Journal of

Agriculture Policy

(JAP)

CARI Journals

Journal of Agricultural Policy

Vol. 3, Issue No. 2, pp 1 – 6, 2020

www.carijournals.org

EVALUATION OF VEGETABLE VERMICOMPOST ON THE CHEMICAL PROPERTIES OF TWO DIFFERENT SOILS

*Nweke, I. A. Chime, E. U., Ogugua U. O.

Department of Soil Science Chukwuemeka Odumegwu Ojukwu University

College of Agriculture and Environmental Science, University of South Africa

***Corresponding Author Email:** ikechukwunweke48@yahoo.com

Abstract

Vermicompst is a rich source of vitamins and growth hormones and contains most nutrients in plant available form. Ten adult earthworms (*Eudrilus eugeniae*) were cultured for three (3) months and three (3) weeks in sack made from old window mosquito net. The resultant product at harvest – vermicompost made of mostly worm casts was used to incubate sandy and clay soils respectively at the ratio of 50g: 300g for two (2) months and replicated five (5) times. The results of the study shows that the produced vermicompost enriched the two types of soil with favourable pH level, high content of P, Ca, Mg and OM. Available P, pH level, Ca, Mg and OM were significantly ($P < 0.05$) increased and varied among the treatments. Exch. K and microbial biomass (MB) result showed higher value in clay while sand recorded higher value in N, Na and exchangeable acidity (EA). The findings of this study are of evidence that vermicompost improved the fertility of the soils by releasing mineral elements in the forms that are available for uptake of crops. **Keywords**: *Earthworm, Eudrilus eugeniae, chemical properties, vermicompost*

Introduction

Vemicompost contain higher percentage of plant nutrients necessary for crop growth and yield in readily available forms. However, its nutritional value is dependent on its origin. Golchin et al. (2006) reported higher nutritional status in vermicompost made from animal manure compared with that derived from municipal waste. For example, Atiyeh et al. (2000abc) observed that the rate of germination, growth and flowering of a range of ornamental and vegetable seedlings were increased by vermicompost made from cattle and pig manure as well as food wastes compared with vermicompost from other sources. While Theunissen et al. (2010) and Quaik et al. (2012) found out that diluted vermiwash and vermicomposting lichate when used as nutrient were higher when compared with the control. Vermicompost have large particulate surface areas according to Shi - Wei and Fu – Zhen (1991) and Aalek et al (2008) this provides many micro sites for microbial activity and for the strong retention of nutrients. It is rich in vitamins and hormones that regulate plant growth, soil is generally considered fertile when it has good physical structure, adequate plant nutrients in readily available form and sufficient active microbial activity (Mader et al. (2002). The imbalance in any of the aforementioned parameters acts as a limiting factor that invariable affect plant growth. Prasad and Power (1997) noted that a fertile soil consists of 5070% mineral particles, 30 to 50% pore spaces containing water and air and 5 to 15% organic matter. Apart from H, CO_2 and O_2 sourced from atmosphere, plants assess every other nutrient from the soil. However, continuous cropping without adequate nutrients replenishment depletes the soil nutrient levels particularly N, P and Ca (Ndakideni and Semoka 2006). Sandy soils tend to be acidic and low in nutrients. These soils have quick water drainage and are easy to work with. They are quicker to warm up in dry season and suffer from low plant nutrients that are washed away by rainfall. The addition of OM can help give the plants an additional boost of nutrients by improving the nutrient and water holding capacity of the sandy soil. Clay soils are heavy soils, with high amount of water holding capacity. And in most cases, waterlog. Because these soils drain slowly and take longer time to warm up in dry season with OM addition the plasticity nature of the clay soils can be abridged increasing nutrient release ability. Thus, the objective of this study is to evaluate the effect of vegetable vermicompost on the chemical properties of two contrasting soil types.

Materials and Methods

Site location and description

This research work was conducted at Chukwuemeka Odumegwu Ojukwu University Igbariam Campus Anambra State which is located within the latitude5^{0}45 and 6^{0}45 north and longitude 6^{0}40 to 7^{0}20 east.

Collection of materials

Soil sample was collected from Chukwuemeka Odumegwu Ojukwu University Igbariam. The soil was collected using shovel at 15-20cm deep after scrapping off 0-5cm from two different areas in the Faculty of Agriculture premises. After the collection of the soil sample, dirty particles, stones and hard clods where carefully removed to ensure fine silt before measuring the soil. The soil was replicated into ten different polythene bags, 5clay and 5 sandy respectively of 300g of soil each. The soil was thoroughly mixed with vermicompost in the ratio of 50g:300g and incubated for two months the vermicompost used for the study was gotten from the non treated vegetable vermicompost (i.e. not mixed with animal manure). The chemical properties of the two contrasting soils before incubation are recorded in Table 1 and Table 2 respectively. At end of the study an aliquot of the sample was used to analyze for the chemical parameters of soil based on the principles of Black (1965). All data collected were subjected to T –Test analysis and LSD at 5% was used to compare the treatment means.

