Methodology of the accelerated aging test in tiny tomato seeds
(*solanum lycopersicum* var. *cerasiforme*)

Metodologia do teste de envelhecimento acelerado em sementes de mini
tomate (*solanum lycopersicum* var. *Cerasiforme*)

Metodología del ensayo de envejecimiento acelerado en pequeñas
semillas de tomate (*solanum lycopersicum* var. *cerasiforme*)

DOI: 10.55905/oelv22n3-196

Originals received: 02/23/2024
Acceptance for publication: 03/15/2024

Flávia Mendes dos Santos Lourenço
PhD in Plant Production
Institution: Universidade Estadual Paulista “Júlio de Mesquita Filho” (UNESP)
Address: Departamento de Fitotecnia e Tecnologia de Alimentos, Ilha Solteira, São
Paulo, Brasil
E-mail: flaviamsl1@hotmail.com

Marco Eustáquio de Sá
PhD in Agronomy
Institution: Universidade Estadual Paulista “Júlio de Mesquita Filho” (UNESP)
Address: Departamento de Fitotecnia e Tecnologia de Alimentos, Ilha Solteira, São
Paulo, Brasil
E-mail: marco.sa@unesp.br

Oscar Mitsuo Yamashita
PhD in Tropical Agriculture
Institution: Universidade do Estado de Mato Grosso “Carlos Alberto Reyes Maldonado”
(UNEMAT)
Address: Faculdade de Ciências Biológicas e Agrárias, Alta Floresta, Mato Grosso,
Brasil
E-mail: yama@unemat.br

Vinicius Martins Silva
PhD in Plant Production
Institution: Universidade Estadual Paulista “Júlio de Mesquita Filho” (UNESP)
Address: Jaoboticabal, São Paulo, Brasil
E-mail: vmsagr@gmail.com
Jéssica Alves de Oliveira  
PhD in Plant Production  
Institution: Instituto Mato-Grossense do Algodão  
Address: Rondonópolis, Mato Grosso, Brasil  
E-mail: jessicaoliveira_nh@hotmail.com

Juliana Trindade Martins  
PhD in Plant Production  
Institution: Universidade Estadual Paulista “Júlio de Mesquita Filho” (UNESP)  
Address: Departamento de Fitotecnia e Tecnologia de Alimentos, Ilha Solteira, São Paulo, Brasil  
E-mail: juliana29martins@gmail.com

Grace Queiroz David  
PhD in Plant Production  
Institution: Universidade do Estado de Mato Grosso “Carlos Alberto Reyes Maldonado” (UNEMAT)  
Address: Faculdade de Ciências Biológicas e Agrárias, Alta Floresta, Mato Grosso, Brasil  
E-mail: gracequeiroz david@hotmail.com

Walmor Moya Peres  
PhD in Plant Production  
Institution: Universidade do Estado de Mato Grosso “Carlos Alberto Reyes Maldonado” (UNEMAT)  
Address: Faculdade de Ciências Biológicas e Agrárias, Alta Floresta, Mato Grosso, Brasil  
E-mail: walmorperes@unemat.br

ABSTRACT  
The objective of this study was to study whether the variations in the performance of the accelerated aging test, in terms of exposure time and temperature involved in the test methodology, performed in the traditional way or in saturated salt solution, would result in an efficient combination to evaluate the physiological quality of seeds tiny tomato (*Solanum lycopersicum* var. *cerasiforme*). The seeds were submitted to the tests of total germination, germination speed index, first germination count, substrate emergence, seedling length, seedling dry matter, cold test, electrical conductivity and variations in the conduction of the accelerated aging test. The treatments (36, 38, 40 and 42 °C) x exposure time (24, 36, 48 and 72 hours) x procedures (traditional and saline) were used, with four replications each lot. The averages were compared by the Tukey test at 5% probability. The simple correlation coefficient (r) between the accelerated aging test results and the emergence test of substrate seedlings was also determined. The traditional accelerated aging test in the combinations of 24 hours at 36 °C and the accelerated aging test with saline in the combinations of 72 hours at 36 °C showed sensitivity for the evaluation of the physiological potential of tiny tomato seeds. For both accelerated aging
tests, the temperature of 36 °C was efficient for the evaluation of the physiological potential of tiny tomato seeds.

