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COMPARATIVE ASSESSMENT OF THE NUTRITIVE VALUE OF COMPOST RICE HUSKS AND N-P-K BRANDED INORGANIC FERTILIZERS

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ABSTRACT

Rice husk is the byproduct of the rice milling industry. It is generated in large quantity annually as waste. It is suspected to be of environmental importance if not properly disposed, but most importantly it is believed to be useful as agricultural soil input, hence the need for this study. An assessment to ascertain the usefulness of rice husk as a soil input vis a vis the quality of two NPK branded inorganic fertilizers: 15-15-15 and 20-10-10. Analysis of rice husks revealed its content to be nitrogen(1.90 %), phosphorus (0.48 %), potassium (0.81 %). The analysis further revealed that rice husks contain most micro nutrients which make it more advantageous over the inorganic fertilizer. Mean concentrations of the micro nutrients were: calcium, 0.27 %, magnesium 0.24 %, iron 0.058%, zinc 0.016 %, manganese 0.013%, copper 0.0007%, sodium 0.02 %. Organic carbon, organic matter, carbon to nitrogen ratio (C: N), and pH were found to be 24.94 %, 43.12 %, 13.1 % and 7.0 respectively. Macro nutrients (Nitrogen, Phosphorus and potassium) in the compost rice husk were significantly lower than the inorganic branded fertilizers.

KEYWORDS: rice husk, inorganic and organic fertilizers, macronutrients and micronutrients

INTRODUCTION

It is no doubt that every activity of man generates waste [1]. In fact quantification of waste generated each day needs not to be over emphasized. To exist is to pollute in some form or another and to exist at levels of affluence is to be a supper polluter. Strictly speaking, to talk of"clean environment" and "pollution free" are rather scientific absurdity [2]. This is reasonable because the law of conservation of matter - energy states: matter can neither be created nor destroyed but only transformed from one form to another. This could be restated as matter or waste cannot be eliminated rather transported in various forms from one place to another. Hence it is more appropriate to expend energy on waste management instead of waste elimination/ pollution elimination [1].

Human activities like agriculture generate waste at high levels more than municipal industrial waste production. Most of the wastes generated from agric consist primarily of animal manure, crop residues and various by products of food production [1]. Rice husk is an example of such waste. It is produced in large quantities as a waste in Africa, Asia and other parts of the world. It is only felt that it may be useful as agricultural soil input hence the need not to dispose of it strictly as waste by burning.

Rice husk is biodegradable like other agro residues. It is seen to be a source of plant nutrient, which could be recycled back to the soil from where they were absorbed. Recycling could be through biochemical or chemical transformation of waste into products like fertilizers [1]. The process of bioconversion is the technique where the breakdown of rice husk by aerobic bacteria under manipulated conditions into humus like substance that may be used as a soil conditioner or fertilizer [3]. This type of bio conversion is composting.

The methods commonly employed in disposing of agricultural waste in Benue State, Nigeria are ploughing under of crop residues and open burning of plant waste.This practice is common in areas where the residues have become fairly decomposed as a function of time as is seen in places like local rice mills. Plants grown on soils where residues like rice husk have been ploughed were observed to have rich chlorophyll and yielded richly.

Organic fertilizers were the chief source of added plant nutrients before the advent of inorganic fertilizers. It was certain they were a good source of nitrogen and under tropical conditions, almost as quick acting as ammonium sulphate [4]. To meet with increasing nitrogen needs for global food production, Haber- Bosch method for synthesizing ammonia from nitrogen and hydrogen was developed [5].

