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ORIGINAL

Soil improvement in the Santo Domingo canton in the San Gabriel del Baba sector on the property of Captain Ruben Recalde with organic fertilizers

Mejoramiento del suelo del canton Santo Domingo en el sector de San Gabriel del Baba en la propiedad del Capitan Ruben Recalde con abonos orgánicos

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ABSTRACT

Introduction: organic fertilizers are essential for sustainable agriculture. These materials, of plant or animal origin, decompose and release nutrients to the soil gradually.
Objective: to determine the physical and chemical characteristics of the soil on Captain Rubén Recalde's property before and after the application of organic fertilizers.
Method: an observational, descriptive and cross-sectional study was carried out related to the physical and chemical characteristics of the soil on Captain Rubén Recalde's property before and after the application of organic fertilizers. The sample will consist of 32 people from said territory selected by a non-probabilistic convenience sampling
Results: 38 % of the population surveyed says that they have been involved in agriculture for less than 5 years. 72 % of people say that they do use chemical fertilizers, 84 % of the population considers that organic fertilizer is the best. 44 % tell us that they use fertilizers on their crops every 3 months. 94 % say they would recommend the use of organic fertilizers to others, 60 % say that organic fertilizers release nutrients more slowly and steadily
Conclusions: organic fertilizers are a natural form of fertilizer produced from organic materials of plant or animal origin. Fertilizers are intended to nourish the soil and improve fertility, which in turn provides favorable conditions for plant growth and development.

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

RESUMEN

Introducción: los abonos orgánicos son esenciales para la agricultura sostenible. Estos materiales, de origen vegetal o animal, se descomponen y liberan nutrientes al suelo de manera gradual.
Objetivo: determinar las características físicas y químicas del suelo en la propiedad del Capitán Rubén Recalde antes y después de la aplicación de abonos orgánicos.
Método: se realizó un estudio observacional, descriptivo y transversal relacionado con las características físicas y químicas del suelo en la propiedad del Capitán Rubén Recalde antes y después de la aplicación de abonos orgánicos. La muestra estará formada por 32 personas de dicho territorio seleccionada por un muestreo no probabilístico por conveniencia.
Resultados: el 38 % de población encuestada dice que ha estado involucrado menos de 5 años en la agricultura. El 72 % de personas manifiesta que sí utiliza fertilizantes químicos, el 84 % de la población considera que el abono orgánico es el mejor. El 44 % nos dice que cada 3 meses utiliza abonos en sus cultivos. El 94 % afirma que recomendaría el uso de abonos orgánicos a otras personas, un 60 % nos expone que los abonos orgánicos

liberan nutrientes de manera más lenta y sostenida.
Conclusiones: los abonos orgánicos son una forma natural de fertilizante producida de materiales orgánicos de origen vegetal o animal. Los abonos tienen la misión de nutrir el suelo y mejorar la fertilidad, lo que, a su vez, proporciona condiciones favorables para el crecimiento y el desarrollo de las plantas.

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

INTRODUCTION

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 water retention capacity.[1]

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 excessive chemical fertilizers and pesticides, 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.[2]

The soil is a natural resource that is fundamental for agriculture, as it provides the physical support and nutrients necessary for plant growth, coinciding with the opinion of several authors.[3,4,5,6,7] In the Santo Domingo canton, San Gabriel sector, the soil has suffered 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.[1]

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 maintain fertility and agricultural productivity since its loss through erosion or inadequate agricultural practices can significantly affect soil health and crop yields.

A soil with a good structure 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 nutrition for the plants, improving the soil's long-term fertility and reducing the risk of nutrient shortages, which can contaminate water sources.[2]

The soil in San Gabriel can vary from sandy to clay. This affects how it retains water and how it allows air to circulate. The soil structure can be damaged in areas where intensive agriculture is practiced. Soils in Santo Domingo are often acidic, ensuring nutrients are unavailable to plants. Excessive use of chemical fertilizers can cause an imbalance of nutrients, with too much nitrogen and phosphorus but a lack of other micronutrients. Organic matter is essential for soil fertility. However, there may be a lack of this matter in areas with a lot of deforestation and intensive cultivation without replenishing organic waste.

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 diseases and pests. In addition, microbial activity helps form soil aggregates, which improve soil structure and aeration.

Given the above, this article aims to determine the physical and chemical characteristics of the soil on Captain Rubén Recalde's property before and after applying organic fertilizers.

METHOD

An observational, descriptive, and cross-sectional study was carried out on the physical and chemical characteristics of the soil on Captain Rubén Recalde's property before and after the application of organic fertilizers in the Canton Santo Domingo in the San Gabriel del Baba sector.

The explanatory approach will allow us to determine the causal relationships between the use of different types of organic fertilizers and the changes observed in soil properties.

