VOL. 18 NO. 9
ISSN: 2278-1897
SEPTEMBER, 2020

African Scholar Publications & Research International

African Scholars Journal of pure and Applied Science (JPAS-9)

Effects of Poultry Manure on Soil Fertility in Federal College of Forestry, Jos Plateau State.

[1]Yahaya, U. F., [2]Bako, A., [3]Maikano, S., [4]Popoola, A. S., [5]Ademola, T. O., [6]Okechalu, S. O., [7]Likita, M. S., and [8]L. G. Lapkat.

[1]Agricultural Extension, Federal College Forestry Afaka, Kaduna State. [2,6&8]Horticulture and Landscape Technology Department, Federal College Forestry Afaka, Kaduna State. [3]Forestry Technology, Federal College Forestry Afaka, Kaduna State. [4]Forestry Technology Department, Federal College Forestry, Jos Plateau State. [5]Agricultural Technology Department, Federal College Forestry Afaka, Kaduna State. [7]Basic Science Department, Federal College Forestry Afaka, Kaduna State.

Abstract

Quantitative impact of poultry manure on soil fertility was studied in Federal College of Forestry Jos Plateau State. Poultry droppings was use as organic material for the study. Laboratory analysis were carried out on the droppings soils amended with poultry droppings (post soil samples) and the Un-amended soil (pre-soil samples) for the assessment of their fertility status. The result clearly indicated a considerable increase in the soil fertility parameters assessed. The increase between the pre and post soil parameters are as follows; p^H (1091), N (0.41), OM (14.00), P (7793.7), Na (3798.81), Ca (9726), Mg (3777), K (4825) H^+ (0.93), Al^{3+} (Nil), CEC (14.63), Clay (1.92), except for silt which have the same percentage(18.0) and there is reduction in percentage of sand(1.92) due to the impact of microbial activities in the soil. The paired T-test result revealed significant differences on Nitrogen content (0.020) Organic matter (0.001), Phosphorus (0.001), Sodium (0.002), Calcium (0.005), Magnesium (0.001), *Potassium (0.001), and Cation Exchange Capacity (0.001), there were no significant differences between the pre and post soil samples on the pH (0.356), Hydrogen ion (0.288), Clay(0.070), Silt (0.942), and Sand (0.151), contents of the soil. The study suggest that increasing microbial activities in the soil should be encouraged by Farmers for Optimum soil management and crop production.*

Keywords: *Poultry droppings, fertility, Soils, Manure and impact.*

Introduction

Soil is a complex mixture of minerals, water air, organic matter and countless organisms that are the decaying remains of once living things. It forms at the surface of land, skin of the earth, soil is capable of supporting plant life and is vital to life on earth. Of all the factors influencing the evolution of soil, water is the most powerful due to its involvement in erosion, transpiration and decomposition of the materials of which soil is decomposed (Chesworth *et. al.*, 2008). One of the basic functions of soil microorganisms is the decomposition and the transformation of organic materials which are mostly derived from above and below-ground plant residues. Thus, soil microbial communities play a critical role in ecosystem processes, such as carbon cycling, nutrient turnover, or the production of trace gases, soil microbial activities, populations and communities are governed by environmental variable and agricultural system (Araujo *et, al.*, 2008; Melero *et, al.*,2005). Animals soil mesofauna and microorganisms mix soils as they form, burrow and create pores, allowing moisture and gases to move about. Earthworm, ants, and termites mix the soil as they burrow. Earthworm ingest soil particles and organic residues, enhancing the availability of nutrient for plants.(Voroney, 2006) the use of farm yard manure will help to improve soil fertility, since many small holder farmers cannot afford to buy expensive chemical fertilizers to improve soil fertility, but organic matter application can increase soil fertility and increase yields (Sanchez, 2002).