**Keywords:** exposure time, temperature, vigor, adaptation methodology, physiological quality of seeds.

**RESUMO**

O objetivo deste estudo foi estudar se as variações no desempenho do teste de envelhecimento acelerado, em termos de tempo de exposição e temperatura envolvidas na metodologia do teste, realizado de forma tradicional ou em solução salina saturada, resultariam em uma combinação eficiente avaliar a qualidade fisiológica de sementes de tomate minúsculo (Solanum lycopersicum var. cerasiforme). As sementes foram submetidas aos testes de germinação total, índice de velocidade de germinação, primeira contagem de germinação, emergência do substrato, comprimento de plântula, matéria seca de plântula, teste de frio, condutividade elétrica e variações na condução do teste de envelhecimento acelerado. Foram utilizados os tratamentos (36, 38, 40 e 42 ºC) x tempo de exposição (24, 36, 48 e 72 horas) x procedimentos (tradicional e salina), com quatro repetições cada lote. O teste de envelhecimento acelerado tradicional nas combinações de 24 horas a 36 ºC e o teste de envelhecimento acelerado com soro fisiológico nas combinações de 72 horas a 36 ºC mostraram sensibilidade para avaliação do potencial fisiológico de sementes minúsculas de tomate. Para ambos os testes de envelhecimento acelerado, a temperatura de 36 ºC foi eficiente para avaliação do potencial fisiológico de sementes minúsculas de tomate.

**Palavras-chave:** tempo de exposição, temperatura, vigor, qualidade fisiológica de sementes.

**RESUMEN**

El objetivo de este estudio fue estudiar si las variaciones en el rendimiento de la prueba de envejecimiento acelerado, en términos de tiempo de exposición y temperatura involucradas en la metodología de prueba, realizada de la manera tradicional o en solución de sal saturada, daría como resultado una combinación eficiente para evaluar la calidad fisiológica de semillas de tomate diminuto (Solanum lycopersicum var. cerasiforme). Las semillas fueron sometidas a las pruebas de germinación total, índice de velocidad de germinación, primer recuento de germinación, emergencia de sustrato, longitud de plántula, materia seca de plántula, prueba en frío, conductividad eléctrica y variaciones en la conducción de la prueba de envejecimiento acelerado. Se utilizaron los tratamientos (36, 38, 40 y 42 ºC) x tiempo de exposición (24, 36, 48 y 72 horas) x procedimientos (tradicional y salino), con cuatro repeticiones cada lote. Los promedios fueron comparados por la prueba de Tukey con una probabilidad del 5%. También se determinó el coeficiente de correlación simple (r) entre los resultados de la prueba de envejecimiento acelerado y la prueba de emergencia de plántulas de sustrato. El ensayo tradicional de envejecimiento acelerado en las combinaciones de 24 horas a 36 ºC y el ensayo de envejecimiento acelerado con solución salina en las combinaciones de 72 horas a 36 ºC mostraron sensibilidad para la evaluación del potencial fisiológico de las semillas.
de tomate diminutas. Para ambas pruebas de envejecimiento acelerado, la temperatura de 36 °C fue eficiente para la evaluación del potencial fisiológico de pequeñas semillas de tomate.

**Palabras clave:** tiempo de exposición, temperatura, vigor, metodología de adaptación, calidad fisiológica de las semillas.

**1 INTRODUCTION**

Unlike the common tomato, the cherry tomato (*Solanum lycopersicum* var. Cerasiforme), was introduced in Brazil through the feces of migratory birds and by Italian immigrants who arrived in the country at the end of the 19th century. The cherry type has become an alternative for most farmers, since it has good rusticity, tolerance to pests and diseases, high market value, higher productivity and good acceptance by consumers (Azevedo Filho and Melo 2001).

Among the vegetables, the tomato stands out for the high commercialization value of its seeds, deserving special attention regarding the physiological quality of the commercialized seeds. Seed technology, as a segment of the production process, has sought to improve the tests used to assess their physiological potential, with the aim that the results express the potential performance of the seed lot under field conditions (Tunes et al. 2012a).

