Original Research Article

Soil Quality Assessment and Agricultural Impact of Swine Waste Open Disposal

Abstract.

Agricultural impact of swine waste open disposal in Ubakala area of Abia State were evaluated. Results indicates an increase in soil temperature with increasing soil depth while soil pH was observed to be slightly acidic. Increased soil nutrients, soil enzymes were recorded from the study. This findings suggest that even the swine dumpsite may be good for agricultural purposes but adequate treatment measures should be taken prior to its application as fertilizer.

Keywords. Swine waste, assessment,soil quality, agricultural

Introduction

Pig production generates large amounts of organic wastes that are often times discharged into surrounding agricultural sites presenting serious disposal and agricultural challenges. Oriola and Hammed [1] posited that animal excreta is a valuable plant nutrient resource that can improve soil fertility, soil productivity and soil quality. These disposals may increase microbial activity, soil pH and potentially mineralizable nitrogen that may build up in the soil resulting in plant toxicity and affect soil productivity. The present work is therefore designed to evaluate agricultural functinality of swine waste disposal.

Metarial and Method

Analytical procedures

Soil temperature was determined at the site of soil samples collection using mercury in glass thermometer [2]. The soil pH was determined by the method of Bates [3] using air dried soil sample while soil moisture content was determined according to the method described by APHA [2]. Cation exchange capacity was evaluated by the method of Dewis and Freitas [4] while soil organic carbon/organic matter of the samples were determined according to the method outlined by Walkely and Black [5] and soil electrical conductivity was determined using digital electrical conductivity meter according to the method described by Whitney [6].Soil Urease activity was determined according to Nanniperi *et al.,* [7] and Kandaler and Gerber [8].The soil dehydrogenase was determined by the method described by Casida *et al.*

[9] as modified by Naranjo *et al*. [10]. Acid Phosphatase Activities were determined according to Tabatabai [11] while soil hydrogen peroxidise was determined using titration method according to Alef and Nannipieri [12].

Study sites.

The research was carried out using pigry sites and wastes in Ubakala, Umuahia, Abia State

Fig. I Pigrey farm at Ubakala, Umuahia Abia Stat

Fig II. Swine waste dumpsite at Ubakala, Umuahia Abia State

Results

Table 1: Physicochemical Characteristics of Soil Samples From Swine Dumpsite Soils

Group	Temperature (^{O}C)	pH	E.C. (µs/cm)	Organic Matter (%)	Moisture (%)	C.E.C. (cmol/kg)
Control	28.00±0.08^{a}	4.51±0.01^{a}	12.10±0.63^{a}	78.86±0.41^{a}	30.90±0.01^{a}	40.24±0.02^{a}
Centre	25.40±0.10^{a}	4.98±0.03^{a}	10.71±0.78^{a}	80.15±0.83^{a}	21.50±0.09^{a}	48.19±0.01^{a}
North$_1$	27.00±0.46^{b}	5.02±0.33^{b}	17.68±0.08^{b}	13.37±18.83^{b}	45.88±0.02^{b}	18.13±0.01^{b}
North$_2$	26.00±0.15^{c}	5.12±0.07^{b}	13.13±0.03^{c}	19.93±17.19^{c}	49.65±0.04^{c}	24.29±0.03^{c}
South$_1$	27.50±0.05^{f}	5.14±0.04^{n}	18.82±0.02^{f}	28.89±4.64^{f}	20.88±0.02^{f}	23.43±0.05^{f}
South $_2$	26.30±0.02^{g}	5.19±0.01^{e}	17.41±0.08^{g}	31.55±0.05^{g}	31.58±0.01^{g}	27.32±0.10^{g}
East$_1$	27.20±0.02^{j}	4.50±0.02^{g}	16.70±57.73^{j}	1.34±o.01^{k}	41.20±0.04^{j}	20.75±0.05^{j}
East$_2$	26.80±0.05^{k}	5.10±0.00^{k}	12.27±0.02^{k}	19.21±1.06^{k}	45.31±0.02^{k}	22.82±0.12^{k}
West$_1$	27.50±0.05^{n}	4.70±0.02^{j}	11.02±57.75^{n}	15.58±0.35^{n}	45.60±0.20^{n}	38.19±0.02^{n}
West$_2$	27.00±1.11^{p}	4.60±0.01^{p}	14.72±57.70^{p}	15.78±0.4^{p}	49.45±0.05^{p}	39.68±0.05^{p}

Results are mean of triplicate determination ± standard deviation. E.C =electrical conductivity, C.E.C =Cation Exchange Capacity.North$_1$,South$_1$, East$_1$ and West$_1$= Top soil (0-20cm depth).North$_2$, South$_2$, East$_2$ and West$_2$ =Bottom soil (21-30cm soil depth). Values in the same colum having different alphabets are significantly different(P≤0.05)

