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(DOI): 10.5777/PAeT.V5.N3.02
This article is presented in English with abstracts in Spanish and Portuguese.
Brazilian Journal of Applied Technology For Agricultural Science, Guarapuava-PR, v.5, n.3, p.17-26, 2012.

Scientific paper

Test germination of corn seeds in different environments

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Abstract

The germination test aims to determine the maximum potential of germination of the seed lot and estimate the value of sowing in the field. The objective of this study is to assess the germination of maize seeds in different types of germination environments. The experiment was conducted in a completely randomized design, factorial scheme (3 x 2) with eight replicates. For the development of this experiment, the maize seeds were subjected to three environments (treatments) which were used in the germination test: BOD germinator, Thermal Seed Germinator and mini plastic tray. Tests were installed with eight replications of 50 seeds per lot, at a temperature of 25 °C. The counting of seeds subjected to the environments was held at four days and seven days after sowing. It was evaluated the characteristics: normal and abnormal seeds. It was observed that the different environments provided significant differences in the germination test of maize seeds. Through the results of the germination test at 4 and 7 days of counting, there was significant difference between the environments, being that the treatment carried out in BOD incubator had a higher germination percentage in relation to the other two treatments, with a percentage of 90,25%. It was verified that the best environment for conducting germination of maize seeds is in the BOD germinator.

Keywords: environments germination, normal seeds, seed quality.

Teste de germinação de sementes de milho em diferentes ambientes

Resumo

O teste de germinação tem por finalidade determinar o potencial máximo de germinação do lote de sementes e estimar o valor de semeadura no campo. Diante disso, objetivou-se com esse trabalho avaliar diferentes tipos de ambientes germinativos visando determinar o mais adequado para germinação de sementes de milho. O experimento foi conduzido em delineamento inteiramente casualizado, em esquema fatorial (3 x 2), com oito repetições. Para o desenvolvimento da pesquisa, as sementes de milho foram submetidas a três ambientes (tratamentos), que foram utilizados no teste de germinação: germinador B.O.D, Germinador Térmico de Sementes e mini bandeja de plástico. Os testes foram instalados com oito repetições de 50 sementes por lote, à temperatura de 25ºC. A contagem das sementes, submetidas aos três ambientes, foi realizada aos quatro e aos sete dias após o plantio. Foram avaliadas as características: sementes normais e sementes anormais. Observou-se que os diferentes ambientes proporcionaram diferenças significativas no teste de germinação de sementes de milho. Através dos resultados do teste aos quatro e sete dias de contagem, observou-se diferença entre os ambientes, sendo que o tratamento realizado na incubadora B.O.D teve um índice germinativo maior em relação aos outros dois tratamentos, tendo uma porcentagem de 90,25%. Verificou-se que a germinadora B.O.D. demonstrou ser o melhor ambiente para a germinação de sementes de milho.

Palavras-chave: ambientes de germinação, sementes normais, qualidade de sementes.

Prueba de la germinación de semillas de maíz en distintos ambientes

Resumen

La prueba de germinación tiene por objeto determinar la máxima germinación potencial del lote y estimar el valor de la siembra en el campo. El objetivo de la investigación fue evaluar diferentes tipos de ambientes germinales para determinar el adecuado para la germinación del maíz. El experimento se realizó en un ensayo completamente aleatorizado en un

Received in: 13/05/2012 Accepted for publication: 02/12/2012

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factorial (3 x 2) con ocho repeticiones. Para el desarrollo de la investigación, las semillas de maíz fueron sometidas a tres ambientes (tratamientos) que se utilizaron en la prueba de germinación: germinador B.O.D, germinador térmico de semillas y mini bandeja de plástico. Las pruebas fueran instaladas con ocho repeticiones de 50 semillas por lote, a una temperatura de 25 ºC. La contaje de lo numero de semillas, sometidas a los tres ambientes se realizó a los cuatro y siete días después de la siembra. Las características evaluadas fueran: semillas normales y semillas anormales. Se observó que los diferentes ambientes produjeron diferencias significativas en la germinación de las semillas de maíz. A través de los resultados de las pruebas a los cuatro y siete días de recuento, se observó diferencias entre los ambientes, y el tratamiento realizado en la incubadora BOD tuvo un índice de germinación más elevado en comparación con los otros tratamientos, con un porcentaje de 90,25%. Se verificó que la germinadora B.O.D. demostró ser el mejor medio para la germinación de maíz.

Palabras clave: ambientes de germinación, semilla de calidad normal, semillas.

