Effect of seed treatments and containers on chilli seed viability

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. The samples were drawn at quaterly intervals for ascertaining the seed quality parameters. The seeds treated with flusilazole (2g 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, fungicides, seed quality, storage

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 (Anonymous, 2017).

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 (Abdul-Baki and Anderson, 1973). 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. (Doijode, 1988).

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 (Tanweer, 1982). Therefore, the present study entitled "Effect of seed treatments and containers on chilli seed viability" was carried out.

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 seeds were treated with fifteen fungicides @ 2 g kg^{-1} seed and 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. 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	Treatments	Fungicides @ 2 g kg^{-1} seed
T_1	Untreated (Control)	T_9	Kitazine 48% EC
T_2	Carbendazim 75% WP	T_{10}	Propineb 70% WP
T_3	Tebuconazole 2 DS	T_{11}	Dimethomorph 50% WP
T_4	Difenoconazole 25% EC	T_{12}	Chlorothalonil 78.2% WP
T_5	Propiconazole 25% EC	T_{13}	Captan 70 % + Hexaconazole 5% WP
T_6	Tricyclazole 75% WP	T_{14}	Carbendazim 12 % + Mancozeb 63 % WP
T_7	Flusilazole 40% EC	*T_{15}	Famoxadone 16.6 % + Cymoxanil 22.1 % S
T_8	Azoxystrobin 23% SC	T_{16}	Flusilazole 12.5 % + Carbendazim 25 % SE
Systemic fungicides from T_2 to T_{12} and Combi-fungicides from T_{13} to T_{16} * Combi-fungicide T_{15} was used @ 2ml kg^{-1} seed			

The chilli seeds and fungicide were weighed 21g and 0.042g, respectively, wearing gloves using appropriate weighing balance for each treatment. The seeds and fungicides were mixed in beakers and shacked 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. Then, the treated seeds were kept in different containers (metal box, cloth bag and plastic zipling bag) in the laboratory under ambient conditions. The total numbers of treatments were 48 with three replications.

The experiment consisted of two factors (three different packing materials as storage container were used as level factor "C" and the sixteen fungicides treatments 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 twelve months and observations were recorded for seed technological parameters.

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 (ISTA, 2O11). The germination was checked on first count after 7^{th} day and final count was taken on 14^{th} day and normal seedlings were considered for per cent germination.

$$\text{Seed germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds placed for germination}} \times 100$$

Ten normal seedlings per replication were selected at random at the time of final count of standard germination 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.

Seeds/Seedling dry weight used for final count of shoot and root length was also assessed for then dry weight (mg) as usual.

Vigour indices: Seedling vigour indices were calculated as per Abdul-Baki and Anderson (1973).

(a) Seed Vigour Index I = Seed germination (%) × Average seedling length (cm)

(b) Seed vigour Index II = Seed germination (%) × Average dry seedling weight (mg)

The data obtained from the experiments were analyzed as per standard method (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

The perusal of data in table 1 revealed that the germination at the end of storage period (12 months) was found 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 of Hunje (2002).

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 *viz*,. Dhyani *et al*., (1991), Ramanathan and Sivaparkasam (1992), Chandrasenan (1996), Sharanamma B. (2002) and Kavitha (2009) also revealed the similar findings.

Table 3 indicates flusilazole again proved at par with tebuconazole in case of root length. Among 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 of Hunje *et al.*, (2007).

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 by Surya Kumari *et al.*, (2012) as revealed in table 4.

Table 5 illustrates 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 and in case of table 6 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 by Chaudhary *et al*., (2013).

Thus chilli seeds treatment with flusilazole fungicide and stored in metal box under ambient conditions proved excellent for chilli seed health because of no exchange of moisture and gases in the packaging material.

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

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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

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