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REVITALIZING NORTHERN NIGERIAN SOILS: UNRAVELING THE INFLUENCE OF POULTRY BIOCHAR ON ELECTROCHEMICAL PROPERTIES IN ALFISOL AND VERTISOL

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Mubarak Habib Abubakar

Department of Soil Science, Faculty of Agriculture, Federal University Dutse, Jigawa State, Nigeria

Lawal Victor Chinyere

Department of Soil Science and Meteorology, College of Crop and Soil Sciences, Michael Okpara, Nigeria

ABSTRACT

This study delves into the transformative potential of poultry biochar on soil electrochemical properties in Alfisol and Vertisol of Northern Nigeria. Through a comprehensive investigation, we unravel the intricate influence of poultry biochar application on soil pH, electrical conductivity, nutrient availability, and other electrochemical parameters. The findings provide valuable insights into sustainable soil management practices, offering a pathway to enhance agricultural productivity in this region.

KEYWORDS

Poultry Biochar, Soil Electrochemistry, Alfisol, Vertisol, Northern Nigeria, Sustainable Agriculture, Soil pH, Electrical Conductivity, Nutrient Availability, Soil Management.

NTRODUCTION

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The soil health and fertility of agricultural lands in Northern Nigeria are crucial determinants of regional agricultural productivity and food security. In the pursuit of sustainable soil practices, this studv. management titled "Revitalizing Northern Nigerian Soils: Unraveling the Influence of **Poultry** Biochar on **Properties** Electrochemical in Alfisol and Vertisol," investigates the potential transformative effects of poultry biochar on soil electrochemical properties.

Northern Nigeria, characterized by diverse agroecological zones, experiences challenges related to soil degradation, nutrient depletion, and suboptimal crop yields. In addressing these concerns, biochar, a carbon-rich material derived from the pyrolysis of organic residues, has gained recognition for its potential to enhance soil quality and agricultural sustainability. Poultry biochar, specifically derived from poultry litter, offers a valuable organic amendment due to its nutrient-rich composition.

This research aims to unravel the intricate influence of poultry biochar on the electrochemical properties of two predominant soil types in the region - Alfisol and Vertisol. Electrochemical properties, including soil pH, electrical conductivity, and nutrient availability, play pivotal roles in determining the overall fertility and health of soils. Understanding how poultry biochar interacts with these properties is essential for tailoring soil management practices to the specific needs of Northern Nigerian agricultural landscapes.

The introduction of poultry biochar into the soils has the potential to alter their physicochemical characteristics, enhance nutrient retention, and improve water-holding capacity. By unraveling these influences, this study seeks to contribute valuable insights to the development of sustainable agricultural practices in Northern Nigeria. The findings may inform local farmers, policymakers, and researchers about potential benefits of incorporating poultry biochar into soil management strategies, thereby fostering resilient and productive agricultural systems in the region.

As we embark on this exploration of revitalizing Northern Nigerian soils, the study underscores the importance of responsible and contextspecific soil management practices in the pursuit of agricultural sustainability and resilience in the face of changing environmental dynamics.

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METHOD

The process of revitalizing Northern Nigerian soils through the application of poultry biochar and unraveling its influence on electrochemical properties in Alfisol and Vertisol involved a systematic and multifaceted approach. The study began with the careful selection of representative study sites, each showcasing the predominant soil types found in the region. These sites were chosen to capture the diverse agroecological conditions prevalent in Northern Nigeria, ensuring that the research findings would have broad applicability.

Poultry biochar, a key component of the study, was produced through the controlled pyrolysis of locally sourced poultry litter. The production process was meticulously managed to yield biochar with consistent properties. This biochar was then finely ground, facilitating its uniform incorporation into the soil during the experimental phase.

The field experiments were structured using a randomized complete block design (RCBD), with multiple plots assigned to different treatments. These treatments encompassed varying concentrations of poultry biochar application,

ranging from a control group with no biochar to incremental levels of application. The inclusion of replication within each treatment aimed to ensure the statistical validity of the results.

Soil samples were collected both before and after the application of poultry biochar to assess changes electrochemical properties. Parameters such as soil pH. electrical conductivity, nutrient content, and cation exchange capacity (CEC) were rigorously analyzed in a laboratory setting, utilizing standardized methods to ensure accuracy and consistency.

Simultaneously, the physicochemical properties of the poultry biochar were characterized to gain insights into its composition and potential impact on soil properties. This step was crucial for understanding the biochar's role in altering the electrochemical characteristics of the soils.

The collected data underwent comprehensive analysis, including ANOVA and statistical regression analysis, to evaluate the impact of poultry biochar on soil electrochemical Relationships properties. between biochar application in rates and changes soil characteristics were explored to discern patterns

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and trends, ultimately providing a nuanced understanding of how poultry biochar influences the selected soil types in Northern Nigeria.

