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Research Article

Production and Characterization of Organic Fertilizer from Organic Wastes

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ABSTRACT

Organic wastes are generally believed to constitute aesthetic, environmental and health problems. To abate these problems, boost the economy of the nation and provide employment to our teeming population, one out of the many samples of organic materials lying waste was chosen for fertilizer production. Fresh sample of rumen content of cow was collected, dried, ground and analyzed for nitrogen, phosphorus and potassium. 10kg of the sample was then composted in two pits with other organic waste materials namely wood, ash, fish scraps and poultry droppings for 28 days. The composted sample was dried and analyzed for the above mentioned elements. Cow bone was also dried, burnt, ground and analyzed similarly. The composted rumen content and bone sample were then compounded in the ratio of 70%:25% by weight. A granulated organic fertilizer with N, P, K value of 9.6 and 4 was obtained with a pH range of 6.5-7.5, good handling characteristics and 19% weight efficacy.

Key words: Organic fertilizer, Organic Wastes, Rument content, Cow bone.

INTRODUCTION

Organic fertilizers are usually wastes from industrial processing of parts of plants or animals. They contain more nitrogen and phosphorus than manure and are classified as fertilizers rather than manure.

Generally, fertilizers are substances applied to soil to increase crop yields by providing one or more of the elements that are essential plant nutrients. Wastes from crops (such as straw) and natural vegetation and animal excreta have been used to fertilize cropped land for thousands of years. Marl and other liming materials were used in roman times to supply calcium and improve soil. These were the only fertilizers until natural deposits of sodium nitrate and bones were dissolved by sulphuric acid, the calcium phosphate they contain become water soluble and formed super phosphate. This process was developed by J.B. Lawes at Rothamsted in the 1840's and with it he laid the foundation of the chemical fertilizer industry (Ulysses, 1987).

Kongressband (1997) produced organic and inorganic fertilizers which were applied to wheat and oat. The organic fertilizer was 6tons of straw, 25 tons of compost, 30 tons of fresh manure and 30 tons of heaped manure and the composition of the mineral fertilizer was 180kg of N, 216Kg of K and 66kg of P. The combination of organic and inorganic fertilizer increased crop yield.

Ulysses (1987) also described the processing and analysis of some wastes for fertilizer and animal feeds. The wastes included dried blood, leather garbage, sewage compost, fish scrap, and cotton seed meal cocoa shell meal and castor pomace.

To offset the problem of environmental pollution resulting from the indiscriminately dumped waste material, to reduce the gap between demand and supply of inorganic fertilizers and to check the high cost of inorganic fertilizers, production of organic fertilizer from animal (rumen content of cow and bone) was embarked upon.

MATERIALS AND METHODS

Sample Preparation: Rumen content of cow collected from abattoir in Awka Nigeria, was allowed to dry under the sun for some days, ground and passed through a sieve of 1mm diameter.Bone sample from abattoir in Awka, Nigeria was allowed to dry under the sun for some days, burnt, ground and sieved with the same sieve as above.

Proximate Analysis: This was carried out on rumen content of cow, cow bone and compost. Nitrogen was determined by the micro kjeldhal method.

Mineral Analysis: Potassium was determined in the samples by the atomic absorption method as described in

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AOAC (1990). Unicam 929 model of atomic absorption spectrophotometer was used.

Phosphorus was determined colourimetrically by using the phosphovanadomolybdate method. 2g of finely ground sample was weighed into crucible and ashed by heating at 600^{o}C in a muffle furnace. The heating was continued until all the carbon had been burnt away (within a period of 5-6 hours). To the ash after cooling, 40ml HCl was added and also few drops of nitric acid. This was cooled and was transferred to 250ml volumetric flask and made up to mark with deionised distilled water. After shaking, some quantity of the sample ranging from 10ml to 25ml were pipetted into 100ml flask with addition of 20ml of molybdovanadate reagent and were made up to mark. Molybdovanadate reagent was obtained when 40 g of ammonium molybdate $4H_2O$ was dissolved in 400ml hot water and cooled. Then, 2g ammonium metavanadate was dissolved in 250ml hot distilled water, cooled and 450ml of 70% perchloric acid was added. The molybdate solution was then added gradually to the vanadate solution with stirring after which the solution was diluted to 2dm^3. The samples were then mixed and allowed to stand for 10minutes after which their absorbances were read at400mu.