Table 2 : Level of Soil Enzymes in Swine Dumpsite Soils

Group	Urease ($mgNH_3Ng^{-1}drysoil2h^{-1}$)	ALP (mg/h)	Acid Phospatase (mg/g/h)	Hydrogen Peroxidase ($m10.0mlKMnO_4g^{-1}$)	Dehydrogenase ($mgTpFg^{-1}drysoil6h^{-1}(x10^{-5})$)
Control	31.20±0.08^{a}	7.81±0.01^{a}	9.23±0.97^{a}	2.17±0.05^{a}	11.62±0.09^{a}
Centre	30.92±0.02^{a}	7.10±0.01^{a}	9.80±0.01^{a}	2.09±0.01^{a}	11.58±0.09^{a}
$North_1$	9.30±0.20^{b}	4.15±0.10^{b}	6.10±0.10^{b}	0.46±0.13^{b}	3.13±0.06^{b}
$North_2$	9.47±0.11^{c}	4.88±0.08^{c}	6.76±0.10^{c}	0.59±0.09^{c}	3.21±0.11^{c}
$South_1$	8.83±0.08^{f}	1.98±0.18^{f}	7.01±0.10^{f}	0.44±0.08^{f}	5.29±0.16^{f}
$South_2$	8.95±0.05^{g}	2.00±0.10^{g}	7.11±0.09^{g}	0.50±0.10^{g}	5.01±0.00^{g}
$East_1$	6.99±0.06^{j}	4.01±0.09^{j}	9.15±0.09^{j}	0.56±0.14^{j}	3.90±0.55^{j}
$East_2$	6.15±0.08^{k}	4.56±0.00^{k}	9.70±0.12^{k}	1.02±0.10^{k}	3.76±0.14^{k}
$West_1$	4.13±0.11^{n}	5.03±0.10^{n}	4.79±0.00^{o}	0.77±0.14^{n}	5.10±0.17^{m}
$West_2$	4.79±0.09^{p}	5.14±0.08^{p}	5.12±0.09^{p}	0.48±0.02^{p}	5.23±0.05^{p}

Results are mean of triplicate determination ± standard deviation. E.C =electrical conductivity, C.E.C =Cation Exchange Capacity.$North_1$,$South_1$, $East_1$ and $West_1$= Top soil (0-20cm depth).$North_2$, $South_2$, $East_2$ and $West_2$ =Bottom soil (21-30cm soil depth). Values in the same Colum having the different alphabet are significantly different

Discussion

Animal wastes are valuable sources of manure for agricultural functionality of soils. Soil temperature plays pivotal role in most biological interactions and chemical reactions that occur in soil which changes with climatic conditions[13].The increase in soil temperature with increasing soil depth as observed from the study may have resulted from long term accumulation of degradable swine waste in the soil. This findings is in accordance with the report of Akubugwo *et al.* [14].Soil pH which is a variable that affects soil biotransformation and mineralization as well as microbial activities. The slight low (acidic pH) observed from the study may have resulted as a result of swine waste dumping in the study area as well as increased dumping of urine contaminated waste following the metabolism of ammonia. Similar findings was observed by Chinyere *et al*.[15] who posited low acidic pH in cattle waste contaminated soil. Percentage moisture content is directly proportional to water retaining capacity of soil. Results obtained from this study varied with soil depth relative to control. This could be as a result of the overall topographical predisposition of the study area. Nwaugo *et al.* [16] posited that soil moisture varies widely with increasing soil depth and has been reported to stimulate plant productivity and microbial driven chemical processes in soils. Soil organic matter is often considered the fertility index of soil and is correlated to numerous factors influencing agricultural functionality and sustainability of soils [17]. Organic carbon/matter contents of soil are the reservoirs of essential nutrients for plant growth and development. Anikwe and Nwobodo,[17] opined that high organic carbon/matter is directly related to high soil productivity. The increase in soil organic matter recorded from this study may be due to regular dumping and degradation of swine wastes. Cation exchange capacity (CEC) is the capacity to which soil can absorb and exchange cations. These activities have been reported to give the soil a buffering capacity which may slow down the leaching of nutrients [18]. Finding from this study implies that the soil may be fertile enough to support plant growth as high level of cation exchange capacity have been shown to inhibit the leaching of essential nutrients. The slight increase in electrical conductivity may have resulted from the predisposition of the area under study as well as the natural weathering of rocks. Soil enzymes catalyze chemical reactions necessary for life processes of micro-organisms in soils, decomposition of organic residues, cycling of nutrients and formation of organic matter and soil structure [19]. Although enzymes are primarily of microbial origin, it can also originate from plants and animal sources. These enzymes are constantly being synthesized, accumulated, inactivated and or decomposed in the soil. The measurement of soil enzymes can be used as an indicator of the biological activities or biochemical process taking place in the soil. Soil enzymes help in the biochemical transformations of pollutants in the soil and also function as a measure of soil fertility. Results indicate an increase in level of soil enzymes relative to control. This could have resulted from the accumulation of organic waste due to increased dumping of swine waste.

