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Application Technology in the use of Correctives in Corn Culture

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Corn is one of the most cultivated cereals in the world and is used for various purposes and its production is linked to its economic importance, requiring the use of means and methods that enable the increase of its production and one of them is the correction of the ground. The objective of this work is to carry out a brief literature review on the application technology in the use of correctives in the corn crop, highlighting the benefits of its use and the need for its use in the crop. The present study was developed based on a literature review and relevant research on the technology of application of correctives in corn crop, highlighting the benefits of its use and the need for its use in corn crop. Agriculture went through a long development, improving its production system and application technology came with one of the alternatives helping to maintain and improve soil quality, enabling the application of correctives in the soil with greater efficiency. The need for soil correction has to do with the relationship between the plant and the soil, highlighting the acidity, which in many cases is a problem for the cultivation of crops. The use of correctives to correct soil acidity brings many benefits to the physical and chemical characteristics of the soil, reduces fertilizer losses caused by leaching, provides calcium and magnesium to the soil adjusting the soil profile so that plants can benefit from available nutrients. Thus, application technology is

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essential for the corn crop and for the entire production system, even more in the application of correctives, as acidity is one of the causes of yield limitations. Thus, application technology favors soil correction, ensuring the benefits provided by proper application, becoming a means of increasing crop productivity and corn as well, due to the various productive aspects provided by the correct application in the soil.

Keywords: Liming; nutrients; productivity; quality; soil.

1. INTRODUCTION

Corn (*Zea mays* L.) is the most produced and consumed cereal in the world, belongs to the Poaceae family and is considered the second most traded commodity second only to soybeans. Its cultivation dates back to the beginning of its discovery, with great prominence and high importance in our country [1-3].

Of the worlds cereal producers, Brazil stands out as the third largest corn producer in the world, behind the United States and China [4]. With the cultivation of its culture, over the years, with the development of other sectors, the corn production chain became very important, as the grain that was intended for human and animal food became an exportable commodity, in addition to be a quality energy matrix in the production of ethanol [5,6].

According to Ferreira et al. [7] and Bernardi et al. [3] corn stood out with its uses in human and animal food and its importance increased even more due to its various uses, as already mentioned in the energy matrix, in the manufacture of fuels, beverages and polymers.

According to data from Bernardi et al. [3], approximately 1.13 billion tons of corn are produced in the world, with the United States as the largest producer, followed by China and Brazil, representing the largest producers of this crop.

Following with the largest corn producers, Brazil produced 97 million tons in 2017, approximately 81 million tons in 2018 and 100 million tons of corn in 2019 [8,9].

According to Conab [10], in 2020 corn production was approximately 102 million tons, but in 2021 an estimated production of 86 million tons of corn.

Even with the amount of corn production in Brazil in relation to other countries, there is a constant search for higher productivity and profitability in crops, for this, innovation in new technologies and means for the cultivation of the cereal is sought, either by techniques, practices, technologies, machines or the handling itself [8,11].

In order to have the best development of corn, many methods and means can be used, thus, it becomes necessary to make the best use of cultivation techniques. To ensure a good development of the crop, one aspect to be improved is the soil, as by improving soil conditions, it can help to have a greater exploration of the plants root system, thus increasing nutrient absorption [12,6,3].

Thus, one of the practices or even technologies implemented on soil management and to enable better crop development, seeking greater production and which is an important factor for corn cultivation is soil correction.

Corn, which is dependent on many nutrients, especially nitrogen, needs adequate environments to increase its production and as most soils are acidic, soil correction is essential for its cultivation [13, 14].

According to Parizotto et al. [15] and Fernandes et al. [16] limestone applications can leverage corn crop production, thus, application technology in the use of correctives is important to increase corn productivity, requiring its proper knowledge and application in the soil.

The objective of this work is to carry out a brief literature review on the application technology in the use of correctives in the corn crop, highlighting the benefits of its use and the need for its use in the crop, demonstrating how much liming is necessary for its development and production.

2. LITERATURE REVIEW

2.1 Application Technology

Agriculture has gone through a long development, improving its production system and one of the factors that enabled its growth was the application technology, helping to maintain and improve soil quality, enabling the application of correctives in the soil with greater efficiency.

The most adequate definition for the term application technology is the use of technologies and procedures, seeking in a technical, efficient, safe and careful way the proper application of products in a defined and/or undesirable target in the culture, without risk to society, animals and the environment [17,18].

