



Assess the effect of natural ageing and storage containers on seed quality of tomato seeds

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Summary

The present study entitled "Seed quality assessment in the naturally aged seed of tomato was conducted during rabi 2020-2021 and 2021-2022 at the Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar. The freshly stored seed was observed to be highest in seed quality parameters i.e., germination per cent, seedling length, seedling dry weight and seed vigour indices as compared to when seeds were stored in different containers during 18 months storage period. As the storage period increase, the seed quality parameter goes on decreasing. Among the containers, 18-month seeds stored in a polythene bag (> 700 gauge) recorded significantly higher seed germination (60.67%), seedling length (8.77cm), seedling dry weight (11.42 mg), vigour index -I (532) and seed vigour index-II (793) as compared to a cloth bag. Standard germination percentage was maintained up to 15 months of storage in a polythene bag. In both containers, polythene bags performed better than cloth bags throughout the storage period.

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Keywords: Seed; germination percentage; vigour index; storage container

INTRODUCTION

Tomato (*Solanum Lycopersicon L*) is one of the world's most important vegetable crops and is consumed fresh and cooked and is grown over four million hectares of land area. Tomatoes are one of the most widely grown and consumed vegetables worldwide.¹⁰ In India, tomato is cultivated in 841 thousand ha area with an average annual production of 20.33 lakh million tons and productivity of 24.2 million ton per hectare (ministry of agriculture farmer's welfare, Govt. of India 2021). One of the most popular vegetables grown and consumed globally is the tomato. Especially in diets where high-energy, low-micronutrient items predominate, demonstrate dietary diversity and quality. Tomato belongs to the Solanaceae family; this family also includes other well-known species, such as potato, eggplant (aubergine), tobacco & peppers. The tomato originated in the Americas. Tomatoes were introduced to Africa in the 16th century and are currently one of the most widely grown vegetables by small-landholder farmers.⁴

Seed viability and storability largely depend upon seed moisture, relative humidity and temperature. High seed moisture and high temperature would hasten the process of seed deterioration resulting in loss of seed viability. Seed longevity is generally determined by pre-harvest factors and storage environment. In certain vegetable crops like cucurbits, seeds are stored as such in fruit form till the next growing season. This, not only preserves germinability but is also beneficial in the absence of refrigeration. However, such information is not available in tomato. The tomato seeds are packed in cloth and polythene bags. The seeds when stored in ambient conditions lose their viability and cause great economic loss to tomato growers. This investigation was carried out to study the storage behaviour of tomato seed moisture pervious and impervious containers and kept in ambient conditions which aimed to develop low input technology suitable under resource limitation.

Materials and Methods

A storage experiment was carried out for 18 month of storage period during 2020-2021 and 2021-2022 at the research farm and laboratory of the Department of Seed Science & Technology, CCS Haryana Agricultural University, Hisar. Seed material comprised of Tomato (variety Selection-7) having germination (>70%) above Indian Minimum Seed Certification Standard (IMSCS)

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were collected from the Department of Vegetable Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar, and two containers viz., seeds stored in a cloth bag (C1), seeds stored in > 700-gauge polythene bags (C2). These containers were kept in ambient condition. The observations were recorded on seed quality parameters such as seed germination (%), seedling length (cm), seedling dry weight (mg), vigour index -I and vigour II. The standard germination test, seedling length test and vigour index were determined by adopting the standard procedure in vogue. The results were statistically analyzed and presented in tables 1, 2, 3, 4. and 5.

Observation recorded

The different observations recorded were

- i. Germination (%)
- ii. Seedling length (cm)
- iii. Seedling dry weight (mg)
- iv. Seedling vigour index -I (Germination percentage × Seedling length)
- v. Seedling vigour index -II (Germination percentage × Seedling dry weight)

I. Standard germination (%)

In three replicates, one hundred seeds of both crop seeds were placed in between sufficiently moistened rolled towel papers (BP) separately and kept at 25°C in a seed germinator. The first count was taken on the 7th day and the final count on the 14th day. Only normal seedlings were considered for per cent germination, according to the International Seed Testing Association.⁵

II. Seedling length (cm)

Ten normal seedlings at the time of final count were randomly selected from each replication of all the seed lots and their length was measured in centimeters. The average length of these seedlings was calculated.

III. Seedling dry weight (mg)

Ten normal seedlings which were used for the measurement of seedling length were also used for seedling dry weight measurement. Seedlings were dried in a hot air oven at 80°C temperature for 48 hrs, removed from the oven, and allowed to cool in desiccators for 30 minutes before weighing on an electronic balance. The average weight of dried seedlings from each replication was calculated and expressed in milligrams.

IV. Seed vigour indices

Seedling vigour indices were calculated by using the formula suggested by Abdul-Baki and Anderson (1973)⁷ as follows: -

Vigour Index-I

Vigour Index-I = Standard germination (%) × Average seedling length (cm)

Vigour Index-II

Vigour Index-II = Standard germination (%) × Average seedling dry weight (mg)

Results and Discussion

Seed storage containers influenced seed storability at different storage environments. Generally, seeds stored in moisture impervious containers (polythene bag > 700 gauge) stored better compared to moisture pervious (cloth bag) under ambient conditions with low seed moisture content. The results in the present study revealed that the seeds stored in a polythene bag (> 700 gauge) were significantly superior in maintaining viability and vigour compared to the seeds stored in cloth bag throughout the storage period (18-month storage period). The seeds stored in polythene bags > 700 gauge recorded higher germination with a low reduction in germination per cent compared to cloth bags throughout the storage (Table 1). The highest reduction in germination per cent was observed in the seeds stored in a cloth bag (85.67 to 55.67).