The study population will focus on the agricultural soils of Santo Domingo in the parish of San Gabriel. The

sample will consist of 32 people from that territory selected by non-probabilistic convenience sampling since access to the population was conditioned by the participants' availability and willingness to collaborate in the research.

Farmers in San Gabriel, Santo Domingo, were surveyed to gather information on the use of organic fertilizers, the reasons for their use, and the expected results in terms of production and durability.

RESULTS

It can be seen in figure 1 that 38 % of the population surveyed say they have been involved in agriculture for less than 5 years.

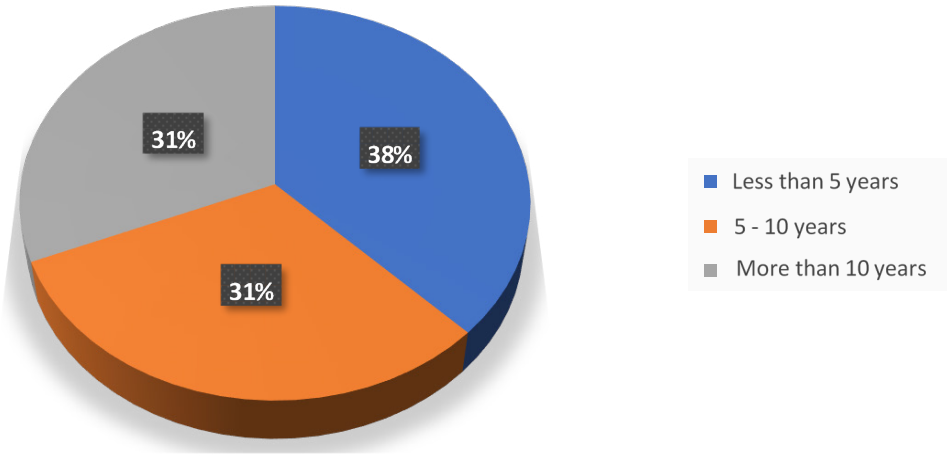

Figure 1. Distribution according to time spent in agriculture.

Of those surveyed, 38 % said they owned between 1 and 5 hectares of land, 37 % said they had less than 1 hectare, and 25 % said they managed more than 5 hectares. 72 % said they used chemical fertilizers, while 28 % denied it.

In figure 2, we can see that 84 % of the population considers organic fertilizer to be the best.

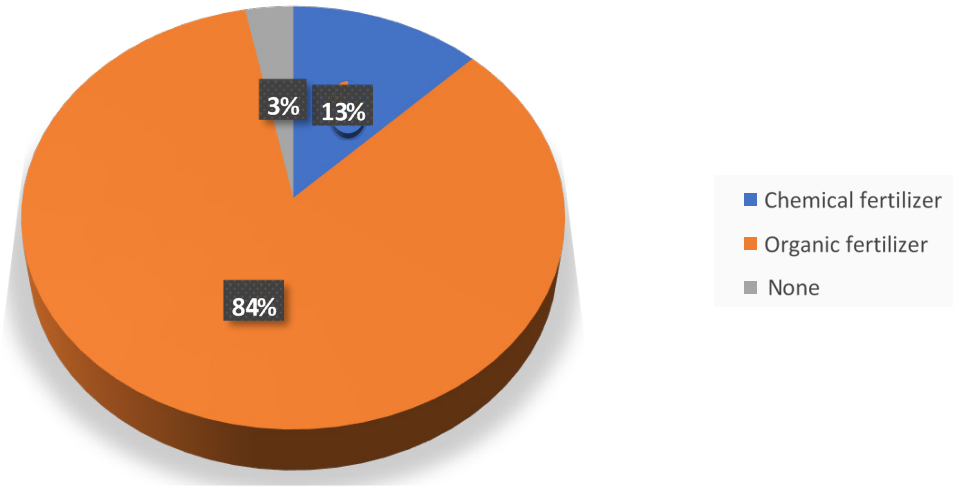

Figure 2. Distribution according to which fertilizer they consider to be the best

44 % say they use fertilizers on their crops every 3 months, 34 % say they use them monthly, another 19% use them weekly, and 3 % never use them. 50 % of those surveyed stated that they expected to increase production using fertilizer, 41 % said that they expected to improve soil quality, and 9 % said their objective was to help the environment.

In figure 3, 47 % of the population says they would be willing to pay more for products grown with organic fertilizer, while 41 % say they might.