The resistance of soil to changes in P^H as a result of the addition of acid or basic materials is a measure of the buffering capacity of the soil increase as the cation exchange. Capacity increase (Mc-Carthy, 1982). Some microorganisms are able to metabolize organic matter and release ammonium in the process of mineralization (Retallack, (2008). The use of farmyard manure will help to improve soil fertility since many small holder farmers cannot afford to buy expensive chemical fertilizers to improve soil fertility, but organic matter application can increase soil fertility and increase yield (Sanchez, 2002). The effectiveness of different sources of organic matter varies depending upon their physical and chemical nature, rate of nutrient cycling and release of nutrients. Many Farmers cannot afford to buy chemical fertilizers, or fertilizers are not available when needed (Ajayi *et, al.,* 2007a). The use of farm yard manure practices can alleviate some of the problems of declining soil fertility (Agbede *et al.,* 2010). Leguminous plants can produce large amount of foliages which can release nutrients to increase soil fertility, reduce fertilizer needs an increase yields (Albercht, *et al.*, 2003). Nutrient cycling refer to the transfer of nutrient already in the soil plant system from one component to another (Auke, 2001). Other processes involved in nutrient cycling are the return of crop residues such as stover back to the crops in nutrient cycling through leaf drop or root decomposition. Residues such as stover, manure into the soil and transfer of nutrients from soil to crops and crop to soil through pruning, leap drop or root decomposition (Sanchez, 2002). Inorganic fertilizer do not contain such carbon sources: therefore, most of the nitrogen fertilizer not used by crops is subjected to leaching, a and denitrification losses, while much of the nitrogen released from organic inputs and not utilized by crops could build soil organic nitrogen capital as well as having an important role in building of soil moisture capacity. Sanchez (2002), reported that the accumulation of soil organic inputs is likely to make a difference in terms of long term sustainability. Thus the potential for improved nitrogen management needs to be qualified in cropping system by measuring process, such as mineralization, de nitrification, volatilization, and leaching.

However, appropriate cropping systems can maintain or even restore nitrogen fertility through biological nitrogen fixation, deep nitrate capture and several cycling mechanisms. Phosphorous fertility however cannot be replenished by agro forestry, alone, but it can perhaps be made more available through cycling (Brady, *et al.,* 2002). Nitrogen is essential for many biological processes. It is in all amino acids, incorporated into proteins and is present in bases that make up nucleic acids. In plants much of the nitrogen is used in chlorophyII molecules which are essential for photosynthesis and further growth, (Rafiq 2010). Other plants get nitrogen from the soil by absorption of their root in form of either nitrate ions or ammonium ions. The source of ammonium is decomposition of dead organic matter called decomposer, which provide ammonium ion (NH4+) in well oxygenated soils these ions are then oxygenated first by nitrifying bacteria into nitrite(NO_2) and then into nitrate (NO_3). These two steps of conversion of ammonium into nitrate are called nitrification (Rafiq 2010).

The conversion of ammonia to nitrate is performed primarily by soil living bacteria the primary stage of nitrification, the oxidation of ammonia (NH_3) is formed by bacteria called nitrosomonas which converts ammonia to nitrate (NO_2) other bacterial species such as the nitrobacteria are responsible for the oxidation of the nitrates and ammonium are converted directly into dinitrogen gas. Denitrification is the reduction of nitrates back into the largely inert nitrogen gas (N_2), completing the nitrogen/nutrients cycle. This process is regulating the flow of nutrients in forest ecosystem include litter fall, mineralization of organic matter and path ways for the uptake and translocation of nutrient elements (Tella *et al.*, (2010) has reported that release of nutrients from decomposing litter is an important pathway for nutrients influx in forested ecosystem. Foliage quality and a range of environmental factors affect the rate and efficiencies of these processed and they inadvertently influence site fertility and determine to a large extent, the potential increase and or decline of productivity. It follows therefore that the understanding of the chemistry and nutrient status of plant foliages, is vital for the sustainability of farmland. Leguminous plants can provide large amount of foliage, which when released increase soil fertility, reduce fertilizer need and increase crop yields in relation to the plant foliage which varies as do their effects on nutrient status or cycling and crop yields. Tropical humid forest accumulates large quantities of nutrients in their vegetation as the forest grow , with mature forests reaching steady state valves of 700-2000kgN, 30-150kgP, and 400-3000kgK, per hectare/standard (Auke, 2001)

The efficient cycling of nutrients from the soil to the biomass and back to the soil makes possible a well-nourished soil. Though, agricultural systems differ from natural systems in one fundamental aspect; there is a net output of nutrients from the site via crop harvests or removal. The magnitude of nutrients removed can result in net negative balances if nutrients are not replaced. The magnitude of nutrients removed can result in net negative balances if nutrients are not replaced. The magnitude of nutrients running as a result crop harvest in Africa is huge. Net losses of about 700kgN, 100kgP, and 450kgK per hectare during the past 30 years have been estimated in 100million hectares cultivated land (Smaling, *et al.*, 2002). Soil fertility depletion is therefore the fundamental bio-physical reason for the decline per capita food production in small holder farms in Africa (Izac, 2003). However some basic factors such as the effects of PH, excess of other nutrients leaching and oxidation and crop removal always influences the availability of crop plant nutrient in the soil. The objectives of the study is to assess the fertility status of both pre and post soil samples of the study site and determine the impact of poultry manure on soil fertility.

