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Evaluation of physiological quality of sweet corn seeds under different conditions

A. A. C. Rivera, I. V. A. Fiorini, R. G. Von Pinho, H. D. Pereira, E. L. Resende, C. S. Pereira

Universidade Federal de Lavras-MG

Autor for correspondence: arielcanedo@yahoo.es

Abstract. The objective was to evaluate the physiological quality of seeds of sweet corn in two types of packages under different storage conditions. Used supersweet corn seeds of cultivar SwB585 classified in flat sieve. The seeds were placed to soak in distilled water with GA3 at concentrations of 0, 10 and 20 mg L^{-1}, then were placed in vacuum plastic packaging and paper packaging and stored in two environments (cold 10 °C and room temperature 25 °C). The evaluations were made by the germination test, electrical conductivity, accelerated aging and cold test. The experiment was conducted for two types of packaging, in a factorial scheme (2x3x5), corresponding to the two environments, the three doses of GA3 and the five assessment times (0, 60, 120, 180 and 240 days), with four replications. It was found thatthe packages did not influence the physiological quality of seeds, except in the cold test. However, we determined that the best preserved seed physiological potential in refrigerated at 10°C. With the passage of time of storage the gibberellic acid loses effect on seed performance. The seeds of sweet corn vigor decreases linearly with the passage of time in storage.
Key words: Germination, Giberellins, Shape of seeds, Packaging, Storage, Vigour.

Introduction

Sweet corn, due to its form of cultivation and use, can be considered an industrial vegetable and is believed to become an important profitable agronomic alternative in Brazil, because its production is mainly directed to "in natura" use and for processing industrial. With this, there is demand for high quality seeds in the market (Raymond, 1989).

Unlike common corn, sweet corn is high in sugars and low in starch, a result of the action of individual recessive genes, or associated in double and triple combinations (Tracy, 1994). In addition to these genetic combinations, the intense selection process provided the sweet corn cultivars with the presence of thin pericarp and soft texture of the endosperm, making it superior for human consumption compared to common corn (Silva, 1994). However, these characteristics mean that sweet corn seeds present problems of physiological quality when compared to common maize, such as low resistance to pest and disease attack, rapid loss of viability, low storage tolerance and lower germination percentage, leading to the low uniformity of the stand (Paliwal, 2001; Araujo et al., 2006).

As these seeds are more propitious to loss of vigor, it is important to evaluate their storage potential (Marcos Filho, 2005). The preservation of the quality of these seeds during storage is a fundamental aspect to be considered in the production process (Grisi & Santos, 2007). In addition to a suitable storage environment, it is important to have adequate packaging in the process. Packaging that allows high rate of gas exchange and humidity between seeds and the environment can accelerate the process of deterioration (Araujo et al., 2008).

In this context, some artifices are being used with the objective of improving the physiological quality of the seeds in several species. Lopes & Souza (2008) showed that the use of gibberellin, combined with other treatments in pre-sowing, can promote a significant increase in seed emergence, exerting an important hormonal regulation and inducing germination. Considering the factors that may influence the physiological quality of sweet corn seeds, there are few researches showing the best type of packaging, environment, storage time and doses of gibberellic acid for sweet corn seeds. Further studies are needed to improve the physiological quality of sweet corn kernel seeds. The objective of this work was to verify the effect of the association between the storage environment, storage time and the application of gibberellic acid, for the two types of packaging used.

Methods

The experiments were conducted in the Laboratory of Seed Analysis of the Department of Agriculture of the Federal University of Lavras-MG. Sweet corn seeds of SWB585 were used. This cultivar is a simple hybrid of the precocious superdocean type, with cream color grain and tender texture, recommended for use in canned, in natura and industrial consumption. The flat seeds were separated using 18/64 "sieves. Initially, all seeds were placed to soak in gibberellic acid (GA3) in solutions with distilled water at concentrations of 0, 10 and 20 mg L-1 for six hours, then dried at room temperature until reaching approximately 12% moisture .