There are many tests that assess the physiological quality of seeds under stress conditions, simulating the adversities suffered by those in the field. Among the various vigor tests, the accelerated aging test is one of the most used to assess the physiological potential of several species (Tekrony 1995).

The accelerated aging test is based on the fact that the rate of deterioration of the seeds increases considerably, due to their exposure to high temperature and relative humidity, these being the environmental factors most related to the deterioration of the seeds (Pereira et al. 2010). Other alternatives were studied for the accelerated aging test, such as the replacement of deionized water used in the traditional procedure, with saturated salt solutions, thus reducing the relative humidity and reducing the speed of water absorption by the seeds, favoring results more reliable. As observed by Ramos et
al. (2004), one of the aspects that must be considered in the accelerated aging test is the difference in water absorption between the seeds exposed to the humid atmosphere, generating inconsistent results mainly in small seeds.

Thus, the objective was to study whether the variations in the performance of the accelerated aging test, in terms of exposure time and temperature involved in the test methodology, carried out in the traditional way or in saturated saline solution, would result in an efficient combination to evaluate the physiological quality of mini tomato seeds (*Solanum lycopersicum* var. *cerasiforme*).

2 MATERIAL AND METHODS

The experiment was carried out at the Seed Analysis Laboratory of the São Paulo State University “Júlio de Mesquita Filho” - UNESP - of the Ilha Solteira, SP, Brazil, using three commercial lots of untreated red cherry tomato seeds (mini tomato), Top Seed Garden - Blue Line. The seeds were submitted to the tests of total germination, germination speed index, first germination count, substrate emergence, seedling length, seedling dry matter, cold test, electrical conductivity and variations in the conduction of the accelerated aging test.

The water content was determined by the greenhouse method at 105 ± 2 °C for 24 hours (Brasil 2009), with two subsamples of 20 seeds for each batch. The germination test was performed with four replications of 50 seeds, distributed in plastic boxes (gerbox), containing a sheet of germibox paper moistened with deionized water in a proportion of 2.5 times the mass of the non-hydrated paper, in which they were kept in the germinator at a temperature of 25 °C, with counts being performed 8 days after sowing (Brasil 2009). The first count was performed together with the germination test, computing the percentage of normal seedlings, obtained five days after the installation of the test.

The germination speed index was obtained together with the germination test, being calculated according to the formula of Maguire (1962), in which daily counts were carried out from the implantation of the germination test as established by the RAS (Rules for Analysis of Seeds), computing the number of normal seedlings.
To carry out the seedling emergency test, expanded polystyrene (Styrofoam) boxes with substrate and daily irrigations (twice a day) were used. Seedling evaluation was carried out at 8 days after sowing, by counting emerged seedlings, considering the two cotyledon leaves open and above the substrate (Nakagawa 1999), using four replications of 50 seeds. After counting, ten seedlings from each repetition were separated into aerial part and root, being submitted to a forced air circulation thermoelectric oven set at 65 °C for 48 h. After the drying period, the samples were weighed using an analytical balance (0.0001g), and the weight obtained for each repetition was divided by the number of normal seedlings evaluated, resulting in the average mass per seedling.

For seedling growth, four replications of 20 seeds per treatment were used, sown on three sheets of germitest paper, two at the bottom and one at the top, over a line drawn in the upper third with a 3 cm longitudinal distance. The samples on paper rolls were placed in plastic bags and closed with elastic, being taken to the germinator and remaining for seven days in the dark at 25 °C. After this period, the length, in cm, of the aerial part and root of normal seedlings was measured, with the aid of a ruler graduated in mm (Nakagawa 1999).

Together with the seedling length test, the dry matter mass was measured, whose parts of the measured seedlings were placed in paper bags and taken to a thermoelectric oven with forced air circulation, regulated at 65 °C for 48 h. After the drying period, the samples were weighed using an analytical balance (0.0001g), and the weight obtained for each repetition was divided by the number of normal seedlings evaluated, resulting in the average mass per seedling.