MATERIAL AND METHODS

Study Site

The experiment will be carried out at the premises of Federal College Forestry, Jos. The area lies in the Northern Guinea Savannah zone, on latitude 9^0 57' N and longitude 8^0 54'E with a height of about 118cm above sea level. The mean annual rainfall for the location is between 1200mm and 1250mm and mean temperature of 23^0 $^-25^0$C. The soil is sandy-loam light to darkish in colour. (University of Jos Meteorological Station, 2000)

Methods

Soil samples were taken at a depth of root zone (0-20cm) from an uncultivated piece of land in the College. The samples were air-dried for analysis at Agricultural Training and Service Centre (ASTC), Kassa Plateau State to determine the fertility status of the un-amended soil. A sample of the poultry dropping was collected, air-dried and analysis as well. The remaining portion was packed in a sack and place under shade for six (6) week to undergo mineralization. The mineralized dropping was then mixed with the soil collected from the site. The mixture was allowed stay for Eight (8) weeks for microbial organism's activities to take place. After the experiment, samples were taken again for analysis as described by Carter (1993). The value of the fertility parameters found in the analyzed pre-soil samples were subtracted from that of the mixture of mineralized Poultry droppings and original soil to check the impact of microbial activities on the original soils after Eight (8) weeks.

Parameters to be assessed

The parameters are pH, Nitrogen, Organic matter, Magnessium, Potassium, Hydrogen ion, Percentage silt, Clay and Sand.

Data analysis

Data collected will be clarified using bar chart and percentage tables while Statistical Package for Social Sciences (SPSS) 20.0 software was used for analysis. Significant differences between fertility parameter of pre and post soils samples was assessed with T-test as statistical tool.

RESULTS AND DISCUSSION

Result

The result of this study is presented in table 1 below:

The preliminary soil sample, poultry dropping and post-soil laboratory analysis result is presented in table 1. The result clearly indicates a considerable increase in the soil fertility parameters assessed. The increase between the pre and post soil parameters are as follows; PH (1.91), N (0.14), OM (14.00), P (7793.7), Na (3798, 81) Ca (9726), Mg (3777), K (4825), H^+ (0.93), AL^{3+} (Nil), CEC (14.63), Clay (1.92). Except for silt which have the same percentage (18.0) and there is reduction in percentage of sand (1.92) due to the impact of microbial activities in the soil.

Table 1: Average values of pre-soil samples, poultry droppings and post-soils laboratory analysis result.

Sample	PH	N (%)	OM (%)	P (ppm)	Exchangable bases (ppm)				Exchangable acidity (mMol/100g)		CEC (mMol/100g)	Clay (%)	Silt (%)	Sand (%)	Textural class
					Na	Ca	M	K	H	Al					
Pre-soil	5.95	0.07	2.42	6.3	1.19	62.4	123	95	1.47	Nil	4.05	14.24	18	67.76	Loam-Sandy
Poultry Droppings	8.2	3.2	5.81	2.46	1.32	28.6	0.16	1.36							
Post-soil	7.86	0.48	16.42	7800	3800	10350	3900	4900	2.47	Nil	16.43	16.16	18	65.84	Loam-Sandy

(Source: Author's Field work)

Table 2 shows the paired samples T-test of the soil analysis, checking for paired difference between the pre and post soil analyzed in the laboratory. The result revealed significant differences on Nitrogen content (0.020). Organic matter (0.001), Phosphorus (0.001), Sodium (0.002), Calcium (0.005), Magnesium (0.001), Potassium (0.001) and Cation Exchange Capacity (0.001). There were no significant difference between the pre and post soil samples on the PH (0.356), Hydrogen ion (0.288), Clay (0.070) Silt (0.942) and Sand (0.151) contents of the soil. This implies that the increase in values recorded between pre and post soils test in table 1 for PH, Hydrogen ions, Clay, Silt and Sent contents were not sufficient enough to establish statistically the impact of microbial activities in the mineralization process of biomaterial in the soil.

