

Assessment of the physiological potential of super sweet corn seeds¹

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ABSTRACT – The assessment of physiological potential is essential in seed quality control programs. This study compared the sensitivity of different procedures for evaluating super sweet corn seed vigor, focusing on the primary root protrusion test. Six seed lots, each of the SWB 551 and SWB 585 hybrids, were used. Seed physiological potential was evaluated by germination and vigor tests (speed of germination, traditional and saturated salt accelerated aging, cold test, seedling length, seedling emergence and primary root protrusion). Primary root protrusion was evaluated every 12 hours at 15 °C, 20 °C and 25 °C using two criteria (primary root protrusion and seedlings at the 2 mm root stage). It was concluded that the primary root protrusion test at 15 °C can evaluate super sweet corn seed vigor by counting the number of seedlings at the 2 mm root stage.

Index terms: *Zea mays* L., seed testing, germination, vigor, primary root.

Testes para avaliação do potencial fisiológico de sementes de milho superdoce

RESUMO – A avaliação eficiente do potencial fisiológico é fundamental para a composição de programas de controle de qualidade de sementes. O objetivo do presente trabalho foi verificar a eficiência de diferentes procedimentos para diferenciar o vigor de lotes de sementes de milho superdoce, com ênfase ao teste de emissão da raiz primária. Utilizaram-se sementes dos híbridos SWB 551 e SWB 585, cada um representado por seis lotes. A avaliação do potencial fisiológico foi efetuada mediante a condução de testes de germinação e de vigor (velocidade de germinação, envelhecimento acelerado tradicional e com solução saturada de NaCl, teste de frio, comprimento e emergência de plântulas e emissão da raiz primária). No teste de emissão da raiz primária, foram avaliados, a cada 12 horas, os efeitos de três temperaturas (15 °C, 20 °C e 25 °C), utilizando-se dois critérios (protrusão da raiz primária e registro de plântulas com raiz primária de, pelo menos, 2 mm de comprimento). Concluiu-se que o teste de emissão da raiz primária a 15 °C, quando são computadas plântulas com raiz primária de, no mínimo, 2 mm de comprimento, é sensível para a avaliação do potencial fisiológico de sementes de milho superdoce.

Termos para indexação: *Zea mays* L., análise de sementes, germinação, vigor, raiz primária.

Introduction

Sweet corn is classified as a special corn and is exclusively for human consumption. Its seeds generally have a low physiological potential due to various factors, including high sensitivity to damage by imbibition, a fragile membrane system after drying, low amide content and a high quantity of sugars in the endosperm. This consequently results in susceptibility to microorganisms since sugars become a substrate for pathogen growth on the seed surface (Styer and Cantliffe, 1983; Douglas et al., 1993).

Seed physiological potential is routinely evaluated by the germination test conducted under theoretically ideal conditions. However, seed lots with similar germination may show distinct performances in the field when conditions

are not ideal. Therefore, vigor tests were developed to complement the information obtained from the germination test with the aim of estimating seed potential under a wide variety of environmental conditions (AOSA, 1983).

Among the most common vigor tests are those based on seedling behavior. These are classified as physiological tests (McDonald, 1975), since they try to determine specific physiological activity, which depends on vigor. They include germination speed, seedling emergence speed and seedling length tests, which have desirable characteristics for a vigor test because they are simple to do, fast and cheap.

Despite the advantages of these seedling development tests, they have generally been considered less sensitive for detecting small vigor differences compared to those which evaluate stress tolerance (Marcos-Filho, 2005), such as, for

¹Submitted on 11/30/2012. Accepted for publication on 04/04/2013.

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example, accelerated aging and cold tests. After Torres (1998) evaluated the efficiency of different tests to determine the physiological potential of corn seeds, he concluded that the cold and accelerated aging tests should be recommended to differentiate different vigor levels in corn seed.

