INFLUENCE OF POULTRY DROPPINGS ON SOIL CHEMICAL PROPERTIES AND PERFORMANCE OF RICE (*Oriza Sativa* L.)IN SOKOTO,SUDAN SAVANNA ZONE OF NIGERIA.

Abstract

With proper management, poultry manure could be a sustainable source of fertilizer for increased rice production inSokoto. An experiment was conducted in a screen house at the botanical garden, biological science department of the Sokoto state polytechnic,to determine the influence of poultry dropping on some chemical properties of soil and performance of rice. The treatments consisted of three levels of poultry dropping: 2t, 5t and 10tha^{-1} and a control (0tha^{-1}). The experiment was laid in a completely randomize design (CRD) replicated three times. The resultrevealed that treatments have significant ($P<0.05$) effect on soil organic carbon, available phosphorus, exchangeable K, Na, Ca, Mg , CEC andrice performance in which application of 10 th^{-1} recorded the highest rice grains yield.This research therefore, concluded that application of poultry dropping is an important means of replenishing nutrients in the soil and that, application of 10 th^{-1} can produces the best growth and yield of rice in the study area.

Key words; Poultry Droppings, Levels, Soil and Rice

INTRODUCTION

Soil in the savanna region of Nigeria is relatively low in nutrients and organic matter content (Usman*et al.,* 2007).Furthermore, the soil of the Savanna is prone to degradation by wind that may also result in nutrient depletion (Ogunwole*et al.,* 2005; a and Ogunwole, 2007). Replenishment of nutrients and enhanced quality of tropical soils could be achieved through the addition of inorganic fertilizers, organic manures or both (Shangakkara*et al.,* 2004). However, the use of inorganic fertilizers alone is incapable of tackling the problem because, it fails to redress the problem of physical fragility and has yielded limited success in Africa (Obi and Ofoduru, 1997). Many small scale farmers in Nigeria have limited access to inorganic fertilizers due to high cost and unavailability during the growing season (Sobulo and Osiname, 1985). But,the Impact of the organic material as fertilizer has been seen overtime in providing growth regulating substances and improves the physical, chemical and microbial properties of the soil Belay *et al.*, (2001).Besides fertilizing crops, manures also supply other essential plant nutrients and serve as a soil amendment by adding organic matter, which helps improve the soil's moisture and nutrient retention. Organic matter persistence will vary with temperature, drainage, rainfall, and other environmental factor Michael et al, 2013).Organic manure application on the farm has yielded good response of crops and residual effect on soils. Agboola and

Obatolu (1989), Lombin*et al.,* (1991), Ojeniyi and Adeniyan (1999), and Kwari (2003) have all demonstrated the use of organic manure as a sound strategy for maintaining soil fertility.

There are different types of manure including cow dung, poultry manure, compost, green manure etc. Poultry manure had been reported to improve growth and yield of maize (Ezeibekwe et al., 2009). It also improves the chemical and biological qualities of the soil which increases crop productivity than chemical fertilizers (Obi and Ebo, 1995).

Rice belongs to the grass family poaceae from the genus Oryzaof which two species are cultivated *Oryza sativa* and *Oryzaglaberima*. It is normally grown as annual plant, in the tropical area; it can survive as a perenial and can produce a ratoon crop for up to 30 years (IRRI, 2008).Rice is the staple food of over half of the world population. It is predominately dietary energy source for 17 countries in Asia and the pacific, 9 countries in North and South America and 8 countries in Africa. Rice provides 20% of the world dietary energy supply, while wheat supply 19 and maize supply 5% (FAO, 2004). In Nigeria, rice is a major cereal crop and is consumed by over 120 million population of the country(EIARD, 2013). Rice respond well to N.P.K fertilizer at the rate of 120:40:40kg/ha (short duration), 150:50:60kg/ha (medium duration), 150:50:80kg/ha for long duration (Ezui et al., 2008).

