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Evaluation of the effects of temperature and time of soaking in the speed of germination in malagueta peppers

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Abstract: Peppers are indispensable ingredients in the national cuisine, besides being consumed fresh, can be processed and used in several lines of products in the food industry. Pre-germination treatments of vegetable seeds reduce the time between sowing and emergence of seedlings and increase seed tolerance to adverse environmental conditions. The objective of this work was to evaluate the effect of different imbibition times, and different water temperatures, on the quality and speed of germination in chilli pepper seeds. The seeds were submitted to soaking in water previously heated at 30 °C, 60 °C and 90 °C for 15 seconds, 30 seconds and 60 seconds, and then placed in a gerbox with moist germ paper. The gerboxes were kept in greenhouse with luminosity and constant temperature of 23 °C. The design was completely randomized with 10 treatments (3 soaking times x 3 water temperatures + 1 control) and three replications. The seeds were evaluated daily after germination. The temperature of 90 ° C proved to be detrimental to the germination of the seeds, while the other temperatures showed no significant difference. It was concluded that the temperature of 90 ° C may have caused death of the embryo.
Keywords: Germination test, *Capsicum frutescens*, overcoming dormancy.

Introduction

Capsicum peppercorns are native to America, but their exact origin is controversial: some researchers believe that they originated in the Amazon Basin, while others claim that they originated in Central America or even in Mexico (Bontempo, 2007), belong to the family Of Solanaceae and can be widely produced in Brazilian soils and climates, being found several types of varieties, which have their own characteristics such as: color, flavor, size, among others (Embrapa Hortaliças, 2014).

The consumption of pepper in Brazil is highlighted in several sectors of the economy both in the "in natura" or processed form, due to its usefulness in cooking, and also in the preparation of alternative products in agriculture, medicine production, agroindustrial products, and it is very Required by customers in restaurants (Embrapa Hortaliças, 2012).

This important market for national agriculture registered a market volume of 11,071 t in 2015, being the state of São Paulo the highest expression of 5,496 t, representing 49.6% of the national market (CONAB, 2015).

Being one of the most consumed spices in the world, chilli pepper has been present on our table for more than 500 years. The growing demand for the internal and external market for peppers has led to the expansion of cultivated area in several Brazilian states, mainly in family agriculture initiatives (Filgueira, 2008).

The chilli pepper has vigorous shrub plants, with a height of 0.9 to 1.2 m and quite branched. The fruits have about 1.5 to 3.5 cm in length and 0.3 to 0.5 cm in diameter, when ripe they have red coloration and considered very spicy. The fruits are harvested as maturation occurs because maturation is uneven, as well as showing an indeterminate growth habit, simultaneous vegetative and reproductive growth. However, the fruits are climacteric, that is, it allows harvesting in the immature stage and, after resting period, maturation occurs, modifying the color, which is an excellent morphological marker of maturity.

In order to standardize the germination of seeds, it is necessary to identify the type of dormancy, applying a specific method to overcome it, among them the physicists, characterized by the impermeability of the integument, and the physiological, due to hormonal balance or Pigment concentration, such as red or extreme red phytochrome. The wavelength of red (660 nm) or extreme red (730 nm) allows for the reversal of phytochrome, which is the main light receptor, influencing the germination of photoblastic seeds (Smith & Morgan 1983). One of the methods used to promote the overcoming of physiological dormancy is the use of stratification (Debska et al., 2013), which consists of keeping the seeds at low temperatures (Keshavarzian et al., 2013), or the exogenous application of solutions containing Gibberellins. Giberelic acid, considered an endogenous enzymatic activator, may promote seed germination (Dalastra et al., 2010), when exogenously applied.

Some numbness can be overcome by the imbibition process. Water plays an important role in the germination process by accelerating metabolic reactions. Therefore, imbibed seeds are expected to germinate with greater speed and uniformity when compared to seeds that have not been soaked.

Montardo et al. (2000) tested the effects of thermal scarification by immersion in hot water at 60 °C for 5 minutes in seeds of 5 species of the genus Adesmia, and proved the efficiency of this method. In addition to overcoming dormancy, heat treatment has also been widely used as a new method of pest eradication of plant material. This treatment aims at reducing the use of pesticides, minimizing the risks of introducing new species in exempt areas, and benefiting farmers, who can use this type of technique as a preventive and curative measure for seed-related pests (Tenente et al., 2005).

Therefore, the present work aimed to evaluate the effect of the thermal treatment on the pepper seeds, as a function of the imbibition time, aiming at the higher germination content of normal seedlings, in a shorter time.

Methods

The experiment was conducted at the seed technology and phytopathology laboratories, located at UEM (State University of Maringá) Campus Fazenda de Umuarama - PR, located at 23°45'53'' S and 53° 19'30'' W, 442 m of altitude and average rainfall of 1512 mm per year (Iapar).

