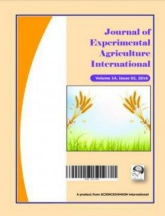

Journal of Experimental Agriculture International

36(2): 1-10, 2019; Article no.JEAI.49065
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

Effect of Seed Treatments and Containers on Chilli Seed Viability

Sunil Kumar[1*] and S. S. Jakhar[1]

[1]Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar-125004, India.

Authors' contributions

This work was carried out in collaboration between two authors. Author SK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SSJ guided during whole period of study and author SK managed the analyses of the study. Authors SK and SSJ managed the literature searches. Authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEAI/2019/v36i230030
Editor(s):
(1) Dr. Mohamed Fadel, Professor, Microbial Chemistry, Department Genetic Engineering and Biotechnology, Division National Research Center, Egypt.
Reviewers:
(1) Dr. R. Mahalakshmi, India.
(2) Liamngee Kator, Benue State University, Makurdi, Nigeria.
Complete Peer review History: http://www.sdiarticle3.com/review-history/49065

Original Research Article

Received 12 February 2019
Accepted 05 May 2019
Published 16 May 2019

ABSTRACT

An experiment was conducted to investigate the influence of fungicides and packaging materials on longevity of chilli seed (variety: RCH-1). The seeds were treated with 15 fungicides and were kept in three containers *viz*. Metal box, Cloth bag and Plastic zipling bag up to 12 months under ambient conditions in seed pathology laboratory of Department of Seed Science & Technology, CCSHAU, Hisar, India. The samples were drawn at quaterly intervals for ascertaining the seed quality parameters. The seeds treated with flusilazole (2 g kg^{-1} seed) and stored in metal-box were found better for maintenance of higher seed quality parameters [germination, root length, shoot length, mean seedling dry weight, vigour indices] during the study period. The study suggested that use of appropriate packaging material and seed treatment could be useful to prolong the storage life of chilli seeds.

Keywords: Chilli; containers; fungicide; seed quality; storage.

**Corresponding author: E-mail: maliksunil25@gmail.com;*

1. INTRODUCTION

Horticulture production of about 300.6 million tons in India during 2017 has not only brought prosperity to small and marginal farmers, but also provided food and nutritional security to the Nation. India is ranked as the second largest producer of Fruits & Vegetables in the world and horticulture has emerged as one of the vibrant part of Indian agriculture [1].

Chilli (*Capsicum annuum* L.) is also known as hot pepper is one of the most important cash crops in India. Deterioration of seed is associated with ageing phenomenon which is defined as an irreversible degradation changes in the quality of a seed. Its maximum quality level and the seed deterioration also start immediately after attaining the physiological maturity on the plant itself [2]. Since the loss of viability impairs biological and planting value of seed, it is of special concern to breeders, businessmen and farmers. Several factors *viz.,* inherent genetic potential, initial seed quality, environment during seed production, seed moisture content, mechanical damage, seed borne mycoflora, storage insects, seed dressing chemicals and seed treatments influence the seed longevity and affect subsequent field performance. Hence, storage of seeds after harvest till next planting time assumes prime importance for successful seed production programme.

As the seed is hygroscopic in nature, its quality is being affected due to variations in the environmental conditions *viz*., relative humidity, temperature, moisture content, gaseous exchange, packaging material, etc. [3].

It is unquestionable that suitable storage container and proper seed treatment can substantially improve the quality of seed and seedling with satisfactory increase in the yield. Seed treatment with fungicides not only controls the seed-borne diseases but also improves seed health, plant stand and crop yield [4]. Therefore, the present study entitled "Effect of seed treatments and containers on chilli seed viability" was carried out.

2. MATERIALS AND METHODS

The present study was carried out on chilli seed (variety: RCH-1) having seed germination (79 per cent) above Indian Minimum Seed Certification Standards. The seed was procured from Director of Research, Agriculture University, Jodhpur, Rajasthan, India. The seeds were treated with fifteen fungicides as mentioned in table below. The chilli seeds and fungicide were weighed 21 g and 0.042 g, respectively, wearing gloves using appropriate weighing balance for each treatment. The seeds and fungicides were mixed in beakers and shake up for some time for uniform distribution all over the seeds. All the fungicides were in powder formulation except famoxadone 16.6% + cymoxanil 22.1% SL, which was measured by micro-pippete and mixed thoroughly. The treated seed were kept in Metal box, Cloth bag and Plastic zipling bag (40 microns) under ambient conditions in Seed Pathology Laboratory of Department of Seed Science & Technology, CCSHAU, Hisar, India. The total numbers of treatments were 48 with three replications.