Beside these tests, the primary root protrusion test, although little studied, is easy to do and promising for determining corn seed vigor (Toledo et al., 1999; Matthews and Khajeh-Hosseini, 2006, 2007; Khajeh-Hosseini et al., 2009). The Executive Committee of ISTA (International Seed Testing Association) recently approved the inclusion of the primary root protrusion test, as an additional method for evaluating corn seed vigor, in the International Rules for Seed Analysis, (ISTA, 2011).

Although seedlings cannot be evaluated from the early protrusion of the primary root based on the rules established by the Seed Analysis Rules (Brasil, 2009), this test can estimate corn seed vigor since it associates the number of seeds which emit the primary root with the germination speed (Toledo et al., 1999).

There is research with other species, such as tomatoes (Martinelli-Seneme et al., 2004), cabbage-broccoli (Martins et al., 2002) and pepper (Demir et al., 2008), which describe the possible use of the primary root protrusion test to evaluate vigor.

Since information about the efficiency of vigor tests to evaluate the physiological potential of super sweet corn seeds is relatively scarce, studies should continue. The objective of the current study is to evaluate the efficiency of different tests, especially of primary root protrusion, to obtain data, which can offer alternative tests to use in quality control programs.

Material and Methods

The research was done at the Seed Analysis Laboratory of the Plant Production Department of ESALQ (Escola Superior de Agricultura “Luiz de Queiroz”), São Paulo University (USP), in Piracicaba, São Paulo state. The experiment included evaluations of the performance of super sweet corn seeds in two time periods, three months apart.

Two super sweet corn hybrids (*sh2*) were used, SWB 551 and SWB 585, supplied by Dow AgroSciences, each represented by six seed lots, treated with a fungicide and an insecticide. Lots with different physiological potentials were obtained by submitting part of the seed samples of each hybrid to artificial aging.

Two seed lots of the SWB 551 hybrid were received, weighing 1.3 kg (lot 1) and 8.7 kg (lot 2), respectively. Lot 1 was kept unchanged, whereas lot 2 was divided into four portions: three were artificially aged at 41 °C for 24, 48 and

72 hours, constituting lots 3, 4 and 5, respectively. Lot 6 was obtained by mixing 250 g of lot 2 with 170 g of lot 3, based on the results of preliminary physiological potential tests.

A similar procedure was used to obtain seed lots for the SWB 585 hybrid, with lot 7 corresponding to seeds not aged artificially and lots 8, 9 and 10 to seeds aged at 41 °C, for 12, 24 and 48 hours respectively. Lot 11 was obtained by mixing 290 g of lot 7 with 292 g of lot 8, and lot 12 by mixing 408 g of lot 7 with 175 g of lot 9, also based on preliminary test results.

After aging and careful homogenization of each seed lot, the seeds were dried at room temperature (around 25 °C), until water content was close to initial levels (8.3% to 9.9%). Later, the seeds of each lot were placed in Kraft paper bags and stored in a dry chamber (20 °C and 50% air humidity) during the experiment. The following evaluations were made: *seed moisture content* – measured before the germination and vigor tests using the oven method at 105 °C (± 3 °C), for 24 hours (Brasil, 2009), with two replications for each lot. The results were expressed in mean percentage (wet basis) per lot; *germination* – with four replications of 50 seeds per lot, in paper towel rolls, moistened with an amount of water equivalent to 2.5 times the weight of dry paper at 25 °C, for seven days. Evaluations were made according to criteria established by the Seed Analysis Rules (Brasil, 2009) and the results expressed as the mean percentage of normal seedlings per lot; *germination speed* – determined during the germination test from daily counts of normal seedlings until the data stabilized. The germination speed index was calculated according to Maguire (1962), and the results expressed in mean indices for each lot; *accelerated aging (traditional and with a saturated solution of NaCl)* – using plastic boxes (11.0 x 11.0 x 3.0 cm) with internal metal mesh supports on which seeds were distributed in a single layer. Inside each box were added 40 mL of water or saturated NaCl solution. The boxes were kept sealed and in B.O.D. chambers at 41 °C for 72 hours (Hampton and TeKrony, 1995). After this, the germination test was done and evaluated four days after sowing. The seed moisture content was also determined after aging to observe if test conditions were uniform; *cold test* – plastic trays (34 x 23 x 7cm) were used with 1 kg of substrate (soil/sand mixture). Two replications of 50 seeds were distributed on each tray and covered with 1 kg of substrate. Water availability in the substrate was adjusted to 70% of the retention capacity. The water used was previously cooled to 10 °C. Evaporation was reduced by protecting the trays with a plastic bag and transferring them to a cold chamber at 10 °C, for seven days. The trays were then kept in a germinator at 25 °C and the number of normal seedlings

