



Influence on seed quality parameters under different temperature and artificial ageing treatment in cumin (*Cuminum cyminum*)

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ABSTRACT

The experiment was conducted in the Department of Seed Science and Technology, B A College of Agriculture, Anand Agricultural University, Anand to know the influence on seed quality parameters under different temperature and artificial ageing treatment in cumin (*Cuminum cyminum* L.). Two varieties were tested for seed quality, viz. Gujarat Cumin 1 (GC 1) and Gujarat Cumin 4 (GC 4). The laboratory experiment was laid out in completely randomized design (factorial concept) with four temperature treatments (10°C, 15°C, 20°C and 25°C) and three repetitions. The artificial ageing experiment consisted of three ageing treatments (0 day, 3 days and 5 days) with four repetitions. The experiment results revealed that, the different temperature regimes showed significant effect on seed germination and other quality parameters in cumin genotypes. The GC-1 interacting with 20°C was higher for different quality parameters like first count (45.66%), final count (94%), seedling length (9.33 cm), seedling fresh weight (219.66 mg), seedling dry weight (10.76 mg), seedling vigour index I (877) and seedling vigour index II (93). In seed ageing experiment, the different days of artificial ageing also showed significant effect on the seed viability and longevity. GC-1 recorded higher germination (55.50%), seedling length (3.45 cm), seedling dry weight (27.57 mg), vigour index –I (192) and vigour index –II (1539) as compared to GC-4 at the end of five days ageing period.

Key words: Artificial ageing, Cumin, Seed viability, Seed vigour, Temperature

India is considered as the land of spices and grow near about 53 major spices in the country. Most of them are tropical and they play a major role in the Indian economy. Cumin (*Cuminum cyminum* L.) is an important annual herbaceous seed spice crop belonging to family umbelliferae of dicotyledonous group. It is native to Egypt and Mediterranean region (Anonymous 2016). India is the largest producer, consumer and exporter of cumin in the world. It is widely grown in Gujarat, Rajasthan, Uttar Pradesh and Punjab. The Gujarat and Rajasthan are the major producers of cumin in India and they account for ~92% of total Indian production. Gujarat state alone contributes around 65% of the total national production. In India, cumin is sown from October to until beginning of December and harvesting starts from February (Anonymous 2015). The demand for cumin is fairly increasing in the domestic as well in international market. However, the production and productivity of cumin is decreasing year after year due to several reasons, viz. non-availability of good quality seed, slow and uneven germination, low adoption of seed production technologies, degradation of seed quality due to microbial load, heavy infestation of diseases and pests,

traditional harvesting & processing, unscientific and unhygienic handling at post-harvest and storage are the major problem. Poor physical purity and seed germination directly affects the establishment of plant population and causing diseases in the field conditions leading to poor seed yield (Mahajan *et al.* 2013).

Temperature is one of the important environmental factor influencing the seed germination and vigour. Poor germination is a common phenomenon at sub-optimal temperatures which is a great concern of seed growers that grow cumin seedlings in late winter and early spring in the Mediterranean region (Heidari *et al.* 2014). Deterioration of seed is associated with ageing phenomenon, which is defined as an irreversible degradation in the quality of seed after it has reached specific stage. Its maximum quality level and the seed deterioration also start immediately after attaining the physiological maturity on the plant itself. Accelerated ageing is the most important test among all the seed vigour tests to know the longevity of seed. Hence, the present investigation was carried out with the objective to optimize the temperature requirement to obtain maximum germination and to know the storage potential of cumin genotypes.

MATERIALS AND METHODS

Seeds of cumin genotypes, Gujarat Cumin 1 (GC 1) and Gujarat Cumin 4 (GC 4) were obtained from the Centre for Seed Spices Research Station, S D Agricultural University,

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Jagudan, Gujarat. The two laboratory experiments were performed in the Department of Seed Science and Technology, B A College of Agriculture, AAU, Anand for testing the influence on seed quality parameters under the different temperature and artificial ageing treatment.

