1. ULUSLARARASI MARMARA BİLİMSEL ARAŞTIRMALAR VE İNOVASYON KONGRES

1. INTERNATIONAL MARMARA SCIENTIFIC AND INNOVATION

EDITORS
Assoc. Prof. Dr. Veysi ÜNVERDİ
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21 - 22 AĞUSTOS 2021 / İSTANBUL

CONGRESS BOOK

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IKSAD Publishing House

COMPARISON OF NITROGEN, PHOSPHOROUS AND POTASSIUM (NPK) IN YOUNG AND MATURED COW, GOAT AND POULTRY MANURES FOR FARMERS' UTILIZATION AS BEST ALTERNATIVE TO INORGANIC FERTILIZER DURING COVID-19 PANDEMIC LOCK-DOWN

Hauwa Idris MUHAMMAD
Department of Chemistry, Ibrahim Badamasi Babangida University Lapai, Niger State, Nigeria

Musa Bola BUSARI
Centre for Genetic Engineering and Biotechnology, Federal University of Technology Minna, PMB 65 Minna, Niger State, Nigeria
Department of Biochemistry, Federal University of Technology Minna, PMB 65 Minna, Niger State, Nigeria

Mohammed YUSUF
Department of Chemistry, Ibrahim Badamasi Babangida University Lapai, Niger State, Nigeria

ABSTRACT

The current COVID-19 pandemic that resulted into lockdown of the activities all over the world have actually affects all industries including fertilizer industry from producing their various products. Furthermore, the adverse environmental consequences and high costs of inorganic fertilizers make them not only undesirable, but also uneconomical to farmers. These aforementioned problems have led the farmers to be using animals dungs as alternative to industrial fertilizer. The Nitrogen, Phosphorus and Potassium (NPK) contents in young and matured cow, goat and poultry manures were analysed using standard methods and compared for possible soil nourishment efficacy. The Percentages of nitrogen in manure from both matured and young poultry were significantly higher ($p < 0.05$) than what were measured in manures from cow and goat. The contents were observed in the following order: poultry manure (2.943 and 2.345%) > that of the goat manure (1.943 and 1.824%) > that of the cow manure (1.628 and 1.371%). The same trends were also observed in the percentage compositions of phosphorus and potassium in the manures. Conclusively, manure from poultry, especially the matured ones have highest percentage of N, P and K compositions than that of the goat and cow, and may have greater positive growth effects when utilized as manure for plant development. As such, it may remain as the best alternative to inorganic fertilizer during the current pandemic and beyond.

Keywords: COVID-19 Pandemic, Manure, Inorganic Fertilizer, Nitrogen, Phosphorus, Nitrogen

Introduction

The current COVID-19 pandemic that resulted into lockdown of the activities all over the world have actually affects all industries including fertilizer industry from producing their various products. Furthermore, the adverse environmental consequences and high costs of inorganic fertilizers make them not only undesirable, but also uneconomical to farmers. These aforementioned problems have led the farmers to be using animals dungs as alternative to industrial fertilizer.The use of inorganic fertilizers to increase yields was found to be effective few years ago, requiring continuous long-term use (Ojeniyi et al. 2009). The adverse environmental consequences and high costs of inorganic fertilizers make them not only unwanted, but also uneconomical and

out of reach of the poor farmers who still dominate the Nigerian agricultural sector (Shiyam and Binang 2011). This has led to increased use of organic wastes, readily available alternatives that are more environmentally friendly. Recently, due to the rising prices of inorganic fertilizers coupled with their failure to provide the necessary nutrients to the soil, emphasis has been on organic manure. These are environmentally friendly and can combine the best compost qualities with chemicals in a cost-efficient way. Nevertheless, the value of organic compound fertilizer and compost is importantly monitored (Beggs 2009). A research conducted by Akhtar et al. (2011) discovered that a mixture of organic manure and inorganic fertilizers is a cost-effective way to soil fertility and increases crop yields. The use of organic manure is preferred due to the possibility that single application can increase nutrient efficiency throughout the plant cycle (Shaviv 2005, Zhao et al. 2010, Arrobas et al. 2011) or at least reduce the frequency of top dress fertilization (Zhao et al. 2010).

Soil fertility is determined by the availability of soil nutrients such as nitrogen, ammonia, phosphorus, and potassium. Non organic fertilizers also contain phosphate, nitrate, ammonium and potassium. However, the continuous use of fertilizers causes soil deterioration, acidification and degradation of elements. Inorganic fertilizer industries have been regarded to be sources of natural radionuclides like ^{238}U, ^{232}Th and ^{210}Po, and heavy metals like Cd, As, Pb, Cu, Ni and Hg (FAO 2009). The use of fertilizers causes accumulation of heavy metals in soil, which affect the plants and also the food chain.