counted five days later (Caseiro and Marcos-Filho, 2000); *seedling length* – the substrate was prepared as described for the germination test, with four replications of 20 seeds per lot. The seeds were distributed on the upper third of a paper towel with the radicle tip pointing towards the lower part of the towel. The rolls were kept in a germinator at 25 °C for four days, after which the length of the normal seedlings was measured. Results were expressed in mm.seedling⁻¹, to one decimal place (Nakagawa, 1999); *primary root protrusion (protrusion)* – with four replications of 50 seeds from each lot, distributed on moist paper towel sheets, with an amount of water equivalent to 2.5 times the weight of dry paper, and kept in a germinator at 15 °C, 20 °C and 25 °C. The number of seeds which emitted a primary root (protrusion) was counted every 12 hours and classified as criterion 1. Later, the primary root protrusion precocity index was calculated according to Maguire's (1962) formula for calculating the germination speed index; *primary root protrusion (root length ≥ 2 mm)* – done according to procedure already described for primary root protrusion (protrusion); the number of seeds, which emitted a primary root at least 2 mm long was counted every 12 hours (criterion 2). The primary root protrusion precocity index was calculated in a similar manner; *field seedling emergence* – with four replications of 50 seeds, each one represented by a 4 m long row, 40 cm apart, where the seeds were distributed equidistantly in furrows 7 cm deep and covered with about 3 cm of earth. Seedling emergence was evaluated 14 days after sowing, registering the mean percentage of emerged normal seedlings for each lot. The emergence speed index was also calculated according to Maguire's (1962) formula. *Statistical procedure*: the experimental design was completely random (laboratory tests) and with random blocks (field tests) and the data were submitted to an analysis of variance. Means were compared using Duncan's test ($p \leq 0.05$).

Results and Discussion

Both hybrids had seeds with an initial moisture content between 8.3% and 9.9% for the two experimental periods. After traditional accelerated aging (TAA), these values varied from 29.7% to 31.8% and from 29.7% to 32.7% for the seeds of the SWB 551 and SWB 585 hybrids respectively; after saturated salt accelerated aging (SSAA), water content varied between 11.6% and 12.7%. This factor, therefore, did not affect seed behavior during the tests since variations occurred within acceptable limits (Marcos-Filho, 1999b). The lower variation between the samples submitted to SSAA was foreseen because this happens in an environment with a lower humidity (approximately 75%), favoring a slower, more uniform and less

intense absorption of water compared to TAA.

During the experimental period, the lots of both hybrids showed more than 60% germination (Tables 1 and 2), the minimum value established for super sweet corn seed sales in Brazil (Brasil, 2005). This is important since vigor tests should compare the performance of lots which follow the requirements established for commercialization and should have similar germination values (Powell, 1986).

The analyses of variance of the SWB 551 hybrid data for the two experimental periods showed significant effects between the lots for all the parameters evaluated. Lot 1 showed the worst performance for all the tests but there were variations for the identification of the most vigorous lot (Tables 1 and 3). The superiority of any lot for percentage and speed of germination and percentage seedling field emergence was not evident from the results for the first experimental period (Table 1); however, in the second period, these tests indicated that lot 6 tended to be superior. Lot 2 was the most vigorous for seedling emergence speed for both periods but lot 6 also gave a similar result for the second period.

