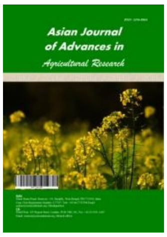

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Soil Quality Indices and Agricultural Impact of Swine Waste Open Disposal

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Authors' contributions

This work was carried out in collaboration among all authors. Author UKO designed the study, performed the statistical analysis while author ECC wrote the first draft of the manuscript and managed the literature search. All authors read and approved the final manuscript.

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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 swine dumps may not be good for agricultural purposes unless adequate treatment measures are taken prior to its application as fertilizer.

Keywords: Swine waste; assessment; soil quality; agricultural.

1. INTRODUCTION

Pig production generates large amounts of organic wastes that are often discharged into surrounding agricultural sites presenting serious environmental and agricultural challenges. Oriola and Hammed [1] posited that animal excreta are a valuable plant nutrient resource that can improve soil fertility, soil productivity and soil quality. These disposals may increase microbial

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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 designed to evaluate agricultural functinality of swine waste disposal.

1.1 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].

1.2 Study Sites

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

2. RESULTS AND DISCUSSION

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).

Fig. 1. I Pigrey farm at Ubakala, Umuahia Abia State

Fig. 2. Swine waste dumpsite at Ubakala, Umuahia Abia State

Table 1. Physicochemical characteristics of soil samples from swine dumpsite soils

Group	Temperature (°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}

Table 2. Level of soil enzymes in swine dumpsite soils

Group	Urease (mgNH$_3$Ng^{-1}drysoil2h^{-1})	ALP (mg/h)	Acid Phospatase (mg/g/h)	Hydrogen peroxidase (m10.0mlKMnO$_4$g^{-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.

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 from swine waste dumping in the study area as well as increased dumping of urine contaminated waste following the metabolism of ammonia. This could also explain the reason for scanty growth of grasses in the dumpsite as the pH obtained may not be conducive for plants to strive. 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.

3. 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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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