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Accelerated Aging Test in Determining the Vigour of Sunflower Seeds With and Without Pericarp

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Abstract
The standard germination test alone is insufficient to attest the quality of seeds, making necessary correlation's with vigour tests, to determine more accurately the physiological potential of a seeds lot. The accelerated aging test is an option for determine the vigour and consists in submits seeds to high temperatures and humidity, for different periods of time, has not yet standardized. The objective of this work was to analyze the efficiency of the accelerated aging test in the assessment of the effect of a lot of sunflower seed, by three periods of aging (48, 56 and 72 hours) in 42 °C temperature, in seeds with and without pericarp (manually removed) and relate the results with electrical conductivity test and germination first count. The experimental design was a completely randomized design and the comparison of averages made using Tukey's test at 5% probability. The results showed that standard germination, electrical conductivity and germination first count, the seeds without pericarp showed better performance. In relation to the accelerated aging, only in the period of 72 hours of aging there was no significant difference between the treatments. In this way, the appropriate period to identify differences in force between the treatments was 72 hours, which showed a positive correlation with the germination first count and electrical conductivity.

Keywords: *Helianthus annuus*, temperature, physiological potential, electrical conductivity.

Introduction

The sunflower (*Helianthus annuus* L.) is an oilseed native to North America, adaptable to several soil and climatic conditions with various marketing forms, is a great alternative to the brazilian producers, but is a culture underexplored, with an estimate production of 68 thousand ha^{-1} planted and 108 thousand tons in agricultural harvest 2013/14, very little compared with 55 million hectares planted in Brazil (Conab, 2013). The state of Mato Grosso contributes about 73,8% of the total planted area and production of 85 thousand tons, with great potential for growth.

The sunflower crop fits perfectly in the nowadays agricultural production system adopted in the state of Mato Grosso, appearing as an alternative option for rotation or succession of crops, favoring the reduction of soybean pests and diseases (main crop), reduction of the population of nematodes and improving nutrient cycling, running as an escape for the succession soybean-corn. The culture presents average production of 1,255 $kg.ha^{-1}$ and the sunflower achenes have different purposes, used for the production of edible oil of excellent quality, biofuel, food and feed (Bortolini, 2008). Can also be used in crop-livestock integration system and associated with beekeeping.

The agriculture development is related directly with seed usage rate, which means the use of quality seeds, physical and genetic purity, germination capacity and sanity. According to Richetti (2005) this rate corresponds to only 12.94 % of the total cost of sunflower production. The minimum standard for marketing of sunflower seed is 98% of purity and 75% of germination (Brasil, 2005).

The germination percentage is defined by the capacity of the seed produce normal seedlings in favorable conditions and specific periods of time (Brasil, 2009). However, this percentage can be affected by several internal factors, like vigour, and external factors, such as the water content, air and oxygen, requiring to correlation of standard germination test with other tests, to better estimate physiological potential of a seed lot (Carvalho & Nakagawa, 2000).

Among the vigour tests used, the accelerated aging test presents a positive correlation with the seedling emergence in field, as described by Albuquerque et al. (2001), Nascimento et al . (2007) and Braz (2009), to sort lots of sunflower achenes. This test is based on the principle that more vigourous seeds stand by more time to high temperature and humidity conditions, unlike less vigorous seeds that tend to deteriorate and become unviable before more vigourous (Carvalho & Nakagawa, 2000). Although the effectiveness of accelerated aging test for sunflower seeds is recognized, still is necessary determine some variables like the exposure period, temperature and relative humidity.

Thus, the objective of this work was to evaluate the efficiency of the accelerated aging test in determining the vigour of a sunflower seeds lot with and without pericarp, in different exposure periods.

Methods

This experiment was carried out in the Laboratory of Analysis of Seeds of the Federal University of Mato Grosso, University Unit of Sinop - MT, using sunflower achenes (considered in this experiment as seeds) of the same seed lot, with pericarp (treatment 1) and without pericarp (treatment 2), submitted to tests described below:

A) *Moisture content* - performed by the 105°C/24h official reference oven method, with two samples of 25 seeds, for initial determination and after the accelerated aging test (Brasil, 2009).

(B) *Germination test* – four replications of 50 achenes were placed on *germitest* paper in a germinator at 25 °C. The first counting was done on the fourth day and the final counting was after ten days, results expressed in normal seedling percentage (Brasil, 2009). In conjunction with the standard germination test was carried out first germination count (Nakagawa, 1999).