For the SWB 585 hybrid lots, the percentage germination and the percentage seedling field emergence were the same for both experimental periods (Table 2). In the second period, there was no significant variation between lots for germination speed and seedling field emergence speed. The physiological potential of the lots for this hybrid was closer, making it difficult to identify different vigor levels. However, for the first period the germination speed and seedling emergence speed showed a worse result for lots 10 and 9, respectively and identified superior vigor in lot 12. Marcos-Filho (1999a) has observed that the manifestation of vigor is directly influenced by the environment and, therefore, tests based on seedling development, such as germination speed and seedling emergence speed may not be sensitive enough to detect small differences in physiological potential if environmental conditions are very favorable for germination.

The importance of temperature in the manifestation of seed physiological processes may be seen from the cold and accelerated aging tests. The numerical values obtained in the cold test were very low for both hybrids, demonstrating the sensitivity of these hybrids to low temperatures and making the separation of lots for vigor more difficult. For this reason, the data from the cold tests have not been included.

On the other hand, the lots of both hybrids could be separated for vigor by using high temperatures and humidities in the accelerated aging tests, without provoking drastic effects (Tables 1 and 2). This may indicate that the genotypes used are less sensitive to high temperatures than to a low temperature.

Table 1. Mean values of germination (G), germination speed index (GSI), percentage (P) and emergence speed index (SI) of field seedlings, traditional accelerated aging (TAA) and with a saturated salt solution (SSAA) and seedling length (SL) for six lots of super sweet corn seed SWB 551, in two different experimental periods.

Period	Lots	G	GSI	P	SI	TAA	SSAA	SL
		(%)	(index)	(%)	(index)	(%)	(%)	(mm.seedling ⁻¹)
First	1	72 B(*)	7.8 B	60 B	4.8 C	44 D	22 C	44.6 C
	2	91 A	11.7 A	84 A	7.2 A	79 AB	82 A	106.7 AB
	3	91 A	12.0 A	82 A	6.7 AB	75 ABC	73 B	116.9 AB
	4	86 A	11.4 A	77 A	6.1 B	67 C	76 AB	103.8 B
	5	86 A	11.4 A	81 A	6.7 AB	70 BC	81 A	114.9 AB
	6	93 A	11.9 A	78 A	6.5 AB	80 A	78 AB	132.0 A
	CV (%)	6.7	5.3	7.3	7.3	8.2	6.8	16.1
Second	1	68 C	9.2 C	56 C	5.0 C	43 C	27 B	117.8 D
	2	91 AB	13.5 AB	88 AB	8.7 A	82 A	80 A	177.9 A
	3	90 AB	13.1 AB	81 B	7.4 B	75 AB	79 A	140.5 CD
	4	88 B	12.6 B	83 AB	7.7 B	71 B	75 A	147.5 BC
	5	89 B	13.0 AB	82 AB	7.8 B	70 B	73 A	153.1 BC
	6	97 A	14.1 A	89 A	8.6 A	80 A	75 A	167.5 AB
	CV (%)	5.1	6.4	6.0	6.1	7.7	11.2	10.3

(*) Means followed by the same letter (within each column) do not differ among themselves according to Duncan's test, $p \leq 0.05$.

Table 2. Mean values of germination (G), germination speed index (GSI), percentage (P) and emergence speed index (SI) of field seedlings, traditional accelerated aging (TAA) and with a saturated salt solution (SSAA) and seedling length (SL) for six lots of super sweet corn seed SWB 585, in two different experimental periods.