Today the dependency on fertilizer to sustain the world's population is indispensable. This has led to enhanced food production. Unfortunately, these gains have incurred environmental costs [6]. Some nitrogen applied to crops escapes into the ground through leaching and surface waters causing eutrophication and pollution of water in general.These losses are influenced by soil moisture, soil pH, cation exchange capacity (CEC) and method and depth of fertilizer application [7]. Leaching losses are influenced by soil texture, structure and organic matter content. Both organic and inorganic fertilizers change the physicochemical properties of the soil as they lead to improved aeration, water retention, increased granulation and flocculation of soil colloids [7]. Although the nutrient needs of plants in organic fertilizers are low hence they are used to supplement

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inorganic fertilizers or as soil amendment to improve soil physical and chemical properties. When organic fertilizers are used primarily as a source of nutrient, their chemical composition becomes significant. However the availability of their nutrient for plants especially nitrogen is dependent on C:N than on the nitrogen itself [7]. A C:N less than 20:1 implies that the microorganisms will obtain adequate nitrogen for their needs and will convert the excess organic nitrogen to ammonium [8]. This property improves microbial properties of the soil which in turn governs the decomposition rate of organic materials [9]. It varies from region to region especially as it relates to temperature and rainfall. It is smaller in arid than in humid regions of comparable temperatures. High values will rapidly multiply because of the large source of added carbon food. The reverse of it will rather reduce available nitrogen to plant as it will be tied up and released from decomposition of microorganisms to original nitrogen level [10].

A distinctive advantage of organic fertilizers over inorganic fertilizers is that they release plant nutrients slowly over a longer period thereby minimizing loss of nutrients. Moreover the organic component is highly beneficial for improving soil physical properties. Organic fertilizers serve as buffering agentfor reducing phytotoxic effect of aluminium, iron and manganese under acid condition through cation exchange capacity [11]. Organic fertilizers vary widely in composition depending on the raw material. It is pointed out that the amount of any nutrient at the end of humification of an organic material will be greater than the present in the original raw material. Furthermore, organic fertilizers contain most major nutrients and a wide range of micronutrients which are absent in inorganic fertilizers [12]. Organic fertilizers supply most of the exchangeable acidities or basicities of acid soils and are a major source of the nitrogen and sulphate and about half of the phosphorous taken up by unfertilized crops [13].

It is suspected that rice husk may be rich in nitrogen as well as other elements required for healthy plant growth. This study therefore intends to (1) assess the potent of rice husk as nutrient source by determining specifically the content of nitrogen, phosphorus, potassium, calcium, magnesium, iron, manganese, copper and sodium contained in it, (2) to compare the contents of N,P,and K in rice husk with those of inorganic branded NPK fertilizers (3)to determine its C:N ratio as an important factor that influences the availability of nitrogen in the soil.

MATERIALS AND METHODS

Materials

Reagents and Apparatus

All reagents for analysis were analaR grade and were purchased either fom Merck and Riedel de Haen Germany, BDH Poole England or Hopkins and William England. Apparatus used include AAS (model 210 VGP, Bulk scientific), flame photometer (model Unicam) and micro Kjeldahl apparatus.

Sampling and Preparation of Sample Material

Compost rice husk samples were takenfrom different rice husk heaps around the Gboko main rice mill plant at 30 cm depth. All samples were homogenized and a composite sample was obtained for analysis. The composite sample of rice husk was air dried for 48 hours prior to analysis.

The air dried sample was ground to pass through 0.5 mm sieve. 0.5 g of the ground sample was introduced into a digestion tube and 5 mL HNO3 - HClO4 acid mixture (2:1) were added.

The sample was left in the fume chamber at 150 0C for 2 hours after which the temperature was increased to 230 0C for 30 minutes. This temperature was reduced again to 150 0C and 1 mL conc. HCl was added to the sample and digestion continued another 30 minutes.

The sample was allowed to cool and its volume made up to 50 mL with distilled water. Analysis was conducted at the Analytical laboratory of the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria

Analyis of rice husk sample

Total nitrogen was estimated using Kjeldahl method [14] while phosphorus was obtained using ascorbic acid test method [15]. Percentagesof: iron, zinc, magnesium, manganese and copper, were estimated using atomic absorption spectrophotometer while potassium using flame photometry [16]. Organic carbon was obtained using Walkey - Black method (dichromate wet digestion) and organic matter was derived by multiplying organic carbon by 1.729 [16].

The pH of the rice husk was determined using 6 mL distilled water in 50 mL beaker with a glass electrode dipped into the suspension after allowing it to stand with occasional stirring for 30 minutes [17]

Results and Discussion

Table 1 shows the percentages of both macro and micro nutrients contained in the compost rice husk as compared with the NPK brands of fertilizer. The composition of 15-15-15 and 20-10-10 in terms of macronutrients are identified by NPK codes.