This study was aimed to determine the influence of poultry manure on soil chemical properties and performance of rice in Sokoto,Sudan Savanna agro-ecological zone of Nigeria

MATERIAL AND METHOD

The pot experiment was conducted during the 2012/2013 dry season in a screen house at the Botanical Garden of the Biological Science Department, Sokoto State Polytechnic,Sokoto. Sokoto falls in the Sudan Savannah agro-ecological zone of Nigeria that is characterized by erratic and scanty rainfall that last for about four months (mid June - September) and dry period (October - May). The annual rainfall of the area is highly variable over the years and averages around 700mm (Rao, 1983)

Treatment consisted of three levels of poultry manure: 2t, 5t and 10tha^{-1} corresponding to 7.5g, 18.75g and 37.5 g in 7.5kg of soil per pot respectively and a control (0tha^{-1}). An improved rice Variety (Faro$_{44}$) was planted as a test crop. The experiment was laid in completely randomized design (CRD) replicated three times.The poultry dropping was mixed evenly with soil and watered to field capacity and allow for a period of one week before planting. The soil was analysed before and after the experiment for pH, organic C,total nitrogen,available phosphorus,CEC and exchangeable bases contents using 1:1 soil-water ratio using a glass electrode pHmeter, modified Walkley-Black method as described by Nelson and Sommer (1982), Bray's no. 1 method as

described by Bray and Kurtz (1945), Kjeldahl digestion and distillation procedure as described in soil laboratory staff (1984), 1.0N neutral ammonium acetate (NH_4OAC) solution respectively. Data were collected on growth parameters, such as plant height, number of leaves per plant, number of tillers at 2 weeks interval and for yield at harvest. The data was subjected to analysis of variance (ANOVA). Significant difference in the treatments means was further seprated using least significant difference (LSD)

RESULT AND DISCUSSION

Table 1: Initial Soil and Poultry Dropping Analysis

SoilParameters	Value
pH (H_2O) 1:1	7.01
Organic Carbon (%)	2.87
Total Nitrogen (%)	0.09
Available phosphorous ($mgkg^{-1}$)	0.99
Cation exchange capacity (CEC)($Cmol\ kg^{-1}$)	9.42
Exchangeable bases ($Cmol\ kg^{-1}$)	
Calcium (Ca^{2+})	1.35
Magnesium (Mg^{2+})	0.55
Potassium (K^{+})	0.31
Sodium (Na^{+})	0.96
Sand (%)(9.0)	
Silt (%)	(5.0)
Clay (%)	(86.0)
Texture	Clay
Poultry Dropping	
Total nitrogen (%)	0.64
Available phosphorous ($mgkg^{-1}$)	1.68
Potassium ($Cmolkg^{-1}$)	0.54

Result for the initial soil properties is presented in Table 1. The result indicated that organic carbon content of the soil was high while, total nitrogen, and available phosphorus of the soil was very low (table 1). Exchangeable potassium and sodium were high while magnesium was moderate. Cation exchange capacity was moderate and exchangeable cassium was low according to the rating ofEsu (1991).

Table 2: Influence of Poultry Manure on Chemical Properties of Soil

Exchangeable bases

Treatment	pH	OC	TN	AP	Ca	Mg	K	Na	CEC
		%		mg/kg	Cmol(+)kg^{-1}				
0	7.08	1.84c	0.08	0.41d	1.23c	0.56b	0.35b	0.55b	4.25b
2	7.15	2.49b	0.09	0.46c	1.44b	0.76a	0.56a	0.62b	4.70b
5	7.25	2.71ab	0.10	0.51b	1.65a	0.75a	0.55a	0.58b	5.45a
10	7.26	2.82a	0.12	0.57a	1.77a	0.84a	0.57a	0.75a	5.27a
SE	0.21	0.09	0.04	0.01	0.04	0.03	0.02	0.02	0.13
SIG.	NS	*	NS	*	*	*	*	*	*

Means followed by same letter (s)within the same raw are not significantly different at 5% level of probability.
NS=not significant.
*= significant at 5% level.