The study was conducted up to twelve months to assess the effect of fungicides and containers on chilli seed quality parameters.

Treatments	Fungicides @ 2 g kg^{-1} seed
T_1	Untreated (Control)
T_2	Carbendazim 75% WP
T_3	Tebuconazole 2 DS
T_4	Difenoconazole 25% EC
T_5	Propiconazole 25% EC
T_6	Tricyclazole 75% WP
T_7	Flusilazole 40% EC
T_8	Azoxystrobin 23% SC
T_9	Kitazine 48% EC
T_{10}	Propineb 70% WP
T_{11}	Dimethomorph 50% WP
T_{12}	Chlorothalonil 78.2% WP
T_{13}	Captan 70% + Hexaconazole 5% WP
T_{14}	Carbendazim 12% + Mancozeb 63% WP
*T_{15}	Famoxadone 16.6% + Cymoxanil 22.1% SL
T_{16}	Flusilazole 12.5% + Carbendazim 25% SE

*Systemic fungicides were from Treatments T_2 to T_{12} and Combi-fungicides were from T_{13} to T_{16} * Combi-fungicide T_{15} was used @ 2 ml kg^{-1} seed*

The experiment consisted of two factors {three different packing materials as storage container were used as level factor "C" and the 15 fungicides treatments and an untreated (control) were used as level factor "T"} were laid out in completely randomized design (CRD). Seeds were taken from each of the different containers at quarterly intervals up to 12 months and observations were recorded for seed technological parameters.

2.1 Laboratory Parameters

2.1.1 Standard germination (%)

Four hundred seeds of chilli were placed in three replications in between the germination paper and placed in germinators at 25±1°C [5]. The germination was checked on first count after 7th day and final count was taken on 14th day and normal seedlings were considered for per cent germination.

Seed germination (%) = {(Number of seeds germinated/Total number of seeds placed for germination) × 100}

2.1.2 Shoot and root length (cm)

Ten normal seedlings per replication were selected at random at the time of final count of standard germination (14 days) for shoot and root length (cm) was measured using a measuring scale from the tip of the shoot to the end of the shoot and that of tip of the radical to its end and average length was worked out.

2.1.3 Seedling dry weight

Seedling dry weight was assessed after the final count in the standard germination test (14 days). Ten seedlings of each lot replicated thrice were taken. Seedlings were dried in a hot air oven for 24 hrs at 80±1°C. The dried seedlings of each replication were weighed and average seedling dry weight was calculated.

2.1.4 Vigour indices

Seedling vigour indices were calculated as per Abdul-Baki and Anderson [2].

(a) Seed Vigour Index I = Seed germination (%) × Average seedling length (cm)
(b) Seed vigour Index II = Seed germination (%) × Average dry seedling weight (mg)

2.1.5 Statistical analysis

The data obtained from the experiments were analyzed as per standard method [6]. All the statistical analysis was carried out by using OPSTAT statistical software.

3. RESULTS AND DISCUSSION

3.1 Standard Germination (%)

The perusal of data in Table 1 revealed that the germination decreased gradually as the storage period increases but at the end of storage period (12 months) germination was maintained above Indian Minimum Seed Certification Standards (IMSCS) in all the containers. The fungicide flusilazole was found better along with tebuconazole. The containers effect was found non-significant during the period of storage. Interaction effect of metal box and plastic zipling bag was found at par with flusilazole and better than others at the end of storage period. Results were in conformity with the earlier findings [7].

3.2 Shoot Length (cm)

The result in Table 2 indicated that the shoot length was found better in seed treated with flusilazole followed by tebuconazole. The metal box proved better among containers and the interaction effect of both metal box and cloth bag was at par with flusilazole. The researcher in the past [8-12] also revealed the similar findings.

3.3 Root Length (cm)

The Table 3 results indicated that flusilazole again proved at par with tebuconazole in case of root length. Among the containers, plastic zipling bag was at par with cloth bag. Interaction effect of plastic zipling bag with flusilazole was found better than others. The results corroborated with the findings [13].

3.4 Seedling Dry Weight (cm)

The seedling dry weight was found highest when seeds were treated with flusilazole which was statistically at par with tebuconazole. The containers effect was found non-significant in all the four quarters. Interaction effect of metal box with flusilazole was found better. The results are similar to the earlier study conducted [14] as revealed in Table 4.

3.5 Vigour Index I

The result in Table 5 illustrated that among fungicides, flusilazole proved better followed by tebuconazole for vigour index-I and among containers, cloth bag was found statistically at par with metal box. Interaction effect of plastic zipling bag with flusilazole was found better over others.