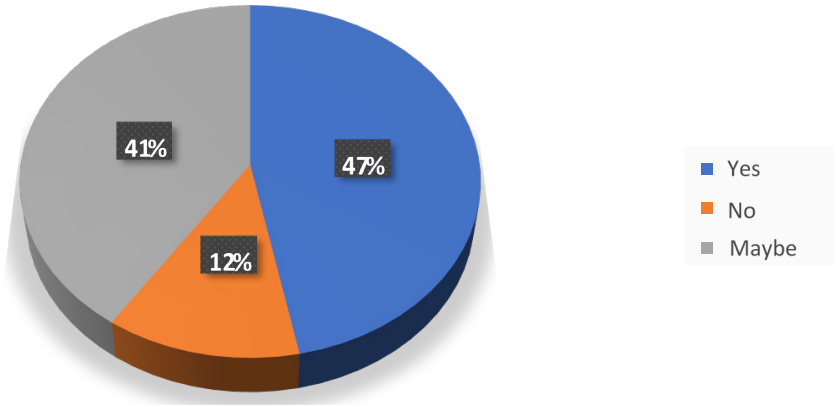

Figure 3. Distribution according to willingness to pay more for products grown with organic fertilizer

94 % said they would recommend using organic fertilizers to others, 3 % said they would not suggest it, and 3 % said they might. According to the type of fertilizer they would use, 44 % said they preferred compost, 34 % said they preferred manure, 16 % chose worm castings, and 6 % selected others.

Figure 4 shows that 69 % state that the soil quality on their land is good.

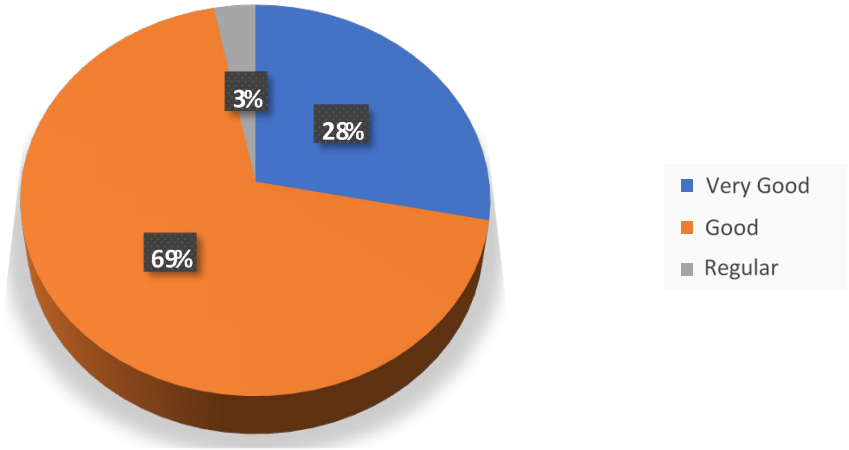

Figure 4. Distribution according to how they rate the soil quality on their agricultural land.

According to the irrigation system used, 47 % of respondents said they used sprinkler irrigation, 25 % drip irrigation, 22 % did not use any irrigation system (only rain), and 6 % used flooding as their method. Some 56% of respondents said they use river or stream water to irrigate their land, 25 % use the community irrigation system, 13 % use stored rainwater, 3 % use healthy water, and 3 % use another water source.

In figure 5, 60 % of inhabitants say they have observed worms or organisms in the soil.

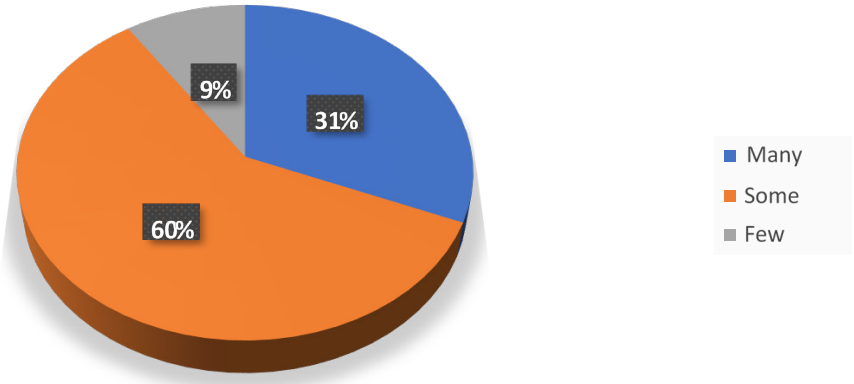

Figure 5. Distribution according to whether they have observed the presence of worms or other organisms in their soil

According to the advantages they consider organic fertilizers to have, 60 % tell us that organic fertilizers release nutrients more slowly and in a more sustained manner, 28 % say that they are easier to mass produce, 9 % report that they contain more synthetic nitrogen and 3 % point out that they do not require composting. Regarding the positive effects of organic fertilizers on food, 41 % chose that organic fertilizers have a higher nutritional value, 31 % said there is a lower risk of toxic residues, 16 % thought that they improve the taste of food, and 12 % said that they preserve freshness.