Results

The initial soil properties presented in Table 1 and Table 2 show that the tested properties of the two soils were of lower values. The soils are acidic and the pH of the soils was 5.45 for clay soil and 4.48 for sandy soil respectively. The available phosphorous (P) content of the soils was relatively high with a value of 32.60Mgkg^{-1} clay soil and 10.03 Mgkg^{-1} sandy soils respectively. The values of total nitrogen 0.14% (clay soil), 0.03% (sandy soil), organic carbon 0.49% (sandy soil), and exchangeable bases (Ca^{2+}, Mg^{2+}, K^+, and Na^+) of the soils were generally low. The organic matter (OM) and exchangeable acidity (EA) were 3.87%, 2.08cmol$^+$kg^{-1} and 0.84%, 0.72cmol$^+$kg^{-1} respectively for clay and sandy soils. The soils contain low level of major nutrient elements. Hence the soils used for the experiment is considered poor in these essential plant nutrient elements.

Table 1 Chemical properties of clay soil before incubation with vegetable vermicompost

PARAMETER	VALUE
pH H_2O	5.45
P mgkg^{-1}	32.60mgkg^{-1}
N	0.14%

www.carijournals.org

OC	2.24%
OM	3.87%
Ca	3.20cmolkg^{-1}
Mg	1.60cmolkg^{-1}
K	0.19cmolkg^{-1}
Na	0.23cmolkg^{-1}
EA	2.08cmolkg^{-1}
Microbial biomass	9.2x10^{4}cfuml^{-1}

Table 2 Properties of sandy soil before incubation with vegetable vermicompost

PARAMETERS	VALUE
pH H_2O	4.48
P	10.03mgkg^{-1}
N	0.03%
OC	0.49%
OM	0.84%
Ca	2.80 cmolkg^{-1}
Mg	1.20 cmolkg^{-1}
K	0.09 cmolkg^{-1}
Na	0.13 cmolkg^{-1}
EA	0.72 cmolkg^{-1}
Microbial biomass	2.5x10^{5}cfuml^{-1}

Table 3 and 4 shows the mean values of the chemical parameters of two contrasting soils as influenced by vegetable vermicompost. From the result the vermicompost increased the pH level of sandy soil to alkaline with a value of 9.69, while that of clay is slightly acidic. The value of available P recorded in sandy soil was higher compared to the value obtained from clay. For the N the nitrogen level of sandy soil was a little higher than the value of clay. The application of vermicompost increased OM content of clay to 4.77%. The Ca obtained in clay is higher compared to the sandy which is moderate. Vermicompost increased the Mg content of clay and moderate in sandy. The value of Na recorded in sandy soil is higher compared to the value obtained in clay soil. The application of vermicompost increased the value of exchangeable acidity (EA) of sandy soil visa-vies its content in initial (untreated) soil while the value of EA in clay soil were found to decrease visa vies the value in the initial soil (Table1). The microbial biomass in sandy soil was greatly enhanced compared to its value in Table 2.

Table 3 Effect of vegetable vermicompost on two contrasting soils

TREATMENT	pH	P	N	OM
	H_2O	mgkg^{-1}	%	%
SANDY	9.69	41.04	0.19	2.8
CLAY	6.56	35.44	0.18	4.77
LSD 0.05	0.49	5.4	NS	1.76

Table 4 Effect of vegetable vermicompost on two contrasting soils

TREATMENT	Ca	Mg	K	Na	EA	MB
←	cfuml^{-1}		→			cmolkg^{-1}
SANDY 5.26x10^5	30.24	7.48	0.15	0.27	0.88	
CLAY 6.27x10^4	38.64	11.60	0.17	0.23	0.72	
LSD0.05	5.82	NS	NS	NS	NS	NS

MB = microbial biomass

Discussion

Properties of clay and sandy soils at beginning of the study

The selected chemical properties analysed in relation to this work are indices for measuring soil productivity in relation to crop production. The studied soils are acidic in reaction according to the ratings of USDA-SCS (1974) and Chude et al. (2012) who considered soils of pH 4.8-5.1 to be strongly acidic in reaction. The organic matter value 0.84% of sandy soil was below the low value ratings of 1.7% by Defoer *et al*. (2000), and very much below the critical level of 3% specified by FAO (1983) suggesting that crop production cannot be sustained in this soil under continuous land use without appropriate soil amendment. The TN content of the two studied soils is below the critical value for soils of south eastern, Nigeria for crop production (FMANR 1990). These results indicate that the two soils were poor and deficient in the essential plant nutrient elements. The low values may have resulted from leaching activities. The exchangeable (Ca, Mg, K and Na) are below their critical levels USDA, (1986) indicated that the two soils is of low base status. These scenarios simply suggest that the studied soils will benefit immensely from the vermicompost application.

