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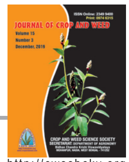

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Pre-sowing seed priming effect on seed quality parameters of coriander (*Coriandrum sativum* L.) under storage condition

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ABSTRACT

The objective of this study was to find out seed quality deterioration pattern under storage condition. Different seed priming treatments were adopted before sowing of seeds to produce quality seeds during Rabi 2017-18 and the harvested seeds were kept under storage condition during 2018-19. Seeds were treated with four concentrations of KNO_3 [viz. T1-0.5% of KNO_3, T2-0.25% of KNO_3, T3-0.1% of KNO_3, T4-hydrated seed (control)] and three durations of soaking [viz. D1-12 hours of soaking, D2-16 hours of soaking, D3-20 hours of soaking]. Treated seeds were sown in the field and replicated thrice. After harvest, seeds were kept under ambient storage condition and seed quality parameters were studied at three months interval upto next year of sowing. It was revealed that among the seed quality parameters seeds harvested from the treatment combination T3D2 (0.1% of KNO_3+16 hours of soaking) showed maximum germination percentage (100%), seedling length (21.30 cm), vigour index (2130) and minimum electrical conductivity (1.267mScm^{-1}) immediately after harvest. Seeds harvested from the treatment combination T3D2 also showed maximum values of the above characters even nine months after storage.

Keywords: Coriander, Seed Priming, Seed Quality, Storage

Coriander (*Coriandrum sativum* L.) is an annual herb that belongs to the family Apiaceae (Umbelliferae) with chromosome number of 2n=22. It is used as spices and its seeds are used for extracting essential oils, *i.e.*, linalool (72.7%), limonene, geraniol and petroselinic acid. India is a major seed spices producer in the world because of its favourable climatic and soil conditions for growing spices and other tropical herbs therefore it is known as the "Home of Spices". The area, production and productivity of coriander during 2017-2018 in India were 664 thousand ha, 861 thousand MT and 1.3 MT per ha respectively. In West Bengal during 2016-2017 the area, production and productivity were 11.45 thousand ha, 14.52 thousand MT and 1.24 MT per ha respectively (Spice Board, India and Ministry of Agriculture and Govt. of India). India ranks first in terms of area and production in the world (FAO, 2016). In India it is mainly grown in the states of Rajasthan, Gujarat, Madhya Pradesh, Andhra Pradesh and Tamil Nadu.

Seed germination and seedling establishment are critical steps in plant life, and the successful establishments of plant depend on rapid and uniform germination of seed under adverse environmental conditions also. Besides this, the rate of deterioration of seed quality parameters in coriander is rapid during storage resulting poor vigour and establishment of crops. For this reason, the minimum germination percent has been fixed at 60% for this crop (IMSCS, 2013). Since availability of quality seed of coriander is very low, seed priming is an excellent technique which improves germination and better crop stand (Taylor *et al.,* 1998; Ashraf and Abu-Shakra, 1978).Thus, seeds produced by those crops will produce better quality seeds. Seed priming is a control procedure where seeds are allowed to soak in solutions of different concentrations to enhance seed germination and growth in stress environment. In halopriming, the seeds are soaked in salt solutions, which help to invigorate the seed and facilitate the process of seed germination and seedling emergence evenly under adverse environmental conditions. It has been established that seeds produced from such crop have higher seed quality than the crops which has been raised from non-primed seeds. Therefore, the present study was carried out to investigate the effect of halopriming on enhancing germination and seedling vigour of coriander seed and to explore the deterioration pattern of next generation seed for seedling parameters under storage condition.

MATERIALS AND METHODS

The field experiment was carried in the Mondouri Teaching farm, Mondouri during Rabi 2017-18 of Bidhan Chandra KrishiViswavidyalaya, Nadia, West Bengal. The laboratory experiment was conducted at the Departmental Laboratory of Department of Seed Science and Technology, Bidhan Chandra KrishiViswavidyalaya, Nadia, West Bengal during 2018-19.The seeds of coriander variety Ranaghat Local were soaked in four aqueous solution of KNO_3 [*viz.* T1-