1000ppm stock phosphorus standard was prepared by dissolving 8.788g potassium dihydrogenorthophosphate in deionised distilled water and the solution was made up to 1dm^3 in volumetric flask. The working solution was prepared by diluting the stock solution1:20 to give a working solution of 0.1mg /dm^3. Aliquots of working standard containing 0.5, 0.8,1.0 and 1.5mg phosphorus were transferred to 100ml flasks and were treated as above. The standard and samples were read at 400mu, setting the 0.5mg standard at 100% transmission. The amount of phosphorus in each sample aliquot was determined from a standard curve.

Composting: Two pits with dimension 1m deep by 0.5m wide were made. 10kg of fresh sample of rumen content of cow was dumped into the first pit and 1kg of other waste materials (fish scraps, poultry droppings, wood ash and shredded corn cob) were also added in the same pit one after the other. The materials were added to increase the nutrient value. To the pit small quantity of water was added to keep the materials moist and this is done to enhance rapid decomposition since water is essential for all enzymatic processes. The two pits were protected from rainwater to avoid leaching away of some nutrients and the pits were left open to ensure aerobic compositing was being carried out. This was as a result of faster decomposition and less odoriferous advantages of aerobic composting over anaerobic composting. After 14days, the first pit content was transferred into the empty second pit and was allowed to decompose for another 14 days. The composting lasted for 28 days. The content was removed and dried for some days, ground and analyzed to determine the NPK value of the compost. The results obtained were shown in Table 1.

Compounding: Compounding which is the process of mixing together the various fertilizer materials and other additives to obtain a compound product was done by bulk blending. Bulk blending involved physical mixing of solid fertilizer materials into multi-nutrients in contrast to homogenous mixing of two or more nutrient carrier in slurry and then drying.

Compounding processes: Compounding processes include mixing, granulation and drying.

Mixing: Mixing was carried out in a plastic bowl. 250g of the bone sample and 700g of the compost were weighed and transferred to the bowl. 50g of loam soil sample was added. The materials were mixed in the bowl by stirring with a wooden stirrer.

Granulation: 50 ml of water was added to the mixture to wet it. 200ml of water was used to prepare 20g of carboxyl methyl cellulose for jelling. The prepared carboxyl methyl cellulose was transferred into the bowl containing the mixture and the mixture was stirred until a sticky mixture was obtained. The sticky mixture was forced through a metal sieve of 1cm diameter by pressing the mixture over the metal sieve surface and uniform sized granules was obtained of the sticky mixture. These were collected on black polythene material spread under the metal sieve. The material was replaced with another when the entire surface was covered with the granules and was sent for drying.

Drying: The wet granules were dried for two days under the sun and dried granulated organic fertilizer was obtained. Black polythene material was used because black surface absorbs heat thereby reducing the drying period.

RESULTS AND DISCUSSION

NPK Values in Grams per Kilogram of the Fertilizer Materials:

Compost

$$N_2\text{---------} \frac{12.20X\ 1000}{100} = 122g$$

$$P_2O_5\text{--------} \frac{3.0\ X\ 1000}{100} = 30g$$

$$k_2O\text{--------} \frac{6.1X1000}{100} = 61g$$

Cow Bone

$$N_2\text{----------} \frac{3.6x\ 1000}{100} = 36g$$

$$P_2O_5\text{-------} \frac{18.5X1000}{100} = 185g$$

$$K_2O\text{--------} \frac{0.3X1000}{100} = 3g$$

Total Weights in g per Kg, for Compounding: The ratio in percentage of compost, cow bone and loam soil sample per kg used in compounding is given by 70:25:5.

