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Termite Mound Soil: A Potential Source of Biofertilizer in Koraput, Odisha

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Abstract

Mass use of chemical fertilizers and extensive agriculture has reduced soil's physiochemical properties and nutrient profile, generating crops with higher chemical residues, resulting unhealthy human population. Sustainable and cost effective nature friendly alternative methods of agriculture are the present need, to overcome the crisis. The study with Termite Mound Soil, TMS, in Koraput district of Odisha, India was performed to find nutrient composition and its potential as an ecofriendly, sustainable biofertilizer. For soil analysis samples were collected from the top, middle and bottom layers of the mound and for comparison surrounding soil were collected from 1m and 10m distance from mound. The termite mound soil samples showed presence of high organic content and rich macronutrients (Nitrogen, Phosphorus and Potassium) concentrations, with varying pH values ranging from ~3.7 to ~6.4. The unique properties of TMS can contribute towards better plant growth and development as it possess great physiochemical properties with advanced soil structure, higher water retaining capacity, high organic matter, nutrient deposition, microbial influence and enhanced aeration . Soil nutrient composition and pH values vary from top to bottom within termitarium, which directs further studies regarding its effective use as biofertilizer for cultivation of different crops. The findings conclude TMS has significantly higher nutrient composition and good physiochemical properties from the surrounding ground soil indicating its potential as biofertilizer. The cause for occurrence of pervasive number of termite mounds in Koraput district may further be investigated which will pave the way for its effective use as an alternative to chemical fertilizers.

Keywords: Termite Mound Soil (TMS), Biofertilizer, Macronutrients, Phosphorus

INTRODUCTION

To meet the nutritional demand of increasing population, enormous chemical fertilizers and pesticides are used in agricultural field for surplus production. The extensive use of these chemicals has induced concerns towards soil degradation, environmental contamination, and harmful effects on human well-being. Shift towards nature friendly and sustainable agriculture like use of biofertilizers can overcome deteriorating environment and human health. Biofertilizers are the natural promotes of plant growth constituting live microbes which promotes plant growth like plant growth promoting rhizobacteria (PGPR) which inhabit rhizosphere of plants [1].

Termites, a group of social insects often considered under soil macrofauna, are found in abundant numbers in the tropical areas. They construct termite mounds by mixing their secretions, excreta or saliva with clay and organic matter (Sujada et al., 2014). Many microorganisms can be found in the termite mound because of its enriched nutrient concentration (Nithyatharani and Kavitha 2018). The termites are not given much

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importance because of their feeding behavior and for being a menace to agricultural produce. Around 20% of the 2600 known species of termites have harmful impacts on humans society (Deke et al., 2016). Regardless of the 20% termites, rest have positive impacts in nutrient cycling and soil formation, and are widely located in open vegetation as well as in the tropical rainforests (Cancello et al., 2014). Termites have the ability to have a sustained effect on agroecosystem and are often termed as ‘bioengineers’ and ‘ecosystem engineers’ due to their role in pedological processes and maintenance of soil fertility [2].

Termites are ecological indicators of soil health and fertility, as they have crucial role in soil transportation, nitrogen fixation and nutrient cycling which creates good impact on soil porosity, water retaining capacity and deposition of organic matter (Engaboma and Babalola, 2019b). The termite mounds have essential macro and micronutrients which directs its use as a natural biofertilizer. When compared with surrounding soil TMS showed presence of high organic matter, magnesium, potassium, zinc, iron, phosphorus, copper and clay content The unique physiochemical properties therefore make TMS natural and cost effective soil amendment often used by small scale farmers. Substantially enriched nutrient profiles were located in termite mounds when compared to adjacent surrounding soils (Engaboma & Babalola, 2019a).

Termite mound is a hotspot for bacterial population. [3] The diversity of bacterial colonies is affected by some factors like topography of the area and type of termite species in mound found around 200 bacterial isolates from termite mound soil. The soil contained many useful bacteria like *Bacillus sp*., *Citobacter ferundii*, *Azotobacter chroococcum* and *Pseudosomonas aeruginosa* that have the ability to solubilize phosphate and potassium, promoting plant growth and reducing plant-soil pathogen. The presence of high nutrient content and helpful soil microbes in termite mound directs its potential to enhance crop production, therefore can be used as biofertilizer (Fall et al., 2004). The parent soil type determines the physiochemical property of mound hence nutrient deposition will vary (Jouquet et al., 2015) which paves the objective of the study. The present study was undertaken to estimate the levels of organic carbon and macronutrients (N, P and K) in the termite mound soil (TMS) in Koraput district of Odisha, India. Further the study focuses on comparison of TMS with its surrounding soil which can determine its potential for using as biofertilizer [4-6].

