ABUAD Journal of Engineering and Applied Sciences (AJEAS)

ISSN: 2992-5584

Volume 2, Issue 2, 24-27

Analysis of Macro Element Composition in Organic Manure Derived from Cow Dung, Sawdust, and Charcoal for Enhanced Productivity of Arable Crops and Vegetables

Waleola Ayo AKINFIRESOYE[1], John Akintomide OGIDAN[1], and Christianah Dolapo OLUMAKINWA[2]

[1]*Agricultural Technology Department, Federal Polytechnic, Ile-Oluji, Ondo State.*
[2]*Physical Planning Directorate, Federal Polytechnic, Ile-Oluji, Ondo State.*

walakinfiresoye@fedpolel.edu.ng, jogidan@fedpolel.edu.ng, christydola@gmail.com

*Correspondence: walakinfiresoye@fedpolel.edu.ng; Tel.: +2348033573716

Date Submitted: 07/09/2024
Date Accepted: 22/11/2024
Date Published: 31/12/2024

***Abstract*:** *The increase in the cost of inorganic fertiliser and the danger it poses to the health of consumers when used to grow crops motivated the production of pelletised organic manure (OM) from fresh cowdung (CD), sawdust (SD), and charcoal (CH) at the demonstration farm of the Agricultural Technology Department, Federal Polytechnic, Ile Oluji. CD, SD, and CH were mixed based on weight ratios of 2:1:1 and 1:1:1, respectively, and allowed to decompose anaerobically for 21 days. OM produced was subjected to macro element presence and was discovered to be rich in nitrogen (N), phosphorus (P), and potassium (K), which were the major elements needed for growing arable crops and vegetables. The percentage of the NPK slightly increased as the weight of the CD increased. NPK contents were 1.21%, 0.83%, and 1.12%, respectively, for the CD, SD, and CH ratios 2:1:1, while it was 0.81%, 0.6%, and 0.73% for ratios 1:1:1, respectively. The temperatures of the OM were 38 °C and 36 °C for the two ratios, respectively, and the pH was 8.8 and 8.4, respectively, at the end of the 21 days of decomposition. Based on this analysis, the OM produced is recommended for growing arable crops and vegetables. It will equally give the youths employment opportunities and assist the nation in converting waste into wealth.*

Keywords: Organic manure, cow dung, sawdust, charcoal, vegetables.

1. INTRODUCTION

Organic Manure (OM) is a solid biological compost containing both micro and macro nutrients plants need to grow according to [5]. It is prepared by decomposing animal dung, crop residues, peels of fruits, vegetables, and other non-toxic waste vegetables [15]. After decomposition, they provide a wide range of nutrients to the plants and it is the most natural and chemical-free substance to increase the soil crop yield and improve soil production efficiency [21]. Nitrogen (N), Phosphorus (P), and Potassium (K) are the primary macro elements that play a vital role in improving the yield and quality of crops and Cow manure is rich in these nutrients according to [8, 7, 13, 5]. These researchers discovered that OM produced from Cow dung has about 3% Nitrogen, 2% Phosphorus, and 1% Potassium, 3-2-1 N, P, K. According to [17, 3], Nitrogen is an essential component of plant enzymes and proteins. It is needed for the metabolic process of energy transformation in plants. Phosphorus aids in photosynthesis, stimulates early root development, leaf size, tillering, flowering, and grain yield, and helps plants to survive in harsh winter conditions. Phosphorus is second only to nitrogen in importance as an essential crop nutrient. It is critical for plant growth, especially in the early jointing stages, and for enhancing grain yield and yield components. Sawdust serves as a bulk agent for the reduction of the moisture content of OM and improves aeration during the period of decomposition [15]. The addition of Charcoal to OM reduces odours and also improves soil fertility and structure by retaining nutrients and water [11]. As observed by [12, 13], aside from the high cost of inorganic fertilizers, there is also the danger posed to human health due to its residual in the crops when consumed. This is one of the needs for this study whereby natural waste free from toxic elements is decomposed to form organic manure. The OM produced was pelletized for ease of accurate and specific measurement when applied to the farmland. The offensive odour associated with cow dung was also removed through this study, thereby making the OM appealing to the end-users.