After drying, the seeds were used in two types of packaging. In the first one, the seeds were packed in vacuum-packed waterproof plastic bags (pressure at 0.1 atm). In the second, permeable packaging of bags of double kraft paper (approximately 80 g / bag) was used. These seeds in their respective containers were kept in two environments: in the cold room with a controlled temperature of 10 ° C and in a storage room at a controlled temperature of 25 ° C. The seeds were evaluated in five storage periods (0, 60, 120, 180 and 240 days). After storage, an evaluation of the moisture content of the seeds in each treatment was performed by the greenhouse method at 105 ± 3 ° C for 24 hours, using two replicates. The results were expressed as percentage, on wet basis.

The germination test was performed as specified in the Seed Analysis Rules (BRASIL, 2009). To perform the electrical conductivity test, 50 seeds were weighed, placed in plastic cups containing 75 ml of distilled water and kept in a BOD chamber with a constant temperature of 25 ° C for 24 hours. After this period, the electrical conductivity of the solution was read in a conductivity meter. The results were expressed as μS cm -1 g -1 of seeds (Vieira & Krzyzanowski, 1999).

For the accelerated aging test, the seeds were submitted to 72 hours of incubation in the BOD type incubator under the conditions of the test (100% RH of the air, 41 ° C), after which they were placed in the Standard Germination Test, following the already explained. The cold test was conducted in plastic boxes with four replicates of 50 seeds for each treatment and as a substrate a mixture of two parts of sand and one of soil was used, adjusting the humidity of the substrate to 60% of the capacity of field. Soon after the boxes were placed in a cold chamber at 10 ° C for seven days, after that period, the boxes were taken to a germinator regulated at 30 ° C, where they remained for seven days.

Then, the percentage of normal seedlings emerged was evaluated. For each experiment, a factorial scheme (2 x 3 x 5) was used, corresponding to the two environments, the three GA3 doses and the five evaluation periods, with four replications.

For the comparisons between quantitative factors, storage times and gibberellin doses, regression analyzes were performed. The Tukey test (P> 0.05) was used to compare the means of the two storage environments and the two types of packages. Data analysis was performed using the SISVAR statistical program (Ferreira, 2008).

Results and discussion

The coefficients of variation (CV) vary from 8.22% to 15.44%, which proves the good experimental precision. The two types of packages presented significant differences only for the cold test. The seeds packed in a vacuum in a waterproof plastic bag presented a germination percentage higher than 2% in relation to the seeds that were packed in a permeable paper bag (Table 1) in the cold test. This result indicates the viability of the vacuum storage, and was verified with other species (Bee & Barros, 1999; Oliveira et al., 2003; Oliveira et al., 2009). The impermeable packaging may provide better conservation of the physiological quality of the seeds during long storage periods, a fact already reported with tomato seeds (Oliveira et al., 2003).

Table 1. Germination averages in the cold test (%) of superdocele seeds of flat form in two types of packages. UFLA, Lavras/MG, 2011.

Packaging	Average
Vacuum Impermeable	65,33 a*
Permeable	63,27 b

* Averages followed by the same letter in the column belong to the same grouping by the Tukey test, at 5% probability.

The two storage environments, the periods of storage and interaction of these factors influenced the physiological quality of the seeds evaluated in all tests performed (Table 2). It was observed that in storage in a cold chamber environment at 10 ° C the physiological quality of sweet corn seeds was better preserved. This was also confirmed by Camargo & Carvalho (2008). The temperature of the storage environment, associated with the relative humidity of the air and seeds, are the factors that most affect the maintenance of quality (Spinola et al., 2000). In the tests in which the seeds were submitted to severe adverse conditions (Cold Test and Accelerated Aging), it was observed that the fall in the physiological quality of the seeds was much more expressive when evaluated in the environment of 25 ° C. This confirms that sweet corn seeds, when compared to common corn, are more susceptible to loss of physiological quality when subjected to stress conditions.

The electrical conductivity test in the refrigerated environment did not show a statistical difference in the storage periods, so this test was not a good indicator of the intensity of the deterioration process of seeds stored at low temperatures (Figure 1D), which was also verified by Panobianco et al. al. (2007) with pea seeds. Coimbra et al. (2009) found that seed performance of a hybrid of superdocele corn was decreasing with storage time (0-16 months), especially when the emergence of field seedlings was evaluated. In all physiological quality tests it was found that seeds stored at 10 ° C were higher than those stored at room temperature at all storage times (Figure 1).