Introduction

Being used in many ways, corn is between the crops of higher importance worldwide, for consumption as well as for animal food. Therefore, for production, the corn independent from the scale of production needs good quality seeds (OLIVEIRA et al., 2011).

In Brazil, maize has a high yield potential, reaching 10 t ha^{-1} grain in experimental crops, and for farmers who adopt appropriate technologies (Carvalho et al., 2004). However, the average of national productivity does not reflect its potential reached by most producers, since this comprises yields obtained for various properties with diversified production systems, where, in many cases, are not used essential techniques to obtain high productivities, as liming, fertilization, improved cultivars and cultural techniques of green manure (SANTOS et al., 2010).

According to DUARTE and PATERNIARI (1998), the leading agricultural frontier producer of maize in Brazil and worldwide is the Brazilian cerrado which covers 204 million acres of national territory, which corresponds to almost the entire Midwest and parts of the North, Northeast and Southeast. In this context it is inserted the state of Tocantins, located in the central region cerrado, which has as its main economic sector animal agriculture, accounting for 40% of GDP, according to the Department of Planning of the State of Tocantins - SEPLAN. Now, among the agricultural products stand out the maize crop (BONACELLI and RODRIGUES, 2002).

The cultivation of maize under cerrado in Tocantins is constituted in one of the main agricultural activities, making the 2010/2011 season, an acreage close to 67 000 ha, with production of about 226 000 tons (SEAGRO, 2012). Being an activity which covers several segments of producers and environmental conditions, productivity levels are variable, whose average does not exceed 2 tons ha^{-1} (SEAGRO, 2012).

According to POPINIGIS (1985), one of the requirements of fundamental importance to achieve greater productivity in agriculture is the use of high quality seeds. Besides the correct use of cultural practices, the use of seeds with high germination and high vigor is essential for faster and more uniform emergence of seedlings under wide range of environmental conditions, providing the achievement of adequate plant stand in the field (DEL GIUDICE et al. 1998). To MACHADO et al. (2001), the establishment of plants in the field, among other characteristics, depends on the quality of the seed used.

The seed quality is given by the sum of all genetic attributes, physical, physiological and health that influence the ability of the seed in originate plants highly productive (POPINIGIS, 1985).

In the case of tests of physiological quality of seeds for sowing purpose and merchantability, germination tests are of great importance and is recommended to be performed under ideal conditions, artificial or both, capable of producing high germination values (MAIA et al., 2011).

After obtaining the data with germination test, they are used to compare the physiological quality of lots to determine the rate of sowing and serve as a benchmark for marketing of seed which, to be marketed is made the adoption of a standard procedure in the installation, conduction and evaluation of the tests, which allows to obtain comparable results between laboratories suppliers and buyers of seeds (ISTA, 2004).

When the test of germination of the seed is not made in protected locations occurs uneven germination of the seed. At the time of sowing occurs often, problems related to water availability and both

the water from substrate as the vigor of the seeds are active agents in the process of establishment of seedlings in the soil (PIANA, 1994). Being able to get a low percentage of germination and seedling establishment in the crop.

With this methodology and use of germinators is evolving so that there is precision and improvement of the quality of seed lots, which is of fundamental importance in decisions to be taken at the production and sale of lots avoiding the processing, transportation, marketing and planting material of lower quality (KRZYZANOWSKI and FRANCE NETO, 1991).

Therefore, the objective of this study was to test the germination of corn seeds in paper rolls, plastic bag with perforated and non-perforated in different types of environments.

Materials and methods

This study was conducted in the laboratory of seed of the Educational Institute of Santa Catarina (IESC), University Guaraí - FAG, located in the Midwest region of the state of Tocantins, at 259 meters altitude, at coordinates 08 º 50'03 "south latitude and 48 º 30'37 "west longitude. According to the climatic classification of KÖPPEN (1948), the regional climate is the type B1wA'a' humid with moderate water deficit. The average annual temperature is 28 ° C, with average annual rainfall of 1800 mm.

In the germination test was used maize seeds of the cultivar SOMMA TL of the company Syngenta. The cultivar has a short life cycle, type of orange hard grain, good productive roof, excellent stability, good leaf and grain health, reduces nematode population, plant population of 55-70 thousand plants / ha in the summer and 50 to 60 thousand plants / ha in the second crop, suitable for the conditions of average investment.