3.6 Vigour index II

The data of Table 6 revealed that the fungicides treated seeds stored in different containers when tested for vigour index-II, the flusilazole proved better and was statistically at par with tebuconazole. Containers effect was found non-significant during the period of storage. Interaction effect of metal box with flusilazole was found better than others. The results are in the same pattern as reported [15].

Table 1. Effect of seed treatments with fungicides and containers on germination (%) in chilli seeds (variety: RCH-1)

Trt.	3 months				6 months				9 months				12 months			
	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
T_1	75.0	74.0	75.0	74.7	70.0	71.0	70.0	70.3	66.0	67.0	66.0	66.3	65.0	64.0	68.0	65.7
T_2	78.0	79.0	78.0	78.3	73.0	72.0	72.0	72.3	68.0	68.0	72.0	69.3	68.0	67.0	70.0	68.3
T_3	79.7	80.0	80.0	79.9	77.0	77.0	75.3	76.4	74.3	73.7	74.7	74.2	71.0	70.3	70.7	70.7
T_4	77.0	78.0	78.0	77.7	73.0	76.0	73.0	74.0	68.0	73.0	69.0	70.0	69.0	68.0	67.0	68.0
T_5	79.3	80.0	78.0	79.1	76.0	76.3	75.0	75.8	72.0	72.0	67.0	70.3	67.0	69.0	66.0	67.3
T_6	80.0	78.0	79.0	79.0	72.0	73.0	76.0	73.7	70.0	67.0	72.0	69.7	66.0	70.0	67.0	67.7
T_7	82.0	81.3	81.3	81.6	78.0	78.0	77.0	77.7	73.0	75.3	76.0	74.8	72.0	71.3	72.0	71.8
T_8	79.0	78.3	78.3	78.6	76.0	75.3	75.0	75.4	69.0	70.0	71.0	70.0	67.0	69.0	68.0	68.0
T_9	76.0	79.0	78.0	77.7	73.0	73.0	70.0	72.0	68.0	72.0	68.0	69.3	67.0	67.0	68.0	67.3
T_{10}	76.0	77.0	76.0	76.3	72.0	75.0	73.0	73.3	71.0	68.0	69.0	69.3	69.0	68.0	69.0	68.7
T_{11}	78.0	80.0	77.0	78.3	71.0	76.0	74.0	73.7	72.3	68.0	71.0	70.4	68.0	68.0	69.0	68.3
T_{12}	79.0	79.0	79.0	79.0	73.0	72.0	73.0	72.7	72.0	69.0	70.0	70.3	70.0	66.0	67.0	67.7
T_{13}	78.0	77.0	80.0	78.3	74.0	74.0	74.0	74.0	67.0	68.0	72.0	69.0	71.0	70.0	70.0	70.3
T_{14}	76.0	76.0	77.0	76.3	76.0	73.0	72.0	73.7	69.0	72.0	68.0	69.7	68.0	69.0	67.0	68.0
T_{15}	79.0	81.3	79.0	79.8	71.0	74.0	76.0	73.7	70.0	70.0	69.0	69.7	67.0	67.0	66.0	66.7
T_{16}	79.0	77.0	76.0	77.3	72.0	73.0	75.0	73.3	72.0	71.0	68.0	70.3	66.0	68.0	68.0	67.3
Mean	78.2	78.4	78.1		73.6	74.3	73.8		70.1	70.3	70.2		68.2	68.2	68.3	
CD (P=0.05)		C	T	C×T		C	T	C×T		C	T	C×T		C	T	C×T
		NS	1.72	2.20		NS	1.39	2.41		NS	1.35	2.33		NS	1.33	2.30

C_1:Metal box; C_2:Cloth bag, C_3:Plastic zipling bag (40 microns)

T_1: Untreated (Control); T_2: Carbendazim 75% WP; T_3: Tebuconazole 2 DS; T_4: Difenoconazole 25% EC; T_5: Propiconazole 25% EC; T_6: Tricyclazole 75% WP;T_7: Flusilazole 40% EC; T_8: Azoxystrobin 23% SC; T_9: Kitazine 48% EC; T_{10}: Propineb 70% WP; T_{11}: Dimethomorph 50% WP; T_{12}: Chlorothalonil 78.2% WP; T_{13}: Captan 70% + Hexaconazole 5% WP; T_{14}: Carbendazim 12% + Mancozeb 63% WP; T_{15}: Famoxadone 16.6% + Cymoxanil 22.1% SL; T_{16}: Flusilazole 12.5% + Carbendazim 25% SE

Table 2. Effect of seed treatments with fungicides and containers on shoot length (cm) in chilli seeds (variety: RCH-1)