Commercial Malagueta pepper seeds, soaked at different times, were used at different water temperatures. The experiment was conducted in a completely randomized design in a factorial scheme 3x3 + 1 (3 soaking times x 3 temperatures + 1 control), constituting ten treatments and four replications (25 seeds).

For each treatment, 25 pepper seeds were used, which were soaked in water at temperatures of 30 °C, 60 °C and 90 °C for the times of 15 seconds 30 seconds and 60 seconds and the control temperature 25 °C without undoing . These seeds were then placed in gerbox plastic boxes (11 x 11 x 3.5 cm), lined with 3 sheets of germitest paper moistened in the ratio 2.5 times the weight of the same hydrated. Gerbils were kept in germination chambers of type B.O.D., with controlled luminosity and temperature (25 °C).

The effect of the temperatures and soaking times on the performance of the seeds was evaluated by the germination test according to the rules of seed analysis (Brazil, 2009), using 4 replicates with 25 seeds each. The evaluations were performed daily in the seeds with primary root emission greater than 2 mm in length. The duration of the test was determined as the number of days from which the germination stabilized; Germination rate (IVG) according to Maguire's formula (1962), shoot length (CPA) and root length (CRCraiz) of the germinated seeds, as well as the mass of the fresh mass of seedlings (MFP) and dry mass of seedlings (MSP).

The data were submitted to analysis of variance and the means were compared by the Tukey test at 5% of probability.

Results and discussion

The interaction between water temperatures and imbibition time was not significant for the evaluated parameters, however, there was a statistical difference for germination averages (G%) and germination velocity index (IVG) in the pretreatment treatment at 90 °C (Figure1).

The temperature has a great influence both on the percentage and the germination speed, especially for altering the speed of water absorption and modifying the speed of the chemical reactions, which will mobilize or degrade the stored reserves and the synthesis of several substances for the growth of the seedlings (Bewley, Black, 1994).

According to Nascimento et al. (2006), the temperature most suitable for germination may vary between different types of pepper. The seeds of most species of *Capsicum* spp., Provided they are not dormant, germinate properly under constant temperature in the range of 25 ºC to 30 ºC. These results indicate that thermal shock has been shown to be beneficial for overcoming dormancy of seeds of various pepper species.

A study carried out by Kikuti and Marcos Filho (2008) with cauliflower seeds, obtained favorable results with hydrocondicionamento, favoring the speed of germination. Corroborating with results obtained by Rodrigues et al. (2009), presenting advantages as to the germination speed after the hydrocondicionamento in the parsley crop (*Petroselinum sativum* Hoffm).

In relation to the time-temperature interaction, there was difference between the treatments that presented germination for the CPA (shoot length) and CR root length variables, except for the treatments with preheated water at 90 °C in which. There was no germination (Figure 2).

The temperatures, 30 and 60 °C, in the time of 15 seconds presented bigger highlights and differed significantly from the time of 60 seconds a variable length of the aerial part. However, for root length treatments at temperatures of 30 °C in the time of 15 and 60 seconds and 60 °C in 15 and 30 seconds were those that presented higher mean significant in relation to the other treatments.

According to Marcos Filho (2005), tissue hydration and temperature are important factors in the germination process, breakage of dormancy and influence in both germination percentage and germination speed, as it interferes with water absorption and biochemical reactions.

Exposure to high temperatures accompanied by prolonged exposure may lead to protein denaturation, alteration in the enzymatic activities required for germination, and even more severe damage to the cellular structures, which may result in germinative delay or blockade (Carvalho et al., 2001; Borghetti; Ferreira, 2004), explaining the absence of germination in the pre-soaked treatments at 90 °C.

In relation to the results of fresh seedling mass (MFP) and dry mass of seedlings (MSP), treatments with temperature 90 °C showed significant differences in relation to the other treatments due to the non-occurrence of germination at this temperature, regardless of the time exposed (Figure 3). The temperatures 30 and 60 °C in the imbibition time of 15 seconds were those that presented significant difference in comparison with the other treatments. For MSP, the imbibition times were the time of 30 seconds at 60 °C, followed by the time of 60 seconds at 30 °C.