There were no significant differences between treatments submitted to different doses of gibberellin in the cold test. It was observed a better physiological performance in the seeds with 20 mg L-1 of gibberellic acid when compared to seeds receiving 10 mg L-1 (Figure 2A). It was observed in the accelerated aging test that the seeds linearly decreased the germination as the doses of gibberellin increased (Figure 2B). According to Marcos Filho (2005), GA3 can accelerate deterioration over time, resulting in damage to the physiological potential of the seeds. It was verified that in corn seeds, under stress conditions, the use of biostimulants (with presence of gibberellin) can reduce the physiological quality of the seeds. In addition to promoting seed deterioration, higher concentrations of gibberellic acid cause some inhibitory effect on cell stretching (Silva et al., 2008). This was also observed in the cotton crop by Vieira & Santos (2005).

The effect of interaction between doses of GA3 x storage periods was significant in the germination test and in the accelerated aging test (Table 2). This result indicates that GA3 applied loses its effect on the seed over time (Figure 3). It was observed in accelerated aging that the 10 mg L-1 dose of gibberellin improved the physiological quality of the seeds when compared to the control dose in the first storage periods (0-60 days) (Fig. 3B).

This result shows that gibberellic acid has a positive effect on the performance of sweet corn seeds when used immediately or up to 60 days after application. It was also verified that the application of GA3 provided better germination and better uniformity in seedlings emerged in sand, which produced a favorable effect on seedling emergence speed (Aragão et al., 2003).

Table 2. Summary of the analysis of variance involving two environments, three doses of GA3 and five storage periods in the germination, accelerated aging, cold test, electrical conductivity tests in flat sweet corn seeds packed in two types of packages . UFLA, Lavras/MG, 2011.

Sources of Variation:	Degrees of Freedom	Square Averages:			
		Germination Test	Accelerated Aging	Cold Test	Electrical Conductivity
Packaging (P)	1	8,07	4,47	256,27 *	13,85
Blocks	6	16,73	1,21	7,42	9,18
Environments (E)	1	4335,00 **	302,11 **	25626,67**	2901,83 **
Doses GA3 (G)	2	635,42 **	302,11*	3,80 **	129,01 **
Times (T)	4	1247,48 **	4,71 **	5992,89	480,73 **
E x G	2	36,05	0,81	65,87**	10,94
E x T	4	1032,36 **	45,80 **	3864,46	341,94 **
G x T	8	87,063 *	3,30	69,22	29,94
E x G x T	8	24,74	0,48 *	59,28	29,75
E x A	1	15,00	10,49	180,27	151,80
E x G	2	91,32	1,37 *	57,27	63,11 **
E x T	4	48,20	0,33	161,64 **	21,70 **
Error	196	40,32	1,52	48,13	17,71
CV (%)		8,22	11,56	11,12	15,44
Overall Average		77,78	63,33	64,30	27,25