Period	Lots	G	GSI	P	SI	TAA	SSAA	SL
		(%)	(index)	(%)	(index)	(%)	(%)	(mm.seedling ⁻¹)
First	7	89 A(*)	10.8 AB	82 A	6.8 AB	69 A	72 A	93.2 A
	8	90 A	11.0 AB	76 A	6.2 AB	51 B	74 A	85.2 AB
	9	91 A	11.3 AB	74 A	5.9 B	53 B	61 C	100.0 A
	10	88 A	10.5 B	74 A	6.1 AB	33 C	70 AB	61.6 B
	11	90 A	11.5 AB	78 A	6.3 AB	55 B	63 BC	104.8 A
	12	90 A	11.8 A	84 A	7.0 A	61 AB	77 A	82.3 AB
	CV (%)	4.9	6.0	8.5	9.0	16.8	8.0	21.7
Second	7	89 A	12.4 A	79 A	7.2 A	67 A	72 A	113.0 AB
	8	86 A	12.1 A	75 A	6.9 A	61 A	73 A	106.0 B
	9	88 A	12.2 A	76 A	6.9 A	60 A	69 A	117.6 AB
	10	87 A	11.9 A	75 A	6.9 A	46 B	73 A	85.7 C
	11	84 A	11.8 A	79 A	7.1 A	64 A	74 A	129.2 A
	12	82 A	11.8 A	73 A	6.7 A	60 A	68 A	100.4 BC
	CV (%)	6.1	6.7	9.9	10.2	11.6	7.4	11.1

(*) Means followed by the same letter (within each column) do not differ among themselves according to Duncan's test, $p \leq 0.05$.

The results of the traditional accelerated aging test (TAA) for the SWB 551 hybrid in both experimental periods showed that the better performance of lot 6 was accompanied by lot 2 in the second period (Table 1). This was also seen for seedling emergence speed for lot 2. The efficiency of the traditional accelerated aging test has been confirmed by Santos et al. (2002), using temperatures

of 45 °C and 42 °C for 24 and 72 hours, respectively, to differentiate super sweet corn seed lots into different vigor levels. However, for the saturated salt accelerated aging test (SSAA), the more vigorous lots were only identified for the first period (lots 2 and 5). For the SWB 585 hybrid, results from the traditional test showed that lot 10 gave the worst

performance for both periods and that lot 7 was identified as the most vigorous in the first period and with a tendency to be superior in the second period (Table 2). However, the test with the saturated solution of NaCl separated the lots for vigor only for the first period, indicating lot 9 to have the least vigor. It can be seen for this test (SSAA) that lot 10 did not differ from the best lots. This probably occurred because the seeds absorbed less water, more slowly, resulting in a lower deterioration rate, and consequently, less variable results.

Thus the results showed that for the SWB 551 hybrid, the traditional accelerated aging and seedling emergence speed tests were similar for both time periods; for the SWB 585 hybrid, only the traditional accelerated aging test was sensitive enough to differentiate lot vigor in both experimental periods.

The seedling length test was also efficient for separating the lots of both hybrids for vigor (Tables 1 and 2). The results for the SWB 551 hybrid showed that lot 6 gave the best performance in the first period and lot 2 in the second period. These results were similar for both periods with those obtained for the traditional accelerated aging test. Teixeira et al. (2006) also observed similar results for corn lot vigor between seedling length and traditional accelerated aging tests. For the SWB 585 hybrid in both periods, the results of the seedling

length test showed lot 10 as having the worst performance and lot 11 the best performance in the second period (Table 2). There was also coherence in this hybrid between the results obtained in the seedling length and traditional accelerated aging tests, regarding the least vigorous lot in both periods.

Table 3 shows the results of the primary root protrusion test for the SWB 551 hybrid. In the first period, for the primary root protrusion test done at 25 °C (criterion 2), lots 2 and 6 were identified as the most vigorous; for the tests done at 15 °C and 20 °C, lot 2 showed the best performance considering both criteria. In general, the results of the primary root protrusion test for the second period were similar to those obtained in the first period, showing the superiority of lot 2, accompanied or not by other lots (4 or 6). These results agreed with those obtained for seedling emergence speed, traditional accelerated aging and seedling length (Table 1). Similarly, Matthews and Khajeh-Hosseini (2006) observed a close relationship between primary root protrusion (primary root protrusion or when seedlings have a primary root at least 2 mm long) at 13 °C, and the mean time for seedling field emergence; the corn seed lots which emitted the primary root more quickly also had faster seedling emergence.