For the cold test, four repetitions of 50 seeds were used for each batch, distributed in plastic boxes (gerbox), containing a sheet of germibox paper moistened with deionized water in the proportion of 2.5 times the mass of the non-hydrated paper. The boxes were kept in B.O.D. at 10 ºC, for seven days. After this period, they were transferred to the germinator at a constant temperature of 25 ºC, where they remained for another seven days, when normal seedlings were counted.

In the electrical conductivity test, 25 seeds were weighed on a precision scale of 0.0001 g, being placed in plastic cups containing 75 mL of deionized water and kept in a
germinator for 24 hours at 25 ºC. The readings of the electrical conductivity were performed in a conductivity meter and the average values, expressed in µS.cm⁻¹.g⁻¹ of seed.

The accelerated aging test (traditional procedure) was conducted using transparent plastic boxes (11.5 x 11.5 x 3.5 cm) with individual compartments (mini-chambers), known as the gerbox method, having inside supports for supporting a wire mesh. On the surface of each of these, approximately 220 seeds were distributed in a single layer for each batch.

To control the relative humidity of the air inside the boxes, 40 ml of deionized water were placed. The boxes were covered and kept in closed B.O.D chambers during the aging periods 24, 36, 48 and 72 hours, using four temperatures 36, 38, 40 and 42 ºC. After each aging period, the seeds were submitted to the germination test, and the evaluation was carried out five days after sowing. The results were expressed as a percentage of normal seedlings, for each lot. It was also determined the degree of seed moisture, after each aging period, aiming to evaluate the uniformity of the test conditions, imposed by the test conditions.

As for the accelerated aging test using a saturated NaCl solution, it was conducted in the same way as the traditional procedure, except that 40 mL of saturated NaCl solution was added to the bottom of the plastic box, replacing water. This solution was obtained by mixing 40 g of NaCl in 100 mL of water, thereby establishing an environment with 76% relative humidity (Jianhua and McDonald 1996).

The germitest and germibox sheets used were moistened with a 0.2% KNO₃ solution, to break seed dormancy.

A completely randomized design was used with the treatments obtained from the combination of temperatures (4) x exposure times (4) x procedures (2), with four repetitions for each batch. The averages were compared using the Tukey test at 5% probability. The simple correlation coefficient (r) between the results of the accelerated aging tests (traditional procedure and with saline solution) and the seedling emergence test in substrate was also determined. When necessary, the data were transformed to √(x) for the cold test, and √ (x + 1) for seedling length and dry matter.
3 RESULTS AND DISCUSSION

The data referring to the average percentages of the initial moisture content of the seeds (Table 1), were similar for the three batches of mini tomatoes studied. This fact is important in the execution of accelerated aging tests, since the uniformity of the water content of the seeds is essential for the standardization of the procedures and the obtaining of consistent results (Marcos Filho 2005). The results of the germination test (Table 1), indicated significant differences between the batches, highlighting batch 3 as the top quality and batches 1 and 2 are of inferior quality without differing from each other. However, similar and high results in the germination test, do not mean that all the batches have high vigor, because the germination test is conducted under favorable conditions of temperature, humidity and oxygen levels, allowing the batches to express the maximum potential, for produce normal seedlings (Marcos Filho 1999). However, for the first germination count, considered a vigor parameter, batch 3 continued to perform better, however, it did not differ from batch 1, the two batches being superior to batch 2 (Table 1).

The electrical conductivity test (Table 1) was able to detect differences between the three batches, and it can also characterize batch 3 as the most vigorous, intermediate batch 1, and batch 2 as the least vigorous. Torres et al. (2015), using four coriander cultivars, evaluated the quality of seeds by the electrical conductivity test, and found that the test was efficient in assessing the physiological potential of these cultivars. Sá (1999), when evaluating seeds from four commercial tomato batches by the electrical conductivity test, observed that the determination of vigor through this test was efficient to differentiate the studied batches.

The germination speed index (Table 1) confirmed the results of the electrical conductivity test, in which batch 3 has greater potential, batch 1 being intermediate and batch 2 lower. It can be observed that the batches that presented low germination speed, had inferiority in the germination percentage in the test of first germination count (Table 1).