Trt.	3 months				6 months				9 months				12 months			
	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
T_1	10.96	10.48	9.35	10.26	9.07	7.83	8.59	8.50	6.79	5.53	6.39	6.24	5.29	4.99	4.13	4.80
T_2	11.25	9.91	9.34	10.17	8.50	8.01	8.56	8.36	6.34	5.71	6.36	6.14	4.84	4.96	4.31	4.70
T_3	11.29	11.24	11.21	11.25	9.79	9.19	8.91	9.30	7.28	7.00	6.64	6.97	5.74	5.61	5.48	5.61
T_4	10.75	10.42	8.37	9.85	8.67	7.69	8.21	8.19	6.60	5.39	6.01	6.00	5.10	4.61	3.99	4.57
T_5	10.91	11.06	11.10	11.02	9.35	8.24	8.44	8.68	6.62	5.94	6.24	6.27	5.12	4.84	4.54	4.83
T_6	10.15	9.84	9.45	9.81	8.27	8.33	8.23	8.28	6.18	6.03	6.03	6.08	4.68	4.63	4.63	4.65
T_7	11.61	11.43	11.50	11.51	9.95	9.36	9.06	9.45	7.54	7.48	6.94	7.32	5.93	5.93	5.75	5.87
T_8	11.20	11.02	10.79	11.00	9.11	8.12	8.12	8.45	6.54	5.82	5.92	6.09	5.04	4.52	4.42	4.66
T_9	10.79	9.75	8.87	9.81	8.86	7.53	8.32	8.24	6.77	5.23	6.12	6.04	5.27	4.72	3.83	4.61
T_{10}	10.45	10.03	9.54	10.01	8.53	8.04	8.21	8.26	6.33	5.74	6.01	6.03	4.83	4.61	4.34	4.59
T_{11}	10.57	10.18	8.82	9.86	8.68	7.46	8.66	8.27	6.57	5.16	6.46	6.06	5.07	5.06	3.76	4.63
T_{12}	10.68	10.19	8.84	9.90	8.64	7.46	8.33	8.14	6.51	5.16	6.13	5.93	5.01	4.73	3.76	4.50
T_{13}	10.81	10.40	9.41	10.21	8.60	8.03	7.94	8.19	6.41	5.73	5.74	5.96	4.91	4.34	4.33	4.53
T_{14}	11.01	10.25	9.05	10.10	8.75	7.67	8.55	8.32	6.48	5.37	6.35	6.07	4.98	4.95	3.97	4.63
T_{15}	10.70	9.81	9.22	9.91	8.33	7.72	8.23	8.09	6.22	5.42	6.03	5.89	4.72	4.63	4.02	4.46
T_{16}	11.01	9.99	9.50	10.17	8.30	8.07	7.94	8.10	6.13	5.77	5.74	5.88	4.63	4.34	4.37	4.45
Mean	10.88	10.38	9.65		8.84	8.05	8.39		6.58	5.78	6.19		5.07	4.84	4.35	
CD (P=0.05)		C	T	C×T		C	T	C×T		C	T	C×T		C	T	C×T
		0.10	0.23	0.40		0.09	0.04	0.03		0.08	0.20	0.35		0.06	0.15	0.26

C_1: Metal box; C_2:Cloth bag; C_3:Plastic zipling bag (40 microns)

T_1: Untreated (Control); T_2: Carbendazim 75% WP;T_3: Tebuconazole 2 DS; T_4: Difenoconazole 25% EC; T_5: Propiconazole 25% EC; T_6: Tricyclazole 75% WP; T_7: Flusilazole 40% EC; T_8: Azoxystrobin 23% SC; T_9: Kitazine 48% EC; T_{10}: Propineb 70% WP; T_{11}: Dimethomorph 50% WP; T_{12}: Chlorothalonil 78.2% WP; T_{13}: Captan 70% + Hexaconazole 5% WP; T_{14}: Carbendazim 12 % + Mancozeb 63% WP; T_{15}: Famoxadone 16.6% + Cymoxanil 22.1% SL; T_{16}: Flusilazole 12.5% + Carbendazim 25% SE

Table 3. Effect of seed treatments with fungicides and containers on root length (cm) in chilli seeds (variety: RCH-1)