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0.5% of KNO_3, T2-0.25% of KNO_3, T3-0.1% of KNO_3, T4-hydrated seed (control)] and three durations of soaking [*viz.* D1-12 hours of soaking, D2-16 hours of soaking, D3-20 hours of soaking] with three replications at 25ºC. After that, treated seeds had been washed with distilled water and shade dried properly to restore the previous moisture content of the seed. After proper drying, the treated seeds were sown in the field. After harvesting coriander seeds were properly sun dried, kept in separate paper packets (treatments and replication wise) and kept under ambient storage condition. Observations on standard germination (%), root length (cm), shoot length (cm), seedling length (cm), shoot dry weight (mg seedling^{-1}), root dry weight (mg seedling^{-1}), seedling vigour index-I and electrical conductivity (ìScm^{-1}) were calculated as per procedure described by ISTA (2014). Data were taken immediately after harvest, 3 months after harvest, 6 months after harvest and 9 months after harvest for all characters except electrical conductivity (ìScm^{-1}) where data were taken upto 6 months after harvests. For electrical conductivity (ìScm^{-1}) test five grams of seeds were taken from each treatment and soaked overnight in 50 ml of distilled water for collecting the seed leachates. Electrical conductivity of seed leachates was measured by digital electrical conductivity meter and expressed in ìScm^{-1} (Dadlani and Agarwal,1983).

Statistical analysis was computed using OPSTAT software programme where first factor (T) was considered the combination of different priming with KNO_3 and duration of treatments.The second factor (M) was different storage period *i.e.* 0 months after harvest, 3 months after harvest, 6 months after harvests and 9 months after harvest. The Critical Difference (C.D.) at 5% level of significance was worked out for comparing various treatment means, whenever the F value in ANOVA was found to be significant. The Standard Error of Means [SEm (±)] was also calculated for better conclusion of different interaction effect.

RESULTS AND DISCUSSION

Analysis of data revealed that there was significant variation in different treatment combinations of harvested seeds as well as different duration of storage period (Table 1). Maximum germination percentage (100%) was recorded in case of seeds harvested from the treatment combinationT3D2(0.1% of KNO_3 +16 hours of soaking) immediately after harvest of crop (M1), followed by seeds harvested from the treatment combinationT4D1(hydrated seed + 12 hours of soaking) (95.3%).This may be due to better quality seed production under seeds harvested from the treatment combinationT3D2 (0.1% of KNO_3 + 16 hours of soaking). The germination percentage due to seed priming with duration of treatments although showed highest value in seeds harvested from the treatment combinationT3D2, but the trend of reduction of germination percentage was higher with advancement of storage period. When the means of months of duration of storage of germination percentage were compared the results revealed that there was a decreasing trend with the advancement of storage (Fig.1) irrespective of treatment combinations.

The results on seedling length under laboratory condition have been presented in Table 1. After 21 days, glass plates were taken out and the individual seedling was plucked out from the blotting paper and the seedling length was measured with centimetre scale accurately. Under different storage conditions, the seeds harvested from the treatment combination as well as different duration of storage period has shown significant variation for seedling length. Maximum seedling length (21.3cm) was recorded in case of seeds harvested from the treatment combinationT3D2 after harvest of crop (M1), followed by T3D3 (0.1% of KNO_3 +20 hours of soaking) (19.23cm).This may be due to better quality seed production under T3D2. When the means of months of duration of storage of seedling length were compared, the results revealed that there was a decreasing trend with the advancement of storage (Fig 2). The results are conformity with the work of Nego *et al.* (2015), where primed onion seeds with 1% KNO_3 for12 hrs showed enhanced seedling performance than the non-primed seeds.

Study on vigour index represented in Table 1 and Fig. 4 revealed that there was significant variation in different treatment combinations as well as different duration of storage period. Maximum vigour index (2130) was recorded in case of seeds harvested from the treatment combinationT3D2 after harvest of crop (M1), followed by T2D2 (0.25% of KNO_3 +16 hours of soaking) (1722.1). When the means of months of duration of storage of vigour index were compared the results revealed that there was a decreasing trend with the advancement of storage. The results are in conformity with the work of Khan *et al.* (2009), where sorghum primed seeds showed higher vigour index than the non-primed seeds.

