TECHNICAL NOTE

Characterization of ID-David Fertilizer for the Mechanized Application of Agromena-G

Caracterización de la fertilizadora ID-David para la aplicación mecanizada del abono órgano mineral Agromena-G

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ABSTRACT: The unavailability of chemical fertilizers to obtain high yields in Cuban agriculture has led to the development of other organic mineral fertilizers, such as Agromena - G, produced by Empresa Geominera del Centro in Villa Clara. The objective of this work was to characterize the ID-David fertilizer for the mechanized application of the Agromena - G organic mineral fertilizer produced by Empresa Geominera del Centro. The methodology included the determination of the uniformity of the transverse distribution of the fertilizer and the general characterization of the work of the fertilizer spreader. The characterization of the ID-David fertilizer spreader, fertilizer locator trailer, during the application of the Agromena - G organic mineral fertilizer showed that this machine performs reliable and stable work. The uniformity of the fertilizer application had a coefficient of variation of 15.29%, which is considered adequate for the distribution of fertilizers with high delivery doses.

***Keywords*:** Fertilizers Spreaders, Coefficient of Variation, Uniformity of the Fertilizer Application.

RESUMEN: La no disponibilidad de fertilizantes químicos para obtener altos rendimientos agrícolas en la agricultura cubana ha motivado el desarrollo de otros abonos órganos-minerales, como Agromena - G, producido por la Empresa Geominera del Centro en Villa Clara. El objetivo de este trabajo fue caracterizar la fertilizadora ID-David para la aplicación mecanizada del abono órgano mineral Agromena - G. La metodología incluyó la determinación de la uniformidad de la distribución transversal del fertilizante y la caracterización general del trabajo de la fertilizadora. La caracterización de la abonadora ID-David, remolque localizador de fertilizantes, durante la aplicación del abono órgano mineral Agromena - G demostró que esta máquina realiza un trabajo confiable y estable. La uniformidad de la aplicación del abono tuvo un coeficiente de variación de 15,29%, el cual se considera adecuado para la distribución de fertilizantes con altas dosis de entrega.

***Palabras clave*:** Fertilizadora, Coeficiente de variación, Uniformidad de aplicación.

INTRODUCTION

Organic mineral manures and fertilizers are applied to agricultural soils to improve the available amount of nutrients for plants and the physical conditions of the soil. The uniform distribution of these and their proper location are fundamental in order to obtain the maximum response from the crop with the minimum cost (Ortis-Cañavate, 2012).

Solid fertilizers are the most used. They include mineral and organic fertilizers that can be applied to the soil in different ways, for example, they are distributed on the surface before plowing or delivered to the bottom of the furrow opened, applied in depth with subsoilers, spread on the soil and mixed with the soil after plowing and before planting or sowing. They can also be applied in conjunction with planting, applied in bands or rows, on the surface or in the soil in established row crops (Ortis-Cañavate, 2012).

The physical properties of a fertilizer are of utmost importance for the performance of the machines used for its distribution. For example, the granulometry produces a segregation or separation by grain size that causes its irregular distribution in the field, when it is dispersed by fertilizing machines. Based on the

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granulometry, the grains of the fertilizer or manure are organized within the deposits, as Carciochi and Tourn (2017), affirm, so that most of the smaller particles tend to accumulate in the central and upper part of the pile of storage, while the largest particles do so at the base and on the outside of the pile. The same situation occurs inside the hoppers, due to the vibrations produced during the transport of the bulk fertilizer.

The Research Center for the Mining-Metallurgical Industry (CIPIMM) developed an organic mineral fertilizer (Agromena) based on the use of organic matter (coal) and minerals such as phosphorus, zeolite, magnesium and others, which has had good results in terms of improvement of the physical properties of the soil and the increase of agricultural yields of various crops (Velázquez *et al.*, 2013).

Organic mineral fertilizers are mixtures of natural minerals used as soil nutrients and other products of organic origin that are used for the same purpose. In Cuba, they have been used in crops such as sugarcane, banana, coffee, corn, tomato, other vegetables and other crops (Ochoa *et al.*, 2001; Corrales *et al.*, 2011; Cairo *et al.*, 2015; Rodríguez *et al.*, 2015; Cairo *et al.*, 2017; Chaveli *et al.*, 2019).

The Empresa Geominera del Centro produces the organic mineral fertilizer Agromena G, with some differences in terms of the components of the product originally developed by the CIPIMM, and different in terms of its physical properties from the other fertilizers used in Cuba. This must be applied in high doses per hectare; therefore, work is being done on the identification of the fertilizing machines that could be used for its application to the soil.

The objective of this work was to characterize the ID-David fertilizer for the mechanized application of the organic mineral fertilizer Agromena - G, produced by the Empresa Geominera del Centro.

MATERIAL AND METHODS

The research was carried out during the years 2021 and 2022. To evaluate the fertilizer, areas of Valle del Yabú Agroindustrial Company were used. The organic mineral fertilizer used was Agromena - G produced in Tasajeras, a unit belonging to the Empresa Geominera del Centro.

The evaluation of the fertilizer consisted of the characterization of the machine and the determination of the delivery uniformity of the fertilizer. These works were carried out at the farm El Pirey of Valle del Yabú Agroindustrial Company, in Santa Clara, geographic coordinates 22°28´50¨ N and 80°01´08¨. Figure 1 shows the fertilizer spreader during a work break. For the characterization of the fertilizer, bibliography available by the manufacturer was used (ID DAVID, 2022). In addition, information was obtained from producers and technical staff.