Trt.	3 months				6 months				9 months				12 months			
	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
T_1	5.60	5.44	5.42	5.49	4.41	4.54	4.70	4.55	3.21	3.24	3.50	3.32	2.41	2.82	2.54	2.59
T_2	5.21	5.25	5.17	5.21	4.17	4.66	4.84	4.56	2.97	3.36	3.64	3.32	2.17	2.94	2.66	2.59
T_3	6.15	5.71	6.00	5.95	4.87	5.47	5.13	5.16	4.06	4.12	3.97	4.05	2.87	2.94	3.26	3.02
T_4	5.91	4.94	5.10	5.32	4.21	4.17	4.70	4.36	3.01	2.87	3.50	3.13	2.21	2.80	2.41	2.47
T_5	5.93	5.69	5.84	5.82	4.62	4.23	4.48	4.44	3.21	2.93	3.28	3.14	2.51	2.68	2.48	2.56
T_6	6.08	4.94	5.23	5.42	4.23	4.94	4.68	4.62	3.03	3.64	3.48	3.38	2.31	2.78	2.77	2.62
T_7	6.29	6.00	6.10	6.13	5.07	5.69	5.12	5.29	4.36	4.30	4.09	4.25	2.95	3.03	3.52	3.17
T_8	5.88	5.65	5.60	5.71	4.44	4.70	4.62	4.59	2.89	3.40	3.42	3.24	2.09	2.72	2.57	2.46
T_9	5.25	4.76	5.02	5.01	4.13	4.49	4.64	4.42	2.93	3.19	3.44	3.19	2.13	2.74	2.70	2.52
T_{10}	5.66	4.91	6.17	5.58	5.23	4.57	4.43	4.74	4.03	3.27	3.23	3.51	2.23	2.53	2.77	2.51
T_{11}	5.93	5.11	5.14	5.39	4.09	4.64	4.95	4.56	2.89	3.34	3.75	3.33	2.09	2.48	2.78	2.45
T_{12}	5.60	5.20	5.81	5.53	4.56	5.30	4.81	4.89	3.36	4.02	3.61	3.66	2.59	2.70	2.52	2.61
T_{13}	5.41	5.16	5.32	5.30	4.39	4.60	4.31	4.43	3.19	3.30	3.11	3.20	2.42	2.41	2.77	2.53
T_{14}	5.16	5.17	5.61	5.31	4.61	4.54	4.73	4.63	3.41	3.24	3.53	3.39	2.64	2.83	2.62	2.70
T_{15}	5.29	5.48	5.46	5.41	4.45	4.64	4.25	4.45	3.26	3.42	2.93	3.20	2.49	2.32	2.79	2.53
T_{16}	5.15	5.50	5.72	5.46	4.67	4.65	4.65	4.66	3.52	3.04	3.29	3.28	2.72	2.59	2.47	2.59
Mean	5.66	5.31	5.54		4.51	4.74	4.69		3.33	3.42	3.49		2.43	2.71	2.73	
CD (P=0.05)		C	T	C×T		C	T	C×T		C	T	C×T		C	T	C×T
		0.10	0.23	0.41		0.09	0.22	0.38		0.07	0.17	0.30		0.08	0.18	0.31

C_1: Metal box; C_2: Cloth bag; C_3:Plastic zipling bag (40 microns)

T_1: Untreated (Control); T_2: Carbendazim 75% WP; T_3: Tebuconazole 2 DS; T_4: Difenoconazole 25% EC; T_5: Propiconazole 25% EC; T_6: Tricyclazole 75% WP; T_7: Flusilazole 40% EC; T_8: Azoxystrobin 23% SC; T_9: Kitazine 48% EC; T_{10}: Propineb 70% WP; T_{11}: Dimethomorph 50% WP; T_{12}: Chlorothalonil 78.2% WP; T_{13}: Captan 70% + Hexaconazole 5% WP; T_{14}: Carbendazim 12% + Mancozeb 63% WP; T_{15}: Famoxadone 16.6% + Cymoxanil 22.1% SL; T_{16}: Flusilazole 12.5% + Carbendazim 25% SE

Table 4. Effect of seed treatments with fungicides and containers on seedling dry weight (mg) in chilli seeds (variety: RCH-1)