The data relating to seedling fresh weight and dry weight is shown in Table 2. Analysis of data regarding seedling fresh weight and dry weight revealed that there was significant difference in different treatment combinations as well as different duration of storage period. Among different treatment combinations seeds harvested from the treatment combinationT3D2 showed maximum seedling fresh weight (34.83mg) and dry weight (2.83mg) after harvest of crop (M1). It was

Table 1: Effect of seed priming on germination percentage, seedling length and vigour index of coriander

Treatment combinations (T)		Germination percentage* Duration of storage (M)					Seedling length (cm) Duration of storage (M)					Vigour index Duration of storage (M)				
Treat-ments	**Duration of treatments**	**M1**	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**
T1	D1	85.00	60.67	51.33	50.67	61.91	16.73	15.36	13.83	13.43	14.84	1,337.8	932.0	708.0	681.8	914.9
	D2	71.33	64.33	52.67	50.67	59.75	18.36	15.57	14.29	13.83	15.51	1,334.9	1,001.3	758.7	700.8	948.9
	D3	74.00	61.33	53.67	54.67	60.91	18.72	15.95	15.03	14.53	16.06	1,386.3	975.4	812.8	795.6	992.5
T2	D1	70.66	57.33	51.00	50.33	57.33	16.77	12.79	15.09	13.63	14.57	1,190.9	734.2	771.7	686.6	845.8
	D2	89.33	59.33	53.67	52.67	63.75	19.09	15.83	15.30	14.00	16.05	1,722.1	944.7	820.6	738.4	1,056.4
	D3	72.00	61.33	57.00	50.00	60.08	16.30	15.29	14.80	12.90	14.82	1,185.3	933.4	847.2	645.4	902.8
T3	D1	84.67	60.67	53.00	54.67	63.25	17.90	16.89	13.70	13.50	15.49	1,518.1	1,024.0	730.6	756.8	1,007.4
	D2	100.00	70.00	61.67	58.00	72.41	21.30	18.31	18.24	14.66	18.13	2,130.0	1,288.9	1,119.0	850.2	1,347.0
	D3	78.67	68.67	56.33	56.67	65.08	19.21	17.06	17.70	12.46	16.61	1,514.7	1,172.8	985.8	749.6	1,105.7
T0	D1	95.33	70.00	61.00	55.33	70.41	16.79	15.43	13.14	13.50	14.71	1,603.0	1,081.6	797.8	750.0	1,058.1
	D2	77.33	62.67	53.67	56.00	62.41	17.74	16.52	15.40	13.80	15.86	1,376.9	1,046.1	829.6	771.7	1,006.1
	D3	82.00	60.00	55.67	54.00	62.91	18.24	16.13	14.24	12.46	15.27	1,507.8	963.3	786.1	672.4	982.4
	Mean	81.69	63.02	55.05	53.69		18.09	15.93	15.06	13.56		1,484.0	1,008.2	830.6	733.3	
		Treatment combinations (T)		**Storage period (M)**		**T X M**	**Treatment combinations (T)**		**Storage period (M)**		**T X M**	**Treatment combinations (T)**		**Storage period (M)**		**T X M**
SEm (±)		2.129		1.229		4.527	0.543		0.314		1.087	58.03		33.503		116.06
C.D(at 5%)		5.985		3.455		NS	1.528		0.882		NS	163.15		94.198		NS

T1: (0.5% of KNO_3), T2: (0.25% of KNO_3), T3: (0.1% of KNO_3), T4: hydrated seed (control)
D1: (12Hrs of soaking, D2: (16Hrs of soaking), D3: (20Hrs of soaking),
M1: After Harvesting , M2: 3 months After Harvesting , M3: 6 months After Harvesting, M4: 9 months After Harvesting
NS: Non significant; * Germination percentage: Data are angular transformed value

Table 2: Effect of seed priming on seedling fresh weight, dry weight and Electrical conductivityof Coriander