The laboratory germination test was conducted as per ISTA (2009) procedure by adopting top of paper method. Freshly harvested and processed 100 seeds in four replications were taken at random from the seed lot of both the genotypes and placed uniformly on germination paper. The top of paper was kept in different germinator, where the temperature was maintained as per treatment and the relative humidity was maintained at 95±1%. The final counts were made on fourteenth day of germination test for normal seedlings and germination was expressed in percentage and other seedling parameters were recorded and calculated (ISTA 2009).

The vigour indices were calculated using the procedure suggested by Abdul-Baki and Anderson (1973)

Vigour index-I = Germination (%) × Seedling length (cm)

Vigour index-II = Germination (%) × Seedling dry weight (mg).

Artificial ageing:

Seeds of each genotype in four replications were tied in a fine muslin cloth bag. The tied seeds were placed in desiccators on a wire mesh. The lower part of the desiccators was filled with water, so that there wasn't any direct contact between water and the seed. The desiccator was covered

with the lid and sealed with paraffin wax to make it air tight. The desiccator was then placed in the accelerated ageing chamber maintained at 45°C temperature and 100% relative humidity for 3 and 5 days. The desiccators were removed after the mentioned period and the seeds were cooled and then tested for normal germination test. The seed quality parameters recorded, viz. germination (%), root length (cm), shoot length (cm), seedling length (cm), seedling fresh weight (mg), seedling dry weight (mg), vigour index –I, vigour index –II and electrical conductivity (μ si/cm/g) were calculated.

The observed data was statistically analyzed by appropriate statistical procedures as suggested by Steel and Torrie (1960). The standard error of mean S.Em \pm and critical difference (CD) at 5% level of probability were worked out and presented in respective tables for interpretation of the results.

RESULTS AND DISCUSSION

The results pertaining to effect of different temperature on seed germination and other quality parameters are presented in Table 1 and Fig 1. The different temperature treatment showed significant effect on cumin genotype. The significantly higher germination per cent (final count) was observed in genotype GC-1 (82.91%) and the treatment 20°C (88.83%) with their corresponding interaction (94 %). Similarly the maximum root length recorded in GC-1 (4.22 cm) and treatment 20°C (4.45 cm) with the highest interaction (5.13 cm). The higher

Table 1 Effect of temperature on seed germination and other quality parameters in cumin

Treatment	Germination (%)		Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (mg)	Seedling dry weight (mg)	Vigour index –I	Vigour index –II
	First count	Final count							
V ₁	28.25	82.91	4.22	3.40	7.59	140.16	10.00	640	75
V ₂	3.41	73.25	3.38	2.85	6.26	102.58	9.61	463	60
CD (P=0.05)	0.64	0.89	0.15	0.17	0.24	1.94	0.17	21.80	3.23
T ₁	7.33	67.16	2.50	2.41	4.88	100.16	9.36	328	54
T ₂	12.16	74.16	4.34	3.33	7.67	113.33	9.53	572	64
T ₃	28.16	88.83	4.45	3.68	8.13	161.666	10.38	728	83
T ₄	15.66	82.16	3.93	3.08	7.01	110.33	9.95	579	69
CD (P=0.05)	0.90	1.26	0.21	0.25	0.34	2.74	0.24	30.83	4.57
V ₁ T ₁	14.33	72.33	2.70	2.43	5.00	99.33	9.80	361	61
V ₁ T ₂	23.66	80.00	4.73	3.53	8.26	122.00	10.13	661	71
V ₁ T ₃	45.66	94.00	5.13	4.20	9.33	219.66	10.76	877	93
V ₁ T ₄	29.33	85.33	4.33	3.43	7.76	119.66	10.06	662	78
V ₂ T ₁	0.33	62.00	2.30	2.40	4.76	101.00	8.93	295	48
V ₂ T ₂	0.66	68.33	3.95	3.13	7.08	104.67	8.93	483	57
V ₂ T ₃	10.66	83.66	3.77	3.16	6.92	103.66	10.00	579	74
V ₂ T ₄	2.00	79.00	3.53	2.73	3.26	101.00	9.83	495	61
CD (P=0.05)	1.28	1.78	0.30	0.35	0.49	3.88	0.35	43.61	N/s
CV %	4.65	1.31	4.57	7.51	3.96	1.80	2.01	4.46	5.35