Trt.	3 months				6 months				9 months				12 months			
	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
T_1	22.0	21.0	22.0	21.7	18.0	19.0	19.0	18.7	18.0	17.0	17.0	17.3	11.0	12.0	12.0	11.7
T_2	24.0	23.0	24.0	23.7	22.0	22.0	24.0	22.7	21.0	18.0	18.0	19.0	13.0	13.0	12.0	12.7
T_3	26.0	25.3	27.0	26.1	26.3	25.7	26.3	26.1	22.3	23.3	22.0	22.6	18.0	17.0	17.3	17.4
T_4	25.0	23.0	23.0	23.7	23.0	25.0	26.0	24.7	21.0	20.0	18.0	19.7	14.0	15.0	17.0	15.3
T_5	24.7	25.7	26.3	25.6	25.0	25.0	25.0	25.0	19.0	19.0	22.0	20.0	15.0	13.0	15.0	14.3
T_6	25.0	25.0	25.3	25.1	23.0	24.0	25.0	24.0	19.0	22.0	19.0	20.0	13.0	15.0	13.0	13.7
T_7	27.7	27.7	28.0	27.8	27.7	27.0	27.7	27.4	23.0	24.3	24.3	23.9	19.0	18.0	18.0	18.3
T_8	24.3	25.3	26.0	25.2	25.0	25.0	23.0	24.3	19.3	19.0	16.0	18.1	12.0	14.0	15.0	13.7
T_9	25.0	23.0	22.0	23.3	24.0	24.0	23.0	23.7	18.0	18.0	18.0	18.0	14.0	12.0	13.0	13.0
T_{10}	24.0	25.0	23.0	24.0	24.0	24.0	22.0	23.3	22.7	19.0	19.0	20.2	17.0	12.0	12.0	13.7
T_{11}	23.0	23.0	24.0	23.3	23.0	23.0	23.7	23.2	19.0	19.0	19.0	19.0	15.0	13.0	13.0	13.7
T_{12}	25.0	24.0	24.7	24.6	25.0	25.0	25.0	25.0	18.0	21.0	21.0	20.0	13.0	14.0	16.0	14.3
T_{13}	23.7	23.0	23.0	23.2	25.0	23.0	24.0	24.0	20.0	22.0	22.0	21.3	15.0	15.0	14.0	14.7
T_{14}	23.0	24.0	23.7	23.6	23.0	24.0	24.0	23.7	17.0	21.0	21.0	19.7	15.0	14.0	15.0	14.7
T_{15}	22.0	23.0	23.0	22.7	22.0	24.0	24.0	23.3	19.0	18.0	18.0	18.3	13.0	16.0	13.0	14.0
T_{16}	23.0	22.0	24.0	23.0	23.0	22.0	21.0	22.0	20.0	19.0	18.0	19.0	14.0	13.0	14.0	13.7
Mean	24.2	23.9	24.3		23.7	23.9	23.9		19.8	20.0	19.5		14.4	14.1	14.3	
CD (P=0.05)		C	T	C×T		C	T	C×T		C	T	C×T		C	T	C×T
		NS	1.32	1.92		NS	1.24	2.12		NS	1.30	2.26		NS	1.36	2.35

C_1: Metal box; C_2:Cloth bag; C_3:Plastic zipling bag (40 microns)

T_1: Untreated (Control); T_2: Carbendazim 75% WP; T_3: Tebuconazole 2 DS; T_4: Difenoconazole 25% EC; T_5: Propiconazole 25% EC; T_6: Tricyclazole 75% WP; T_7: Flusilazole 40% EC; T_8: Azoxystrobin 23% SC; T_9: Kitazine 48% EC; T_{10}: Propineb 70% WP; T_{11}: Dimethomorph 50% WP; T_{12}: Chlorothalonil 78.2% WP; T_{13}: Captan 70% + Hexaconazole 5% WP; T_{14}: Carbendazim 12 % + Mancozeb 63% WP; T_{15}: Famoxadone 16.6% + Cymoxanil 22.1% SL; T_{16}: Flusilazole 12.5% + Carbendazim 25% SE

Table 5. Effect of seed treatments with fungicides and containers on vigour index-1 in chilli seeds (variety: RCH-1)

Trt.	3 months				6 months				9 months				12 months			
	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
T_1	1,242	1,178	1,108	1,176	943	878	930	917	660	587	653	633	502	496	448	482
T_2	1,284	1,198	1,132	1,205	925	912	964	933	634	617	720	657	481	535	488	501
T_3	1,390	1,357	1,377	1,374	1,129	1,129	1,058	1,105	843	819	791	818	611	601	618	610
T_4	1,283	1,198	1,052	1,178	940	901	942	928	653	603	656	637	502	506	454	487
T_5	1,335	1,340	1,321	1,332	970	922	956	949	708	639	638	662	511	518	495	508
T_6	1,299	1,153	1,160	1,204	900	968	981	950	645	648	684	659	461	523	532	505
T_7	1,468	1,417	1,432	1,439	1,171	1,174	1,092	1,146	869	888	838	865	640	639	667	649
T_8	1,349	1,306	1,283	1,313	960	923	917	933	651	646	663	653	472	495	528	498
T_9	1,219	1,146	1,084	1,150	948	877	906	910	659	606	650	639	494	500	460	485
T_{10}	1,225	1,150	1,194	1,190	990	945	922	952	735	612	638	662	550	486	508	515
T_{11}	1,287	1,223	1,075	1,195	906	919	1,006	944	690	578	725	664	490	553	462	502
T_{12}	1,286	1,216	1,158	1,220	963	929	959	950	710	642	682	678	534	503	486	507
T_{13}	1,265	1,198	1,179	1,214	961	934	906	934	643	614	637	631	513	473	526	504
T_{14}	1,229	1,172	1,129	1,176	1,015	891	956	954	683	619	672	658	518	538	461	506
T_{15}	1,263	1,243	1,161	1,222	908	920	939	922	664	619	618	633	484	465	469	473
T_{16}	1,276	1,193	1,157	1,209	937	906	932	925	695	625	614	645	486	468	469	474
Mean	1,294	1,231	1,188		973	945	960		696	648	680		516	519	504	
CD (P=0.05)		C	T	C×T		C	T	C×T		C	T	C×T		C	T	C×T
		19.59	45.25	78.38		8.51	19.67	34.07		11.83	27.33	47.34		11.45	26.46	45.83