**significant at 1%.
*significant at 5%.

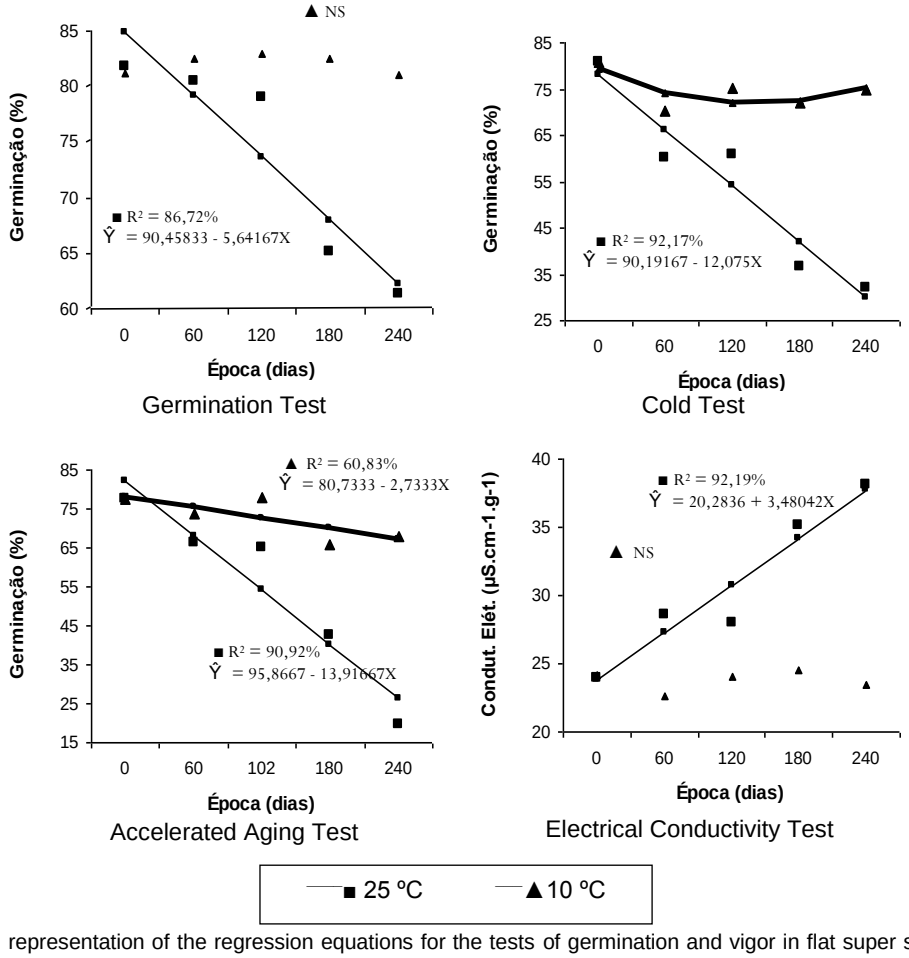

Figure 1. Graphical representation of the regression equations for the tests of germination and vigor in flat super sweet seeds, due to the interaction of five storage periods and two storage environments.