Table 2: Paired Samples T-test of the Soil analysis

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	Upper			
pH	pH of Pre-soil samples - pH of Post soil samples	-1.90833	4.60305	1.87919	-6.73894	2.92227	-1.016	5	**0.356ns**
N (%)	Nitrogen content of Pre-soil samples -	-0.41000	0.29651	0.12105	-0.72117	-0.09883	-3.387	5	**0.020***

	Nitrogen content of Post soil samples								
OM (%)	Organic matter content of Pre-soil samples - Organic matter of Post soil samples	-14.18000	5.18015	2.11479	-19.61623	-8.74377	-6.705	5	**0.001***
P (ppm)	Phosphorus content of Pre-soil samples - Phosphorus content of Post soil samples	-7793.70000	2644.90049	1079.77610	-10569.35284	-5018.04716	-7.218	5	**0.001***
Na (ppm)	Sodium content of Pre-soil samples - Sodium content of Post soil samples	-3798.81000	1636.31577	668.02312	-5516.01809	-2081.60191	-5.687	5	**0.002***
Ca (ppm)	Calcium contenet of Pre-soil samples - Calcium content of Post soil samples	-9722.66667	5017.64693	2048.44578	-14988.36418	-4456.96915	-4.746	5	**0.005***
Mg (ppm)	Magnesium content of Pre-soil samples - Magnesium content of Post soil samples	-3777.00000	940.68337	384.03238	-4764.18665	-2789.81335	-9.835	5	**0.001***
K (ppm)	Potassium content of Pre-soil samples - Potassium content of Post soil samples	-4825.00000	1614.16245	658.97906	-6518.95960	-3131.04040	-7.322	5	**0.001***
H^+ (mMol/100g)	Hydrogen ion content of Pre-soil samples - Hydrogen ion content of	-0.73000	1.50467	0.61428	-2.30906	0.84906	-1.188	5	**0.288ns**

	Post soil samples								
CEC (mMol/100g)	Cation Exchange Capacity of Pre-soil samples - Cation Exchange Capacity of Post soil samples	-12.28000	3.85909	1.57547	-16.32986	-8.23014	-7.795	5	**0.001***
Clay (%)	Clay content of Pre-soil samples - Clay content of Post soil samples	-2.02000	2.14872	0.87721	-4.27494	0.23494	-2.303	5	**0.070ns**
Silt (%)	Silt content of Pre-soil samples - Silt content of Post soil samples	-0.10000	3.20000	1.30639	-3.45819	3.25819	-0.077	5	**0.942ns**
Sand (%)	Sand content of Pre-soil samples – Sand content of Post soil samples	1.92000	2.77322	1.13216	-0.99032	4.83032	1.696	5	**0.151ns**

(***: significant; ns: not significant @ p ≤ 0.05**)
(Source: Author's Field work)

DISCUSSION OF RESULTS

Soil micro-organisms (bacteria, yeast, fungi algae protozoa etc) are present in soils that furnish them with food and water plus a suitable place to live, their food is the energy material turned over to the soil in the form of plant and animal residues. As soil micro-organisms decompose organic matter, they release its nitrogen, phosphorus, and other mineral nutrients in forms available to crops; in addition the decomposing organic matter improves soil tilth, increases the moisture holding capacity, and lessens loss of soil. This study observed that microbial activities on soils do not only enhanced its fertility but also contribute to soil particles breakdown. The low fertility level of the pre-soil samples in this work justifies the need for appropriate soil management techniques for sustaining soil and agricultural productivity poultry manure, as influence by microbial activities brought about improvement in most of the soil chemical properties. Soil PH, organic matter, total nitrogen, available phosphorus exchangeable cations and percent base saturation were improved improvement in nutrient status of poultry manure amended soil implies that poultry manure could be used for soil management for sustainable agricultural production. In support of this, Ano and Agwu (2006) had found that animal manure increased soil PH and macronutrients of soil in southern Nigeria. Also Bahl and Torr (2002), Salako (2008) reported that poultry manure improved surface Phosphorus and other major nutrients and yield of maize. These findings confirmed earlier report by Lombin *et al* (1991) that animal manure improved soil productivity in two ways' through improvement of the physical conditions of the soil and through the nutrient it supplies to the soil. The impact of microbial activities as catalyst in mineralization processes of biomaterials towards soil improvement cannot be over emphasized. The added knowledge to research in quantifying the impact of microbial activities in the mineralization process of biological materials on the field.

CONCLUSION

The quantitative impact of poultry manure on soil fertility of the soil amended with poultry droppings were assessed. The study observed that the nutrient in organic materials such as poultry dropping could not be released to plant except it undergoes mineralization process, as a result of microbial activities in them. The result of the study indicated that poultry manure released enough nutrients which resulted in significant increase between the pre and post soil samples collected on site; also it serves as good source of soil amendment, and improvement of soil properties.