Table 3. Mean indices of precocity of primary root protrusion at 15 °C (PRP 15 °C), 20 °C (PRP 20 °C) and 25 °C (PRP 25 °C), considering primary root protrusion (Criterion 1) and seedlings with a primary root at least 2 mm long (Criterion 2), for six lots of super sweet corn seed SWB 551, in two experimental periods.

Period	Lots	PRP 15 °C		PRP 20 °C		PRP 25 °C	
		Criterion 1	Criterion 2	Criterion 1	Criterion 2	Criterion 1	Criterion 2
First	1	2.7 C(*)	2.5 D	6.8 C	6.3 C	12.0 B	10.3 C
	2	6.3 A	5.0 A	12.0 A	10.1 A	16.5 A	14.6 A
	3	4.8 B	4.4 B	11.4 AB	9.2 B	16.1 A	13.6 B
	4	4.6 B	4.6 AB	10.7 B	8.8 B	15.9 A	13.8 AB
	5	5.0 B	3.8 C	10.8 B	9.3 B	16.4 A	13.5 B
	6	5.1 B	3.8 C	11.2 B	9.2 B	16.9 A	14.5 A
	CV (%)	9.7	7.9	4.3	5.9	5.0	4.3
Second	1	1.8 C	1.8 C	4.7 C	4.8 C	10.2 C	7.6 C
	2	4.9 A	3.7 A	8.9 A	8.1 A	16.1 A	13.6 A
	3	3.9 B	3.0 B	7.9 AB	7.0 B	14.8 AB	12.4 AB
	4	5.0 A	3.7 A	8.3 AB	8.1 A	14.8 AB	12.1 B
	5	4.3 AB	3.0 B	7.4 B	6.6 B	14.2 B	12.1 B
	6	4.2 B	3.2 AB	8.8 A	6.9 B	16.0 A	12.7 AB
	CV (%)	11.6	14.0	10.2	7.7	6.3	6.8

(*) Means followed by the same letter (within each column) do not differ among themselves according to Duncan's test, $p \leq 0.05$.

The primary root protrusion tests could detect differences in vigor between seed lots of the SWB 551 hybrid since the results agreed with those from the germination speed, seedling

field emergence (percentage and speed), seedling length and traditional accelerated aging tests (Table 1).

For the SWB 585 hybrid in the first period (Table 4), the

primary root protrusion test at 15 °C (criterion 1), identified lot 10 as being the least vigorous; however, according to criterion 2, besides showing lot 10 as having the worst performance, lot 12 was shown to be the most vigorous, agreeing with the results of the germination speed test (Table 2). This agreement

may be explained by the fact that these tests are based on the first evaluations of seedling development. In general, the poor performance of lot 10 could also be seen in the test done at 20 °C and at 25 °C; in these tests, lots 11 (at 20 °C) and 8 (at 25 °C) were shown to be the most vigorous.

Table 4. Mean indices of precocity of primary root protrusion at 15 °C (PRP 15 °C), 20 °C (PRP 20 °C) and 25 °C (PRP 25 °C), considering primary root protrusion (Criterion 1) and seedlings with a primary root at least 2 mm long (Criterion 2), for six lots of super sweet corn seed SWB 585, in two experimental periods.