Influence of poultry dropping on chemical properties of soil is presented in Table 3. The result indicated that treatments had significant (P<0.05) effect on all the considered chemical parameters of the soil except on pH and total nitrogen. However, increased in pH was recorded due to treatments application as compare to the initial values with the highest increased due to application of 10th^{-1} , even where the significant difference was recorded among treatments, application of 10tha^{-1}also gave the highest value of organic carbon, available phosphorous, exchangeable bases and cations exchange capacity of the soil at (2.82%, 0.57mg/kg, 1.77, 0.84, 0.57, 0.75 and 5.27Cmol(+)kg^{-1}) respectively. The least values were obtained in pot where no poultry dropping was applied(control). This could be attributed to the influence of poultry dropping on soil fertility as it decomposed and mineralized, resulting to animprovement in the soil condition and microbial activities. The result of this findings was similarly reported by (Balasubramanian and Singh, 1978) and (Wild, 1988) that, application of farm yard manure increased the availability of phosphorous in soil solution and reduced phosphorous adsorption in an experiment conducted on an Ultisol in Nigeria. Pierre and Morrean (1986) observed that the addition of farm yard manure combined with mulch had enhanced the physical properties of a soil. The authors reported that moisture retention, water infiltration and cation exchange capacity in the soil have improved following the application of organic matter (3 and 4 tons ha^{-1}) on a farmland. Poultry manure application is known to improve SOM and micro nutrient status and micro-nutrient qualities of the soil (Maerere*et al*, 2001:

Adeniyan and Ojeniyi, 2003).Adesodun*et al.,* (2005).Has found that application of poultry manure to soil increased soil organic matter, N and P and aggregate stability.

Table 3: Influence of Poultry Manure on Growth Performance of Rice at 16WAP and Yield

Treatment	Plant Height (cm)	No. of Leaves/plant	No. of Tillers/plant	Stalk (g/pot)	GrainYield (g/pot)
0	35.94b	30.11c	8.50c	28.32b	3.20b
2	38.91ab	32.47bc	8.67c	32.55ab	4.35ab
5	46.99a	33.58b	10.17b	33.93ab	5.20ab
10	40.14ab	52.25a	15.59a	38.67a	6.32a
SE	1.58	1.88	0.63	1.10	0.30
SIG.	*	*	*	*	*

Means followed by same letter (s) are not significantly different at 5% level.
* significant at 5% level.

The effect of different levels of poultry droppingon growth and yield parameters of rice is presented in Table 3. The result showed that, levels of poultry dropping had significant effect ($p<0.05$) on plant height, number of leaves and number of tillers per plant.

Plant Height

Application of5tha^{-1}poultry dropping gave the highest (46.99cm)plantheight at 16WAP. However, this was statistically similar with application of 10 and 2th^{-1},while the lowest plant height (35.94cm) was recorded in pots where no poultry dropping was applied (control). This could be due the availability of the required nutrients by the plant throughout the growing period as stated by Farhad et al., (2009) that, the increase in plant height with poultry manure(PM) was mainly due to the reason of more availability of nutrients by PM throughout the growing season. These results are in accordance with the findings of Mitchell and Tu (2005) and Warren et al. (2006)

This result is compatible with the report of Ogatolu and Ibireino (1999), and Opara – Nadi*et al.,* (2000) on increase in the height of maize treated with organic fertilizer. This indicates the significance of organic manure on this very important growth parameter of plant. Furthermore, Awotundun*et al.,* (2000) observed a similar increase in height of maize plant that had cow dung application. Also the report is in agreement with the results of Kwari (2003) who observed that the height of millet increased when 7.5 t ha^{-1} cattle manure was added to soil relative the control plots. The positive influence of organic manure on plant height is also consistent with the report of Arunah*et al.,* (2007) who had also observe that, the height of two sorghum varieties had significantly increased due to amendment of soil with quantities of organic materials that was applied at 2 – 4 t ha^{-1} in Zaria.