RECOMMENDATIONS

Based on the findings of this work, the following recommendations were made;

i. Further studies be carried out to assess poultry manure impact on soil fertility on the field and also test the amended soil with an appropriate crop.
ii. Farmer's adoption programme should be organized by the Agricultural extension workers, in educating them on the benefit of improving the soil with organic material.

REFERENCES

Agbede, T. M., Ojeniyi, S. O. Lawal, S. T., (2010). Tillage and poultry manure effects on soil physical properties, nutrients status growth, dry matter and grain yield of Sorghum journal of Agricultural science and technology 4 (3):45-59.

Ajayi, O.C., Akinnifesdi F.k., Gudeta, S., Chakeredza, S. (2007a). Adoption of Renewable soil fertility replenishment technologies in Southern Africa region: lessons learnt and way forward. National Resource Forum. 31 (4:) inpress.

Araujo, A.S.F., Santos, V.B., Monteiro, R.T.R. (2008). Responses of soil microbial biomass and activity for practices of organic and conventional farming systems in Piaui state. Brazil Enur.J soil Biol 44, 225-230.

Albercht, A Kandiji, S.T., Chakeredza, S. (2005). Carbon Sequestration in trophical agroforestry systems. Agric. Ecosystem and Environment.
Ano, A.O. and Agwu, J.A. (2006). Effect of animal manures on selected soil properties:II Nitrogen potassium and phosphorus, Nigeria Journal of soil science 16:145-150.
Auke, E.T. (2001), social, Economic and Policy Dimension of Soil Orgnic Matter Management is Sub Saharan Africa:Challenges and Opportunities. Nutrient cycling in *Agroecosystem* 61:183-195.
Bahl, G.S and Toor, G.S(2002)influence of poultry manure on phosphorus availabililty and the standard phosphate requirement of crop estimated from quantity-intensity relationship in different soils, Bioresource Technol 85:317-322.
Brady N., Weil, R. and Mitti, J. (2002). Nitrogen and sulfur economy of soils pp. 543-571 in Helba (ed.). The nature and properties of soils, Pearson education, NJ.
Carter, M.K.(1993). Soil sampling and methods of analysis, Canadian Society of soil science, Lewis Publishers, London, p 823.
Chesworth, W., Voroney, R. P., Powlson David (2008). Encyclopedia of soil science. Dordrecht, Netherlands Springer.Xxiv ISBN 1-4020-3994-8
Izac,A. I. N. (2003) Economic aspects of soil fertility Management and Agro forestry practices Scroth. G, and F.L. Sinclair 2003 eds. Trees, crops and soil fertility . CAB international Pp, 13-37 Ingham, E.L. soil Biology Primer, Chapter 3-chapter 6
Lombin, IG; Adepetu, I.A and 16 Ayotade, A (1991), Complementary use of organic manures and inorganic fertilizer in arable production, proceedings of National Organic Fertilizer Seminar Held at Durbar Hotel, Kaduna, Nigeria pg 146.
McCarthy, David F. (1982) Essentials of soil mechanics and foundation:Basic Geotechnies (2^{nd} ed,). Reston, Virginia: Reston publishing ISBN 9780835917810.
Melero, S., Porras, J.C.R., Herencia, J.F;. Madejon E (2005) chemical and biochemical properties in a silty loam soil under conventional and organic management soil Till. Res, 90, 162-170.
Rafiq, I.J..H.(2010) Understanding soil microbes and nutrient recycling in Ohio state University, Available from http://ohioline.esu.edu.
Retallack, G.J.(2008). Soil of the pas: An introduction to paleopedology (2^{nd} ed.) John Wiley & Sons. Pp. 207 ISBN 9780470698167.
Salako, F.K.(2008)Effect of tillage, mucuna pruiens and poultry manure on maize growth on physically degraded alfisols in Abeokuta, southwestern Nigeria journal of soil science, 18:10-21.
Sanchez, P.A. (2002). Soil fertility and hunger in Africa. Sci. 295:2019-2020
Smaling, E. M. A., Sims G. K., and M. M Wander, (2002) Proteolytic activity under nitrogen of sulfur limitation. Appl. Soil Ecol.568:1-5
Teller, B.S., Wander, M.M., Mercka, R., (2010). Predicting selinite absorption by soils using soil chemical Available from:www.ars.usda.govl…/p2160.edu.r
Voronery, R.P.(2006) the soil habitat. Soil microbiology, Ecology and Biochemistry, Eldor, A. paul (ed). 12-546807-5