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REVIEW

Soil improvement through organic fertilizers

Mejoramiento del suelo mediante abonos orgánicos

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ABSTRACT

Introduction: soil is a fundamental natural resource for agriculture, as it provides the physical support and nutrients necessary for plant growth.
Objective: to determine the physical and chemical characteristics of soil after the application of organic fertilizers.
Method: a review of the available literature in databases such as SciELO, Scopus and ClinicalKey was carried out, from which a total of 11 related articles were consulted. Empirical methods such as logical history and analysis and synthesis were used.
Results: soil improvement is essential in modern agriculture. A well-structured soil rich in organic matter is less susceptible to erosion by wind and water. The use of organic fertilizers contributes significantly to environmental sustainability. The creation and use of customized organic fertilizers represents an innovative and sustainable solution for soil improvement. The use of organic fertilizers can restore soil nutrients and increase agricultural productivity.
Conclusions: the implementation of organic fertilizers is an efficient strategy to optimize agricultural performance, and is also a sustainable and environmentally friendly option that contributes to the continuous improvement of soil health and greater stability in crop production.

Keywords: Soil; Organic Fertilizer; Natural Resource; Agriculture.

RESUMEN

Introducción: el suelo es un recurso natural fundamental para la agricultura, ya que proporciona el soporte físico y los nutrientes necesarios para el crecimiento de las plantas.
Objetivo: determinar las características físicas y químicas del suelo a la aplicación de abonos orgánicos.
Método: se realizó una revisión de la bibliografía disponible en bases de datos como SciELO, Scopus y ClinicalKey de las cuales se consultaron un total de 11 artículos relacionados, se utilizaron métodos empíricos como el histórico lógico y de análisis y síntesis.
Resultados: el mejoramiento del suelo es esencial en la agricultura moderna. Un suelo bien estructurado y rico en materia orgánica es menos susceptible a la erosión por viento y agua. El uso de abonos orgánicos contribuye significativamente a la sostenibilidad ambiental. La creación y uso de abonos orgánicos personalizados representa una solución innovadora y sostenible para el mejoramiento del suelo. El uso de abonos orgánicos puede restaurar los nutrientes del suelo y aumentar la productividad agrícola.
Conclusiones: la implementación de abonos orgánicos es una estrategia eficiente para optimizar el rendimiento agrícola, siendo además una opción sostenible y respetuosa con el medio ambiente que contribuye a la mejora continua de la salud del suelo y a una mayor estabilidad en la producción de cultivos.

Palabras clave: Suelo; Abono Orgánico; Recurso Natural; Agricultura.

INTRODUCTION

The soil is a fundamental natural resource for agriculture, as it provides the physical support and nutrients necessary for plant growth, coinciding with the opinion of several authors.[1,2,3,4,5] In the Santo Domingo canton, San Gabriel sector, the soils have experienced degradation due to inadequate agricultural practices and the excessive use of chemical fertilizers. This research focuses on using organic fertilizers as a sustainable alternative to improve soil quality and agricultural productivity on the property through laboratory tests with samples that will be taken to have a better result on soil quality.[6]

Volcanic soils, common in mountainous areas, are good at retaining water. Other soils are acidic and not very fertile, so they need improvement for plants to grow well. There are also younger soils that, although not significantly different from each other, have moderate fertility.

Deforestation, which removes natural vegetation for agriculture or urban development, causes soil erosion. Intensive agricultural practices, such as the overuse of chemical fertilizers and pesticides, also damage soil structure and decrease fertility. In addition, this deterioration caused by heavy rainfall and poor management practices contributes to the loss of the topsoil, which is the richest in nutrients.[7]

The topsoil, also known as the "Horizon" or "arable layer," is essential for agriculture and plant growth. This layer, generally a few centimeters deep, is the richest in organic matter and vital nutrients for plants, such as nitrogen, phosphorus, and potassium. It is in this layer where the most significant biological activity of the soil is found, including beneficial microorganisms that break down organic matter and release nutrients. The preservation of the topsoil is crucial to maintaining agricultural fertility and productivity, as its loss through erosion or inappropriate farming practices can significantly negatively affect soil health and crop yields.