The compounds usually are salts or oxides. They are expressed in percent composition per ton of finished fertilizer [7].

Table 1. Mean percentages of nutrients in compost rice husk in comparison to 15-15-15 and 20-10-10

sample	Macronutrients			Micronutrients							Physicochemical properties			
	N	P	K	Ca	Mg	Fe	Zn	Mn	Cu	Na	O C	O M	C;N	pH
Rice husk	1.9	0.48	0.81	0.27	0.24	0.058	0.016	0.013	0.0007	0.02	24.94	43.12	13:1	7.2
15-15-15	15	15	15	-	-	-	-	-	-	-	-	-	-	-
20-10-10	20	10	10	-	-	-	-	-	-	-	-	-	-	-

Macronutrients

Table 1 shows nitrogen in rice husk having the highest percentage followed by potassium then phosphorous. These elements are higher than the other elements. This explains why they are classified as macronutrients. Rice plant like others require these nutrients in greater amounts and the others in lesser amounts hence are grouped as micronutrients. The percentage of nitrogen in rice in the rice husk sample was less than that in either of the NPK branded fertilizers. Table 1 also showed that phosphorous is lowest of the macronutrients. It is available to plants as phosphoric acid and its contents in plant tissues ranges from 0.02 to 0.4 % [17]. This is comparable with that in Table 1.

Micronutrients

Table 1 show that rice husk contains both classes of nutrients and this makes it a good organic fertilizer and good soil conditioner. Copper has the least percentage which may suggest that it is the least fixed element in the soil therefore not readily available to plants.

Organic carbon and organic matter

The organic carbon and organic matter content of rice husk were quite reasonable, hence it may be recommended for soils deficient in organic matter. The values of 24.94 % organic carbon and 43.12 % organic matter makes rice husk a good source of humus for soil; although organic carbon content decreases due to mineralization [18]. Organic matter decreases infiltration rate and increases water holding capacity, reduces plasticity, cohesion and stickiness of soils. Organic matter stores nutrients which are slowly released through mineralization. Organic acids, polysaccharides and fustic acids attracts Fe^{3+}, Cu^{2+}, Zn^{2+} and Mn^{2+} from edges of mineral structures and bind them in stable organomineral complexes [18].

Carbon to nitrogen ratio (C: N)

Carbon to nitrogen ratio determines readily availability of nitrogen to plants through mineralization. It ranges between 10:1 to 30:1 in legumes and young green plants [18] and it increases towards warmer regions with value as high as 50:1 [6, 8]. On the average, soil microorganisms must incorporate into their cells about eight parts of carbon for every part of nitrogen for a rapid activity. Table 1 show that C: N of rice husk at its stage of decomposition was 13.1. It could be assumed that under natural conditions of climate and rainfall, mineralization will be effective and this can influence the immediate availability of nitrogen. The wide ratio in rice husk could trigger an intense competition among microorganisms for available nitrogen if applied to soil. This could also facilitate the rate of decay of rice husk. Generally, nitrogen will not be released if rice husk has nitrogen less than 1.5 % or if it's C: N is greater than 25:1 [18].

pH

pH of rice husk leachate made with distilled water was neutral as shown in Table 1. This suggests that normal aerobic decomposition of the rice husk was ongoing at the time of sampling. Generally waste materials at a dump site undergo a number of biochemical and biological processes mainly aerobic and anaerobic decomposition that are catalysed at some stages by enzymes. From the onset, the organic material undergoes aerobic decomposition through activity of aerobic microorganisms. This ceases within days as the oxygen trapped in the organic material is exhausted. A long term anaerobic decomposition sets in. at this stage ammonia is produced. It is believed that the relatively high amount of ammonia produced during anaerobic decomposition makes pH of leachates using distilled water alkaline [15].

CONCLUSION

Rice husk alone at this stage may not be enough to provide plant nutrients for good production/ yield but analysis shows that rice husk can be good for economic and friendly organic fertilizer that could provide benefits to poor soil.

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