The application technology is already being established in production systems and is used in the application of soil correctives, insecticides, fungicides and other products, ensuring the deposition of the product on the desired target, efficiently and without loss to the environment [19,20].

When dealing with the chemical part of the soil, according to Mantovani et al. [21] and Souza et al. [5] the correction of soil acidity usually occurs at the surface, mainly in a no-tillage system, as its incorporation into the soil causes essential losses in the production system, such as plant residues in the soil, affecting the structural part of the soil. However, the application of the corrective on the surface causes losses of the product and a lower efficiency, thus, it becomes necessary to use application technology to ensure that the correction of the soil occurs in the best way possible.

2.2 Application Technology in the use of Correctives

The need for soil correction has to do with the relationship between the plant and the soil, mainly in the chemical part of the soil, highlighting the acidity, which in many cases is a problem for the cultivation of crops worldwide. The use of correctives occurs due to the acidity present, which is indicated by the pH (hydrogenionic potential), providing indications of the general conditions through the amount of hydrogen ions (H+) in the soil [21,22].

A soil is characterized as acidic when it has many H+ ions and few calcium (Ca2+), magnesium (Mg2+) and potassium (K+) ions in its colloidal exchange complex. Soils with low fertility and high acidity content have low pH values indicating that the soil is deficient in some micronutrients, as the pH range changes the nutrient ratio, thus showing the need to correct the soil [23-25].

Thus, it is essential to use means that optimize soil correction, such as application technology, which according to Bernardi et al. [26] and Matias et al. [27] uses a variable application rate and works through fertility maps that follow the application recommendation. The maps are generated from soil samples and corrective supply maps are prepared with different quantities depending on the area, applying in each location the representative dose based on the liming recommendation [20,27].

The use of liming in soils has the function of converting or avoiding the possible damage caused by soil acidity, thus, correctives are used, in which the hydrogen ions (H+) are equivalently replaced, reducing soil acidity [21,22,25].

According to Frohlich et al. [20] and Silva et al. [24] when noticing the need for liming, through the results of the soil analysis, based on the recommendation for the species to be cultivated, it is necessary to choose the corrective to be used to correct soil acidity.

The most accessible material for soil correction is limestone, with calcitic having 45-55% CaO and less than 5% MgO and dolomitic containing 25-32% CaO and more than 12% MgO, these being the most used [28,29].

However, the application of correctives must be carried out properly, because when applying insufficient doses to the soil, it will not be able to respond as desired, however, excessive applications can lead to an imbalance between the essential elements in the soil, helping to cause more problems in the development of cultures [30,27].

Thus, it is noted that the application should be as appropriate as possible, following the recommendations, so that it provides a good soil correction, which should be carried out based on soil analysis and preferably with the application technology, with an application with more adequate doses that will make it possible to reach the objective of soil correction and enable the productive potential of the crops.

2.3 Benefits of Corrective Application Technology in Cultures

The use of correctives to correct soil acidity generates many benefits for the physical and chemical characteristics of the soil, reduces fertilizer losses caused by leaching, provides calcium and magnesium to the soil, adjusting the soil profile so that plants can benefit from available nutrients [31].

On the fertilizer side, liming makes it possible to use the applied fertilizers and makes other elements, generally toxic, insoluble. However, the increase in calcium and magnesium contents is a consequence of the application of correctives, so you should apply the appropriate dose, check the characteristics of the products and use the application technique [23,30,32,22].

According to Galindo et al. [28] and Reis et al. [33] the other benefits of liming are the increase in the cation exchange capacity and availability of nutrients such as sulfur and molybdenum, release of phosphorus for plant absorption, reduction in the availability of toxic elements such as aluminum and manganese that cause damage and hinder the plant growth and the increase in the soil organic matter reserve.

The application of correctives favors some crops such as corn, as the increase in organic matter mineralization and the improvement of symbiotic nitrogen fixation are processes mediated by bacteria that are considered basophilic, being affected by soil conditions, so that, under conditions ideal will have a higher proportion of microbial biomass and a more nutritious soil for plants [21,32,27,22].

In addition to the benefits mentioned, liming results in increases in pH-dependent loads, reduction in phosphorus adsorption capacity and induces a deep root system development, favoring the search for water and nutrients in the soil and providing a better environment for the development of culture [28,23].