The seedling emergence test (Table 1), considered an indicator parameter of the efficiency of the tests to assess the physiological potential of seeds (Marcos Filho 2015),
was sensitive when evaluating the three mini tomato batches, confirming the superiority of batch 3, in relation to the other two batches. In the same sense, the cold test (Table 1), was able to evaluate the physiological potential of mini tomato batches, under conditions of high humidity and low temperature, validating the seedling emergence test and the other vigor tests, showing the batch 3 superiority.

For the seedling length and dry weight of the aerial part of the three mini tomato batches (Table 1), there was no significant difference between them. However, the root length and root dry weight of the three batches (Table 1), showed a significant difference, with batches 3 and 1 being superior to batch 2, corroborating with the first germination count test. For the dry mass of the aerial part and the root mass of the seedling emergence (Table 1), the behavior of the batches was the same, with no significant difference. The superior performance of batch 3 in most tests makes it expected that, when subjected to the accelerated aging test or to adverse environmental situations, it will show superiority in relation to the other two mini tomato batches.

The traditional accelerated aging test (Table 2), in the exposure times of 24, 36, 48 and 72 hours for the temperature of 36 °C, were sensitive for the evaluation of the physiological potential of the three batches of mini tomatoes, showing superiority of the batch 3 in relation to the other two batches, agreeing with the initial tests (Table 1).

As for the temperature of 38 °C, the time of 48 hours was the one that best differentiated the three batches, in which batch 3 had the highest physiological potential, batch 2 intermediate, and batch 1 the least potential (Table 2). Casaroli et al. (2006), when studying pumpkin seeds, using the traditional accelerated aging method, found that the 48-hour period was able to stratify the pumpkin batches. Radke et al. (2016), when analyzing coriander seeds, using the accelerated aging test, found that the 48-hour period was also efficient in expressing the vigor of their seeds.

For the temperature of 40 °C, the best time observed was 36 hours, again managing to differentiate the three batches of cherry tomatoes, in which batch 3 had the greatest potential, batch 2 intermediate and batch 1 the least potential (Table 2). The differences in cultivars and species, which characterize the genetic vigor, make several
studies to be carried out, aiming to better adapt the methods, temperatures and exposure times used.

The accelerated aging test with saline solution (Table 3) showed that for the temperature of 36 °C, the best exposure time to evaluate the batches was 72 hours, with batch 3 being the one with the greatest potential. For the temperature of 38 °C, the best exposure time was again 72 hours, with batch 3 as the one with the best development. Barbosa et al. (2011), when evaluating lettuce seeds by the accelerated aging method with saturated saline solution, found that the best exposure time to assess the potential of these seeds was 72 hours. Lopes et al. (2010), also observed that the best period of exposure of okra seeds, using accelerated aging with saturated saline solution was 72 hours.

At 40 °C, the best exposure period was 48 hours, again showing the superiority of batch 3 over the other two batches (Table 3). Results such as Pereira et al. (2011), presented the exposure time of 48 hours, as being efficient to evaluate the coriander seed batches, by the accelerated aging test with saturated saline solution.

For the temperature of 42 °C, the exposure periods that were efficient in separating the batches were 24, 48 and 72 hours, showing the superiority of batch 3 in relation to the other two batches (Table 3), in agreement with the initial tests (Table 1) and the traditional accelerated aging test (Table 2).

Regarding the water content of the seeds after the periods of traditional aging (Table 4), the results were generally similar for the three studied batches. There was also an increase in humidity as the temperature and exposure time increased. Even batch 3 did not have lower water contents than the other two batches, which was expected, therefore, a batch with relatively higher humidity than the other batch, theoretically should have a higher deterioration speed, and batch 3 stood out in all the tests submitted, mainly those of traditional accelerated aging and with saline solution.

