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Effect of sowing speed on germination percentage in corn crop (*Zea mays*)

Efecto de la velocidad de siembra sobre el porcentaje de germinación en el cultivo de maíz (*Zea mays*)

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Abstract

The objective of the study was to evaluate the effect of three sowing speeds in commercial hybrid corn on the germination percentage in the Mezquital Valley, Hidalgo. The P3270W hybrid was planted in the spring-summer cycle of 2023, with humidity at field capacity, at a density of 90,000 plants ha^{-1}. The germination percentage was evaluated at three sowing speeds: 3.5 km hr^{-1}, 5 km hr^{-1} and 7 km hr^{-1}. The experimental design was completely randomized with 81 m^2 per experimental unit, with three repetitions. Seed emergence data were collected at 5, 6 and 7 days after sowing. A completely randomized and Tukey (5%) design was used. A significant difference was observed in the germination percentage between the treatments. Sowing speed is decisive to obtain a higher germination percentage.

***Zea mays*, Germination, Sowing speed**

Resumen

El objetivo del estudio fue evaluar el efecto de tres velocidades se siembra en maíces híbridos comerciales sobre el porcentaje de germinación en el Valle del Mezquital, Hidalgo. El hibrido P3270W se sembró en el ciclo primavera verano de 2023, con humedad a capacidad de campo, a una densidad de 90,000 plantas ha^{-1}. Se evaluó el porcentaje de germinación en tres velocidades de siembra: 3.5 km hr^{-1}, 5 km hr^{-1} y 7 km hr^{-1}. El diseño experimental fue completamente al azar con 81 m^2 por unidad experimental, con tres repeticiones. La toma de datos de la emergencia de la semilla fue a los 5, 6 y 7 días después de la siembra. Se utilizó un diseño completamente al azar y Tukey (5%). Se observó diferencia significativa en el porcentaje de germinación entre los tratamientos. La velocidad de siembra es determinante para obtener un porcentaje de germinación más alto.

***Zea mays*, germinación, velocidad de siembra**

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Introduction

The Mezquital Valley in Hidalgo is characterised as a region largely dedicated to agriculture, which accounts for 59% of the state's total production. An essential characteristic of the Valley is its semi-arid climate and low rainfall, which makes it a region where agricultural activity would be limited. However, for more than a hundred years it has been receiving wastewater from the Metropolitan Zone of the Valley of Mexico (ZMVM), as a response to the serious flooding problems suffered by Mexico City. This led to a growth in agricultural activity in the Valley, mainly in the central sub-region, positioning it as the main agricultural producer in the State (García-Salazar, 2020).

Maize is one of the three main cereals produced in the world, along with wheat and rice, and it is also a cosmopolitan crop, which has allowed it to develop in an infinite number of climatic, soil, social and ecological conditions. There are many factors that influence maize productivity, starting from crop planning to harvesting. In this sense, rapid and uniform germination sets the first stage for achieving the potential yield at the end of the production cycle (Ramos, 2013) (Ángel Martínez Rengel, 2021). Maize is the most important agricultural crop in our country, from a food, industrial, political and social point of view (Government, 2020).

A quality seed contributes to greater productive varietal efficiency, as it is able to emerge quickly and uniformly, under different environmental conditions. Seed quality is a concept based on the assessment of different attributes (Kelly, 1988), which improve plant establishment in the field, including genetic, physiological, physical and sanitary quality (Basra, 1995; Copeland and McDonald, 1995). On the other hand, physical quality involves characteristics such as: moisture content, weight per volume and purity (Mendoza, 1996).

Faiguenbaum and Romero (1991) point out that physiological seed quality for different species is related to seed size. Other authors (Shieh and McDonald, 1982; Kelly, 1988) report that physiological quality does not depend on seed size.

Martinelli and Moreira de Carvalho (1999), when evaluating the influence of maize seed size in the field, found that large seeds germinated faster than small seeds, resulting in taller plants 25 days after sowing and, subsequently, ears with a higher number of grains per row and higher yield per unit area. These authors also mention that the type of hybrid causes different response to seed size variations.

Modern agriculture demands high quality seed, which is the main input in agriculture that must meet different attributes, including genetic, physiological, physical and sanitary quality. Germination and viability tests have been widely used in the evaluation of seed quality. It should be noted that physiological quality refers to intrinsic mechanisms of the seed that determine its germination capacity, the emergence and development of those structures essential to produce a normal seedling under favourable conditions. However, in recent years, emphasis has been given to the measurement of other parameters, such as vigour and the variables associated with this parameter (Josué Israel García-López, 2016).

In Mexico, different studies have been carried out in maize to quantify the effect of seed size on some seed quality characteristics, both agronomic and grain yield (Kurdikeri et al., 1998). Based on the above, the present research was carried out with the objective of knowing the effect of sowing speed on the germination percentage of maize seed.

