Influence of seed moisture content in the development of a controlled deterioration method for tomato seeds

Audrey Dupont, Marie-Hélène Wagner, Sylvie Ducournau
GEVES, Station Nationale d'Essais de Semences, 25 rue G. Morel, 49071 Beaucouzé - FRANCE

INTRODUCTION

Over time, seed ageing differs from one species to another. It depends also on the physiological characteristics of the seed sample, and on the conditions in which seeds are stored. Controlled deterioration (CD) tests make possible to artificially age seed samples, enabling us to measure seed storage capacity and characterize the vigour of small seeds (ISTA, 2025).

This study was carried out to test first the effect of various parameters such as seed moisture content (SMC: 25 and 30%), and incubation time (24, 48, 72 and 96 hours) at high temperature (47°C), on 5 samples of tomato seeds (*Solanum lycopersicum* L.). In a second part, additional trials on 6 samples were carried out to study the correlation between the controlled deterioration results, greenhouse emergence, and usable tomato plants.

EXPERIMENTAL DESIGN OF CD TEST

Seed moisture content ajustment | Seed ageing | Standard germination

COMBINING MOISTURE & TIME FOR CD

Overall standard germination (SG) was 86.8% for the five seed lots with T2= 99% ; T1, T3 and T4 all at 90% and T5= 64%.

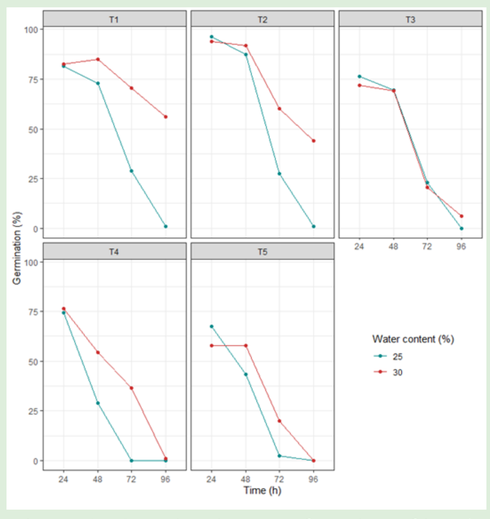
The vigour of the three lots with identical SG is particularly interesting to follow using CD tests.

Table 1 : Average standard germination obtained after each CD at 47°C with different durations (TIME) and seed moisture content (SMC).

TIME\SMC	25%	30%	p. value
24h	79,3 ± 10,6	76,6 ± 13,2	0.586
48h	60,5 ± 22,6	71,7 ± 15,5	0.026**
72h	16,4 ± 17,2	41,5 ± 21,7	3.1E-06***
96h	0,4 ± 0,7	21,4 ± 25,1	6.6E-05***

**** ANOVA: results with significant difference.*

There was a significant difference between the percentage of germination obtained with adjustments at 25 and 30% after 48 h of incubation and more.



Evaluation of lots vigour through CD test incubation times :

- **After 24h**, the two WC rates are unable to differentiate the vigour of the lots.
- **After 48h**, we obtained 60 and 72% of germination and the lots seem to behave differently.
- **After 72 and 96h**, the mean germination is highly decreased.

Figure 1 : Germination as a function of incubation time at 47°C.

Impact of SMC on seed lots ranking after a CD of 48h at 47°C

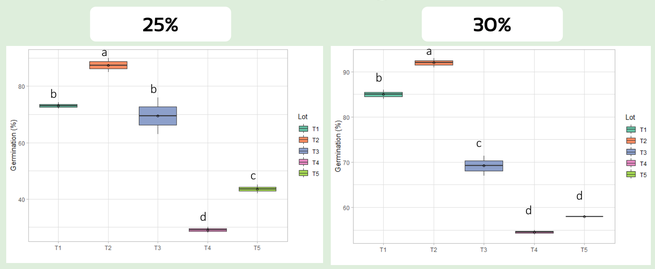


Figure 2 : Box-plot representation and SNK ranking of five seeds lots for the two CD methods tested at 47°C.