MATERIALS AND METHODS

Study Site

The study was carried out at Government College, Koraput (Campus Garden and Kolab Reservoir Bank) of Koraput district of Odisha, India. The district is located in southern Odisha and shares its boundaries with adjacent states of Andhra Pradesh and Chattisgarh. The district extends it land boundaries in between latitudes18.5°N to 19.9°N and longitudes 82.5°E to 84.2°E, with an elevation of 900 to 1,500 meters above sea level. Figure 1

Soil Sampling

The soil samples were collected from the top (TMT), middle (TMM) and bottom (TMB) zones of the termite mound at a depth of 1.5 inches. For comparison, soil samples were taken from 1m (SS1) and 10 m (SS10) distance from the mound. From each mound 5 no. soil samples were taken for analysis. Surrounding soil samples were collected at 6 inches depth to ensure appropriate results.[7-9] The collected soil samples were air dried for two days. For analysis, soil samples were grinded and sieved with the help of a 2mm mesh sieve Figure 2.

Physiochemical Analysis of the Soil Samples

Determination pH and Electrical Conductivity

The pH and electrical conductivity (EC) of the soil samples were measured by suspending 20g of soil sample in 100ml of water with the help of a pH meter and an EC meter respectively (Anderson et al., 1993).

Determination of Organic Carbon

Walkley-Black method was used to determine soil organic carbon, the soil samples were oxidized with potassium dichromate and sulfuric acid (Walkley & Black, 1934). The organic carbon content was calculated from the reduced dichromate amount.

Figure 1. Photographs showing Termite Mounds at different locations of Koraput, Odisha, India (Top Left- Mound at Govt. College, Koraput, Top Right- Duruguda, Koraput
Bottom Left- Sunabeda, Koraput, Bottom Right- Janiguda, Koraput)

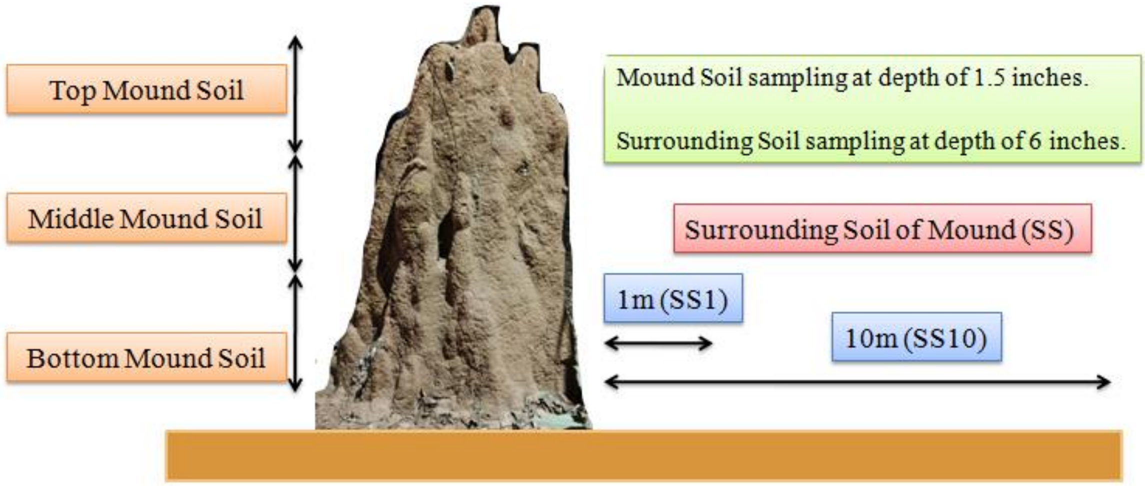


Figure 2. Sampling Sections of Termite Mound and Surrounding Soil.