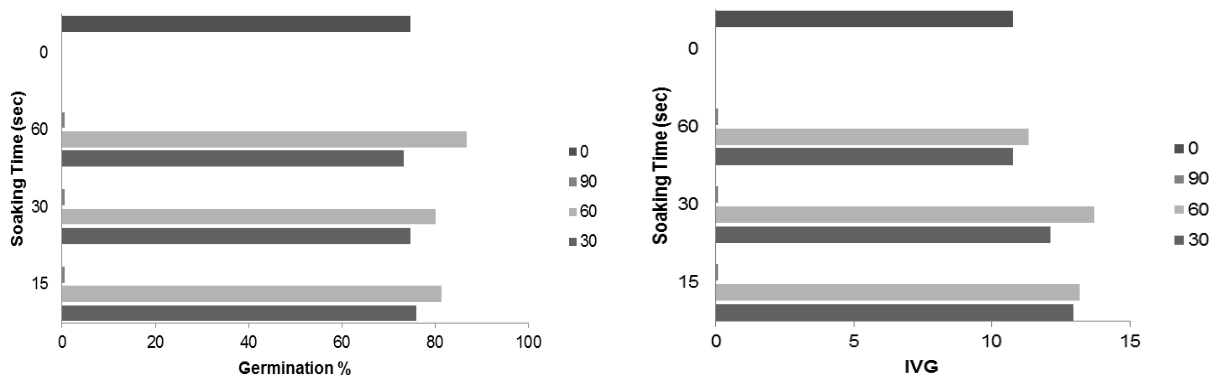

Figura 1 – Seed germination and IVG of *C. frutescens*

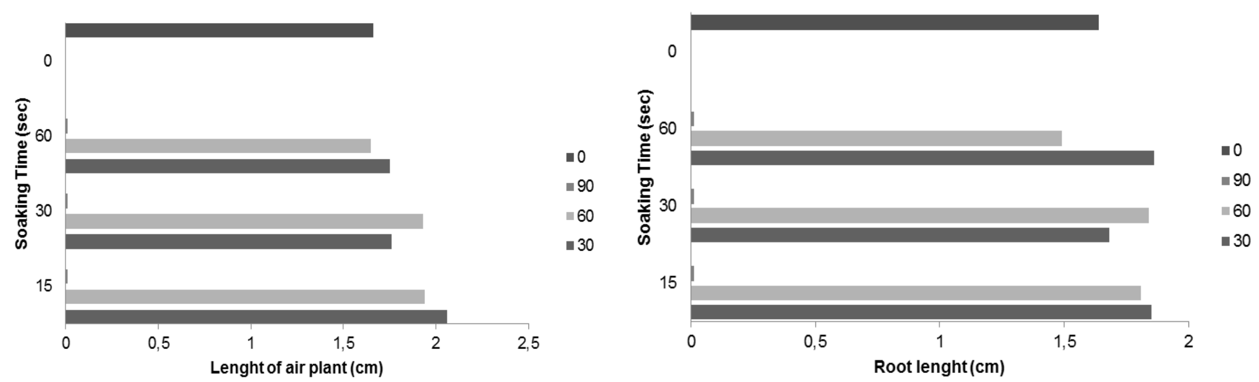

Figure 2 - Mean values of shoot and shoot length of *C. frutescens*

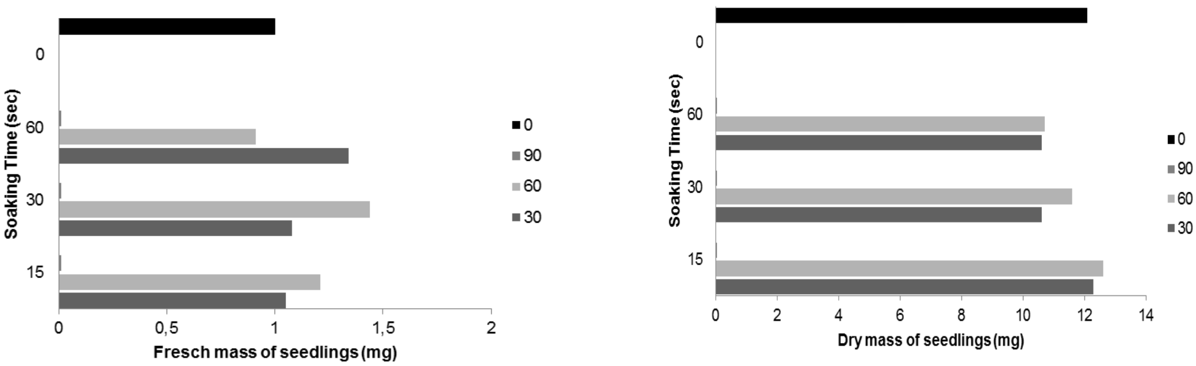

Figure 3 - Mean values of fresh seedling mass (MFP) and dry mass of seedlings (MSC) of *C. frutescens*

According to Nakagawa (1999), lots with lower germination tend to have higher values of dry mass of seedlings than lots with larger germination, perhaps because they enjoy greater space in germination boxes.

Conclusion

Temperatures too high above 90 °C tend to decrease germination, as well as the formation of normal seedlings and, may even lead to the death of the embryo.

The temperature of 60 ºC and the time of 60 seconds provided a higher percentage of germination when compared to the other treatments. The ambient temperature 25 °C did not provide efficient germination compared to the temperatures tested.

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