The experiment was conducted in a completely randomized design in a factorial scheme (3 x 2), the first factor refers to environments where they will be primed seeds for germination and the second factor regarding the dates of counting of germinated seeds with eight replications.

For the development of this experiment, maize seeds were subjected to three environments (treatments) that were used in the germination test: germinator B.O.D., Thermal germinator of seeds and mini plastic tray.

Tests were installed with eight replications of 50 seeds per lot, in rolls of paper moistened with deionized water at a ratio of 3.0 times the weight of the dry paper, at temperature of 25 ºC.

The first test was conducted in a germinator, BOD, a vertical chamber, containing ten removable shelves of wire, temperature control, air circulator through continuous vertical fan diffuser, with water at top and bottom tank. The second in a thermal germinator of seeds, model MANGELSDORF electronic digital temperature controller with division of 0, 1 °C thermostat of precision, door entirely of glass with dual chamber, for better visibility and light input, superior part, also of glass, enabling execution of germination tests in daylight or in the dark, five shelves, inner dimensions of 60x55x87cm of height and 110 / 220V. The third environment was in a mini plastic tray (GERBOX) measuring 10X10X3 cm length, width and depth, which was used sand washed with deionized and sterilized water.

In the conduction of the germination test, located in the germinator BOD and Thermal germinator of seeds, were used to wrap the sets of paper rolls with seeds, polyethylene transparent bags with dimensions of 28 cm x 38 cm with thicknesses of 0.033 mm (thin plastic) perforated (128 holes of a diameter of 5 mm per side) or not perforated.

In the environment B.O.D. seeds were germinated in bag untapped, now in the thermal germinator of seeds plastic seeds were packaged in bag with holes. For each treatment were performed eight repetitions with 50 seeds each.

The seeds subjected to treatment in the mini plastic tray (GERBOX), was performed with washed sand. The sand was washed with deionized and sterilized water in the autoclave for one hour and then the pH was analyzed, which achieved a value of 6.5. The seeds were germinated in sand moisture which was equal to 60% capacity of retention.

At the bottom of the mini tray was placed a layer of two inches of washed sand and seeds were planted. After sowing was placed an inch of sand in coverage of the seeds. To each tray were sown 50 seeds, a total of eight trays. Were placed to germinate in the thermal germinator of seeds at a temperature of 25 °C. Both the germinator, as the B.O.D. incubator, maintained at a constant temperature of 25 ° C, the optimum temperature for germination of maize.

The count of seeds, submitted to the three environments was performed at four days and seven days after planting. These days characteristics were evaluated: normal seeds and seeds abnormal.

Counting up, in the final count, the percentage of normal and abnormal seedlings (BRASIL, 1992).

The data concerning the variables measured were subjected to analysis of variance and the averages were compared by Tukey test at 5% probability by SISVAR software.

Results and discussion

Statistical difference was observed in the germination of corn seeds in different environments.

There was no significant difference between days four and seven from counts to normal seeds (90.25% and 93.75%, respectively) in germinator B.O.D. now, for abnormal seeds, there were differences and values 9.75% and 6.25% for four and seven days, respectively (Figure 1). This difference may be related to favorable conditions for germination, which offers the germinator BOD also analogically, the seeds abnormal has an number of seeds much lower was when compared statistically to the seventh day.

In the treatment of germinator B.O.D., there was significant difference in the percentage of normal and abnormal seeds. Seed germination in laboratory test is the emergence and development of the essential structures of the embryo, demonstrating its ability to produce a normal plant under favorable conditions of the crop. To BRAZIL (1992), normal seedlings are those who show potential to continue its development and result in normal plants, when grown under favorable conditions. Abnormal seedlings are those who show potential to continue its development and result in normal plants, even growing in favorable conditions.

It was observed that the seeds conditioned in the environment B.O.D had more than 90% of normal seeds. Possibly is related to conditions favorable for germination of maize, such as water, substrate, temperature and other factors. CARVALHO and NAKAGAWA (2000) states that water availability is the most important environmental factor for seed germination, because it is necessary for there to be the rehydration of the seed, who lost moisture during the ripening and drying, and so give the first step for the germination process. To MARCOS FILHO (2005), the germination process suffers influence of temperature, both in the aspect of total germination and speed of germination. The germination process is influenced by the rate of water absorption as the biochemical reactions.