Number of Leaves and Tillers

Application of poultry dropping at $10th^{-1}$recorded the maximum number of leaves and tillers per rice plant at 16WAP (52.25 and 15.59 respectively). While the minimum number of leaves and tillers were obtained from plants in control (30.11 and 8.50 respectively). This could also be attributed to the availability of the required plant nutrients in that treatment which help in promoting the vegetative growth of the plant.This is in line with the finding of Akanni (2005) that, manure application improved organic matter, N, P and exchangeable cation concentration of soil that could benefit growing crops. In a similar way, Agbede*et al* (2008) reported that application of 7.5t/ha poultry manure increase growth parameter (plant height, stem girth, leaf area) of Sorghum in south west Nigeria.

Stalk and Grain Yield

Effect of levels of poultry dropping on stalk and grain yield of rice is presented in Table 3. The result indicated that, treatment had significant effect ($p<0.05$) on stalk and grain yield.Application of $10th^{-1}$ recorded the highest stalk and grain yield. This was similarlyreported by arhad et al., 2009 hat, grain yield was significantly affected by the application of different levels of PM. These results are in accordance with the findings of Boateng et al. (2006) and Deksissa et al. (2008) that poultry manure significantly increased the grain yield.

Conclusion

This research revealed that application of different levels of poultry dropping to soils under rice production have significant effect on soil organic carbon content, CEC, available phosphorus content, some exchangeable bases and rice productivity. Also that, application $10th^{-1}$gave the best rice yield which is therefore, recommended for farmers in the study area.

References

Adeniyan, O.N. and Ojeniyi, S.O. (2003).Comparative effectiveness of different levels of poultry manure with NPK fertilizer on residual soil fertility nutrient uptake and yield of maize.*Moor Journal of Agricultural Research,* 4:191-197.

Adesodun, J. K., Mbagwu, J. S. C., Oti, N. (2005). Distribution of Carbon, Nitrogen and Phosphorus in Water Stable Aggregates of an Organic Waste Amended Ultisol in Southern Nigeria.Bioresource technology.96:509 – 916.

Agbede, T.M., Ojeniyi, S.O. and Adeyemo, A.J. (2008).Effect of poultry manure on soil physical and chemical properties, growth and grain yield of sorghum in southwest, Nigeria.*American-Eurasian Journal of Sustainable Agriculture,* 2(1):72-77.

Agboola, A. A. and Obatolu, C. R.(1989). Problems and Prospects of Maintaining Continuous Arable Crops Production in the Humid Tropics Through Soil Organic Matter.Proceedings of International Symposium UNSECO, UNDP, ICSU.Yamoussoukro pp. 641-653.

Akanni, D.I. (2005). Response of Nutrient Composition and Yield Components of Tomato (*Lycopersiconesculentum*) to Livestock Manure.Ph.D. Thesis, Department of Crop, Soil and Pest Management, Federal University of Technology, Akure.Pp. 120.

Aruna, U.L., Chiezey, U.F. and Aliyu, L. (2007). Effect of Nitrogen Fertilizer and Poultry Manure on Growth Attributes of Two Sorghum Varieties. In: Uyovbisere, E.O., Raji, B.A., Yusuf,

A.A., Ogunwole, J.O., Aliyu, L. and Ojiniyi, S.O. (eds.) soil and water management for poverty alleviation and sustainable environment. Proceedings of the 31st Annual Conference of Soil Science Society of Nigeria, held at Ahmadu Bello University, Samaru Zaria. Nov. 13th – 17th, 2006. Pp. 299 – 304.

Awotundun, J.S., Okuntade, A.O. and Oyinloye, R. (2000). Comparative Effects of Organic and Inorganic Fertilizers on the Yield of an Open Pollinated Maize. In: Babalola O.A., Ogunkunle, A.O., Olayinka A., Fagbemi, A.A., Agboola, A.A., Ewenzor, W.O. (ed.) proceedings of the 26th Annual Conference of the Soil Science Society of Nigeria, held at Ibadan Oyo State Oct., 30th to Nov., 3rd 2000. Pp. 136 – 139.

