

Stage of Fruit Maturity on Seed Quality during Storage in Tomato (*Lycopersicon esculentum* Mill.)

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ABSTRACT For seed purpose, tomato fruits are harvested at red ripe stage and the fruit picking is a continuous process as the fruits mature over a period of time. A study was conducted with an indeterminate tomato cv. Arka Vikas to know the feasibility of harvesting fruits at different maturity stages so as to reduce the number of fruit pickings. Fruits were picked at various stages starting from mature green to over ripe soft stage and the seeds were extracted on the day of harvest. There was no significant difference among fruit maturity stages on seed germination when assessed at 2 months after extraction. The germination was above 93% in all the cases. However, the seed extracted from mature green fruits had significantly lower test weight, poor seed lustre, decreased root length and vigour index compared to others. Same trend was noticed during storage under ambient conditions up to 10 months, without any significant reduction in germination. At the end of 14th month of storage a slight reduction in germination was observed in all fruit maturity stages except for seeds from over ripe firm fruits and it remained so up to 18th month. However, differences among various maturity group for seed quality was obvious at the end of 22nd month of storage. Only seeds extracted from over ripe firm fruits maintained germination above 85% at the end 22nd month of storage.

Keywords: harvesting; fruit maturity; seed quality; storage

Tomato fruits are usually harvested at complete red ripe stage for seed extraction purpose. At a given time, the tomato plant is loaded with fruits of different maturity stages. Number of days required from pollination to red ripe maturity is 45-50 days and the effective pollination period in case of hybrid tomato seed production is approximately 25 days [1] and hence the fruit picking duration spreads over 20-25 days, which is highly labour intensive. Restricting the number of pickings to one or two, or going for mechanical harvesting, means harvesting fruits of varying maturity stages. This raises the question of seed quality of such fruits. Many studies have reported little or no effect on seed quality when fruits were harvested from breaker stage to over ripe soft stage [2-4]. These studies were limited to testing the quality of seed immediately after extraction and not covered the quality of such seeds in storage. The underdeveloped seeds may produce normal seedlings but are known to lose viability and vigour faster than well-developed seeds in storage. The present study, therefore, was taken up to assess the effect of fruit harvest at different maturity levels on quality of fresh and stored seeds of tomato.

MATERIALS AND METHODS

Tomato cv. Arka Vikas was selected for this study. The seed crop was grown at Indian Institute of Horticultural Research, Bangalore, India during 2001-2002 Rabi-Summer with recommended agronomic practices. The fruits at different maturity stages viz., mature green (when fruits started to turn from green to yellow and the mucilage around seeds started to turn green to reddish); breaker (when fruit skin started showing stripes of red colour); half red (when half of fruit turned red); full red (when whole fruit turned red); over ripe but firm (full ripe fruits left for 3-4 days on plant without shrinkage of skin) and over ripe soft (when full ripe fruits left for 6-7 days with softening of fruit and shrinkage of skin) were picked during peak harvesting stage. Fruits were crushed and kept for fermentation on the day of harvest. The seeds were separated by washing in water after 24 h fermentation and dried under shade to ~8% moisture. The dried seeds were kept in butter paper bags and stored under ambient conditions. The observations such as test weight (100-seed weight), final germination percentage, seedling root

and shoot length and vigour index were recorded 2 months after extraction and then at 4 months interval up to 22 months. The germination test was conducted as per ISTA rules [5]. Four replicates of 50 seeds each were used for germination test. The first count was taken on 7th day and the final germination on 14th day. The vigour index was calculated by multiplying seedling length and germination percentage. The data was analysed using ANOVA technique with CRD.

RESULTS AND DISCUSSION

The data on 100-seed weight, percentage germination, and seedling root and shoot length and vigour index are given in Tables 1 & 2. The seeds from over ripe fruits recorded the highest 100-seed weight (0.310g) and was significantly superior over other maturity stages. But, for other seed quality attributes it was found to be on par with the other maturity stages except with mature green fruit stage when tested after 2 months of extraction. The seeds from mature green fruits were found to be significantly inferior in quality to the seeds from other maturity stages with respect to test weight, root length and vigour index, and the seeds were greenish and dull in appearance. However, there was no significant difference with respect to germination percentage.

During storage, similar trend was observed at 6th and 10th month of storage (Tables 1 & 2). There was no appreciable decline in seed quality until 10th month of storage in seeds of all maturity stages. Seeds extracted from mature green stage were on par with others with respect to germination but differed significantly in seedling root length and vigour index. No definite trend was observed with respect to seedling shoot length.