It was found that the water content of the seeds exposed to the saline solution (Table 5) showed lower values, after the aging periods in relation to those observed for the traditionally aged seeds. This indicates that the use of saline solution contributes to delay the absorption of water by the seeds in the accelerated aging test (Lopes et al. 2010). Tunes et al. (2012b) observed that in traditionally aged broccoli seeds, they reached
higher water contents and with greater variations, when compared to aging with saline solution. Costa et al. (2008), when studying the accelerated aging test in brassica seeds, observed that the traditional procedure resulted in greater variations between the water content of the cabbage and cabbage broccoli seed batches, when compared to the water content of the procedure with saline solution, showing greater uniformity of the test conditions.

The positive correlation between traditional accelerated aging and seedling emergence (Table 6), showed an adequacy of coefficients above or equal to 0.80, for the following temperatures and exposure times: 36 °C to 24, 36, 48 and 72 hours; 38 °C to 48 hours; 40 °C to 36 hours; it was found that for the temperature of 42 °C, there was no correlation for any of the exposure times tested.

For the correlation between accelerated aging with saturated solution and the emergence of seedlings (Table 6), the coefficients above or equal to 0.80 were adequate for the following temperatures and exposure times: 36 °C to 72 hours; 38 °C at 24 and 72 hours; 40 °C to 48 hours; 42 °C at 24, 48 and 72 hours. This indicates that the correlation of the aging test (Traditional/Saline solution) with seedling emergence is efficient to evaluate the physiological quality of mini tomato seeds, when subjected to temperatures of 36, 38, 40 and 42 °C in times of 24, 36, 48 and 72 hour exposure, showing high correlation with substrate emergence.

4 CONCLUSION

The traditional accelerated aging test using combinations of 24 hours at 36 °C, showed sensitivity for the evaluation of the physiological potential of mini tomato seeds.

The accelerated aging test with saline solution, using the combinations of 72 hours at 36 °C, showed sensitivity for the evaluation of the physiological potential of mini tomato seeds.

For both tests of accelerated aging, the temperature of 36 °C was efficient for the evaluation of the physiological potential of mini tomato seeds.
ACKNOWLEDGMENT

The Coordination for the Improvement of Higher Education Personnel (CAPES), for financial support; the São Paulo State University “Júlio de Mesquita Filho”, campus of Ilha Solteira-SP, for the availability of the physical structure and work materials.
REFERENCES


Table 1. Degree of humidity (HU), germination (G), first germination count (FGC), germination speed index (GSI), electrical conductivity (EC), seedling emergence, cold test (CT), values shoot mean (SM), root length (RL), shoot dry mass (SDM), root dry mass (RDM), emergency shoot dry mass (ESDM) and emergency root mass (ERM), in three mini tomato seed batches (*Solanum lycopersicum* var. cerasiforme).

<table>
<thead>
<tr>
<th>Batches</th>
<th>HU</th>
<th>G (%)</th>
<th>FGC</th>
<th>EC (µS.cm⁻¹.g⁻¹)</th>
<th>GSI</th>
<th>Emergency (%)</th>
<th>CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.34</td>
<td>79.00 b</td>
<td>64.00 a</td>
<td>304.95 b</td>
<td>8.79 b</td>
<td>65.50 b</td>
<td>67.50 b</td>
</tr>
<tr>
<td>2</td>
<td>8.15</td>
<td>78.00 b</td>
<td>44.50 b</td>
<td>361.82 c</td>
<td>7.50 c</td>
<td>73.50 b</td>
<td>62.00 b</td>
</tr>
<tr>
<td>3</td>
<td>8.76</td>
<td>94.00 a</td>
<td>71.50 a</td>
<td>46.87 a</td>
<td>10.46 a</td>
<td>95.50 a</td>
<td>94.00 a</td>
</tr>
<tr>
<td>CV (%)</td>
<td>5.63</td>
<td></td>
<td>7.47</td>
<td>7.45</td>
<td>5.64</td>
<td>10.24</td>
<td>7.45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Batches</th>
<th>SM (cm)</th>
<th>RL</th>
<th>SDM (g)</th>
<th>RDM (g)</th>
<th>ESDM</th>
<th>ERM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.05 a</td>
<td>2.19 a</td>
<td>1.0193 a</td>
<td>1.0220 a</td>
<td>1.0846 a</td>
<td>1.1042 a</td>
</tr>
<tr>
<td>2</td>
<td>2.11 a</td>
<td>2.04 b</td>
<td>1.0101 a</td>
<td>1.0104 b</td>
<td>1.0804 a</td>
<td>1.0970 a</td>
</tr>
<tr>
<td>3</td>
<td>2.51 a</td>
<td>2.21 a</td>
<td>1.0183 a</td>
<td>1.0220 a</td>
<td>1.0726 a</td>
<td>1.1042 a</td>
</tr>
<tr>
<td>CV (%)</td>
<td>20.35</td>
<td>3.18</td>
<td>0.68</td>
<td>0.33</td>
<td>0.83</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Different letters within the column differ by the Tukey test, at 5% probability.
Source: the authors
Table 2. Percentage of normal seedlings (%) of mini tomatoes (*Solanum lycopersicum* var. Cerasiforme), after periods of traditional aging.