Organic fertilizers are essential for sustainable agriculture. These materials, of plant or animal origin, decompose and gradually release nutrients into the soil. Common examples include compost, manure, crop residues, and vermicompost. This document explores the benefits of organic fertilizers, their types, and their impact on sustainable agriculture. One of the main benefits of organic fertilizers is improving soil structure. By increasing the organic matter content, these fertilizers improve soil texture and its water retention capacity.[6]

Well-structured soil allows for better root growth and facilitates plants' absorption of nutrients and water. Organic fertilizers provide a balanced source of essential plant nutrients, such as nitrogen, phosphorus, and potassium. Unlike chemical fertilizers, which release nutrients quickly, organic fertilizers release them gradually. This ensures constant and prolonged plant nutrition, improving long-term soil fertility and reducing the risk of nutrient shortages, which can contaminate water sources.[7]

Using organic fertilizers encourages the activity of beneficial microorganisms in the soil. These microorganisms break down organic matter, releasing nutrients and improving the soil's overall health. Soil rich in microorganisms is more fertile and resistant to disease and pests. In addition, microbial activity helps form soil aggregates, which improve soil structure and aeration.

Given the above, the objective of this review article is to determine the physical and chemical characteristics of the soil when organic fertilizers are applied.

METHOD

The available literature was reviewed using articles retrieved from SciELO, Scopus, and ClinicalKey databases. Filters were used to select articles in English and Spanish, and empirical methods such as logical history, lysis, and synthesis were used to compile and understand the information obtained. The terms "Soil," "Organic Fertilizer," "Natural Resource," and "Agriculture" were used as keywords in the article. A total of 11 references were selected that addressed different soil characteristics and the effect of organic fertilizer.

RESULTS

Soil improvement is essential in modern agriculture, especially in regions where various human activities have degraded soil. Implementing soil. Organic fertilizers represent a promising strategy for restoring soil fertility and promoting sustainable agricultural practices. This theoretical framework will address the fundamental concepts, the types of soils present in the region, soil degradation, and the role of organic fertilizers in improving soil quality and agricultural productivity.

Well-structured soil rich in organic matter is less susceptible to erosion by wind and water. This is crucial in areas with steep slopes or with typical heavy rainfall.[8] The soil in the San Gabriel sector of Santo Domingo canton has suffered significant degradation due to deforestation, intensive agricultural practices, and water erosion. This degradation manifests in the loss of topsoil, reduced organic matter, soil compaction, and nutrient imbalance, negatively affecting agricultural productivity and environmental sustainability.

The use of organic fertilizers contributes significantly to environmental sustainability. Decreasing dependence on chemical fertilizers reduces the soil and water pollution associated with these synthetic products. In addition, organic fertilizer promotes soil biodiversity by encouraging the activity of beneficial microorganisms, which play a crucial role in the decomposition of organic matter and the release of nutrients. Improving soil

quality translates into an increase in crop yields, directly benefiting farmers with higher harvests and better-quality products.[7]

Organic fertilizers, such as compost, manure, and vermicompost, are proposed as a sustainable solution to improve soil quality. These fertilizers increase the organic matter content, improve the soil's structure and water retention capacity, provide a balanced source of essential nutrients, encourage beneficial microbial activity, and improve quality for beneficial productivity.[8]

San Gabriel, located in the Santo Domingo canton, has various soil types influencing its productive capacity. This region's most common soil types include andisols, ultisols, and inceptisols.[9]

Andisols: These volcanic soils are common in mountainous regions and are characterized by their high water retention capacity, making them ideal for cultivating areas with variable rainfall.

Ultisols: Acidic and low-fertility soils that require management to improve their productivity. Their limited capacity to retain nutrients and their tendency to acidify make the proper management of these soils crucial for agriculture.

Inceptisols: Young soils with a low differentiation of horizons and moderate fertility. Although less fertile than others, these soils can be significantly improved by adding organic matter and nutrients.