C_1: Metal box; C_2: Cloth bag; C_3: Plastic zipling bag (40 microns)

T_1: Untreated (Control); T_2: Carbendazim 75% WP; T_3: Tebuconazole 2 DS; T_4: Difenoconazole 25% EC; T_5: Propiconazole 25% EC; T_6: Tricyclazole 75% WP; T_7: Flusilazole 40% EC; T_8: Azoxystrobin 23% SC; T_9: Kitazine 48% EC; T_{10}: Propineb 70% WP; T_{11}: Dimethomorph 50% WP; T_{12}: Chlorothalonil 78.2% WP; T_{13}: Captan 70% + Hexaconazole 5% WP; T_{14}: Carbendazim 12% + Mancozeb 63% WP; T_{15}: Famoxadone 16.6% + Cymoxanil 22.1% SL; T_{16}: Flusilazole 12.5% + Carbendazim 25% SE

Table 6. Effect of seed treatments with fungicides and containers on vigour index-11 in chilli seeds (variety: RCH-1)

Trt.	3 months				6 months				9 months				12 months			
	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
T_1	1,651	1,553	1,651	1,618	1,259	1,348	1,330	1,313	1,189	1,142	1,123	1,151	716	767	817	767
T_2	1,873	1,816	1,873	1,854	1,605	1,583	1,730	1,640	1,427	1,223	1,297	1,315	885	872	841	866
T_3	1,749	2,027	2,160	1,979	2,028	1,977	1,984	1,996	1,660	1,719	1,642	1,674	1,279	1,196	1,225	1,233
T_4	1,926	1,793	1,797	1,839	1,676	1,899	1,899	1,825	1,425	1,459	1,241	1,375	965	1,021	1,140	1,042
T_5	1,818	2,054	2,054	1,975	1,849	1,847	1,851	1,849	1,369	1,365	1,475	1,403	1,004	898	991	964
T_6	2,003	1,947	2,001	1,984	1,655	1,749	1,900	1,768	1,331	1,473	1,369	1,391	857	1,050	870	925
T_7	1,772	2,251	2,278	2,100	2,159	2,107	2,131	2,132	1,681	1,833	1,850	1,788	1,369	1,284	1,297	1,317
T_8	2,055	1,985	2,037	2,026	1,872	1,799	1,659	1,777	1,335	1,329	1,136	1,266	805	963	1,019	929
T_9	1,901	1,816	1,717	1,811	1,751	1,749	1,612	1,704	1,221	1,297	1,223	1,247	937	805	881	875
T_{10}	1,825	1,924	1,749	1,833	1,727	1,797	1,604	1,710	1,608	1,295	1,310	1,404	1,172	817	827	939
T_{11}	1,797	1,837	1,849	1,828	1,632	1,747	1,751	1,710	1,386	1,293	1,350	1,343	1,019	885	894	933
T_{12}	1,976	1,895	1,951	1,941	1,822	1,801	1,824	1,816	1,295	1,450	1,471	1,405	907	925	1,071	968
T_{13}	1,846	1,770	1,841	1,819	1,849	1,699	1,777	1,775	1,341	1,497	1,583	1,474	1,066	1,051	981	1,033
T_{14}	1,749	1,823	1,822	1,798	1,747	1,749	1,729	1,742	1,174	1,515	1,429	1,372	1,023	967	1,004	998
T_{15}	1,739	1,863	1,820	1,807	1,561	1,775	1,824	1,720	1,331	1,259	1,243	1,278	870	1,073	857	933
T_{16}	1,818	1,693	1,825	1,779	1,655	1,605	1,576	1,612	1,441	1,350	1,225	1,339	925	883	951	920
Mean	1,844	1,878	1,902		1,741	1,765	1,761		1,388	1,406	1,373		987	966	979	
CD (P=0.05)		C	T	C×T		C	T	C×T		C	T	C×T		C	T	C×T
		NS	118.9	206		NS	84.88	147		NS	98.08	169.8		NS	95.12	164.7