Determination of NPK

Determination of Soil NPK involves specific methods. Nitrogen was determined using the Kjeldahl method, involving digestion, distillation and titration Phosphorus content was determined by colorimetric method using a spectrophotometer. Potassium concentration was found with ammonium acetate and measured using flame photometry, with emission intensity proportional to potassium concentration.

RESULTS

pH

The pH value varied at different sections of the mound. The average pH of top mound soil recorded with 4.78, middle mound soil 4.37 and bottom mound soil 4.49. The surrounding soil sample at 1m averaged 5.03 and 10m averaged 5.88.

Electrical Conductivity (EC)

The values of electrical conductivity values of top mound soil averaged 315µs/cm, middle mound soil with 660µs/cm and bottom mound soil averaged 700µs/cm. Surrounding soil at 1m distance averaged at 480 µs/cm whereas at 10m distance averaged 535 µs/cm [10].

Organic Carbon

All the termite mound soil showed the presence of high organic carbon as compared to the surrounding soil. The top mound soil averaged 1.14%, followed by 0.85% of middle mound soil and 0.99% of bottom soil. The surrounding soil averaged 0.53% at 1 m and 0.68% at 10m distance.

Total Nitrogen (N)

The total nitrogen in the top, middle and bottom mound soil averaged 651 kg/ha, 602 kg/hand 568 kg/ha respectively. Surrounding soil resulted in having 495 kg/ha and 516 kg/ha at 1m and 10m distance respectively.

Available Phosphorus (P)

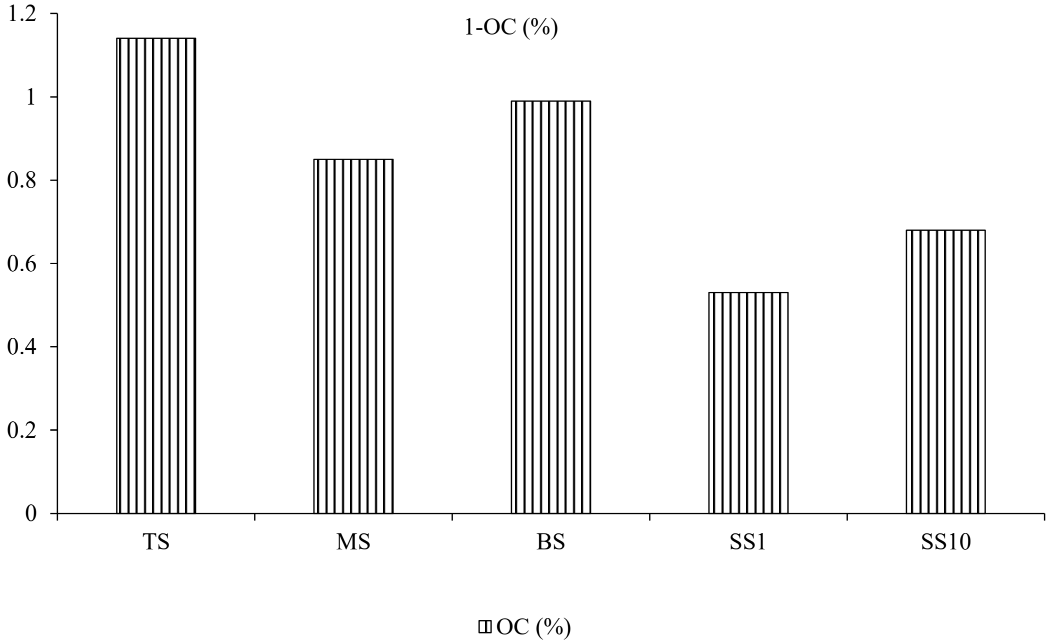
Phosphorous values averaged 5.152 kg/ha in top, 1.344 kg/ha in middle and 1.393 kg/ha in bottom mound soil. Surrounding soil averaged 1.165 kg/ha at 1m and 0.672 kg/haat 10m distance [12-14].