Methodology to be developed

The study was carried out during the spring-summer cycle 2023, in the experimental field of the Polytechnic University of Francisco I Madero, Hidalgo, whose location is 20° 22' 40" N latitude, 99°08'81" W longitude, whose texture is classified as clayey crumb. The research was carried out in two phases: A laboratory phase and a field phase; in both a completely randomised experimental design was used. To guarantee the physiological quality in the laboratory, the "between paper" method (ISTA 1999) was used, which consisted of placing absorbent paper towels previously moistened with distilled water on a flat surface, on which 100 seeds were placed, distributed in ten columns by ten rows.

Once the seeds were properly placed, they were covered with more moistened towels and wrapped in the form of a roll, and then placed in an ICB® incubator at a constant temperature of 25 degrees Celsius. The seeds were monitored on the fourth, fifth, sixth and seventh day, until seedlings were observed with well-defined plumule and root, without malformations. Sowing was carried out on April 13, using the hybrid P3270W with a density of 90,000 plants per hectare deposited in the soil with a John Deere precision planter, previously tests were carried out to adjust the revolutions per minute to achieve the speeds corresponding to each treatment, then the seed was deposited at three sowing speeds: 7 km h-1, 5 km h-1 and 3.5 km h-1. To determine the emergence velocity index (EVI), the Maguire (1962) method was used, taking as emerged seedlings those that protrude from the substrate, this in five linear metres taken at random and in triplicate in each treatment, in the sampling, non-germinated grains and abnormal plants were counted.

Results

Table 1 shows the sowing efficiency according to the different sowing speeds, in which it is evident that the higher the sowing speed, the lower the number of emerged plants compared to the lower speed, this parameter is directly related to the sowing efficiency.

Speed (km/hr)	Actual density (Seeds / hectare)	Theoretical Density (seeds/hectare)	Sowing efficiency (%)
3.5	86130	90,000	95.7
5	82080	90000	91.2
7	81720	90000	90.8

Table 1 Sowing efficiency according to sowing speed

With regard to the emergence of seeds per square metre, it can be observed that the seedlings sown at a speed of 3.5 km hr-1, were those that presented the greatest number of emerged specimens and are statistically different, exceeding up to 12% more sprouted seeds with respect to those sown at a speed of 5 km hr-1. On the other hand, those sown at a speed of 7 km hr-1 are statistically equal to those sown at 5 km hr-1, however, sowing at a higher speed represents a loss of emergence of 0.82%. This factor undoubtedly affects the amount of product obtained per hectare (Figure 1).

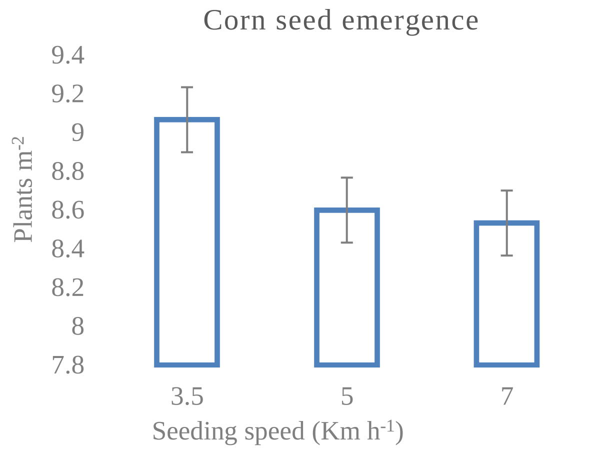

Figure 1 Figure 1.- Number of emerged seeds at different sowing speeds in maize

Figure 2, represents the germinated seeds in laboratory conditions, these values showed that it is a viable seed, because it reached 98 percent of the germination specified in the technical characteristics of the germplasm, allows to establish that the seeds will respond well to field conditions and will develop their potential vigour in in situ conditions.

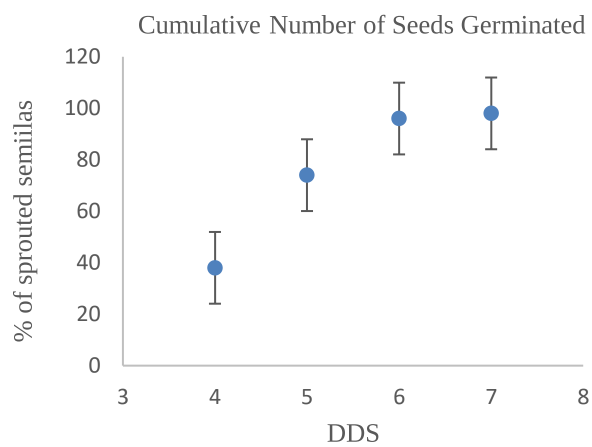

Figure 2

Acknowledgement

Special thanks to the company CORTEVA who kindly donated the test germplasm.

Conclusions

These results suggest that the sowing speed to obtain the greatest amount of emerged maize seeds should not exceed 3.5 km hr^{-1}, in order to guarantee the highest percentage obtained in the emergence of maize plants, because this apparently favours the adequate penetration of the seeds in the soil, implying that working with speeds higher than this value causes a considerable decrease in the amount of emerged germplasm, thus seeking to increase the yield of crops in the region.

Adequate regulation of the machinery avoids or minimises deficiencies in seed emergence, other intrinsic aspects are attributed to the operator's expertise, poor handling of the stubble on the ground, poorly applied irrigation.

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