70% of 1kg = 700g of the compost which contains the following values of NPK in gram:

$$N_2\text{----------} \frac{122x70}{100} = 85.4g$$

$$P_2O_5\text{--------} \frac{30\ X\ 70}{100} = 21g$$

$$K_2O\text{---------} \frac{61X70}{100} = 42.7$$

25% of 1kg =250g of cow bone which contains the following values of NPK in gram:

$$N_2\text{----------} \frac{36x25}{100} = 9g$$

$$P_2O_5\text{----------} \frac{185x25}{100} = 46.25g$$

$$K_2O\text{---------} \frac{3X25}{100} = 0.75g$$

Table 1: Proximate Analysis Result

Parameters	Rumen Content of Cow	Compost	Cow bone
Nitrogen (%)	4.20	12.20	3.6
Phosphorus as P_2O_5(%)	0.60	3.0	18.5
Potassium as K_2O (%)	0.98	6.1	0.3

Table 2: NPK Values in Grams Per Kilogram of the Compost

Parameter	Value (Gram)
N_2	122
P_2O_5	30
K_2O	61

Table 3: NPK Values in Gram per Kilogram of Cow Bone

Parameter	Value in gram
N_2	36
P_2O_5	185
K_2O	3

Table 4: NPK Content of 700g of Compost

Parameter	Value in gram
N_2	85.4
P_2O_5	21
K_2O	42.7

Table 5: NPK Content of 250g of Cow Bone

Parameter	Value in gram
N_2	9
P_2O_5	46.25
K_2O	0.75

Table 6: NPK Values in 950g of Both Samples

N2	85.4 + 9	94.4
P2O5	21+46.25	67.25
K2O	42.7 + 0.75	43.45

Fertilizer grade was obtained as follows:

$$\frac{94.4(N_2) : 67.25 (P_2O_5) : 43.45 (K_2O)}{10} = \text{NPK } 9\text{-}6\text{-}4$$

From the results of the analysis and compounding, a granulated organic fertilizer with grade NPK 9-6-4 was obtained and was tested and confirmed to have the following properties:

Handling Characteristics: The fertilizer is granulated and highly concentrated. The product remains dry and produces no odor during prolonged storage under normal warehousing condition when properly packaged.

pH Value: The pH value of the product is of the range 6.5-7.5 and it was determined using pH indicator paper.

Dissolution in Water: The product dissolved readily in water under normal atmospheric temperature and pressure.

Chemical Characteristics: The organic fertilizer grade is NPK 9-6-4 which contains 9% nitrogen, 6% phosphorus and 4% potassium. If the proportion of the compost and the crushed bone sample are varied, other grades of fertilizer can be obtained.

Method of Application

Broadcasting: The product is uniformly spread on the soil surface or it may or may not be incorporated into the soil.

Deep Banding: The product is placed in a strip at a depth of 14-18cm deeper.

Usually, the strips are 30-70cm apart, placed at planting without regard to row.

Slit Application: The fertilizer is added into two or more portions at different times during the season.

Starter (Pop up): Fertilizer is added with or near the seed (0-50cm) for immediate use by the young seedling.

Fertigation is the application of the fertilizer in water (as irrigation water).

Weight Efficacy: Weight efficacy is the total weight in percentage of a given fertilizer that can offer the maximum fertilizing properties, that is weight out of total weight of fertilizer that offers fertilizers maximal effects. It is given by Total weight of

$$\frac{\text{NPK value x100}}{\text{Total weight (1000g)}}$$

The weight of the fertilizer is 19%.

Conclusion: The results of the analysis and compounding show that the fertilizer produced is of high quality and can attract great demand. Sponsorship can be taken up by government.

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