C_1:Metal box; C_2:Cloth bag; C_3:Plastic zipling bag (40 microns)

T_1: Untreated (Control); T_2: Carbendazim 75% WP; T_3: Tebuconazole 2 DS; T_4: Difenoconazole 25% EC; T_5: Propiconazole 25% EC; T_6: Tricyclazole 75% WP; T_7: Flusilazole 40% EC; T_8: Azoxystrobin 23% SC; T_9: Kitazine 48% EC; T_{10}: Propineb 70% WP; T_{11}: Dimethomorph 50% WP; T_{12}: Chlorothalonil 78.2% WP; T_{13}: Captan 70% + Hexaconazole 5% WP; T_{14}: Carbendazim 12% + Mancozeb 63% WP; T_{15}: Famoxadone 16.6% + Cymoxanil 22.1% SL; T_{16}: Flusilazole 12.5% + Carbendazim 25% SE

4. CONCLUSION

On the basis of present investigation, it is concluded that all the seed quality parameters i.e. standard germination, root length, shoot length, seedling dry weight, and vigour indices decreased gradually with the passage of time. It is also concluded that chilli seeds treated with flusilazole fungicide and stored in metal box under ambient conditions proved excellent for chilli seed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anonymous. Final Estimate. Ministry of Agriculture and Farmers Welfare, Govt. of India. 2016-2017.
2. Abdul Baki AA, Anderson JP. Vigour determination in soybean seeds by multiple criteria. Crop Sci. 1973;13:630-633.
3. Doijode SD. Comparison of storage containers for storage of French bean seeds under ambient conditions. Seed Res. 1988;16:245-247.
4. Tanweer A. Effect of new fungicide on viability of rice and sorghum seeds. Pestology. 1982;6:9-10.
5. ISTA. International rules for seed testing. Chapter 5: The Germination test. ISBN 978-3-906549-53-8. International Seed Testing Association, Baserdorf, Switzerland; 2011.
6. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 4th Ed., ICAR, New Delhi; 1985.
7. Hunje RV. Studies on seed production and post-harvest technique in chilli (*Capsicum annum* L.). Ph.D. Thesis, Univ. of Agric. Sci., Dharwad, Karnataka; 2002.
8. Dhyani AP, Sati MC, Khulbe RD. Seed health testing of red pepper and bell pepper with special reference to the pathogenicity and control of *Myrothecium verrucaria*. Int. J. of Tropical Pl. Dis. 1991;9:207-220.
9. Ramanathan, Sivaprakasam K. Effect of seed treatment with antagonists and fungicides on seed viability and seedling vigour of chilli. Seed Res. 1992;20:134-137.
10. Chandrasenan NV. Effect of provenance on seed quality and halogenations treatment to control seed deterioration. M. Sc. (Agri.) Thesis. Tamil Nadu Agric. Univ., Coimbatore; 1996.
11. Sharanamma B. Effect of provenance, seed treatment and containers on storability of chilli (*Capsicum annuum* L.) seeds. M.Sc. (Agri.) Thesis, Univ. of Agric. Sci., Dharwad, Karnataka; 2002.
12. Kavitha M, Deshpande VK, Vyakaranahal BS, Awakkanavar JS, Yashoda Hegde, Mathad JC. Seed pelleting with organic and inorganic inputs for vigour and viability in chilli seeds. Karnataka J. Agric. Sci. 2006;22(2):15-19.
13. Hunje R, Vyakarnahal BS, Jagadeesh RC. Studies effect of seed treatments on storability of vegetable seeds 31 on halogenation and plant bio - products on storability of chilli seed. Karnataka J. Agric. Sci. 2007;20(3):506-510.
14. Surya Kumari S, Umajyothi K, Giridhar K, Vijayalakshmi T, Rajani A, Venkata Ramana C, Naram Naidu L. Influence of temperature and relative humidity on viability of coated seeds of chilli under stored conditions. IOSR, J. Agric. Veter. Sci., (IOSRJAVS). 2012;7:40–44.
15. Choudhary CS, Jain SC, Ritesh K, Choudhary JS. Efficacy of different fungicides, biocides and botanical extract seed treatment for controlling seed-borne *Colletotrichum* sp. in chilli. Int. J. of Q. Life Sci. 2013;8(1).

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle3.com/review-history/49065