Manure is a by-product of animal production that is inevitable. Manure is made up of urine and faeces from animals and may also contain animal bedding, excess food and additional water (Savci 2012). It is a beneficial fertilizer that provides a wide range of macronutrients such as nitrogen (N), phosphorus (P) and potassium (K), as well as micronutrients such as copper (Cu), zinc (Zn) and manganese (Mn) (FAO 2009). Manure is often a valuable supply of nutrients once properly managed for crop production. It provides a source of all the macro and micro-nutrients required in the available forms, thus improving the soil's physical and biological properties (Abou-El-Magd et al. 2006). The use of animal manure as fertilizer is of great importance for agriculture, but the use of such manures without understanding their nutrient contents could be harmful to plants and soil. As such, the aim of this research work was to comparatively determine the nitrogen, phosphorus and potassium concentrations in manures of young and matured animals of some farms.

Materials and Methods

Chemicals and reagents

The chemicals and reagents used were of analytical grade which were obtained from Sigma Chemical cost Louis, USA. The reagents included methanol, acetone and lead acetate among others.

Sample collection and preparation

The samples used in this study were manures of young and matured cows, goats and poultry. The cow and goat manures were collected from the Ibrahim Badamasi Babangida University animal production farm, while the poultry manure was collected on June 2020 from Hassan farm located in Lapai, Niger State. Exact 50 g of each sample were collected randomly in semi-solid forms within 5 points. All the samples were combined and homogenized in a plastic container using wooden rod. Exact 50 g of the manure samples were then air dried in a hot air oven at 40 °C for 72 hrs. Thereafter, the dried samples were pulverized to pass through 2 mm sieve. The pulverized samples were then stored at ambient temperature in a plastic bottle with tightly closed lid. The samples were then analysed for total N, total P and total K within 2 weeks of collection.

Sample analysis

Analysis of nitrogen concentrations in the animal dung samples

Concentrations of nitrogen in the dung samples were determined by Kjeldahl method using distillation plant. This method is divided into 3 steps, which are digestion, distillation and titration (Bradstreet 1965).

Analysis of phosphorus concentrations in the animal dung samples

The concentrations of phosphorus in the animal dungs were determined using a spectrophotometer as described by Turner et al. (2005). The animal dung samples were then passed through the procedure of wet ashing for estimation of phosphorus.

Different phosphorus standards (P_2O_5) were required for phosphorus estimation. Different standards were developed from the stock solution, i.e. 2, 4, 6, 8 and 10 ppm. Each standard (2 mL) was measured into separate bottles, 4 mL of solution of ascorbic acid was added; subsequently, 5 mL of distilled water was added to each container. The same procedure was carried out on the animal dung samples. Dung samples (2 mL each) were measured into separate bottles, and then 4 mL of ascorbic acid solution and 5 mL of distilled water were added. The standard percentage absorbance value was observed at 820 nm using a spectrophotometer, and a graph of the standard phosphorus curve was plotted. Similarly, each sample's absorbance value was noted and the corresponding values were traced on the phosphorus standard curve.

Analysis of potassium concentrations in the animal dung samples

The concentrations of potassium in the animal dungs were determined using the method described by Ojeka and Ayodele (1995). This method involves the use of flame photometer The sieved manure samples were passed through the procedure of wet ashing for estimation of potassium. Standard of 1-10 mg/mL were prepared and used to prepare standard curve by using interference suppressor solution as a blank. The solutions of the wet

ashing samples (10 mg/mL) were placed in flame photometer at 769.9 nm one after the other and the colour of flame and its intensity were noted for each sample, which indicated the qualitative and quantitative parameters of the element present, respectively. Recovery testing was conducted to evaluate trueness at the content level of 10 % - 20 % (mass fraction). The readings for the concentrations of total potassium in samples were noted.

Results

Comparison of nitrogen, phosphorous and potassium in young and matured cow, goat and poultry manures

The compositions of NPK are shown in Table 1. Both matured and young poultry manure percentages of nitrogen were significantly higher ($p < 0.05$) than other manures. The contents were observed in the following order: poultry manure (2.943 and 2.345 %) > goat manure (1.943 and 1.824 %) > cow manure (1.628 and 1.371 %).

The same trend of goat manures < cow manures < poultry manures was also observed with percentage composition of phosphorus obtained for matured and young cow manures; 0.705 and 0.654 % for matured and young goat manures, and 0.793 and 0.772 % for matured and young poultry manures, respectively.

