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Influence of accelerated ageing test on seed quality of onion (*Allium cepa* L.)

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Abstract
A Laboratory experiment was conducted at Department of Seed Science and Technology, GKVK, UAS, Bangalore during 2013-14 to influence of accelerated ageing test on seed quality of onion (*Allium cepa* L.). The two genotypes of onion hybrid Kirthiman and variety Arkha kalyan seeds subjected to the accelerated ageing at 45±2^{0}C for 100% RH for various time intervals (0,1,2,3,4,5,6,7,8,9,10 days) and seed quality tests of the seed material completed (germination percentage, shoot length, root length, mean seedling length, mean seedling dry weight, seedling vigor index, electrical conductivity and total dehyadrogenase activity), before and after ageing treatments. The seed showed a gradual and sequential reduction in germination percentage and seedling vigour as accelerated ageing duration increased. Seed leachate conductivity increased with ageing duration.

Keywords: onion (*Allium cepa* L.), accelerated ageing

Introduction
Onion (*Allium Cepa* L.) is one of the important commercial biennial cool season vegetable crop, which is used for both fresh and bulb purpose. Onion belongs to family *Amaryllidaceae*. Onion primary origin is Central Asia and considered that the Mediterranean area is the secondary center of origin. Onion is very important vegetable which have diuretic properties, it is beneficial for eyes and being used in the prevention of atherosclerosis and coronary heart disease as they can inhibit the aggregation of human blood platelets to form the clots, which have the potential for arterial blocking with good coagulation efficiency. Onion bulb is strongly contracted subterranean shoot with thickened fleshly leaves as food value. Globally onion occupies an area of 42, 96,495 ha with the production of 8, 33, 55,752 tons with a productivity of 19.4 tones ha^{-1}. India occupies an area of 1051.5 thousand ha with a production of 16813 thousand tones with productivity 16 tones ha^{-1}.

Seed moisture and storage temperature are the two most important factors influencing loss of viability during storage. The rate of seed deterioration was greatly increased by exposing seeds under high humidity (100%) and high temperature (45±2^{0}C) conditions. Information can be obtained on the probable longevity of a seed under more normal conditions and seed storability can be predicted in a few days with the help of accelerated aging test.

The ageing is a universal phenomena occurring in all living organisms during the natural course of development, however, unfavorable/stress conditions hastens it. Seeds of all plants exhibit a maximum potential for germination immediately after the harvest, which declines gradually with an increased storage period. Seed ageing is one of the key factors responsible for the decline in the yield of various food crops and seed crops particularly the vegetables. Ageing of seeds is evident through parameters viz., delayed germination and emergence, slow growth, increased susceptibility to environmental stresses (Walters, 1998) [14]. Many processes have been suggested as possible mechanisms involved in the seed deterioration like chromosomal damage, loss of activity. Hence, keeping above facts in view, the present investigation was carried out to influence of accelerated ageing test on seed quality of onion (*Allium cepa* L.).

Materials and Methods
The experiment was conducted at Department of Seed Science and Technology, Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Bangalore during 2013-14. There were 10days of ageing periods with two genotypes and laid out in Factorial complete randomized design. The experimental data generated was statistically analyzed by using suitable ANOVA as per the method outlined by Gomez and Gomez (1983) [6]. Critical difference (CD) values were computed at 5 per cent level whenever 'F' test was significant.

Plant materials: The freshly harvested seeds of two onion genotypes hybrid Arka kirthiman and variety Arka kalyan were obtained from Indian Institute of Horticulture Research Bangalore.Healthy, infection free and uniform size seeds of onion were used for all experiments.

Accelerated ageing: For accelerated ageing; the seeds were exposed to a temperature 45^{0}C and RH (Delouche and Baskin, 1985) [3] for various time intervals (0, 1,2,3,4,5,6,7,8,9, 10days).Seeds which were not exposed to

the ageing treatments were referred as '0 day'.

Germination: The germination test was conducted in the laboratory by using between paper method as per ISTA (Anon., 2007) [2]. Hundred seeds in four replicates were placed on germination paper and rolled towels were in germination chamber maintained at 25 ± 1°C and 95±3 per cent relative humidity. The germinated seedlings were evaluated on fourth and 10th day as first and final count, respectively.
Ten seedlings from each treatment and replication were used for measuring the seedling length was kept in the hot air oven at 85±1°C for 24 hours.