Balasubramania, V. Singh (1978).Organic Recycling in Asian Small Holder Farms in Semiarid Eastern Kenya. *Experimental Agricultural* 31: 371-381.

Belay, A. Classen, A.S., Wehner, F.C. and Bee, J.M. (2001). Influence or residual manure on selected nutrient elements and microbial composition of soil under crop rotation. *South African Journal of Plant and Soil*, 18:1-6.

Boateng, S. Zickerman, A. J. and Kornaharen (2006).Effect of Poultry Manure on Growth and Yield of Maize.West Afric J. App. Eco.9:1 – 11.

Bray, R. H.,Kurth, L. T. (1945).Determination of Total Organic Matter and Available Forms of Phosphorous in Soils. Soil Sci: 39-45.

Deksissa T., I. Short and J. Allen (2008). Effect of soil amendment with compost on growth and water use efficiency of Amaranth. In: Proceedings of the UCOWR/NIWR annual conference: International water resources: challenges for the 21st century and water resources education, July 22 – 24, 2008, Durham, NC.

EIARD,(European Initiative on Agricultural Research for Development) (2013).Improving smallholder incomes through intensification of upland rice.Published 2013.

Esu, I.E. (1991). Detailed soil survey of Nigerian institute for agricultural research farm at Bunkure, Kano state, Nigeria. p.72.

Ezeibekwe I.O. Ogbonnaya C.I. and Onuoha,C.I. (,2009).

ComparativeEffectofPoultrymanureandUreaon the Growth andYield of Maize ( ).Report and

Opinion, (4) http://www.sciencepub.net/ report.

Ezui, K.S., Daudu,C.K.,Mando,A. Kudi,M.T.,Odunze,A.C.,Adeosun,J.O.,Amapu,I.Y.,Tarfa,B., Bello,I. and Dangbegnon,C. (2010) *Informed Site Specific Fertilizer Recommendations for Upland Rice in Northern Guinea Savannah of Nigeria*. Paper submitted for presentation at the Second Africa Rice Congress, Bamako, Mali, 22-26 March 2010.

FAO (2004). Rice is Life Food and Agricultural Organization of The United Nationals. 2004

Farhad .W, M. F. Saleem, M. A. Cheema and H. M. Hammad (2009) Effect of poultry manure levels on the productivity of spring maize (*Zea mays* L.) The journal of Animal and plant science 19(3); 2009 Pp 122-125

IRRI,(International Rice Research Institute) 2014. Rice Statistics.Accessed Online at http://oryza.com/africa/nigeria/index.shtml on 27th march, 2014.

Kwari, J. D. (2003). Growth and Yield of Millet after four years of Application of Cattle Manure, Millet Residue and Green Manure in Sandy Loam Soils of Maiduguri, Nigeria. In: Ojeniyi, S. O; .Ano, A. O. Awasalam, D. O. and Chukwu, G. O. (Ed.). Land Degradation, Agricultural Productivity and Rural Poverty Implications. Proceedings of the 28th Annual Conference of the soil Science Society of Nigeria, held at the National Root Crops Research Institute, Umudike, Abia State. Nov. 4th – 7th 2003. P.45-57.

Lombin, L. G. Adepetu, J. A. andAyoyatade, K.A. (1991). Complementary Use of Organic and Inorganic Fertilizers. In: Proceedings of National Organic Fertilizers Seminar, Kaduna pp. 146-162.

Maerere, A.P., Kimbi, G.G., Nonga D.L.M. (2001). Comparative Effectiveness of Animal Manures on Soil Chemical Properties Yield and Root Growth of Amaranthus*(Amaranthuscruentus L.)*

Mitchell, C. C and S. Tu (2005).Long term evaluation of poultry litter as a source of nitrogen for cotton and corn.Agron. J. 97: 399-407.