2. MATERIALS AND METHODS

The study was carried out at the demonstration farm of the Agricultural Technology Department of Federal Polytechnic, Ile Oluji. The study area lies between latitudes 7˚14'0"N-7˚14'50" N and 4˚51'0"E-4˚52'10" E. CD was

obtained from Ayeyemi abattoir in Ile Oluji, SD was collected from Federal Polytechnic Ile Oluii Farm and CH was obtained from Yaya Bakery in Ile Oluji. The SD and CH were air-dried to a moisture content of 12% before the commencement of the study. Completely Randomized Design (CBD) was employed for the study. The treatments consisted of 10 kg of each of CD, SD, and CH, and 10 kg of CD, and 5 kg each for SD and CH respectively. Each treatment was replicated thrice, and the experimental units were assigned randomly to the treatments.

Nine compost boxes were constructed using *Ceiba petandra* wood because of its ruggedness and toughness, each measuring 60 cm x 60 cm x 90 cm (length x breadth x height). In each box, 10 kg of CD, SD, and CH were layered in 20 cm thicknesses each in that order with 5 litres of water added to facilitate digestion. The boxes were then covered with nylon to create an anaerobic environment.

The manure was left to digest in the first three boxes for seven days with the temperature and pH measured, after which it was thoroughly mixed and transferred to another three sets of boxes for another seven days. This process was repeated in a third set of boxes for the final seven days. This was done for a thorough mixing of the manure. After a total of 21 days, the organic manure was ready. The temperature and pH of the mixture were taken at the beginning and consequently at the interval when the mixture was moved to other boxes.

This procedure was repeated for the second treatment, which was the 10 kg of CD, and the 5 kg each of SD and CH. This resulted in two sets of organic manure samples based on the different ratios of the components. The processed OM was pelletized for portability, ease of measurement, and application [1].

Figure 1 shows the compost making and the pelletized OM. Samples from the final products were sent to the laboratory for macronutrient analysis (N, P, K). The data obtained from the samples were analysed using descriptive statistics and presented in a bar chart created in Microsoft Excel 2013.

Figure 1: Organic manure processed

3. RESULTS AND DISCUSSION

3.1 Macro Elements Present in the Organic Matter

The results from the laboratory revealed the presence of the macro-elements (N, P, K) in the OM produced for the two ratios.

Figure 2 shows that the 1:1:1 ratio of CD, SD, and CH, the percentages of Nitrogen (N), Phosphorus (P), and Potassium (K) were measured as 0.81%, 0.62%, and 0.73%, respectively. In contrast, in the 2:1:1 ratio, the percentages of N, P, and K were 1.21%, 0.83%, and 1.12%, respectively. This indicates that a higher concentration of CD when in the mixture of CD, SD, and CH leads to a higher percentage of Nitrogen. Therefore, the weight of cow dung should be increased to have a higher concentration of Nitrogen whenever such is needed.

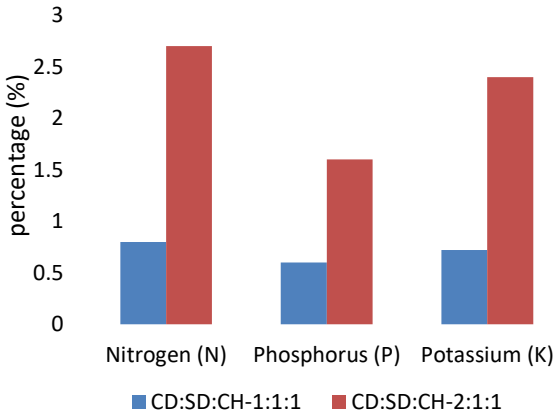

Figure 2: Macro elements presence in cow dung manure

It was also discovered that the values obtained for N, P, and K in both ratios ranged from 0.81% to 1.12%. These results corroborate the findings of [19] in their study on the enrichment of organic manures and their utilization in vegetable crops, where they observed that nitrogen content in cow dung was higher (up to 0.4%) compared to phosphorus (0.2%) and potassium (0.2%) which are beneficial for the growth of vegetables and arable crops. This is further supported by [9] who noted also that the NPK values obtained are within the range suitable for vegetable cultivation. The ratio 2:1:1 of NPK according to [14, 2, 6] is also recommended for the growth of cucumber and other vegetables.

3.2 Temperature Variation of Organic Manure

Figure 3 shows the temperature variation of the manure. At the beginning of the composition, the temperatures were 29 ℃ and 28 ℃ for CD, SD, and CH of ratios 2:1:1 and 1:1:1, respectively. At the end of day 7, the temperature increased to 34 ℃ and 32 ℃, respectively. This increase in temperature was again observed at the end of day 14 as 42 ℃ and 40 ℃, respectively. However, at the end of day 21, the temperature decreased to 38 ℃ and 36 ℃ for the two ratios under investigation respectively.