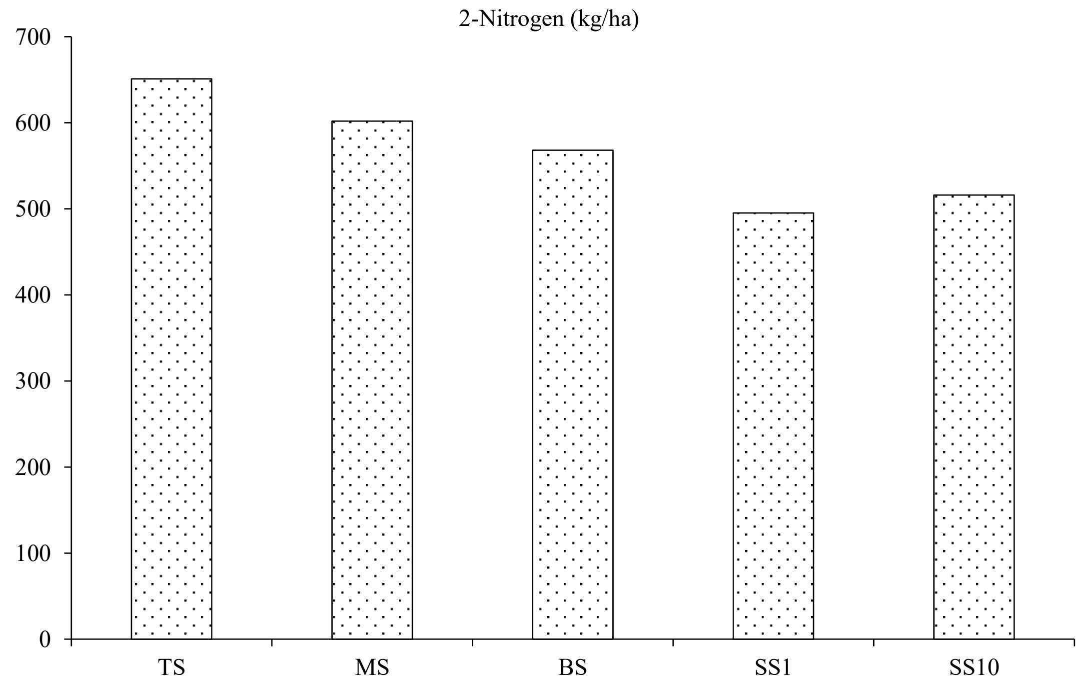
Exchangeable Potassium

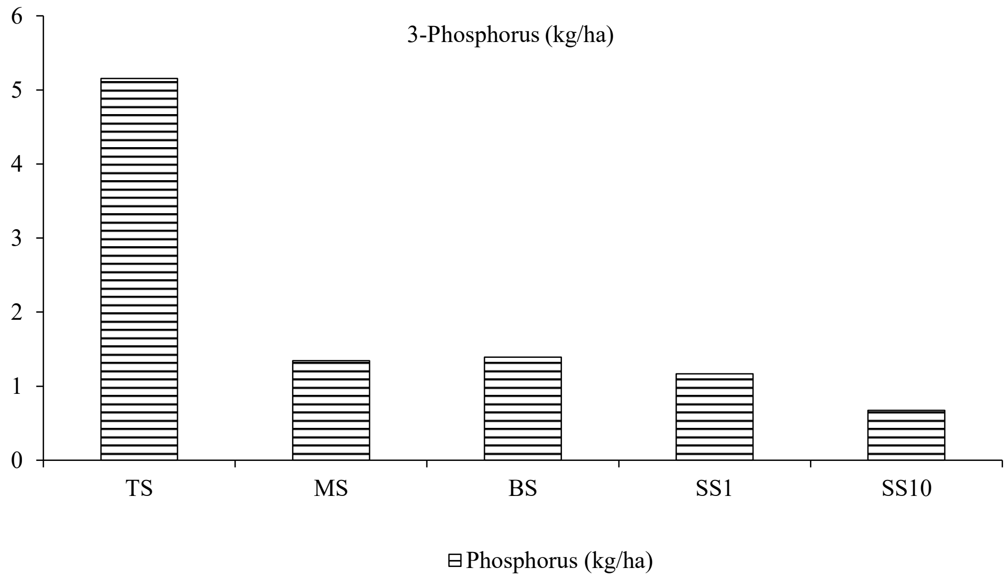
Potassium was calculated in the form of potash (K_2O). Top soil averaged 359 kg/ha, middle soil with 311 kg/ha and bottom soil with 351 kg/ha. Surrounding soil resulted 306.5 kg/ha at 1m and 227.5 kg/ha at 10m distance Table 1 and Graph 1 to 4.