There was a slight reduction in germination at the end of 14th month and it remained until 18th month in all maturity stages. The decline in germination was less in seeds obtained from over ripe firm fruits than from other maturity stages, although the differences were not significant. As the seeds aged further, the differences among various maturity groups for seed quality became more obvious. At the end of 22nd month of storage a drastic reduction in all seed quality attributes was observed in all maturity groups except in over ripe firm fruits (Tables 1 & 2). The level of reduction in germination was more in mature green, breaker and half-red stages with 42.5, 36.0 and 46.5 per cent germination, respectively. Over mature but firm fruits maintained higher germination (85%) and vigour index (1972)

and it was significantly superior to all other treatments. The extent of reduction was significantly lower in seeds from full red and over ripe soft fruits compared to seeds of mature green, breaker and half-red fruits.

Fruits harvested at red ripe stage recorded maximum seed quality with respect to germination, seedling vigour and test weight in tomato [6-7] when tested immediately after extraction and similar observations were made in chilli [8-9]. Chilli seeds harvested at red ripe stage and allowed for 10 days post-harvest ripening had better germination and vigour [10]. Contrary to this very little difference in seed quality was observed among different fruit stages when tested immediately after extraction. Only the seeds from mature green stage showed significantly lower values for 100-seed weight, seedling root length and vigour index when compared to that of other stages but on par in respect of germination percentage. Similar findings have been reported by Valdes and Gray [2], Meher *et.al.* [3], and Prokhorov *et.al.* [4] in tomato. They observed very little or no effect on seed quality when fruits were harvested from breaker stage to overripe soft stage and when tested immediately after extraction.

Most of the studies done so far are limited to immediate evaluation of seed quality after extraction and drying. Demir and Ellis [11] working with bell pepper observed highest seed quality in terms of viability and seedling growth in seeds extracted from the fruits of 10-12 days after physiological maturity and stored under ambient conditions. Similarly, Doijode [12] recorded higher vigour and viability of chilli seeds from ripe fruits compared to seeds from fruits harvested before attaining red ripe stage when seeds were stored for 30 months.

It seems that seed development in tomato continues even after full maturity as in case of bell pepper where post-harvest ripening period is must to get quality seeds. Though the seeds extracted from various maturity stages did not show much difference in quality at the initial stage of storage, differences were obvious at later stages of storage. Very drastic reduction in all seed quality attributes was observed in all maturity groups except in over ripe firm fruits at the end of 22nd month. Fully developed seeds have better membrane integrity and hence, store better. So, it is concluded that for better quality of tomato seeds which can be retained even in storage for longer period, it is always advisable to harvest the fruits at complete ripe stage when fruits turn fully red or yellow as the case may be, and extract seeds after 2-3 days of ripening.

Table 1. Effect of stage of fruit harvest on seed quality (germination and seedling root length) during storage under ambient conditions in tomato cv. Arka Vikas.

Stage of fruit harvest	100-seed wt. (g)	Germination (%)						Root length (mm)					
		2*	6	10	14	18	22	2	6	10	14	18	22
Mature green	0.268	96	98	93	88	86	43	7.2	7.0	9.1	9.1	9.6	8.5
Breaker	0.303	98	98	97	86	88	36	9.2	9.0	10.0	10.2	10.1	8.3
Half red	0.295	96	97	95	89	89	37	8.7	9.4	10.4	10.6	9.9	8.9
Full red	0.290	98	98	97	90	89	63	9.5	10.2	11.4	10.8	10.6	9.4
Over mature (firm)	0.310	97	99	95	96	94	85	10.6	10.3	10.6	11.8	11.7	10.8
Over mature (soft)	0.293	96	96	94	88	88	71	10.1	9.0	12.9	10.8	11.0	10.3
C.D. at 5%	0.012	NS	NS	NS	NS	NS	4.17	1.70	0.54	0.89	1.03	1.21	1.68

* Period in months from start of storage

Table 2. Effect of stage of fruit harvest on seed quality (seedling shoot length and vigour index) during storage under ambient conditions in tomato cv. Arka Vikas.

Stage of fruit harvest	Shoot length (mm)						Vigour index					
	2*	6	10	14	18	22	2	6	10	14	18	22
Mature green	7.15	9.2	9.6	10.8	11.4	12.1	1378	1588	1739	175118	06	886
Breaker	7.43	10.9	11.4	11.7	11.7	12.5	1630	1950	2076	188319	98	749
Half red	8.38	11.1	11.4	12.5	12.3	13.1	1640	1989	2071	205619	76	814
Full red	8.68	11.2	10.9	11.4	13.4	12.7	1782	2097	2163	199821	36	1392
Over mature (firm)	9.25	11.4	11.6	12.3	13.4	12.4	1925	2148	2109	231423	59	1972
Over mature (soft)	8.7	10.6	10.5	10.9	12.8	12.8	1805	1882	2200	191020	94	1640
C.D. at 5%	1.13	NS	NS	1.02	1.09	NS	332	302	341	386	318	309

* Period in months from start of storage

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