<table>
<thead>
<tr>
<th>Batches</th>
<th>36°C</th>
<th>38°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24h</td>
<td>36h</td>
</tr>
<tr>
<td>1</td>
<td>53.00 c</td>
<td>55.25 b</td>
</tr>
<tr>
<td>2</td>
<td>70.00 b</td>
<td>67.00 b</td>
</tr>
<tr>
<td>3</td>
<td>90.50 a</td>
<td>81.00 a</td>
</tr>
</tbody>
</table>

**CV (%)**

12.14

**Accelerated aging (traditional)**

<table>
<thead>
<tr>
<th>40°C</th>
<th>42°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>24h</td>
<td>36h</td>
</tr>
<tr>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>1</td>
<td>60.50 b</td>
</tr>
<tr>
<td>2</td>
<td>60.50 b</td>
</tr>
<tr>
<td>3</td>
<td>84.50 a</td>
</tr>
</tbody>
</table>

**CV (%)**

12.14

Different letters within the column differ by the Tukey test, at 5% probability.

Source: the authors
Table 3. Percentage of normal seedlings (%) of mini tomatoes (*Solanum lycopersicum* var. Cerasiforme), after aging with saline solution.

<table>
<thead>
<tr>
<th></th>
<th><strong>36°C</strong></th>
<th></th>
<th><strong>38°C</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24h</td>
<td>36h</td>
<td>48h</td>
<td>72h</td>
</tr>
<tr>
<td>Batches</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>1</td>
<td>46.50 b</td>
<td>55.25 b</td>
<td>60.00 b</td>
<td>40.00 c</td>
</tr>
<tr>
<td>2</td>
<td>42.00 b</td>
<td>54.00 b</td>
<td>62.00 b</td>
<td>55.25 b</td>
</tr>
<tr>
<td>3</td>
<td>89.00 a</td>
<td>79.50 a</td>
<td>83.25 a</td>
<td>89.50 a</td>
</tr>
<tr>
<td>CV (%)</td>
<td>11.62</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Accelerated aging (saline solution)**

<table>
<thead>
<tr>
<th></th>
<th><strong>40°C</strong></th>
<th></th>
<th><strong>42°C</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24h</td>
<td>36h</td>
<td>48h</td>
<td>72h</td>
</tr>
<tr>
<td>Batches</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>1</td>
<td>47.25 b</td>
<td>54.50 b</td>
<td>56.50 b</td>
<td>45.00 b</td>
</tr>
<tr>
<td>2</td>
<td>57.00 b</td>
<td>52.00 b</td>
<td>59.25 b</td>
<td>38.00 b</td>
</tr>
<tr>
<td>3</td>
<td>73.00 a</td>
<td>83.25 a</td>
<td>89.50 a</td>
<td>85.50 a</td>
</tr>
<tr>
<td>CV (%)</td>
<td>11.62</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Different letters within the column differ by the Tukey test, at 5% probability.

Source: the authors
Table 4. Water content (%) of three batches of mini tomato seeds (*Solanum lycopersicum* var. Cerasiforme), after periods of traditional aging.