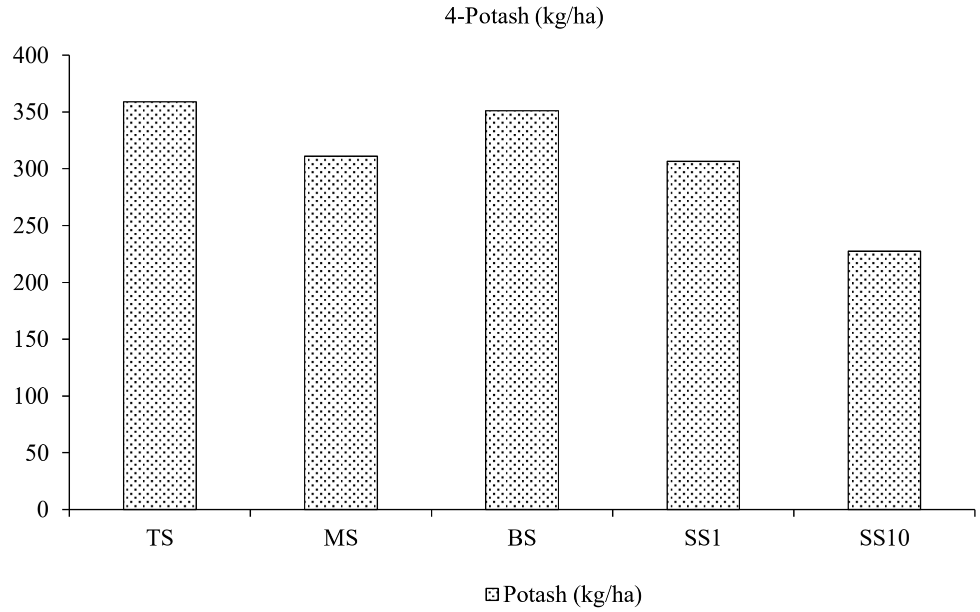
Table 1. Showing the average values achieved after soil analysis.

Soil Sample	pH	EC (μs/cm)	OC (%)	Nitrogen (kg/ha)	Phosphorus (kg/ha)	Potash (kg/ha)
TS	4.78	700	1.14	651	5.152	359
MS	4.37	660	0.85	602	1.344	311
BS	4.49	315	0.99	568	1.393	351
SS1	5.03	480	0.53	495	1.165	306.5
SS10	5.88	535	0.68	516	0.672	227.5









Graphs 1 to 4. Showing the levels of nutrients in termite mound soil and surrounding soil.

DISCUSSION

The termite mound soil showed higher nutrient richness over its surrounding soil. The study revealed that pH of termite mounds is acidic over its surrounding soil, which can be modified for applying to crops. Electrical Conductivity (EC) values in all soil samples were acceptable. As the values were less than 2000 µs/cm hence low salinity levels and supports plant growth 0.4% of soil organic carbon is recommended for agricultural crops (Raina et al., 2019), less than that can result in reduced soil health and improper plant growth. The study finds high organic carbon in mound soil over surrounding soil with a highest average of 1.14% in the top mound soil [15-16].

The total N level was higher in top mound soil. Concentration of nitrogen is significantly higher in mound soil than surrounding soil. The nest construction of ants directs in deposition of high organic matter which results in increased N levels in mound soil (Phosphorus availability is essential for growth and development of plant (). The study resulted average phosphorus level in the top section of mound averages 5.152 kg/ha, highest in all the samples tested. All the samples valued phosphorus levels less than the threshold value ($p<14$). The reported highest phosphorus level in top and bottom sections of mound in Pemba district. They reported obtained phosphorus values as not significant, suggesting its use with cattle manure. The potassium level in all the mound soil samples was high and good for plants. Comparatively higher potash (K_2O) values were obtained in mound soil than surrounding soil. All the soil samples collected from the termite mound showed comparatively higher values for the nutrients studied (OC, N, P and K) when compared to surrounding soil. Apart from phosphorus content all other nutrients were above critical values [17-20].

CONCLUSION

In the present investigation it was found that the nutrient composition varies within mound, from top to bottom. Significantly higher organic carbon and nutrient concentration was found in termite mound soil when compared over its surrounding soil. Hence, the mound contains essential macronutrients (NPK) and organic carbon for plant growth. This suggests further study for its potential use as biofertilizer and efficacy in sustainable agriculture which will benefit the local farmers of Koraput district.