Using organic fertilizers is a sustainable agricultural practice that improves soil health and promotes more productive agriculture. Creating an effective organic fertilizer requires a profound understanding of its components, processes, and benefits. The key aspects of soil improvement and the making of an organic fertilizer are detailed below.

To create a customized organic fertilizer tailored to the specific soil conditions in San Gabriel, several steps must be followed:

Soil Analysis: Perform a physical and chemical analysis of the soil to determine its texture, structure, pH, organic matter content, and essential nutrient levels. This will allow the soil's specific needs to be identified.

Materials Selection: Based on the soil analysis, select the most suitable organic materials to provide the necessary nutrients and improve soil structure.

Compost Formulation: Combine the selected materials in appropriate proportions to create a balanced compost that meets the soil's needs. Natural additives can be included, if necessary, to adjust the pH and improve the availability of micronutrients.

Field Tests: Apply the customized organic fertilizer to experimental plots and monitor changes in the soil's physical and chemical properties, crop growth, and yield. Compare the results with untreated control plots and with other standard organic fertilizers.

Formulation Adjustment: Based on the field test results, adjust the fertilizer formulation to optimize its effectiveness.

Creating and using customized organic fertilizers represent an innovative and sustainable solution for soil improvement in the San Gabriel sector of Santo Domingo. These fertilizers improve soil fertility and structure, promote biodiversity, reduce erosion, and lessen environmental impact. By adopting more sustainable agricultural practices, we contribute to the community's well-being and ensure agriculture's long-term sustainability.[8]

There are numerous alternatives for agricultural production, and one can start with small and large actions to obtain visible and immediate results for crops. The proposal to make organic fertilizer with usable waste has been one of the most used strategies in different contexts. It has been achieved as one of the best solutions for environmental conservation. To reduce dependence on artificial chemicals, the microbiological indices are used as a measure of hygienic and sanitary guarantee for the use of compost. The microbial quality of compost should be evaluated similarly to that of soil. A standard analysis of the microbial content of compost is determined by the concentration of six functional groups of microorganisms.[10]

Analysis of the effect of different types of organic fertilizers on crop yields on the property has shown that using these natural fertilizers contributes significantly to increased agricultural productivity. The research was conducted to determine whether different organic fertilizers, such as compost, vermicompost, and bokashi, promote healthy plant growth, improve their resistance to pests and diseases, and increase the quantity and quality of the harvest. The results suggest that, although all the organic fertilizers applied have positive effects, some provide better results depending on the soil characteristics and the crop type.[11]

To ensure the successful implementation of an organic fertilizer proposal, it is crucial to establish fundamental premises that guarantee the project's success. First, a constant and reliable source of raw materials must be ensured, and proper management must be implemented to maintain the quality of the fertilizer. The infrastructure must be built and designed to meet operational needs and incorporate the necessary equipment for production.

Characterizing an organic fertilizer is a task whose purpose is to determine the properties and the components that guarantee the fertilizer achieves both the necessary effectiveness and quality. In the first case, the raw materials (organic waste, animal manure) are studied according to their composition and carbon-nitrogen ratio to guarantee a decomposition process of the organic materials. Secondly, the production method must be

considered to establish how it can determine the quality of the organic fertilizer obtained.[8]

The fertilizer's nutrient content, pH, texture, and water retention capacity must also be measured. In part, characterization determines that laboratory tests are sufficient to guarantee no pathogens and that the desired nutrients are present. Finally, the environmental impact is considered so that the fertilizer improves soil health and contributes to the sustainability necessary to recycle organic waste.[11]

Production processes must be efficient and modified periodically based on exhaustive analysis and quality control measures. In addition, it is essential to create a comprehensive financial plan and a well-thought-out marketing strategy to establish the fertilizer in the market. Complying with rules and regulations while minimizing environmental impact are crucial factors in ensuring the project's sustainability and long-term success. These premises serve as a solid foundation for the effective and responsible use of organic fertilizers.[9]

Organic fertilizers are a natural form of fertilizer produced from organic materials of plant or animal origin. The purpose of fertilizers is to nourish the soil and improve fertility, providing favorable conditions for plant growth and development. Fertilizers provide nutrients (potassium, nitrogen, phosphorus), improve soil structure, increase water retention capacity, and promote beneficial microbial activity.