Nelson, D. W. And L. E. Sommers (1982).Total carbon, organic carbon and organic matter. In: A. L. Page, R. H. Miller and D. R. Keeney (eds). Methods of soil analysis.Part 2.Agronomy 9, (2nd edn).PP. 539-579. American Society of agronomy, Madison, U.S.A.

Obi M. E. and Ebo P. O. ,1995. The effects of different application rates of organic and inorgan-in fertilizers on soil physical properties and maize production in a severely degraded ultisol in southern Nigeria. (2-3): 117-123.

Obi, M. E. and Ofoduru, C. O. (1997).Effect of soil amendments on the physical properties of a severely degraded loamy soils in southeastern Nigeria, In: B. R annual conference of the Soil Science of Nigeria held at the UsmanuDanfodiyo University Sokoto, 2nd - 5th March 1997. Pp. 65-74.

Ogunwole, J. O.; Atabo, J. O. Taro, D. T. Lawal, A. B. and Alabi, S. O. (2005). Effect of cow dung and poultry litter on soil amendment and extraction of garlic and pepper as insecticide on cotton production in the Nigerian savanna, *Journal of Agronomy* 4 (4): 267-272.

Ojeniyi, S. O and Adeniyan, N. O. (1999). Effect of poultry manure and NPK fertilizer on soil fertility, nutrient content and yield of maize at Akure, Southwestern soil resources of Nigeria

for sustainable agricultural production in the 21stNigeria, held at Benin, 21st-25th Nov. 1999. pp.185-191.

Opera-Nadi, O. A. Omenihu, A. A. and Ifemedebe, S. N. (2000).Effect of Organic Waste, Fertilizers and Mulch on Productivity of an Ultisol. In: Babalola, O.; Ogunkunle, A. O. Olayinka, O. Fagbami, A. Agboola, A. A. and Ewenzor, W. O. (Ed.). Proceedings of the 26th*Annual Conference of Soil Science Society of Nigeria* held at Ibadan Oyo state Nigeria, October 3oth- Nov, 3rd 2000. Oyo State.pp.112-120.

Pierra, C. and Morrean, R. (1997).Soil Fertility and Fertilization of Tropical Crops.John Wiley and Sons, New York 415 p.

Rao, N.N.P. (1983). Preliminary result of the study on Agro-Climatology of Sokoto State. A seminar paper presented at Faculty of Agriculture, University of Sokoto.

Shangakkara, W. R. M.; Liedgens, A. Soldall, A. and Stamp, P. (2004). Root and shoot growth of maize (*Zea mays L.*) as affected by incorporation of *Crotalaria juntia* and *Tithoniadiversifolia* as green manure. *Journal of Agronomy and Crop Science,* 190:139-146.

Sobulo, R. A. and Osiname, O. A. (1985).Fertilizer use in the Tropics, Nigerian Experience. In: Sobulo, R. A. and Udo, E. J. (Ed.). Soil fertility tilth and degradation in the tropics.231 pp.

Soils Laboratory Staff. Royal Tropical Institute (1984). Analytical methods of the service laboratory for soil, plant and water analysis. Part 1: Method of soil analysis. Royal tropical Institute. Amsterdam.

Usman, A., Osunde, O. A. Bala, A. and Ezenwa, M.I.S. (2007). Carbon and Nitrogen Mineralization of Some Selected Legume Species. In: Oyivbisere E. O., Raji, B. A. Yusuf, A. A. Ogunwole, O. Aliyu, L. and Ojeniyi, S. O. (Ed.). Soil and water management for poverty alleviation and sustainable environment. Proceedings of the 31st*Annual Conference of the Soil Science Society of Nigeria*, held at Ahmadu Bello Univeristy, Samaru Zaria Nov 13th-17th 2006. pp. 489-495.

Warren J. G., S. B. Phillips, G. L. Mullins, D. Keahey and C. J. Penn (2006). Environmental and production consequences of using alum- amended poultry litter as a nutrient source for corn. J. Environ. Qual., 35: 172-182.