Effect of Vegetable Vermicompost on the Chemical Properties of the two soils

The use of vermicompost (VC) as a fertilizer source for soil fertility provided advantage; the VC applied improved soil fertility over the untreated soils in Table 1 and 2. Results from this study indicated that vermicompost enhanced soil fertility particularly for the sandy soil type. The vermicompost application to sandy soil increased the pH level to alkaline with a value of 9.69 while that of clay is slightly acidic of which are favourable pH that can promote the availability of plant nutrients. Mineralization is a chemical process by which chemical nutrients in organic compounds are oxidized into various forms such as organic acids, fulvic acids, humic acids, carbon iv oxides, humus etc. This promotes plant available nutrients, thus observed increase in P, N, OM, exchangeable bases (Ca, Mg, K and Na) in the treated soil types could be attributed to mineralization and mobilization activities of microorganisms in vermicompost and ultimate conversion of nutrients to plant available forms. The sandy soil treated with vermicompost amendments generally has high fertility content compared to the clay (Table 3 and 4). The influence of vermicompost on the soil types improves soil organic matter content hence allowing for greater water retention and aeration, especially in the sandy soil type. Vermicompost application affects soil type characteristics in this study and provided further evidence of vermicompost as a suitable alternative type fertilizer for sustainability of crop production activities. Therefore, the use of biofertilizer such as vermicompost can provide various benefits to soils while at the same time providing a fertility source for crops.

Conclusion

From the findings of the study it is clear in this experiment that vegetable vermicompost has significant effect on sandy and clay soils. It can be used as amendment on degraded soil. It generally increased the fertility status of the two contrasting soils. Since the use of vermicompost is environmentally safe, cheap and affordable, poor resource farmers are encouraged to use it in the production of crops. From the result of this study, it is recommended that in order to obtain maximum yield of crop and soil fertility vermicompost should be used.

Reference

Aalok A, Tripathi AK, Soni P. (2008). Vermicomposting: A better option for organic solid waste management J. Hum. Ecol. 24(1):59-64.

Atiyeh RM, Arancon NQ, Edwards CA, Metzger JD (2000a). Influence of earthworm processed pig manure on the growth and yield of green house tomatoes Bioresour. Technol. 75: 175-180.

Atiyeh RM, Edwards CA, Subler S, Metzger JD (2000b). Earthworm processed organic wastes as component of horticultural potting media for growing marigold and vegetable seedlings Compost Sci. Utili. 82: 115-226.

Atiyeh RM, Subler S, Bachman C, Edwards CA, Metzger JD (2000c). Effect of vermicomposts and composts on plant growth in horticulture container media and soil Pedobiologia 44: 579-590.

Black CA. (1965b). Method of soil analysis II chemical and microbiological properties. Am. Soc. Agron. Madison Wisconsin, 1572p.

Chude CC, Olayiwola SO, Daudu C, Ekeoma A. (2012). Fertilizer use and management practices for crops in Nigeria 4th edition Federal Fertilizer Development Ministry of Agriculture and Rural Development Abuja Pp 42

Defoer T, Budelman A, Toulmin C, Carter J E. (2000). Building common knowledge participatory learning and action research (part 1). In Defoer T, Budelman A (eds).Managing soil fertility in the tropics. A resources guide for participatory learning and action research. The Netherland Royal Tropical Institute

Food and Agricultural Organization (1983). Guidelines land evaluation for rain fed agriculture FAO Soil Bulletin 52 FAO Rome, 237pp

Federal Ministry of Agriculture and Natural Resources (1990). Literature review on soil fertility investigation in Nigeria (in five volumes) Federal ministry of Agriculture and Natural Resources Lagos

Golchin A, Nadi M, Mozaffari V (2006). The effect of vermicomposts produced from various organic solid wastes on growth of pistachio seedlings Acta Hort. 726: 301-306.

Mader P, Fliebach A, Dubois D Gunst L Fried P, Niggli U. (2002). Soil fertility and biodiversity in organic farming Sci. 296: 1694-2020.

Ndakidemi PA and Semoka JMR. (2006). Soil fertility survey in western Usambara mountain northern Tanzania Pedosphere 16(2): 237-244.

Prasad R and Power JF. (1997). Soil fertility management for sustainable agriculture CRC Press Boca Raton.

Quaik S, Embrandiri A, Rupani PF, Singh RP, Ibrahim MH. (2012).Effect of vermiwash and vermicomposting leachate in hydroponics culture of Indian Borage (Plectranthus ambionicus) Plantlets. UMT 11th International Annual Symposium on sustainability Science and Management e-ISBN 978-967-5366-93-2:210-214.

Shi-wei Z and Fu-Zhen (1991). The nitrogen uptake efficiency from N labeled chemical fertilizer in the presence of earthworm manure (cast) Pp 539-542 In Advance in management and conservation of soil fauna G K Veeresh, D. Rajgopal, C.A. Biraktamath (eds). Oxford and IBH publishing co. New Delhi, Bombay (1991).

Theunissen J, Ndakidemi PA, and Laubscher CP. (2010). Review- Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production J. Phys. Sci. 5(13):19641973

United States Department of Agriculture (1986). Agricultural hand book No 436 SCA/USA Washington DC USA Pp 206