Root and shoot length (cm)
Ten normal seedlings were selected at random from each treatment. The root length was measured from point of attachment of seed to the tip as the longest root and shoot length was measured from the point as attachment of seed to the growing meristematic tip and expressed in cm.

Mean seedling length (cm)
Ten seedlings taken at randomly from each treatment and replication were separated carefully from the paper towel of laboratory germination test and total length of seedlings after removing the cotyledons was measured using metric scale on the germination table. The mean length of ten seedlings in each treatment and replications was calculated and expressed in centimeters.

Mean seedling dry weight (mg)
Ten seedlings from each treatment and replication were used for measuring the seedling length was kept in the hot air oven at 85±1°C for 24 hours. The dry weight (mg) was measured and expressed as mean dry weight (mg seedling^{-1})

Seedling vigor index [SVI-I and SVI-II]
The seedling vigour index was calculated as per the formula given by Abdul Baki and Anderson (1973) [1].
SVI-I = Germination (%) x Mean seedling length (cm).
SVI-II= Germination (%) x Mean seedling dry weight (mg).

Electrical conductivity (µSppm^{-1})
Ten seeds of two replications were taken randomly from each treatment in a beaker. Then the seeds were soaked in 25 ml of distilled water for 24 hours at 25±1ºC. The steeped water from soaked seeds was collected and the electrical conductivity (EC) of seed leachate was measured in digital conductivity meter (Model: Systronic conductivity meter 306). After subtracting the EC of the distilled water from the value obtained from the seed leachate, the actual EC due to electrolyte was measured and expressed in µS ppm^{-1} (Anon., 2007) [2].

Total dehydrogenase activity
Twenty seeds from each treatment were preconditioned by soaking in water for 24 hours. Then ten pre imbibed seeds were randomly selected in each sample, seeds were cut longitudinally and soaked in 2ml of 0.5 per cent Tetrazolium solution. They were incubated at 25 ± 1^{0}C in dark for 6 h and then washed thoroughly in distilled water. The red colour (Formazan) developed was eluted from the stained embryos by soaking in 5ml of 2 Methoxy ethanol in a screw caped vials until all the seeds discolored. The extract was decanted and the colour intensity was measured in Spectrometer (model SL171) at 480nm with suitable blank. The TDH was expressed in terms of OD value (Perl *et al*., 1978).

Results and Discussion
The seeds of two onion genotypes hybrid Arka kirthiman and variety Arka kalyan were obtained from Indian Institute of Horticulture Research Bangalore. Seeds were subjected to accelerated ageing for 0,1,2,3,4,5,6,7,8,9,10 days at 45±2^{0}C for 100% RH and the following observation was recorded (Delouche and Baskin, 1985) [3]. The experiment was carried out in the PG laboratory of Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Bangalore.
Storage potential was evaluated by using accelerated ageing technique. accelerated ageing results in the progressive loss of seed viability and vigor.
The two onion genotypes hybrid Arka kirthiman and variety Arka kalyan seeds exhibits 99.00 % and 98.00% germination which declined to 45.00 % and 44.00 % after ten days of ageing (Table 1). Among two genotypes, seeds exhibits more susceptibility to the ageing. Besides, germination, root length, shoot length mean seedling length and mean seedling dry weight also elicited a significant decline seed quality parameters. The decline in all these parameters contributed to the decline in the seedling vigour index-I. Ageing results in results in non-functioning of cell division which essential for germination process and development of normal seedling. This collapse results in decreased germination in terms of normal seedling, seedling length, seedling dry weight and increased the number of abnormal seedlings. Seeds became almost unable to support de novo protein synthesis. Electrical conductivity test of seed leachates measures the amount of electrolytes that are leaked in to the imbibing medium from seeds. This test reflects the integrity of cell membrane subsequent to the genotypes. The increased electrolyte leakage can be correlated with the decreased vigour index in seeds. Leaching of electrolytes from the less viable seeds is often attributed to the loss of membrane integrity by distortions of the bilayer configuration and the extent of leakage is directly proportional to the conductivity of solution in which seeds are germinated these results were in conformity with those of Doijode, S.D. (1990) [5] in watermelon, Palanisamy *et al*. (1994) [11] in onion, watermelon and cosmos, Doijode (1995) [4] in onion, Narayanaswamy *et al*. (1996) [9] in field bean, Nargis and Thiagarajan. (1996) [10] in tomato, Mohammad Amjad and Mohammad Akbar Anjum (2002) [7] in onion, Mumtaz khan *et al.* (2004) [8] in onion, Shantappa *et al.* (2006) [12] in Bitter Gourd.