The use of organic fertilizers can restore soil nutrients and increase agricultural productivity. Improving soil morphology helps to increase water retention and nutrient availability. In turn, the level of microbial activity in the soil increases the rate of decomposition of organic matter, which boosts the increase in nutrients and creates healthier soil. Furthermore, using organic fertilizers offers a sustainable approach to preserving the quality of water, soil, and the environment. In sustainable agriculture, improving soil quality using organic fertilizers is a fundamental strategy for promoting soil fertility, plant health, and environmental sustainability.[10]

CONCLUSIONS

Implementing organic fertilizers is an efficient strategy for optimizing agricultural yield and being a sustainable and environmentally friendly option that contributes to the continuous improvement of soil health and excellent stability in crop production.

REFERENCES

1. Vélez Duque P, Centanaro Quiroz P, Juan Javier Martillo JJM, Alvarado Barzallo A. Preparation of a thematic map of agroecological crops using Google Earth. Salud, Ciencia y Tecnología 2024;4:1018. https://doi.org/10.56294/saludcyt20241018.

2. Martínez-Carvajal F, Rojas-Ortega LF, Eslava-Zapata R, Díaz-Ortega N. Personality traits of the small and medium oil palm farmer and crop productivity. Salud, Ciencia y Tecnología 2024;4. https://doi.org/10.56294/saludcyt2024.970.

3. Roco_Videla A, Flores SV, Pérez-Jiménez S, Caviedes-Olmos M, Torres-Bustos V, Maureira-Carsalade N, et al. Comparison of the level of direct contact with the natural environment in Chilean university students according to the geographical area where they live. Salud, Ciencia y Tecnología 2024;4. https://doi.org/10.56294/saludcyt2024.966.

4. Viteri C, Cabrera J, Iza P, Moreno C, Guanga V. Consumption of processed and ultra-processed foods by a young population of Ecuador. An analysis in light of the PAHO model. Salud, Ciencia y Tecnología 2024;4:875. https://doi.org/10.56294/saludcyt2024875.

5. Peña Oliva G, Calle Carrasco A, Araya-Galleguillos F. Sociocultural aspects that influence the perception of occupational health and safety of the artisanal mining population in the atacama Region, Chile. Salud, Ciencia y Tecnología 2023;3:690. https://doi.org/10.56294/saludcyt2023690.

6. Castillo Tarqui J. Evaluación de la calidad de abonos ecológicos (Compost, Bokashi y Lumbrifert) elaborados a partir de residuos sólidos orgánicos de la ciudad de El Alto. UMSA 2015. https://repositorio.umsa.bo/handle/123456789/6835.

7. Gallo Cevallos J. Evaluación de tres abonos orgánicos en el cultivo de fréjol variedad cuarentón (Phaseolus vulgaris L.). UTC 2024. http://repositorio.utc.edu.ec/handle/27000/11733.

8. Vásquez Proaño D. Producción y evaluación de cuatro tipos de bioabonos como alternativa biotecnologica de uso de residuos orgánicos para la fertilización de pasto. DSPACE 2012. http://dspace.espoch.edu.ec/handle/123456789/1503.

9. Caiza D, Chimbo A, Sarduy Pereira L. Propuesta de producción más limpia en el proceso de elaboración de abonos orgánicos con desechos del camal, realizado en el relleno sanitario del cantón Baños. Ikiam 2018. https://repositorio.ikiam.edu.ec/jspui/handle/RD_IKIAM/113.

10. Ramos Agüero D, Terry Alfonso E. Generalidades de los abonos orgánicos: Importancia del Bocashi como alternativa nutricional para suelos y plantas. Scielo 2014. http://scielo.sld.cu/scielo.php?pid=S0258-59362014000400007&script=sci_arttext&tlng=pt.

11. Herrán J, Torres R, Martínez G. Importancia de los abonos orgánicos. UAIM 2008. https://www.uaim.edu.mx/webraximhai/Ej-10articulosPDF/Art[1]%204%20Abonos.pdf.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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