CONCLUSION

Findings from this study show that high concentration of organic matter as well as chemical element may profile the suitability of this soil for agricultural purposes. However the low acidic pH observed is an indication that adequate treatment and application measures should be taken before usage of these swine waste as fertilizer.

References.

1.Oriola EO, Hammed AT (2012). The influence of cattle wastes on degraded savanna soils of Kwara State Nigeria. Ethiopian Journal of Environmental Studies and Management 5(3):268-275.

2. APHA (1998) Standard methods for examination of water works and waste water. American public Health Association, American water works Association and water pollution control federation, 20th edition, Washington DC, USA.

3. Bates RG (1954). Electronic pH determination. John Wiley and Sons Inc. New York.

4.Dewis J, Freitas F (1970). Physical and chemical methods of soil and water analysis. Soil Bulletin

5. Walkely A.J and Black I.A.,(1934).Estimation of soil organic carbon by the chronic acid titration method.Soil Science 37:29-38.

6. Whitney DA (1998). Soil salinity. (in JR. Brown Ed.). Recommended chemical soil test procedures for the North Central Region. North central research publications. No 221 (Revised) Missiouri Agricultural Experiment Station and SB wool 1001:59-60.

7. Nannipieri, P. B., Creccante, A., Cerlli, S. and Matarresse, E. (1980).Extraction of phosphates, urease, protease organic carbon and nitrogen from soil. American Journal of Soil Science. 44: 1011 – 1016

8. Kandeler E., Tscherko D and Bruce K D (2000). Structure and function of the soil microbial community in microhabitats of a heavy metal polluted soil. Journal of Bio Fertility of Soils 32: 390– 400

9. Casida, L. E., Klevin, J. D., and Sntoro, D. (1964).Soil Dehydrogenases Activity. *Soil Science* 98:371–374.

10. Naranjo N.M.,Meima J.A.,Haarstrick A and Hempel D.C (2004).Modelling and experimental

investigation of environmental influence on the acetate and methan formation in solid waste.Waste Management 24: 763-773

11. Tabatabai MA (1982). Soil enzymes. In: page Al, methods of soil analysis, part 2.

12. Alef K, Namiperi P (1995). Methods in applied soil Microbiology and Biochemistry. 3rd edition. Academic Press, London. 345-353.

13. Oluyemi E.A., Feuyit G., Onekunle J.A.O and Ogunfowokan A.O(2008). Seasonal variation in heavy metal concentration in soil and some selected crops at a landfill in Nigeria. African Journal of Environmental Science and Technology 2(5): 89-96

14. Akubugwo,E.I., Gloria Chikaodi O, Chinyere G. C An Ugbogu, E.A (2009). Physicochemical properties and enzymes activity studies in a refined oil contaminated soil in Isiukwuato, Abia State, Nigeria *Biokemistri,* 29(2) 79-84

15. Chinyere G.C., Osuocha K.U., Imo C (2015).Influence of Lokpa cattle market waste on agricultural soil quality. *African Journal of Environmental Science and Technology*, **9(**5):390-395.

16. Nwaugo VO, Etok CA, Obiekezie SO, Chinyere GC (2008). Evaluation of the effect of Okigwe cattle market wastes on the surrounding agricultural soil parameters. *Bio-Research*. 6(11):367-370

17. Anikwe M.A.N and Nwaobodo, K.C. A(2002). long term effect of municipal waste disposal on soil properties and productivity of sites used for urban agriculture in Abakaliki, Nigeria. *Bioresource Technology*, 83(3):241-50.

18. Obasi N A , Akubugwo E I , Kalu K M , Ugbogu A E and Okorie U C (2013). Toxicological assessment of various metals on selected edible leafy plants of Umuka and Ubahu dumpsites in Okigwe of Imo State, Nigeria*. Journal of Experimental Biology and Agricultural Sciences,* **1**(6):441-452.

19. Chinyere, G.C., Obisike, E.S., Ugbogu, A.E. and Osuocha, K.U.(2013). Studies on municipal solid wastes dumping on soil anions, cations and selected enzymes activities at njoku sawmill waste dumpsite, owerri municipal, Imo State, Nigeria. *Ethiopian Journal of Environmental Studies and Management,* 6:774-783

.