Period	Lots	PRP 15 °C		PRP 20 °C		PRP 25 °C	
		Criterion 1	Criterion 2	Criterion 1	Criterion 2	Criterion 1	Criterion 2
First	7	5.2 A(*)	4.7 BC	8.6 AB	7.6 AB	11.7 A	10.7 AB
	8	5.3 A	4.9 AB	7.6 B	7.2 ABC	12.6 A	11.6 A
	9	5.5 A	4.6 BC	7.9 B	6.5 C	11.9 A	10.9 AB
	10	4.2 B	4.3 C	7.7 B	6.6 BC	11.1 A	10.5 B
	11	5.6 A	5.0 AB	9.1 A	7.9 A	11.9 A	10.7 AB
	12	5.3 A	5.2 A	8.4 AB	7.6 AB	12.0 A	10.2 B
	CV (%)	9.7	5.9	7.5	9.6	7.6	5.7
Second	7	4.7 A	4.6 A	7.5 A	7.1 A	10.4 AB	9.0 A
	8	4.7 A	3.5 CD	6.5 B	6.7 AB	10.0 AB	8.9 A
	9	4.0 B	3.9 BCD	6.9 AB	6.0 B	9.8 AB	9.3 A
	10	4.2 B	3.3 D	6.7 AB	6.4 AB	9.0 B	8.6 A
	11	4.9 A	4.2 AB	7.0 AB	6.8 AB	10.2 AB	9.1 A
	12	4.9 A	4.1 ABC	6.7 AB	7.0 A	11.0 A	9.3 A
	CV (%)	7.0	10.2	7.5	8.5	10.4	6.8

(*) Means followed by the same letter (within each column) do not differ among themselves according to Duncan's test, $p \leq 0.05$.

In the second evaluation period, the results from the test done at 15 °C (criteria 1 and 2) confirmed the worst performance for lot 10; this lot was also identified as the least vigorous in the test done at 25 °C (criterion 1). However, at 20 °C, lots 8 (criterion 1) and 9 (criterion 2) were the least vigorous. There was a variation for the most vigorous lot between the results for the three temperatures, with lots 7 and/or 12 standing out, differing from the results from the first experimental period.

Since the differences between the physiological potential of the SWB 585 hybrid seeds were smaller, it is worth emphasizing that in the second experimental period, the primary root protrusion test was one of the few tests where lot differences for vigor could be differentiated, usually giving similar results to those from the traditional accelerated aging and seedling length tests.

An evaluation of results from both seasons shows that for the SWB 551 hybrid, the traditional accelerated aging, seedling emergence speed and primary root protrusion tests at 15 °C (criteria 1 and 2), 20 °C (criteria 1 and 2) and 25 °C (criterion 2), produced similar results for both periods, with lot 1 being the worst and lots 2 or 6 the best.

The test results for the SWB 585 hybrid in both seasons only

identified the worst lot. Thus, the primary root protrusion at 15 °C (criteria 1 and 2), seedling length and traditional accelerated aging tests gave comparable results in both periods, identifying lot 10 as the least vigorous; only the primary root protrusion at 15 °C (criterion 2) among the tests, identified the most vigorous lot in both periods but differently (lot 12 in the first and lot 7 in the second period). This may have been due to the composition of lot 12, where 70% of the seeds came from lot 7.

Therefore, among all the tests done on the two hybrids, the most sensitive one to evaluate super sweet corn seed vigor was the primary root protrusion test at 15 °C (criterion 2). According to ISTA (2011), the primary root protrusion test can be done at 13 °C or at 20 °C; these temperatures were successfully used to evaluate corn seed vigor (Matthews and Khajeh-Hosseini, 2006, 2007; Khajeh-Hosseini et al., 2009). Therefore, the primary root protrusion test is a promising alternative for inclusion in quality control programs since it has desirable characteristics for a vigor test, namely: objectivity, repeatability, simplicity and low cost, thus contributing to the efficient evaluation of seed physiological potential. However, this research should continue in order to

improve the methodology so that it can be standardized.

Conclusions

The primary root protrusion test at 15 °C with primary roots at least 2 mm long, allows super sweet corn seeds to be differentiated for vigor and results are comparable to the traditional tests used for this specie.

Acknowledgements

To FAPESP and CNPq for granting study scholarships and financing this research and to Dow AgroSciences for supplying the seeds.

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