<table>
<thead>
<tr>
<th>Batches</th>
<th>36°C</th>
<th>38°C</th>
<th>40°C</th>
<th>42°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24h</td>
<td>36h</td>
<td>48h</td>
<td>72h</td>
</tr>
<tr>
<td></td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>1</td>
<td>28.45</td>
<td>67.56</td>
<td>67.19</td>
<td>66.94</td>
</tr>
<tr>
<td>2</td>
<td>29.40</td>
<td>63.34</td>
<td>66.88</td>
<td>66.62</td>
</tr>
<tr>
<td>3</td>
<td>27.46</td>
<td>59.12</td>
<td>66.58</td>
<td>66.29</td>
</tr>
</tbody>
</table>

Source: the authors
Table 5. Water content (%) of three batches of mini tomato seeds (*Solanum lycopersicum* var. Cerasiforme), after aging with saline solution.

<table>
<thead>
<tr>
<th>Batches</th>
<th>36°C</th>
<th></th>
<th></th>
<th></th>
<th>38°C</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24h</td>
<td>36h</td>
<td>48h</td>
<td>72h</td>
<td>24h</td>
<td>36h</td>
<td>48h</td>
<td>72h</td>
</tr>
<tr>
<td>1</td>
<td>11.57</td>
<td>13.99</td>
<td>18.29</td>
<td>26.89</td>
<td>7.79</td>
<td>7.95</td>
<td>14.65</td>
<td>28.51</td>
</tr>
<tr>
<td>2</td>
<td>10.46</td>
<td>15.37</td>
<td>17.23</td>
<td>20.95</td>
<td>6.69</td>
<td>8.50</td>
<td>16.04</td>
<td>29.26</td>
</tr>
<tr>
<td>3</td>
<td>12.68</td>
<td>16.75</td>
<td>19.34</td>
<td>24.52</td>
<td>9.30</td>
<td>8.48</td>
<td>17.42</td>
<td>27.76</td>
</tr>
</tbody>
</table>

Source: the authors

---

<table>
<thead>
<tr>
<th>Batches</th>
<th>40°C</th>
<th></th>
<th></th>
<th></th>
<th>42°C</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24h</td>
<td>36h</td>
<td>48h</td>
<td>72h</td>
<td>24h</td>
<td>36h</td>
<td>48h</td>
<td>72h</td>
</tr>
<tr>
<td>2</td>
<td>10.35</td>
<td>9.31</td>
<td>14.06</td>
<td>23.35</td>
<td>9.63</td>
<td>13.29</td>
<td>16.95</td>
<td>23.57</td>
</tr>
</tbody>
</table>

Source: the authors
Table 6. Simple correlation coefficients (r) between the data obtained in the accelerated aging test (traditional procedure and saline solution) and seedling emergence for three mini tomato seed batches (*Solanum lycopersicum* var. Cerasiforme).

<table>
<thead>
<tr>
<th></th>
<th>24h</th>
<th>36h</th>
<th>48h</th>
<th>72h</th>
<th>24h</th>
<th>36h</th>
<th>48h</th>
<th>72h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>36°C</strong></td>
<td>0.90*</td>
<td>0.83*</td>
<td>0.80*</td>
<td>0.80*</td>
<td>0.77</td>
<td>0.78</td>
<td>0.76</td>
<td>0.91*</td>
</tr>
<tr>
<td><strong>38°C</strong></td>
<td>0.69</td>
<td>-0.86</td>
<td>0.80*</td>
<td>0.60</td>
<td>0.88*</td>
<td>0.69</td>
<td>0.72</td>
<td>0.87*</td>
</tr>
<tr>
<td><strong>40°C</strong></td>
<td>0.73</td>
<td>0.86*</td>
<td>0.18</td>
<td>0.78</td>
<td>0.63</td>
<td>0.73</td>
<td>0.84*</td>
<td>0.78*</td>
</tr>
<tr>
<td><strong>42°C</strong></td>
<td>0.67</td>
<td>0.56</td>
<td>0.44</td>
<td>0.60</td>
<td>0.81*</td>
<td>0.71</td>
<td>0.89*</td>
<td>0.81*</td>
</tr>
</tbody>
</table>

* r significant at 5% probability (0.8 ≤ R < 1).

Source: the authors