Treatment combinations (T)		Fresh weight (mg plant^{-1}) Duration of storage (M)					Dry weight (mg plant^{-1}) Duration of storage (M)					Electrical Conductivity (iScm^{-1}) Duration of storage (M)			
Treat-ments	**Duration of treatments**	**M1**	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**Mean**
T1	D1	27.70	21.63	19.46	16.89	21.42	1.93	1.68	1.59	1.38	1.65	1.680	5.983	8.233	5.299
	D2	25.80	22.33	20.16	18.03	21.58	1.90	2.03	1.53	1.30	1.69	1.600	5.897	7.967	5.154
	D3	26.43	22.06	20.30	18.03	21.70	2.03	1.86	1.66	1.40	1.74	1.647	7.017	8.010	5.558
T2	D1	25.33	22.00	20.10	16.06	20.87	1.93	1.76	1.60	1.30	1.65	1.367	5.440	7.867	4.891
	D2	24.53	21.26	20.80	18.13	21.18	1.86	1.60	1.63	1.36	1.61	1.733	5.823	8.067	5.208
	D3	26.73	23.36	20.70	17.20	22.00	2.36	1.93	1.83	1.40	1.88	1.640	5.613	7.487	4.913
T3	D1	26.60	22.36	21.46	19.93	22.59	2.03	1.60	1.26	1.40	1.57	1.467	4.737	7.320	4.508
	D2	34.83	31.76	23.43	20.46	27.62	2.83	2.10	1.83	1.66	2.10	1.267	4.667	6.200	4.044
	D3	26.40	26.80	22.90	19.66	23.94	2.06	2.10	1.76	1.56	1.87	1.467	5.133	7.000	4.533
T0	D1	25.33	23.03	22.66	18.50	22.38	1.73	2.00	1.83	1.60	1.79	1.867	5.833	8.600	5.433
	D2	27.83	22.63	22.06	18.66	22.80	1.93	2.16	1.60	1.30	1.75	1.533	4.733	7.600	4.622
	D3	27.90	25.56	22.16	17.43	23.26	2.03	1.93	1.63	1.53	1.78	1.967	5.367	8.360	5.231
	Mean	27.12	23.73	21.35	18.25		2.05	1.89	1.65	1.43					4.950
		Treatment combinations (T)		**Storage period (M)**		**T X M**	**Treatment combinations (T)**		**Storage period (M)**		**T X M**	**Treatment combinations (T)**		**Storage period (M)**	**T X M**
SEm (±)		0.727		0.420		1.454	0.068		0.040		0.137	0.153		0.076	0.264
C.D(at 5%)		2.044		1.180		NS	0.193		0.111		NS	0.431		0.215	0.745

T1: (0.5% of KNO_3), T2: (0.25% of KNO_3), T3: (0.1% of KNO_3), T4: hydrated seed (control)
D1: (12Hrs of soaking, D2: (16Hrs of soaking), D3: (20Hrs of soaking),
M1: After Harvesting, M2: 3 months After Harvesting, M3: 6 months After Harvesting, M4: 9 months After Harvesting
NS: Non significant