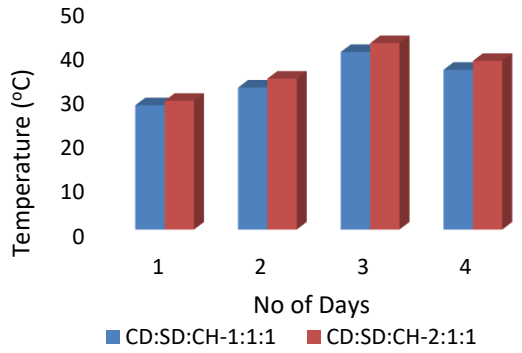

Figure 3: Temperature variation of CD organic manure

The high temperature observed at the end of day 7 was the tearing down the organic materials at the mesophilic-1 phase. At this stage, the OM was not ripe to be applied to the soil and according to [10, 16], such OM with high temperature would harm the soil health, thereby hampering the yield of crops grown on the soil. The temperature rise observed at the end of day 14 when compared to day 7 was a result of the further breakdown of the organic manure structure. This is the thermophilic stage where the high temperature kills off pathogens and weed seeds, thereby preparing the manure for the last phase of decomposition as corroborated in a similar study by [18, 20]. This led to a reduction in the temperature at the end of day 21 as the composting process transitioned to the maturation phase.

3.3 pH of Organic Manure

The pH values at the beginning of the composition for CD, SD, and CH with ratios of 2:1:1 and 1:1:1, as shown in Figure 4 were 11.5 and 11.2. This pH was not suitable for the growth of vegetables according to [4] who observed that the pH of OM in this instance should range from 6.0 to 9.0. The pH was thereafter checked after the seventh day of its composition and found to be 10.8 and 10.3 respectively. The pH was further reduced to 9.1 and 9.8 respectively at the end of the fourteenth day. This trend of reduction was observed to be maintained and at the end of the 21 days, the pH stood at 8.8 and 8.4 respectively which were in line with [4] for the growth of vegetables.

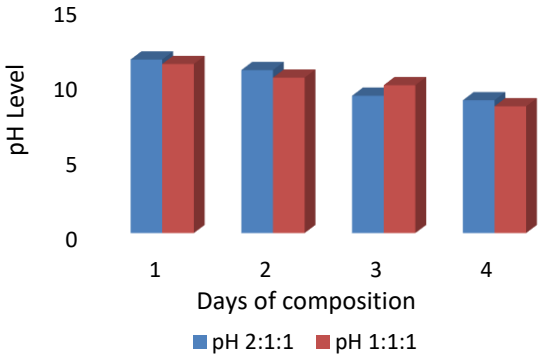

Figure 4: pH of organic manure

4. CONCLUSION

Organic manure (OM) was indigenously produced as pellets from a mixture of cow dung, sawdust, and charcoal in weight-based ratios of 2:1:1 and 1:1:1 to provide the macro-nutrients; nitrogen, phosphorus, and potassium (NPK), necessary for growing vegetables and arable crops by peasant farmers. This study aims to replace expensive, scarce, and toxic inorganic fertilizers. The produced OM which was fully decomposed at an allowable temperature of 38 ℃ was odorless and easy to measure for each plot of farmland due to its pelletized form. Additionally, this study successfully transformed waste into wealth. The concentration of NPK in the two ratios ranged from 0.81% to 1.21%, with the 2:1:1 ratio yielding the highest values of 1.21% nitrogen, 0.83% phosphorus, and 1.12% potassium, indicating suitability for vegetable and arable crop growth. While the OM shows potential as a fertilizer for arable crops and vegetables, it is important to test the soil pH before application, as it's pH stands at 8.8. Further research is needed to establish the effect of this OM on the crops under field conditions.

ACKNOWLEDGMENT

The technologists of Agricultural Technology Department of Federal Polytechnic, Ile-Oluji are appreciated for their support all through this study.

REFERENCES

[1] Akinfiresoye, W.A. and Ogidan, J.A. (2024). Development of indigenous organic manure pelletizer. Proceeding of the 1st International Conference of School of Applied Sciences, Federal Polytechnic, Ile-Oluji, Nigeria.

[2] Akpan, A. D., Ubong, U. U. and Okori, B. S. (2022). Effects of different organic manures and NPK fertilizer on soil properties. *World Journal of Applied Science and Technology*, Vol. 14 No. 2 (2022) .1 – 5.