The initial stage of germination takes place with water uptake by the seeds by soaking (TAIZ and ZEIGER, 2004). The supply of energy and of nutrients needed for the resumption of growth of the embryonic axis occurs with water absorption resulting in tissue rehydration, with the consequent intensification of breath and all other metabolic activities (CARVALHO and NAKAGAWA, 2000). The germination, early growth of root system and seedling emergence dependent upon the movement and availability of water, being these factors influenced by the characteristics of the complex colloidal substrate, namely the osmotic potential of the soil (BEWLEY and BLACK, 1994).

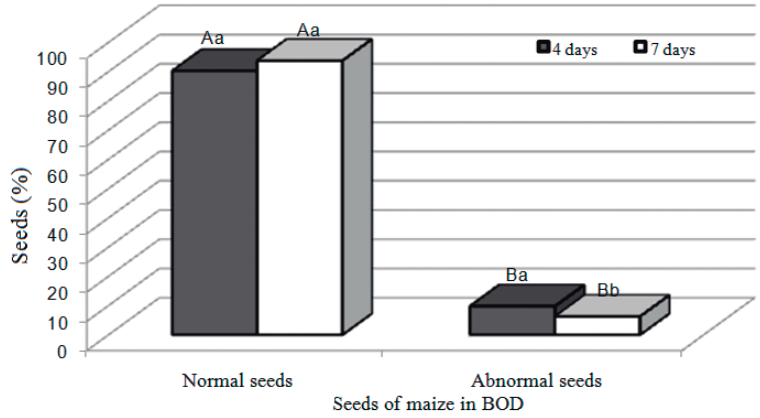

Figure 1. Percentage of germination of maize normal and abnormal in germinator BOD between four and seven days of counting after planting. Guaraí - TO.

Averages followed by the same uppercase considering normal seeds compared with abnormal seeds and lowercase considering normal seeds at 4 and 7 days and abnormal seeds at 4 and 7 days did not differ statistically from each other at 5% probability by Tukey test.

As for seed germination in the thermal germinator was observed that between four and seven days of count after planting there was no significant difference (Figure 2). The germination percentage of normal seeds found between four and seven days did not reach 2% difference between the days of counting, and the first count (the fourth day) had a percentage of 67.25% and in the second (at seven days) 68.75% of normal seeds. As the percentage of abnormal seeds at four days showed 32.75% and a 30.75% reduction at seven days of sowing (Figure 2).

The temperature to which are subjected the seeds has already proven a significant influence, leading to increased germination of maize cultivars and therefore of great importance for obtaining seeds adapted to the many regions of Brazil. BORBA (1995), studying the influence of temperature on seed germination maize, found that the maximum germination was obtained at 30 °C, confirming this experiment.

Studying the influence of temperature on germination of corn seeds, BLACKLOW (1972), found that the elongation of the primary root and of the coleoptile were higher at 30 °C and stopped effectively at temperatures of 9 °C and 40 °C. BIRTH (2000) states that each species has a minimum and maximum temperature, and optimal for germination, and within each species, there may be significant differences among cultivars for germination at different temperatures. The germination temperature range is one of the most important factors for best performance of the seeds and therefore the uniformity of the plants.

In arugula, FERREIRA et al. (2008) observed that there was a higher rate of germination of seeds at temperatures ranging from 25 to 30 °C. As for seeds of beets, arugula and salsa, GOMES et al. (2005) found that mild temperatures (10-15 °C) influenced the germination rate, while the temperature of 25 °C provided greater speed and total germination. It is recommended that constant temperature of 25 or 30 °C for germination of seeds of vegetables such as tomatoes, (OLIVEIRA et al. 2001). On carrots elevated temperatures (35-40 °C), can delay or inhibit the germination of seeds and compromise its establishment in the definitive place (PEREIRA et al., 2007; NASCIMENTO and PEREIRA, 2007).

The use of mini tray for seed germination impaired the germination process, increasing significantly the percentage of abnormal seedlings and reduction of normal seedlings. It was observed that at four and seven days of counting after planting there was significant difference to normal plantlets showing that delaying the counting there was an increase in the germinated seeds and consequently reduction of the abnormal (Figure 3). This probably was due to lack of adequate aeration during the germination process, that is, the water while promoting good maintenance of substrate moisture, should hinder oxygen diffusion thereby impairing the germination process.

The sand substrate, used in germination test should be studied and second TOBE et al. (2005) substrate humidity varies depending on the ambient conditions, affecting seedling growth.