Table 1: Accelerated ageing test influence on seed quality as effect of genotypes in onion (*Allium cepa* L.) seeds.

Ageing period (Days)	Germination percentage (%)		Mean seedling length (cm)	
	Genotypes			
	Arka kirtiman (G_1)	Arka kalyan (G_2)	Arka kirtiman (G_1)	Arka kalyan (G_2)
0	99.00	98.00	18.50	18.20
1	93.00	92.00	18.00	17.60
2	90.00	89.00	17.05	16.45
3	86.00	84.00	16.75	15.70
4	81.00	80.00	15.25	14.90
5	78.00	75.00	14.30	14.00
6	70.00	69.00	13.20	12.85
7	64.00	63.00	12.10	11.80
8	58.00	59.00	10.70	10.20
9	52.00	51.00	9.40	9.10
10	45.00	44.00	8.50	8.20
Mean	71.70	70.60	13.52	13.08
S.Em±	0.95	0.84	0.10	0.14
CD (P=0.05)	2.85	2.52	0.30	0.43
CV (%)	2.34	3.11	3.32	3.82

G = Genotypes, G_1: Arka kirtiman, G_2: Arka kalyan

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Ageing period (Days)	Mean seedling dry weight (mg)		Seedling vigor index I	
	Genotypes			
	Arka kirtiman (G_1)	Arka kalyan (G_2)	Arka kirtiman (G_1)	Arka kalyan (G_2)
0	29.74	29.02	1871	1842
1	27.87	27.40	1765	1619
2	26.96	26.79	1646	1522
3	25.87	25.36	1479	1386
4	23.52	23.44	1328	1304
5	22.83	22.75	1232	1178
6	20.94	20.87	924	876
7	19.22	19.09	730	706
8	18.88	18.67	625	602
9	16.79	16.46	510	490
10	13.94	13.79	423	396
Mean	21.68	21.46	1066.2	1008
S.Em±	0.02	0.01	14.68	18.74
CD (P=0.05)	0.06	0.04	44.05	56.21
CV (%)	3.18	3.09	2.48	3.27

G = Genotypes, G_1: Arka kirtiman, G_2: Arka kalyan

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Ageing period (Days)	Total Dehydrogenase Activity (OD=A_{480nm})		Electrical Conductivity (µSppm^{-1})	
	Genotypes			
	Arka kirtiman (G_1)	Arka kalyan (G_2)	Arka kirtiman (G_1)	Arka kalyan (G_2)
0	1.395	1.390	614.00	618.00
1	1.252	1.255	670.00	675.00
2	1.212	1.213	685.00	688.00
3	1.153	1.154	697.00	700.00
4	1.110	1.114	710.00	713.00
5	1.060	1.070	730.00	732.00
6	0.983	0.986	752.00	753.00
7	0.916	0.920	769.00	771.00
8	0.847	0.850	780.00	782.00
9	0.786	0.790	793.00	796.00
10	0.730	0.733	810.00	814.00
Mean	1.005	1.009	739.60	742.40
S.Em±	0.01	0.01	2.95	3.42
CD (P=0.05)	0.019	0.019	8.84	10.26
CV (%)	1.879	1.981	2.70	2.82

G = Genotypes, G_1: Arka kirtiman, G_2: Arka kalyan

Conclusion

Overall conclusion is that onion seeds quality was reduced during accelerated ageing. The seed showed a gradual reduction in mean germination percentage and vigour as accelerated ageing duration increased. During deterioration, vigour is the first component of seed quality, which is lost, followed by a loss of germination capacity and viability (Trawatha *et al*. 1995).

The results obtained suggest that membrane deterioration leading to a reduction in vigour and germ inability may play a considerable role in onion seed quality loss that may results from prolonged storage in humid tropics.

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