In figure 6; 34 % of those surveyed state that one influencing factor is the cost of inputs, while 31 % say it is the availability of organic material.

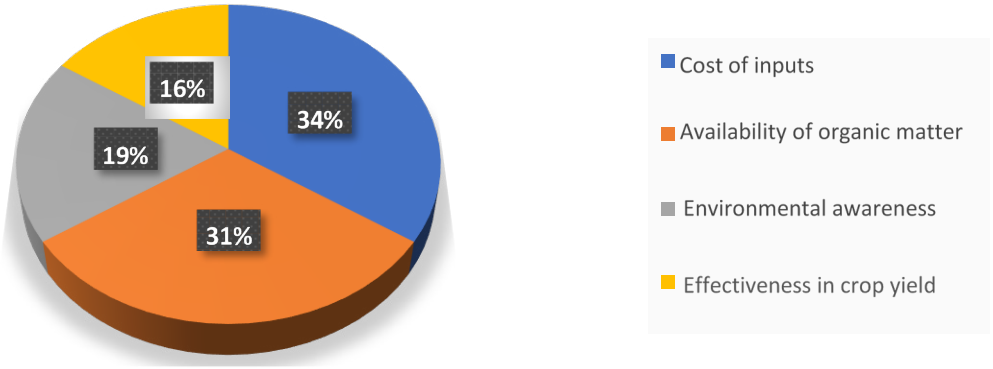

Figure 6. Distribution according to factors influencing a farmer's decision to use organic fertilizers

DISCUSSION

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, reduction of organic matter, soil compaction, and nutrient imbalance, which negatively affects agricultural productivity and environmental sustainability.

The biological importance of composting lies in its ability to convert organic materials into nutrient-rich fertilizer, a crucial step in soil improvement. The use of compost has been shown to improve soil quality, conserve water, and stimulate plant growth. Fermentation techniques, such as bokashi, involve the use of manure, ash, and plant residues to create a fermented fertilizer. Although its effectiveness has not been thoroughly evaluated in the scientific literature, its widespread use highlights its potential benefits.

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 increased crop yields, benefiting farmers with higher harvests and better-quality products.[2]

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, promote beneficial microbial activity, and improve quality for beneficial productivity.[8]

Soil improvement is essential in modern agriculture, especially in regions where various human activities have degraded. Implementing organic fertilizers represents 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.

To create an effective organic fertilizer, knowing the types available and their benefits is necessary. Compost is the perfect combination processed from kitchen scraps and plant debris. Manure is similar to the former, except it comes from animal excrement. This is a powerful energy source, but potential contamination problems make it a last resort. Worm castings are produced by worms from the digestion of organic matter. They have the most potent nutritional properties and also improve soil structure. Beyond that, there is anaerobic digestion, which can produce biogas and liquid fertilizers. In any case, research and development must focus on choosing the right raw materials and improving production processes to produce high-quality fertilizer.

To create a customized organic fertilizer adapted 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.

Material Selection: Based on the soil analysis, select the most suitable organic materials to provide the necessary nutrients and improve the 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 formulation of the fertilizer to optimize its effectiveness.

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

The environmental impact of using organic fertilizers should also be considered. A significant variable is the reduction of greenhouse gas emissions, which contributes to climate change mitigation. In addition, nutrient leaching, which refers to the loss of nutrients through runoff, can negatively affect nearby bodies of water, so it is necessary to evaluate how organic fertilizers can reduce this effect.[9]

There are numerous alternatives for agricultural production, and it is possible to 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 widely used strategies in different contexts. It has been achieved as one of the best solutions for environmental conservation. To reduce dependence on artificial chemicals," microbiological indices are used as a measure of hygienic and sanitary guarantee for the use of compost, indicating that the compost quality is required. 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.[9]

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.[10]

Andisols: These volcanic soils are common in mountainous regions and are characterized by their high water retention capacity, which makes them ideal for cultivation in 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 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 deep understanding of its components, processes, and benefits. The key aspects of soil improvement and the production of an organic fertilizer are detailed below.

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. Research has shown that 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]

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 must be 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 basis for the effective and responsible use of organic fertilizers.[10]

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 secured and properly managed to maintain fertilizer quality. The infrastructure must be built and designed to

meet operational needs and incorporate the necessary equipment for production.

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.[9]

The purpose of characterization of an organic fertilizer is to determine the properties and components that guarantee that 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 this can determine the quality of the organic fertilizer obtained.[8]

CONCLUSIONS

Organic fertilizers are natural fertilizers produced from organic materials of plant or animal origin. Their purpose 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.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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