Table 1: Effect of containers on seed germination (%) of tomato during storage period

Containers (C)	Storage period in months (P)							
	0	3	6	9	12	15	18	Mean
Cloth bag	85.67 (67.73)	82.33 (64.87)	78.33 (60.87)	74.33 (58.24)	70.00 (56.77)	66.00 (54.31)	55.67 (48.24)	72.48 (58.56)
Polythene bag	85.67 (67.73)	83.00 (66.40)	80.00 (63.41)	77.67 (61.09)	73.67 (59.10)	70.00 (56.77)	60.67 (51.14)	75.81 (60.81)
Mean	85.67 (67.73)	83.67 (65.39)	79.17 (62.14)	75.50 (59.67)	71.83 (57.93)	68.00 (55.54)	58.17 (49.69)	
CD (P=0.5)	C=0.643, P=1.203, CXP=1.701							
SE(m) ±	C=0.221, P= 0.413, CXP=0.584							

A similar trend in reduction of seedling length, seedling dry weight and –vigour-index was also observed due to containers during storage. A lower reduction in seedling length was noticed in the polythene bag (16.00 to 8.77 cm) as compared to the cloth bag (Table.2). The lower

reduction in seedling dry weight was noticed in the polythene bag (20.71 to 11.42 mg) and higher in a cloth bag (20.71 to 9.60 mg) throughout the storage period (Table 3).

Table 2: Effect of containers on seedling length (cm) of tomato during the storage period

Containers (C)	Storage period in months (P)							
	0	3	6	9	12	15	18	Mean
Cloth bag	16.00	15.50	14.10	12.63	11.30	9.40	7.30	12.28
Polythene bag	16.00	15.93	14.70	13.60	12.13	10.17	8.77	13.04
Mean	16.00	15.72	14.40	13.12	11.72	9.78	7.90	
CD (P= 0.5)	C= 0.237, P= 0.444, CXP= 0.627							
SE(m) ±	C= 0.081, P= 0.152, CXP= 0.215							

Table 3: Effect of containers on seedling dry weight (mg) of tomato during the storage period

Containers (C)	Storage period in months (P)							
	0	3	6	9	12	15	18	Mean
Cloth bag	20.71	20.20	18.15	16.01	14.12	12.69	9.60	15.93
Polythene bag	20.71	20.51	19.16	17.26	15.14	14.32	11.42	16.93
Mean	20.71	20.36	18.66	16.63	14.63	13.51	10.51	
CD (P= 0.5)	C= 0.312, P= 0.584, CXP=0.826							
SE(m) ±	C= 0.107, P= 0.201, CXP= 0.284							

Similar trends were found in seed vigour Index-I&II (Table 4&5). The lower reduction in seed vigour Index-I was noticed in a polythene bag (1371 to 532) and higher in a cloth bag (1371 to 392). The lower reduction in seed vigour index-II was noticed in a polythene bag (1774 to 793) and higher in a cloth bag (1774 to 566) throughout the storage period. (Table 4 &5). The superiority of seeds stored in a polythene bag for germination percentage and other parameters was due to a lower rate of deterioration as these containers are moisture impervious which did not allow movement of vapour form of moisture from the environment and thus seeds did not deteriorate at a faster rate. Similar results were reported by Doijode (1996)³ in chilli and Sharma et al. (1998)⁷ in chilli varieties. Significant differences in germination percentage,

seedling length and vigour index were observed due to containers throughout the storage period. Similar results were reported by Baldaniya et al. (2018)² in onion seeds the plastic bag maintained the germination potential above the Indian minimum seed certification standard (70%) even after 9 months of storage. Similar results were finding by Kartoori and Biradar Patil (2018)⁶ in onion seeds the seeds stored in a polythene bag and aluminium foil recorded more than 70 per cent of germination till 14 months of storage as compared to a cloth bag. Similar results reported by Kumar *et al.*, (2019)⁹ in brinjal seed polythene bag 700 gauge recorded significantly higher germination and vigour index than the paper bag at the end of 12 months of storage in brinjal. Similar results were reported by Quais *et al.*, (2013)¹⁷ in radish seeds.

Table 4: Effect of containers on vigour index I of tomato during the storage period

Containers (C)	Storage period in months (P)							
	0	3	6	9	12	15	18	Mean
Cloth bag	1371	1261	1076	914	791.	621	392	918
Polythene bag	1371	1338	1176	1043	894	712	532	1009
Mean	1371	1300	1126	978	842	666	462	
CD (P=0.5)	C= 16.9, P= 31.5, CXP= 44.6							
SE(m) ±	C= 5.79, P= 10.8, CXP = 15.3							

Table 5: Effect of containers on vigour index II of tomato during the storage period

Containers (C)	Storage period in months (P)							
	0	3	6	9	12	15	18	Mean
Cloth bag	1774	1643	1410	1213	978	859	566	1206
Polythene bag	1774	1723	1533	1323	1115	1002	793	1323
Mean	1774	1683	1471	1268	1047	931	679	
CD (P=0.5)	C= 31.1, P= 58.2, CXP= 82.3							
SE(m) ±	C= 10.7, P= 20.0, CXP= 28.3							

Conclusion

During natural ageing, standard germination, seedling length, seedling dry weight, and vigour indices, decreased significantly with an increase in the ageing period. In naturally aged seeds of tomato sustained their germination for up to one year which means that the seeds can be stored at ambient conditions up to one year in both containers *i.e.* cloth bag and polythene bag without loosening their viability but the polythene bag maintained constant germination per cent up to 15 months of storage.

Declaration of interests

The authors have no conflict of interest to declare.

Data sharing

All relevant data are within the manuscript.

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