
Cu mgkg-1	69.60	71.45	56.40	62.10	71.40	54.70	59.20	68.75	51.35	59.10	64.30	58.11
Cr mgkg-1	26.70	28.40	13.70	21.35	23.35	11.30	19.20	17.4	10.25	15.03	11.11	12.54
Cd mgkg-1	1.67	1.62	0.29	1.52	1.60	0.20	1.34	1.46	0.18	1.13	1.21	0.14

A = Siam weed and Cowdung, B = Siam weed, C = Cowdung

Table 3: Effect of cowdung, Siam weed and combination of cowdung and Siam weed on yield (Kg) of Tomato (*Lycopersicon esculen tum)* (L) Mill).

	Average Plant height (cm)		Average Numbers of fruits per plant		Average Yield (Kg) Per plant	
Treatment	Roma VF	Beske	Roma VF	Beske	Roma VF	Beske
A	85.9	119.8	21.0	18.0	1.91	1.66
B	71.5	89.4	13.0	15.0	1.05	1.08
C	83.3	104.9	16.0	17.0	1.35	1.47
D	53.1	74.3	11.0	12.0	0.76	0.95
LSD (0.05)	25.3	34.1	9.0	5.0	0.31	0.26

WAP = Weeks after planting, A = Siam weed + Cowdung, B = Siam weed, C = Cowdung and D = ControlD = control

Table4: Effect of cowdung, Siam weed and combination of cowdung and siam weed at 12 WAP on mineral composition of tomato fruit Beske variety.

	Mg (c mol/ kg)	P (cmol/ kg)	K (c mol/ kg)	Zn (mg/kg)	Mn (mg/kg)
Treatments					
A	0.58	0.49	0.67	24.9	27.7
B	0.44	0.34	0.52	16.9	20.9
C	0.51	0.44	0.62	23.1	25.1
D	0.35	0.31	0.47	15.8	16.1

WAP = Weeks after planting, A = Cowdung + Siam weed, B = Siam weed, C = Cowdung, D = Control

Table5: Effect of cowdung, Siam weed and combination of cowdung and siam weed at 12 WAP on mineral composition of tomato fruit Roma variety.

	Mg (c mol/kg)	P (cmol/kg)	K (c mol/ kg)	Zn (mg/kg)	Mn (mg/kg)
Treatments					
A	0.56	0.45	0.61	22.3	23.6
B	0.38	0.31	0.51	19.1	20.7
C	0.42	0.37	0.55	20.1	22.5
D	0.36	0.33	0.49	18.3	17.7

WAP = Weeks after planting, A = Cowdung + Siam weed, B = Siam weed, C = Cowdung, D = Control

CONCLUSIONS

Additive effect of treatment A gave higher mineral element over the other treatments applied. The order of element contributed by the soil amendments are A>C>B>D (Table 4 and 5). Potassium was better improved than the other elements followed by Mg and while Zn was the least. In general application of the soil amendment improved the mineral content of indigenous Beske variety than the exotic Roma variety in the trials.

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