FIGURE 1. ID-David fertilizer spreader coupled to a UMZ tractor.

FIGURE 2. Obtaining the delivery of organic mineral fertilizer Agromena - G for each one of the outputs of the fertilizer spreader.

Methodology to Evaluate the Distribution Uniformity of the Fertilizer

Distribution uniformity was obtained from modifications to NC ISO 5690-1 (2004). Under static conditions, the four fertilizer outlets of the machine were placed with nylon bags that were held by agricultural workers present in the test (Figure 2), the fertilizer was started for one minute and subsequently the amount of fertilizer in each bag was weighed using a 1g precision scale. The test were made three times.

The degree of uniformity of the transverse distribution was determined as α from the following equation (Boto, 2006).

$$\propto = \frac{S}{X}$$

where:

S - mean standard deviation

X - average

RESULTS AND DISCUSSION

The evaluated fertilizer, called by the manufacturer ID-David as a fertilizer locator trailer, allows dosing the product both superficially or located underground. During the application of the organic mineral fertilizer Agromena - G, there were no technological interruptions, the capacity of the hopper is sufficient

for stable work and high productivity of the fertilizer even with high delivery doses.

This machine has a range of tools that allow it to perform multiple operations depending on the user's needs. It is characterized in that the manure or fertilizer falls from the hopper to the ground by gravity. The transversal distribution obtained with it is homogeneous, the working width being equal to the width of the distributor element. This is a towed machine with dosed flow independent of the forward speed of the tractor. It can be used both for the application of low doses of fertilizers and high doses, for example when organic mineral fertilizers or soil amendments (for example lime) are applied, where doses of up to 4 t/ha or higher can be reached. This fertilizer worked in a stable and very reliable way during the application of Agromena - G to a field cultivated with sweet potatoes and another cultivated with corn. Figure 3 shows the fertilizer during the application of the organic mineral fertilizer Agromena - G to the corn crop. With this fertilizer, any type of fertilizer or solid fertilizer, powder, granules or pearls, can be applied.

This machine allows the application of both powder and granulated, pearled or crystallized fertilizer. This fertilizer has a single axle with a load capacity of 2.5 t. The dosage of the fertilizer flow is obtained by means of a conveyor belt with a triple guide and an automatic height-adjustable hatch or rear gate, with automatic closing when the contribution belt stops moving. With this fertilizing machine, the fertilizer can be spread by coupling a body of centrifugal discs. For the application of the localized fertilizer, it has an attachment for the regulation of the working depth.

Figure 4 shows the average weight of the fertilizer distributed by each of the discharge tubes of the fertilizer spreader. As it can be seen in Figure 4, the distribution uniformity was not homogeneous.

The coefficient of variation of the transverse distribution of the fertilizer was 15.29%, higher than the 10% predicted as a standard for granular fertilizers by several authors (Ortis-Cañavate, 1989; Boto y Díez, 1999; Boto, 2006). However, due to the high application rates involved in the use of this organic mineral fertilizer, this coefficient of variation of the transversal uniformity of the application is acceptable. This result could be due to, as the objective of the tests was to evaluate the operation of the fertilizer spreader and not the fertilizer application to the entire field, the hopper was not completely filled, but only with the essential fertilizer to carry out the work, therefore, the fertilizer was not uniformly dispersed throughout the bottom of the hopper.

CONCLUSIONS

The ID-David fertilizer spreader, fertilizer locator trailer was characterized during the application of the organic mineral fertilizer Agromena - G, achieving a reliable and stable work of the machine. The uniformity of the fertilizer application had a coefficient of variation of 15.29%, which is considered adequate for the distribution of fertilizers with high delivery doses.

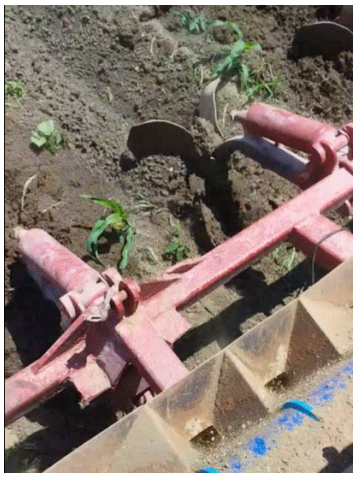

FIGURE 3. Fertilizer during the application of the fertilizer to corn.

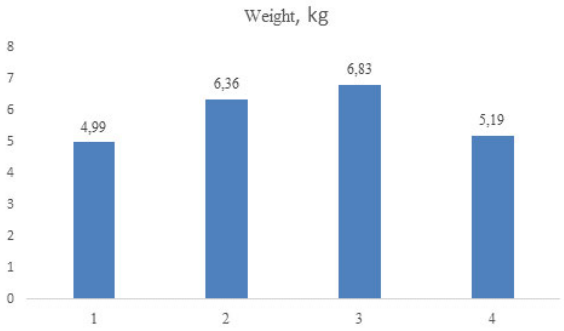

FIGURE 4. Average weight of the fertilizer distributed by the fertilizer spreader in each discharge tube.

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