The percentages of potassium in the manures of matured and young cow were 0.850 and 0.830%, for manures of matured and young goat were 1.040 and 0.963%, and 2.835 and 2.653 % for manures of matured and young poultry, respectively and the trend was poultry manures > goat manures > cow manures.

The results obtained revealed that mean concentrations of nitrogen in the poultry manures were the highest (2.943 and 2.345 %), while the concentrations obtained in the cow manures were the lowest (1.628 and 1.371 %). The comparison of the mean concentrations of phosphorus also showed highest concentrations (0.793 and 0.772 %) in the poultry manures, while the lowest concentrations (0.582 and 0.476 %) were obtained in the cow manures. The table also revealed that highest concentrations of potassium (2.835 and 2.653 %) were found in the poultry manures, while the lowest concentrations (0.830 and 0.850 %) were obtained in the cow manures. The trend of the above concentrations is poultry manure > goat manure > cow manure.

Table 1: Contents of nitrogen, phosphorous and potassium in young and matured cow, goat and poultry manures

Animal manure type		Parameter		
		Nitrogen (%) Mean ± S.D.	Phosphorus (%) Mean ± S.D.	Potassium (%) Mean ± S.D.
Cow manure	Young	1.371 ± 0.003^{a}	0.476 ± 0.002^{a}	0.830 ± 0.005^{a}
	Matured	1.628 ± 0.003^{b}	0.582 ± 0.009^{b}	0.850 ± 0.010^{b}
Goat manure	Young	1.824 ± 0.003^{c}	0.654 ± 0.005^{c}	0.963 ± 0.013^{c}
	Matured	1.943 ± 0.004^{d}	0.705 ± 0.003^{d}	1.040 ± 0.005^{e}
Poultry manure	Young	2.345 ± 0.009^{e}	0.772 ± 0.005^{e}	2.653 ± 0.068^{d}
	Matured	2.943 ± 0.001^{f}	0.793 ± 0.004^{f}	2.835 ± 0.090^{f}

Values are expressed as mean ± standard deviation of five replicates (n = 5). Values with the same superscripts on the same vertical axis are not significantly different at $p < 0.05$.

Discussions

The livestock waste is major source of noxious gases, harmful pathogens and odour; hence, it has public health and environmental concerns. Hence, livestock waste is to be managed properly to mitigate production of these pollutants in order to protect environment. Proper utilization of livestock waste into biogas, compost and vermicompost making can be very useful to increase crop yields and sustainability (Sorathiya et al. 2014). The higher percentage of nitrogen found in poultry manures when compared to cow manures might be as a result of their food consumption. It is quite understood in Nigeria that most of the cow feed on grass, while majority of poultry feed are formulated with different kinds of nutritious food materials. Therefore, the result is pointing to the fact that large quantities of proteins in the poultry feeds might be responsible for the differences observed in the nitrogen contents of the manures. The quantities of proteins obtained in this research are in close range to the values reported by Asawalam and Onwudike (2011) and Adeniyan et al. (2011). Likewise, higher percentages of phosphorus obtained from the poultry manures when compared with cow manures as also in tandem with that of Adeniyan et al. (2011) and Maerere et al. (2001) might be born out of the same reasons explained earlier. Remnants of phosphorous from bone meal and formulated minerals feeds which are being given to the poultry occasionally for the development of strong bones might be passing out with the with the faeces after the consumption of the meal. The disparity in NPK between the goat manure and cow manure observed in this research work might be due to the fact that goat are more exposed to different kinds of home waste nutritious foods apart from the grass consumption. As such, their wastes are expected to have more of these minerals when compared with that of matured cow. The concentrations of potassium in the cow manures found in this work were higher than the value of 82.22 ppm reported by Abbas et al. (2015).

Comparing the mean concentrations of NPK in the young and matured animals, it was found from the results that the mean concentrations of NPK in manures of matured animals were higher than that of young animals. These results are not surprising because most of the feeds being consumed by the young animals will be utilized for their growth. Therefore, less of all these minerals will be excreted along with their dungs when compared to those that will be useful to their body systems. Moreover, the metabolic activities of the young animals are still very active when compared to the adult animals. Additionally, many enzymes are needed for proper metabolic activities of which some of these minerals can serve as co-factors for these enzymes.

Conclusion

In conclusion, adult poultry manure had the highest N, P and K levels, indicating superior mineralization of NPK over adult goat and cow manures. Therefore, adult poultry manure would have greater effect on plant growth due to its high concentration of NPK. Therefore, it may remain as the best alternative to inorganic

fertilizer during the current COVID-19 pandemic and beyond.

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