REFERENCES

1. Adebajo, S. O., Akintokun, P. O., Ezaka, E., Ojo, A. E., Olannye, D. U., & Ayodeji, O. D. (2021). Use of termitarium soil as a viable source for biofertilizer and biocontrol. Bulletin of the National Research Centre, 45, 1-8.
2. Anderson JM, Ingram JSI. Tropical soil biology and fertility: a handbook of methods. 2nd ed. Aberstwyth: CAB International, The Cambrian News; 1993. p. 221.
3. Bremner, J. M. (1996). Nitrogen-total. In Methods of Soil Analysis: Part 3 Chemical Methods.
4. Cancello, E. M., Silva, R. R., Vasconcellos, A., Reis, Y. T., & Oliveira, L. M. (2014). Latitudinal variation in termite species richness and abundance along the Brazilian Atlantic Forest hotspot. *Biotropica*, *46*(4), 441-450.
5. Deke A, Adugna W, Fite A (2016) Soil physic-chemical properties in termite mounds and adjacent control soil in Miyo and Yabello districts of Borana Zone, Southern Ethopia. Am J Exp Agric 4(4):69–74
6. Enagbonma B, Babalola O (2019a) Potentials of termite mound soil bacteria in ecosystem engineering for sustainable agriculture. J Annu Microbiol 69:211–219
7. Enagbonma, B. J., & Babalola, O. O. (2019b). Environmental sustainability: A review of termite mound soil material and its bacteria. *Sustainability*, *11*(14), 3847.
8. Jouquet P, Guilleux N, Shanbhag RR, Subramanian S (2015) Influence of soil type on the properties of termite mound nests in southern India. Appl Soil Ecol 96:282–287
9. Jouquet, P., Bottinelli, N., Shanbhag, R. R., Bourguignon, T., Traoré, S., & Abbasi, S. A. (2016). Termites: the neglected soil engineers of tropical soils. *Soil Science*, *181*(3/4), 157-165.
10. Knudsen, D., Peterson, G. A., & Pratt, P. F. (1982). Lithium, sodium, and potassium. In Methods of Soil Analysis: Part 2 Chemical and Microbiological Properties.
11. Malusa E, Vassilev N (2014) A contribution to set a legal framework for biofertilizers. Appl Microbiol Biotechnol 98(15):6599–6607
12. Nithyatharani R, Kavitha U (2018) Termite soil as bio-indicator of soil fertility. Int J Resolut Appl Sci Eng Technol 6(1):659–661
13. Olsen, S. R., Cole, C. V., Watanabe, F. S., & Dean, L. A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate.
14. Savci S (2012) An agricultural pollutant: chemical fertilizer. Int J Environ Sci Dev 3(1):73–76
15. Sujada N, Sungthong R, Lumyong S (2014) Termite nests as an abundant source of cultivable actinobacteria for purposes. J Microbes Environ 29:211–219
16. Walkley, A., & Black, I. A. (1934). An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Science, 37(1), 29-38.

17. Wyngaard, N.; Cabrera, M.L.; Jarosch, K.A.; Bunemann, E.K. Phosphorous in the coarse soil fraction is related to soil organic phosphorous mineralization measured by isotopic dilution. Soil Biol. Biochem. 2016, 96, 107–118.
18. Raina, J.N.; Sharma, J.C.; Sharma, I.P. Manual on Methods for Physical and Chemical Analysis of Soils; Department of Soil Science and Water Management, Dr Y.S Parmar University of Horticulture and Forestry: Nauni, India, 2007.
19. Sarcinelli, T.S.; Shaefer, C.E.G.R.; Lynch, L.S.; Arato, H.D.; Viana, J.H.M.; Filho, M.R.A.; Goncalves, T.T. Chemical, physical and micromorphological properties of termite mounds and adjacent soils along a toposequence in Zona da Mata. Catena 2009, 76, 107–113.
20. Chisanga, K., Mbega, E. R., & Ndakidemi, P. A. (2020). Prospects of using termite mound soil organic amendment for enhancing soil nutrition in Southern Africa. *Plants*, *9*(5), 649.