The final interpretation of results involved scrutinizing patterns of change, significance levels. and correlations. unraveling multifaceted influence of poultry biochar on the electrochemical properties of Alfisol and Vertisol. This systematic process aimed to contribute valuable insights to the discourse on sustainable soil management practices in Northern Nigeria, potentially paving the way for enhanced agricultural productivity in the region.

Selection of Study Sites:

Two representative study sites were selected in Northern Nigeria, each featuring predominant soil types – Alfisol and Vertisol. The choice of sites aimed to capture the diverse agroecological conditions prevalent in the region, ensuring the applicability of findings to a broader context.

Poultry Biochar Production:

Poultry biochar was produced through the pyrolysis of poultry litter collected from local farms. The pyrolysis process was carefully controlled to yield biochar with consistent

properties. The resulting poultry biochar was finely ground to facilitate uniform incorporation into the soil.

Experimental Design:

A randomized complete block design (RCBD) was implemented for the field experiments, with multiple plots assigned to different treatments. The treatments included varying concentrations of poultry biochar application to the soil, ranging from control (no biochar) to incremental levels of application. Each treatment was replicated to ensure statistical validity.

Soil Sample Collection and Analysis:

Prior to biochar application, baseline soil samples were collected from each plot to determine initial characteristics. soil Following biochar application, soil samples were collected at specified intervals to assess changes electrochemical properties. Parameters such as soil pH, electrical conductivity, nutrient content, and cation exchange capacity (CEC) were analyzed using standardized laboratory methods.

Poultry Biochar Characterization:

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Characterization of the poultry biochar involved physicochemical assessing its properties. including pH, surface area, and nutrient content. This characterization provided insights into the biochar's composition and its potential impact on soil properties.

Data Analysis:

Statistical analyses, including analysis of variance (ANOVA) and regression analysis. conducted to evaluate the impact of poultry biochar on soil electrochemical properties. The relationships between biochar application rates and changes in soil characteristics were explored to discern patterns and trends.

Interpretation of Results:

The results obtained from soil analyses and statistical procedures were comprehensively interpreted to unravel the influence of poultry biochar on the electrochemical properties of Alfisol and Vertisol. Patterns of change, significance levels, and correlations were scrutinized to draw meaningful conclusions regarding the effectiveness of poultry biochar in revitalizing Northern Nigerian soils.

This comprehensive methodology aimed to provide robust insights into the influence of biochar soil electrochemical poultry on properties in the selected study sites. contributing valuable information the discourse on sustainable soil management practices in the region.

RESULTS

The application of poultry biochar to Alfisol and Vertisol in Northern Nigeria vielded notable effects on soil electrochemical properties. The soil pH exhibited a significant increase with higher levels of biochar application, indicating an alkalizing influence. Electrical conductivity demonstrated a moderate rise, suggesting enhanced ion mobility. Furthermore, the cation exchange capacity (CEC) exhibited positive correlations with biochar application rates, signifying improved nutrient retention capacity in the soils. Nutrient analyses revealed increased levels of essential elements, including nitrogen, phosphorus, and potassium, showcasing the biochar's potential to enrich soil fertility.

DISCUSSION

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The observed changes in soil electrochemical properties reflect the transformative impact of poultry biochar on Northern Nigerian soils. The alkalizing effect on soil pH is attributed to the liming properties of biochar, which can ameliorate acidic soils. The increase in electrical conductivity implies improved soil structure and enhanced nutrient availability. The positive correlation between CEC and biochar application suggests a heightened capacity for nutrient retention, vital for sustaining agricultural productivity. These findings align with existing literature on biochar's capacity to enhance soil contribute sustainable properties and to agriculture.

The nutrient analyses substantiate the biochar's role as a nutrient source, particularly in phosphorus and potassium enrichment. The slow-release nature of nutrients from biochar contributes to sustained plant availability over time. This aspect is crucial for addressing nutrient deficiencies commonly encountered in Northern Nigerian soils. The discussion emphasizes the potential of poultry biochar as a viable soil amendment, offering a dual benefit of improving soil fertility and sequestering carbon. contributing to climate change mitigation.

Conclusion

In conclusion, the study "Revitalizing Northern Nigerian Soils: Unraveling the Influence of Poultry Biochar on Electrochemical Properties in Alfisol and Vertisol" provides compelling evidence of the positive impact of poultry biochar on soil health in the region. The observed changes in soil pH, electrical conductivity, CEC, and nutrient content underscore the potential of poultry biochar as a sustainable soil management strategy. The findings offer practical implications for local farmers, agricultural policymakers, and researchers, advocating for the integration of biochar into Northern Nigerian agricultural practices.

The study contributes to the broader discourse on sustainable soil management and agricultural resilience in the face of environmental challenges. As Northern Nigeria grapples with soil degradation and nutrient deficiencies, application of poultry biochar emerges as a promising solution to enhance soil fertility and promote sustainable agricultural development. The research calls for further exploration of optimal application rates and long-term effects, emphasizing the need for context-specific

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approaches to address the unique agroecological conditions of the region. Overall, this study lavs the groundwork for advancing agricultural sustainability in Northern Nigeria through the judicious use of poultry biochar.

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