Factor I-Variety: V₁=Gujarat Cumin-1 and V₂-Gujarat Cumin-4. Factor II-Temperature T₁: 10°C, T₂: 15°C, T₃: 20°C and T₄: 25°C

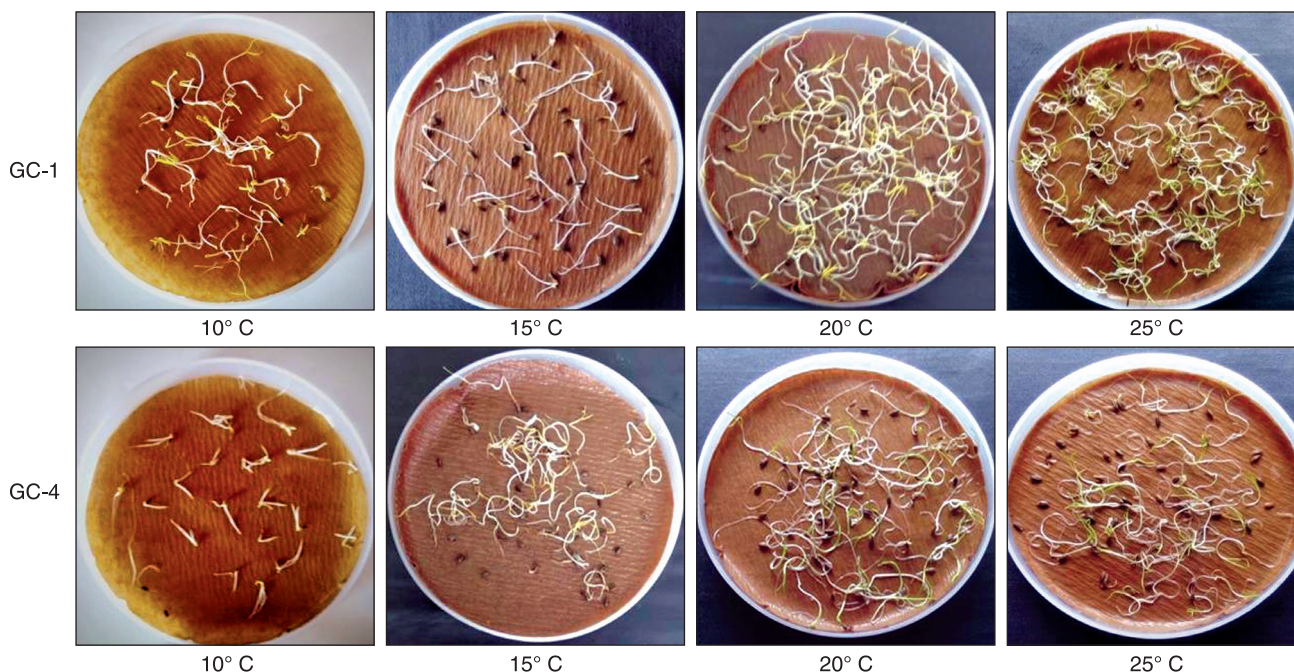


Fig 1 Influence of different temperature treatments and variety on germination (%)

seedling length was recorded in variety GC-1 (7.59 cm) and 20°C (8.13 cm) temperature treatment recorded with their corresponding interaction (9.33 cm). The maximum seedling dry weight was in variety GC-1 (10.00 mg) and temperature treatment 20°C (10.38 mg) with their interaction (10.76 mg). The highest seedling vigour index I was recorded in GC-1 (640) and temperature treatment 20°C (728) with their corresponding highest interaction (877) and maximum seedling vigour index II was recorded in variety GC-1 (75) and 20°C treatment (83)

with highest interaction (93).