[3] Ali, M.S., Sutradhar, A., Edano, M.L., Edwards, J.T. and Girma, K. (2014). Response of winter wheat grain yield and phosphorus uptake to foliar phosphite fertilization. *International Journal of Agronomy*. 8(2).

[4] Al-Wabel, M.I., Al-Farraj, F.A. and Al-Turki, S.I. (2018). pH and electrical conductivity of composed organic waste. *Journal of Environmental Science and Health.* Part B, 53(1), 13020.

[5] Aviantara, I.G.N.A. and Setiyo, Y. (2021). An analysis of the process of composting cow manure with additional organic agricultural waste. *Journal of Global Biosciences*. ISSN 2320-1355 Vol. 10, No 6, pp. 8834-8849.

[6] Ekwu, L. G., Eselebe, H. O. and Okporie, E. O. (2000). Vegetative growth and yield response of cucumber to varying levels of nitrogen and phosphorus fertilizer in Southern Nigeria.

Conference Proceedings of the Horticultural Society of Nigeria, 2000. pp. 117–120.

[7] Guangming, R. X., Juanjuan Q. L. Z., and Tingting, W. (2016). Evaluation of microbial population dynamics in the co-composting of cow manure and rice straw using high throughput sequencing analysis. *Journal of Microbiology and Biotechnology*. ISSN: 0959-3993 (Print) 1573-0972 pg 32:101.

[8] Jochin, Z. (2023). The role of NPK fertilizers in modern agriculture: Fuelling crop growth and maximizing yields. *International Journal of Manures and Fertilizers*, ISSN 2756-3863, Vol. 11 (2).

[9] Katyayan, A. (2019). Fundamental of agriculture. Kushal Publication and Distribution, pp.231-235.

[10] Kumar, S., Saha, J., Kumar, A. and Srivastava, P. (2019). Effect of raw cow dung on soil microbial diversity and enzyme activities. *Journal of Soil Biology and Ecology*, Vol. 101 (1).

[11] Lorimor, J.C. and Fulhage, C.D. (2002). Using charcoal to reduce odours from livestock manure. *Journal of Environmental Quality.* 31 (4), 1163 – 1168.

[12] Makinde, E.A., Ayoola, O.T. and Akande, M. O. (2007). Effects of organo-mineral fertilizer application on the growth and yield of egusi melon. *Australian J. Basic Appl. Sci*., 1:15-19.

[13] Orluchukwu, J. A. and Amadi, C. (2022). Effect of organic and inorganic fertilizers on the growth and yield of cucumber (*Cucumis sativa* L.) in South-South, Nigeria. International Journal of Agricultural Policy and Research Vol.10 (2), pp. 31-37.

[14] Odeleye, F.O., Odeleye, O. M. O., Vessey, J. K., Dong, Z. and Ebuzome, H. N. (2006). Response of cucumber to timing of fertilizer application in Southwest, Nigeria. *Can. J. Plant Sci.* 1 (22).

[15] Parveen, P. and Rakesh, C. (2022). Effect of sawdust and different types of organic waste in composting. *Research Square J.* 1(23).

[16] Patel, R., Ramesh, K., and Siddique, K. (2020). *I*mpact of raw cow dung on soil erosion and water quality. *Journal of Environmental Science and Health.* Vol. 55 (1).

[17] Rajasekar, M., Udhaya, N.D, Swaminathan, V. and Balakrishnan, K. (2017). A review on role of macro nutrients on production and quality of vegetables. *International Journal of Chemical Studies* 5(3):304- 309.

[18] Setiyo, Y., Gunam, I.B., Gunadnya, B.S. and Budi, S. (2017). The implementation of low external input sustainable agriculture system to increase productivity of potatoes (*Solanum tuberosum L.*). *Journal of Food, Agriculture & Environment* JFAE, 15 (2).

[19] Sindhu, V., Ranjit, C., Santhoshkumar, G. M. and Trisha, S. (2022). Enrichment of organic manures and their utilization in vegetable crops. *Current Journal of Applied Science and Technology* 39(32): 10-24, 2.

[20] Yanqoritha, N. (2013). Optimization of activator in the manufacture of organic compost from waste cocoa. *Journal of Mektek*, 15(2), 103 – 108.

[21] Verma, P., Bhavana, T. and Luxmi, K. T. (2021). Role of organic manure in agriculture: A Review. *Marumegh* ISSN: 2456-2904. Vol. 6(3)