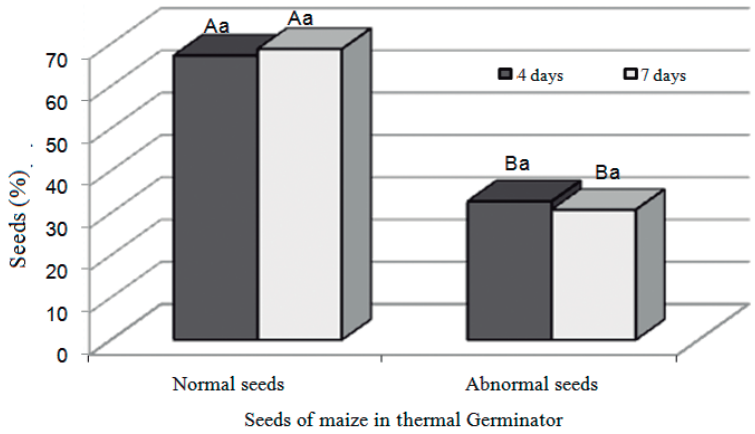

Figure 2. Percentage of germination of maize seeds normal and abnormal in thermal germinator between four and seven days of counting after planting. Guaraí - TO.

Averages followed by the same uppercase considering normal seeds compared with abnormal seeds and lowercase considering normal seeds at 4 and 7 days and abnormal seeds at 4 and 7 days did not differ statistically from each other at 5% probability by Tukey test.

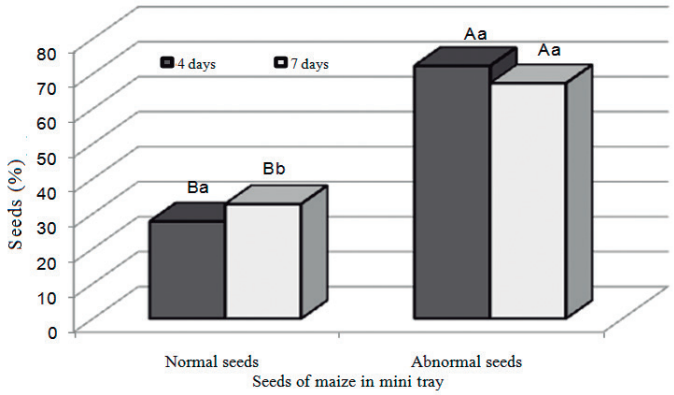

Figure 3. Percentage of germination seeds of maize normal and abnormal mini in tray between four and seven days of counting after planting. Guaraí - TO.

Averages followed by the same uppercase considering normal seeds compared with abnormal seeds and lowercase considering normal seeds at 4 and 7 days and abnormal seeds at 4 and 7 days did not differ statistically from each other at 5% probability by Tukey test.

The amount of retained water must be sufficient for the continuous supply to the seeds and seedlings, and at the same time allow adequate oxygen supply, and root growth. For FIGLIOLIA et al. (1993) the substrates used in germination tests must maintain adequate moisture in order to supply the seeds with a quantity of water needed for its germination and growth.

Through the results of the germination test at four and seven days of counting, there was significant difference between the environments, being that the treatment performed in the incubator B.O.D. had a higher germination percentage in relation to the other two treatments, with a percentage of 90, 25%, since the thermal germinator had germination percentage of 67.25% and the treatment in mini tray 27.75% (Figure 4).

In the second count, the seventh day after planting, it can be observed that the best performance of germination was also through the B.O.D. incubator with 93.75% of normal seeds, the thermal germinator obtained 68.75% and the mini tray, 32.75% (Figure 4). When delaying the count, it was found that the percentage of normal seeds increased in all environments in which it was obtained by the method BOD increase of 3.5% to the thermal germinator 1.5% and for the mini tray 5 % of germinated seeds.

Possibly, although obtaining good germination, there is great difficulty in maintaining the water content of the substrate during the germination test used in germinators. In the case of B.O.D. have control of temperature and photoperiod, but do not control the relative air humidity. In this experiment, we used perforated paper rolls as a way to minimize the problem.

It is noted that heat treatment reduced the germination in approximately 25%. To ISTA (2004) as a way to prevent drying of the substrate inside the germinators, it is recommended to maintain the overall germination test in packaging, which must have adequate size and thickness to gas exchange with the environment of the germinator, enabling thus the diffusion of oxygen into it, without however losing water.