According to Bernardi et al. [26] and Matias et al. [27] other benefits are also generated, in the agronomic, environmental and economic aspects as a whole, whether by the reduction of fertilizers, reduction of costs with soil recovery, less environmental damage, lesser problems with toxic nutrients, among others.

Thus, one can see the amount of benefits that liming can provide in a production system only with the correction of acidity, making the soil more suitable for cultivation and allowing the crop to have greater chances of increasing its production and maintaining a system of productive and quality production.

2.4 Importance of Soil Application Technology for Corn Farming

In the search for greater productivity, agriculture has been developing, using means and methods to increase production gain and as already mentioned, liming brings many benefits to the soil, which will therefore help to increase crop production and allied to technology of application will guarantee good results for the production system [34,27,30].

According to Souza et al. [5] the use of soil corrective application technology is of great importance in crop development due to the benefits generated through application technology and liming and in soil with high acidity and low fertility it can be a solution, solving the problems and making cultivation possible, as some plants do not resist and do not develop in places with low fertility and high acidity, making soil correction one of the possible solutions for the development of crops.

Plants are limited by a number of factors and to enable greater yields to be achieved, a solution is to minimize the main limiting factors for plant development is essential, so solving soil acidity problems is essential [14,25].

As most Brazilian soils have high acidity, there is a higher incidence of aluminum in the soil, as this is the element responsible for high acidity, especially in regions with a predominance of Oxisols, requiring liming to correct the pH, aiming at reduce the toxic effects caused by aluminum in the agricultural production system [33,29,5].

However, in addition to these factors, acidity is one of the main chemical attributes, determining the existence or not of phytotoxic elements and from the pH value, the availability of nutrients is changed, affecting the relationship between nutrients, highlighting the importance correct application of liming to the soil for crops [28,29,25].

According to Bernardi et al. [26] and Andrade et al. [14] the use of correctives in the soil is essential for the development and cultivation of plants, as there are many benefits provided, in addition to its importance in the structural part of the soil and in agriculture, reducing production costs on the agricultural property through the better use of processes in the production of culture.

The correction must also be carried out due to the issue of root growth, which is affected by the toxicity of toxic elements, resulting in less absorption of water and nutrients, and also affects the population of microorganisms that are responsible for the decomposition of organic matter [28,31,29].

In this way, without soil correction when necessary, crops are prevented from reaching their production potential, as soil quality is directly linked to production and soil acidity affects several sectors, whether in relation to nutrients, of microbial biomass, toxic elements, root growth and all of this added together prevents the crop from developing properly. A crop such as corn needs, together with other crops, a suitable soil for its cultivation, and a soil, which is hindered by acidity, will limit its production.

As already shown, the corn crop can benefit from microbial biomass, so soils with low microbial biomass will present a lower rate of nitrogen fixation, which is one of the essential elements and most used by corn, causing limitations in its production. In addition, the corn crop is affected in all other aspects already presented that limit crops, demonstrating how important it is to carry out soil correction, so that the crop achieves higher yields.

However, soil correction should not be carried out in just one year, but in other years as well, always based on the recommendations of the soil analysis, as needed for liming, with an appropriate product, correct dose and application, whenever possible using the application technology and its generated benefits, enabling the guarantee of the mentioned processes and the best disposition of the product [35,14,25].

Thus, application technology is essential for every production system, even more in the application of correctives, as acidity is one of the causes of yield limitations for most crops and for corn as well [19, 20,29.

The technology of application in soil correctives is very important for crops, corn is one of them and a quality soil, with a more adequate soil profile will help to increase its productivity and enable an increase in the production of this crop [26,14,27].

Thus, it is noted that the use of application technology in the use of correctives in the soil is important for the corn crop and for the production system, as it provides many benefits for the soil and for the plant and in all aspects, economic, social and environmental factors, being fundamental for the cultivation of corn.

The use of corrective application technology in agriculture has a great impact on productivity, especially in soils that need liming, so the application technology helps to ensure this product deposition, improving the chemical conditions of the soil and its relationships, providing a more suitable soil for the cultivation of corn, enabling its better development and releasing its production potential.

3. CONCLUSION

Corn is one of the most important crops for the agricultural sector, it stands out for its productions, but there is still the search for increased productivity of the crop, for this, many methods and practices were adopted in the production system, such as soil correction combined with application technology.

The application technology favors soil correction, ensuring the benefits provided by the proper application, becoming a means of increasing crop productivity and of corn as well, due to the various productive aspects provided by the correct application in the soil.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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