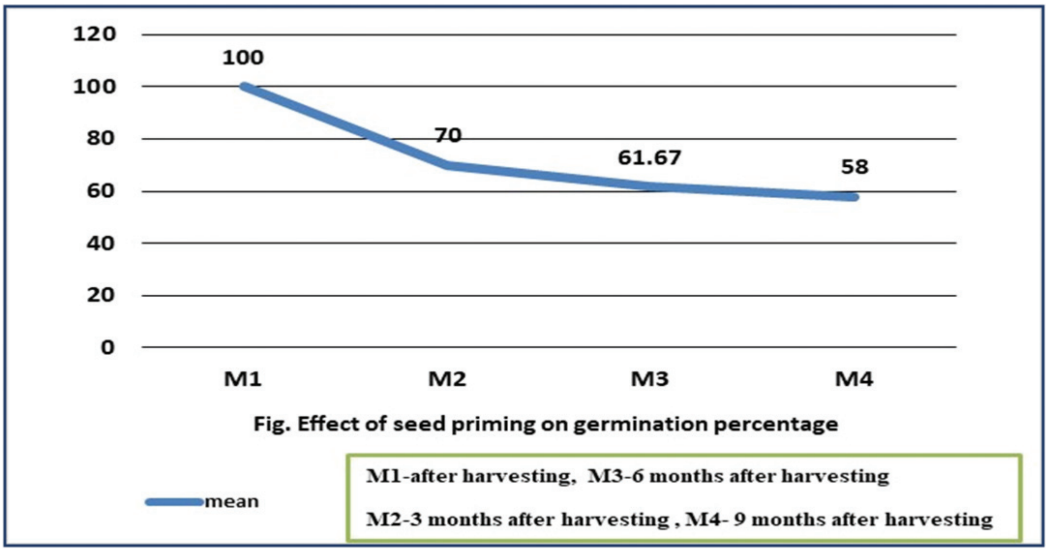

Fig.1 : Mean effect of storage period on germination percentage

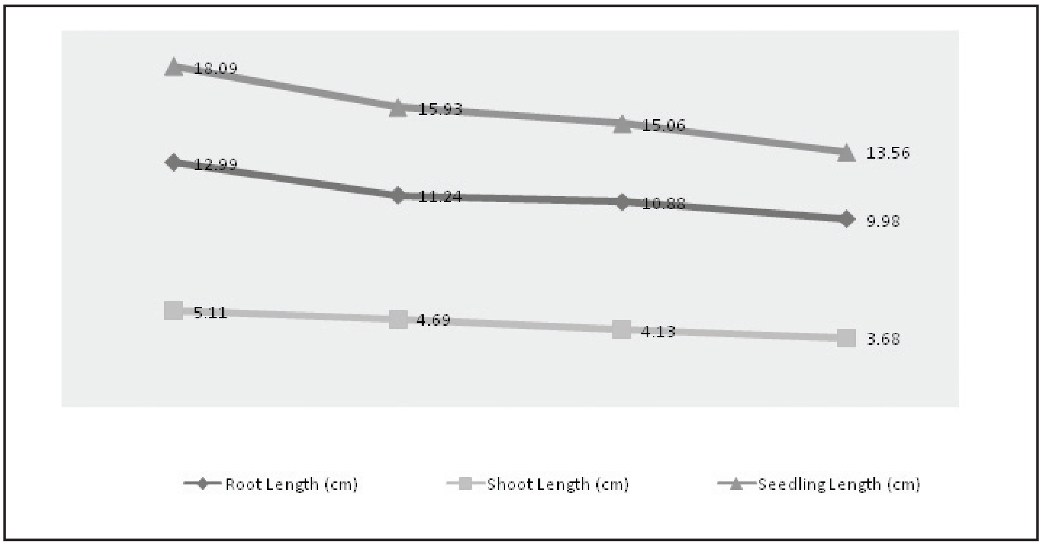

Fig. 2 : Mean effect of storage period on root, shoot and seedling length

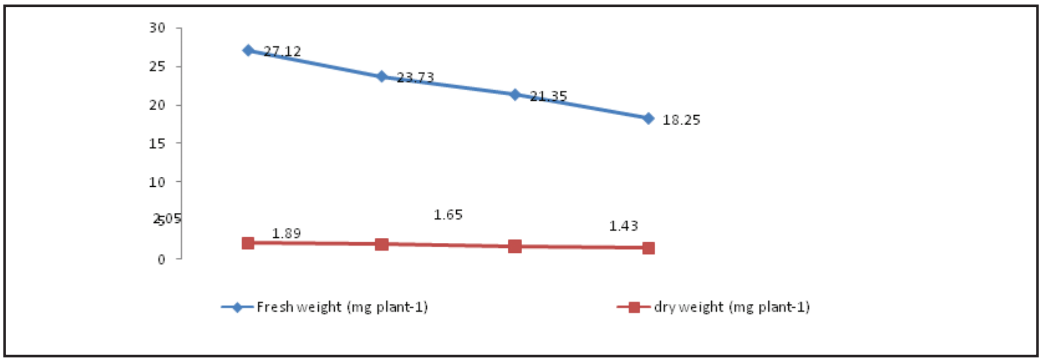

Fig. 3: Mean effect of storage period on fresh weight and dry weight of seedlings