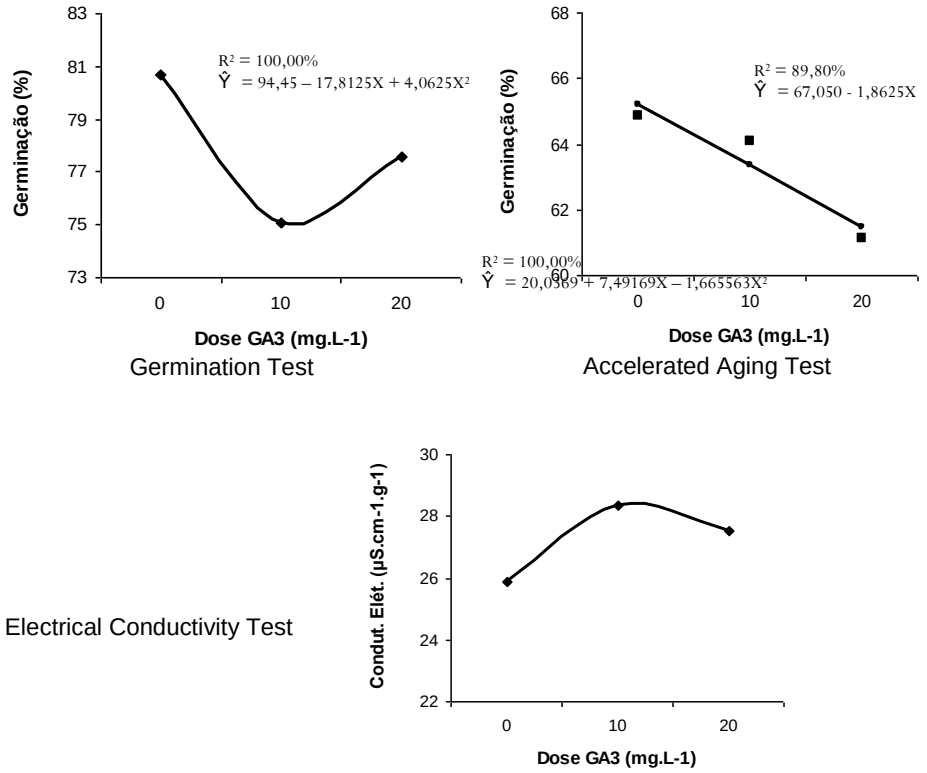

Figure 2. Graphical representation of the regression equations in the evaluation of the physiological quality of super sweet corn seeds in a flat manner, as a function of three doses of gibberellic acid.

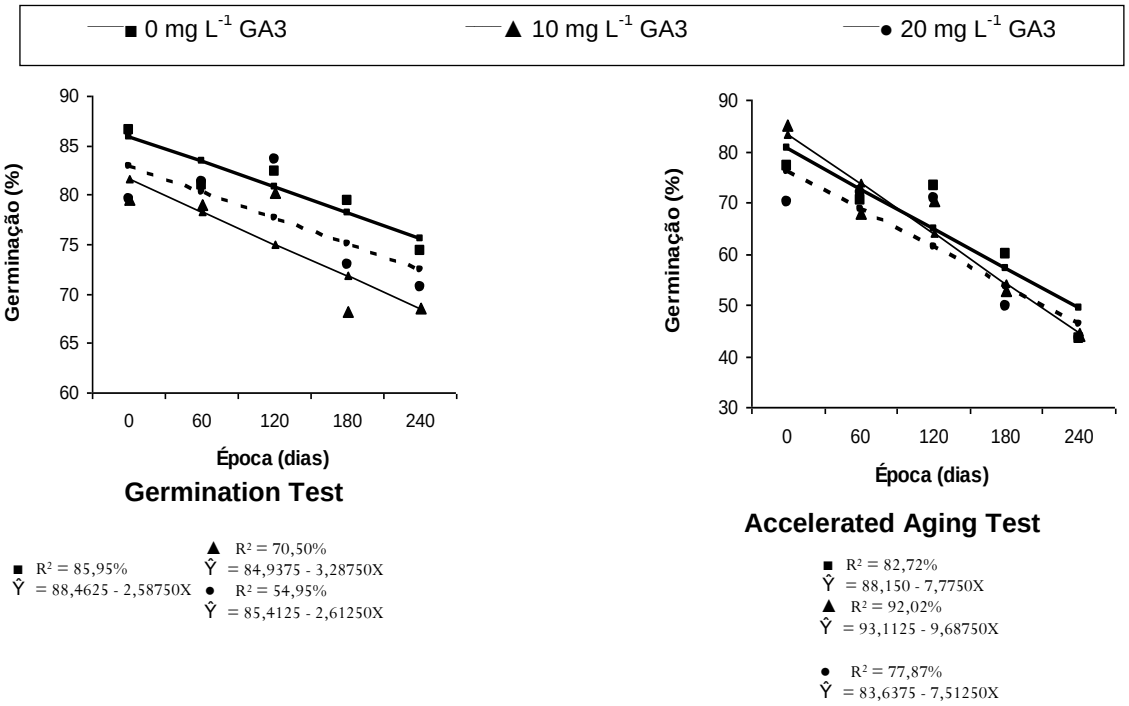

Figure 3. Graphical representation of the regression equations in the physiological quality in super sweet corn seeds in a flat manner, as a function of the interaction of five storage periods and three doses of giber acid

Conclusions

For sweet corn kernel seeds, vacuum packagings in a waterproof plastic bag provided better results than packagings in permeable paper bag only in the cold test.

The packages did not influence the physiological quality of the seeds, however, it was verified that the seeds better preserved their physiological potential in a refrigerated environment at 10 ° C.

With the course of the storage time the gibberellic acid loses effect on the performance of the seeds.

The storage causes the constant deterioration in the performance of sweet corn seeds, regardless of the doses of gibberellin applied in the seeds or the storage environment.

The vigor of flat sweet corn seeds decreases linearly over time in storage.

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