Checking the percentage of abnormal seeds, it can be seen that the treatment conducted with washed sand tray at four days of counting excelled all other treatments, reaching a percentage of 72.25% of abnormal seedlings, the germinator obtained a percentage of 32.75% and the incubator B.O.D. presented the lowest value of abnormal seeds, only 9.75% (figure 5). At seven days of counting there was a similar result to what happened at four days, in which in the tray of washed sand was found with the highest value of abnormal seeds 67.25% in the treatment with the B.O.D. the lowest with 6.25% and in the germinator, 30.75% (figure 5). It is noteworthy that in all environments, by delaying the count, it was found that the percentage of abnormal seedlings reduced considerably.

To MARTINS and CARVALHO (1994) abnormal seedlings may result from genetic factors, environment and management practices that lead to absence or atrophy deformities in their vital organs such as the radicle, hypocotyl and plumule which are difficult or impossible to overcome. It may be assumed that specific causes of seed deterioration lead to the development of specific abnormalities in the seedling.

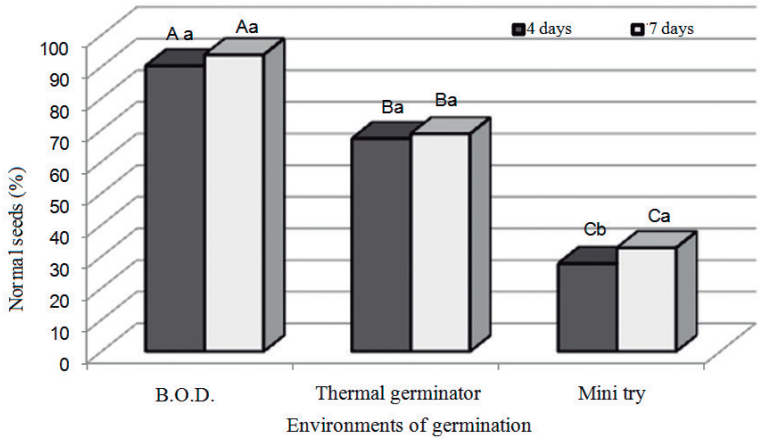

Figure 4. Percentage of germination of normal corn seeds in different environments (B.O.D., thermal germinator and mini tray) at four and seven days of counting after planting. Guaraí - TO.

Averages followed by the same uppercase considering normal seeds compared with abnormal seeds and lowercase considering normal seeds at 4 and 7 days and abnormal seeds at 4 and 7 days did not differ statistically from each other at 5% probability by Tukey test.

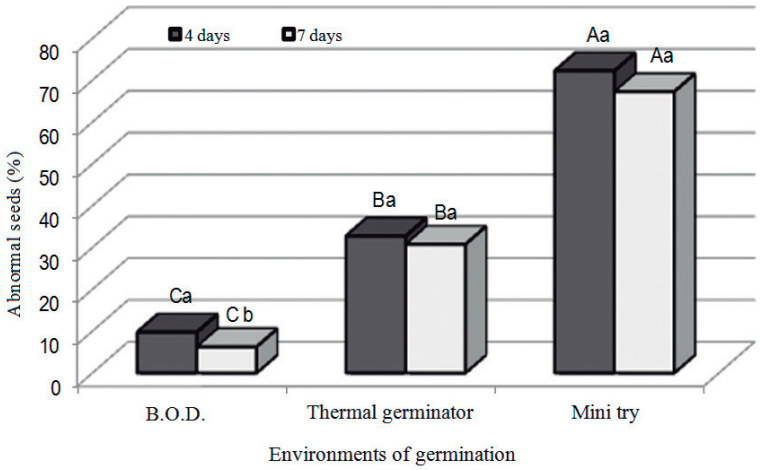

Figure 5. Percentage of germination of maize seeds that did not germinate (abnormal) in different environments (BOD, thermal germinator and mini tray) at four and seven days of counting after planting. Guaraí - TO.

Averages followed by the same uppercase considering normal seeds compared with abnormal seeds and lowercase considering normal seeds at 4 and 7 days and abnormal seeds at 4 and 7 days did not differ statistically from each other at 5% probability by Tukey test.

For purposes of quality control programs, such as of maize seeds would be of great importance that the analyst of the germination test could identify the type of abnormality found in the seedling, the cause of deterioration, which undoubtedly would enable the professionals of production of the company to adopt, for the seeds to be produced in the following harvests, the most appropriate corrective measures.

Conclusions

The three environments contributed to the germination of corn. However, the best test for conducting of germination of maize seeds is on the B.O.D. germinator.

Among the germination tests studied, which contributed less in the percentage of normal seeds was performed in mini plastic tray, with approximately 32% of germination.

The second count, at seven days, helped in raising the percentage of germinated seeds.

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