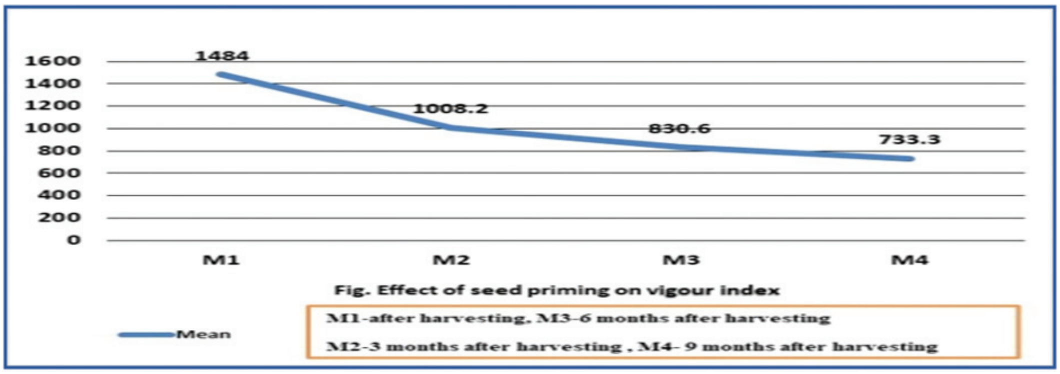

Fig. 4: Mean effect of storage period on Vigour Index

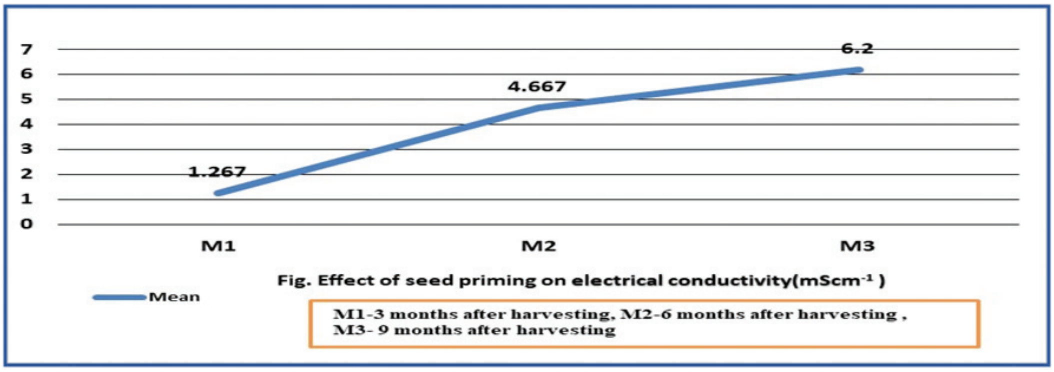

Fig. 5: Mean effect of storage period on Electrical Conductivity (μScm^{-1})

followed by T4D3 (hydrated seed+20 hours of soaking) (27.90mg) for fresh weight and by T2D3 (0.25% of KNO_3 +20 hours of soaking) (2.36mg) for dry weight after harvest of crop (M1).When the means of months of duration of storage of fresh weight were compared the results revealed that there was a decreasing trend with increase in storage duration (Fig.3). The results are in conformity with the work of Ahmad *et al.* (2017), where primed seeds of *Gerbera jamesonii* and *Zinnia elegans* showed maximum fresh weight than control.

Electrical conductivity test is commonly used for the assessment of deterioration pattern of quality seed under storage conditions. The results have been presented in Table2 and Fig 5. Electrical conductivity of the seeds at 3 months interval was measured under different storage periods. The data pertaining to electrical conductivity revealed that there was significant variation in different treatment combinations as well as different durations of storage period. Minimum Electrical conductivity (1.267ìScm^{-1}) was recorded in case of seeds harvested from the treatment combinationT3D2 after harvest of crop (M1), followed by T2D2 (0.25% of KNO_3 +16 hours of soaking) (1. 36ìScm^{-1}). When the means of months of duration of storage of electrical conductivity were compared, the results revealed that there was increasing trend with the advancement of storage indicating high solute leakage. This leakage reflects the incidence of the major causes of lower vigour, seed ageing, imbibition damage, also their interaction and increase of dead tissue within seed.

As per Indian Minimum Seed Certification Standard (IMSCS), the minimum germination percentage of coriander seed should be 60, which is much low compared to other crops. Due to this, seed germination and plant growth is a regular problem among farmers. Based on the results of present study, it may be concluded that, among the seed quality characters seeds harvested from the treatment combinationT3D2 (0.1% of KNO_3+16 hours of soaking) showed maximum germination percentage, shoot length (cm), root length (cm), seedling length (cm), fresh weight (mg), dry weight (mg), vigour index immediately after harvest and even after nine months after storage. Seeds harvested from the treatment combination T3D2 also recorded lowest value of electrical conductivity immediately after harvest as well as nine months after storage compared to other treatment combinations (*i.e.*concentration of $KNO_3$and duration of treatment).Therefore, soaking of coriander seeds for 16 hours with 0.1% concentration of KNO_3can be recommended for production of quality seeds and the produced seeds from such treatment can be safely stored upto next year sowing.

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