(C) Electrical conductivity – the mass method was employed, carried out according to the methodology proposed by the Vigour Committee of the International Seed Testing Association (Ista, 1995). Four replicates of 25 seeds were counted and weighed and then placed in plastic cups containing 75 ml of distilled water and taken to germinator at 25°C. The electrical conductivity readings were taken by a conductivity meter after 24 hours and the results were expressed in $\mu S.cm^{-1}.g^{-1}$ of seeds.

E) Accelerated Aging – 250 seeds of each treatment were place on stainless steel screen, in '*gerbox*' with 50 mL of distilled water. The boxes were kept in B.O.D. at 42 °C for periods of 48, 56 and 72 hours. After aging period, the seeds were submitted to standard germination test and the normal seedlings were evaluated four days after the sowing (Brasil, 2009).

A completely randomized experimental design was used in a 3 x 2 factorial, for the accelerated aging test, being three aging periods and two treatments (with pericarp and without pericarp). The averages obtained were compared by variance analysis and Tukey test at 5% probability.

Results and discussion

The Table 1 below presents the average values for germination, electrical conductivity and first germination count, characterize the initial quality of the seed lot. For these three parameters, the seeds without pericarp were statistically superior in all aspects, showing a higher percentage of germination, first germination count and lower leaching of solutes in the electrical conductivity. This can be explained by the absence of pericarp that improved the water absorption by the seed, even with the water content lower initial in seeds with pericarp.

Table 1. First counting, total germination and electrical conductivity obtained for sunflower seeds with pericarp (treatment 1) and without pericarp (treatment 2).

Treatments	First counting (% normal seedlings)	Germintion (% normal seedlings)	Eletrical conductivity (µS/cm/g)
1	18 b	30.5 b	56.07 a
2	75 a	81.5 a	18.19 b

* Mean comparisons within each column by Tukey test, 5%.

In the moisture content, seeds with pericarp showed higher than seeds without pericarp, statistically difference. This structure is a physical barrier provides regulation of the exchanges of gases between the seed and environment, without them the seed is exposed directly to humidity changes. After periods of accelerated aging, there was no difference between the water contents for both treatments (Table 2), which proves that the uniformity in the conduct of the test is fundamental to obtaining consistent results, being tolerated variation between samples 3 to 4%, according to Marcos Filho (1999).

Results from the normal seedlings percentage after the aging periods (Table 3) indicated that to 48 and 56 hours the accelerated agings were did not enable to to stratify in different vigour levels the seeds lot. On the other hands, after 72 hours aging period was possible detected differences between treatments, demonstrated that the treatment 2 lost less germination potential than treatment 1, that is to say was more vigorous.

Table 2. Initial moisture content and after accelerated aging test with sunflower seeds with pericarp (1) and without pericarp (2).

		Accelerated aging (%)		
Treatments	Initial (%)	48 h	56 h	72 h
1	8.37 a *	26.13	28.03	28.25
2	6.14 b	24.25	28.1	26.56

*Mean comparisons within each column by Tukey test, 5%.

As Bertolin et al. (2001), Tunes et al. (2008) and Adamo et al. (1984) notes, the decline in germination was accompanied by the increase in the rate of deterioration in accordance with the exposure period, as can be seen in the seeds with pericarp, where the decline in germination potential was so gradual.

Contrary to expectations, when the seeds without pericarp were subjected to 72 hours period, there was an increase in germination in relation to 48 and 56 hour periods. Braz (2008) found similar results evaluating the vigour in different sunflower seed lots by accelerated aging test with different initial water content.

Table 3. Aging test of seeds with pericarp (1) and without pericarp (2), expressed in % normal seedlings.

Treatments	Aging Test		
	48h	56h	72h
1	27.5 a	16.5 a	10.17 b
2	34 a	20.5 a	39.5 a

*Mean comparisons within each column by Tukey test, 5%.

Due to fungal development, especially 72 hour period, suggested the employment of alternative methodologies, such as the addition of NaCl saturated solution in the accelerated aging test, as observations of Rodo et al. (2000), that the use significantly reduced the development of fungi.

In this way, the 72 hour period presented more sensitivity in identifying differences between treatments. In disagreement with the observations, Adamo et al. (1984) considered the 48 hour period, at 42 °C, ideal to evaluate the quality of lots, while Braz et al. (2008) consider as more appropriated 42°C/96h. A consensus is still to be reached by researchers for many cultures, searching for appropriate exposure periods and temperature.

Conclusion

The accelerated aging test conducted with exposure period of 72 h at 42°C presented enough sensitivity for the physiological potential evaluation of sunflower seeds, showing correlation with the tests of electrical conductivity and first germination count.

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