TWO VIGOUR ASSESSMENTS

These trials are essential for validating a vigour method in the ISTA Rules. This is the reason why emergence has been tested in greenhouse over 21 days and the usable plant rate for six new varieties.

Greenhouse emergence

Conditions: 20°C, light during 8 hours per day, soil, irrigation with water.

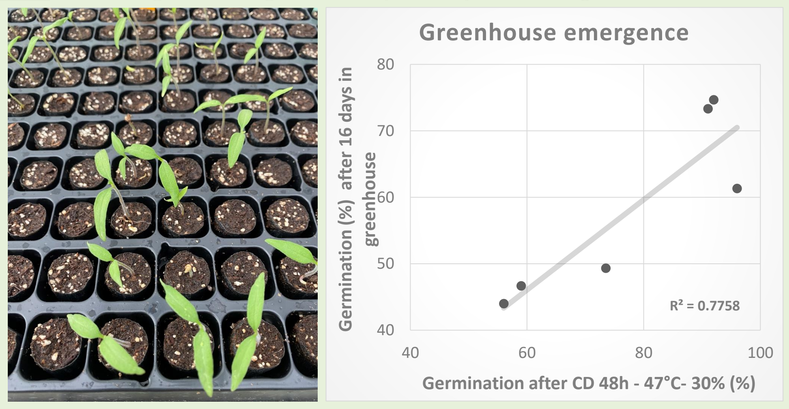


Figure 3 : Correlation between the results of controlled deterioration for 48 hours at 47°C with 30% seed moisture content, first graph (A) with emergence in the greenhouse.

After 16 days, the percentage of emergence was 58.2 ± 13.6% on average, correlated at **R^2=0.776*** with the CD test of 48h at 47°C and 30% of SMC (p value = 0.05).

After 21 days, the percentage of emergence was 71.8 ± 10.0% on average, the correlation was no significant with the CD results.

Usable plant rate

Conditions : 24°C, 4 days at 100% relative humidity then 11 days at 80% relative humidity, stone wool and vermiculite, irrigation with a KOH nutritive solution (pH: 6.6, EC: 1.44 $S.m^{-1}$).

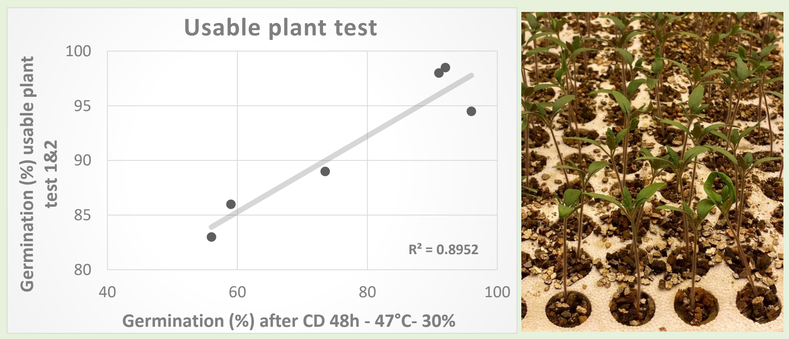


Figure 4 : Correlation between the method of controlled deterioration for 48 hours at 47°C with 30% moisture content with the percentage of usable plants, choice 1&2.

CONCLUSION

The results showed that the higher the seed water content, the shorter the duration for the controlled deterioration test to assess seed vigour. Tomato seeds can be rapidly aged at 47°C with 48 or 72 hours which are enough to significantly decrease standard germination of less vigorous seed lots. The lowest germination was surprisingly obtained with 25% of seed moisture content rather than 30%. It is therefore possible that at high relative humidity, seeds would be able to restart their metabolism and so seed cell repair could occur.

Greenhouse and laboratory trials with usable plants confirmed the seed lots ranking obtained using the CD method. Therefore a controlled deterioration method at 47°C for 48°C after adjusting seed moisture content to 30% is effective in classifying lots according to their vigour.