The germination percentage significantly increased as the temperature increased and attained maximum seed quality at 20°C. The result indicated that poor germination at low temperatures was due to limitation of water flow and reduction in the rate of thermochemical reactions in the seed. Germination temperature may affect the initial processes of water uptake by seeds according to Zhigang *et al.* (2010) and also biochemical processes that result in cell division. Low temperature is an important stress factor

Table 2 Effect of different days of accelerated ageing on seed quality parameters in cumin

Treatment	Germination (%)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (mg)	Seedling dry weight (mg)	Vigour index -I	Vigour index -II	EC (µ si/cm/g)
V ₁	68.16	2.63	2.27	4.87	66.91	32.58	351	2277	567.13
V ₂	64.16	2.15	1.92	4.11	59.25	31.75	281	209	489.70
CD (P=0.0 5)	0.77	0.06	0.08	0.10	0.76	0.58	7.10	7.10	1.08
T ₁	83.87	3.47	2.87	6.35	74.37	37.62	533	3157	443.51
T ₂	61.75	2.00	2.02	4.02	59.12	32.62	248	2012	481.96
T ₃	52.87	1.71	1.40	3.11	55.75	26.25	165	1391.	659.77
CD (P=0.0 5)	0.95	0.07	0.10	0.13	0.94	0.71	8.70	8.70	1.33
V ₁ T ₁	85.50	3.65	3.25	6.90	77.75	38.50	590	3291	479.70
V ₁ T ₂	63.50	2.30	2.07	4.27	64.25	31.50	272	2000	531.77
V ₁ T ₃	55.50	1.95	1.50	3.45	58.75	27.75	192	1539	689.92
V ₂ T ₁	82.25	3.30	2.50	5.80	71.00	36.75	477	3023	407.32
V ₂ T ₂	60.00	1.70	1.97	3.77	54.00	33.75	226	2025	432.15
V ₂ T ₃	50.25	1.47	1.30	2.77	52.75	24.75	139	1243	629.62
CD (P=0.0 5)	N/s	0.10	0.14	0.18	1.33	1.01	12.30	12.30	1.88
CV %	1.36	2.91	4.56	2.74	1.38	2.06	2.60	2.25	0.24

Factor I-Variety: V₁- Gujarat Cumin-1, V₂- Gujarat Cumin-4. Factor II- Ageing periods T₁: 0 day, T₂: 3 days and T₃: 5 days

for germination and emergence that can exhibit significant physiological dysfunction when they are exposed to low temperatures which was in accordance with the findings of Rajasekaran *et al.* (2001). The ideal temperature will permit maximum germination in the least amount of time.

The results pertaining to germination per cent and other seedling quality parameters was influenced by the different days of artificial ageing, genotypes and their interaction which are presented in Table 2. The significantly highest germination per cent at the end of five days was observed in genotype GC-1 (55.50%). Similar trend was observed for other seedling quality parameters like seedling length (3.45 cm), seedling fresh weight (58.57 mg), seedling dry weight (27.57 mg), vigour index –I (192) and vigour index –II (1539) as compared to GC-4, which had lower germination (50.25%), root length (1.47 cm), shoot length (1.30 cm), seedling length (2.77 cm), seedling fresh weight (52.75 mg), seedling dry weight (24.75 mg), vigour index –I (139) and vigour index –II (1243). However, the interaction between the variety and ageing period was found non-significant for seed germination per cent.

The seed germination and other seedling quality parameters are reduced as the seeds advances its age either artificially or naturally. This decrease of quality is due to loss of membrane integrity in ageing process and leading to more loss of electrolytes into the imbibing medium. The main cause for membrane deterioration would be lipid peroxidation according to Parrish and Leopold (1978). High temperature and high seed moisture further accelerates seed deterioration (Abba and Lovato 1999). A large number of reactive oxygen species are generated in the seed during ageing which causes lipid peroxidation (McDonald 1999). This free radical induced non-enzymatic peroxidation, has the potential to damage membrane and is the major cause of seed deterioration in storage. This result was in agreement with Vashisth and Nagarajan (2009) in maize, Khan *et al.* (2004) and Amjad and Anjum (2002) in onion.

Based on the present investigation it was concluded that the cumin seed showed higher germination and other quality parameters at 20°C temperature. The variety Gujarat Cumin 1 recorded higher seed storability under middle Gujarat condition.

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