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Seed Quality as Influenced by Seed Treatment, Packing Material and Storage Condition of China aster (*Callistephus chinensis*)

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ABSTRACT: An investigation was carried out with to study the influence of seed treatment with Captan and Bavistin, packed in polythene bag and paper bag and stored under cold storage and ambient condition, on storability of china aster seeds. Seeds treated with bavistin (T_2) recorded significantly higher germination percentage (65.50%), shoot length (2.48cm), root length (4.56cm), seedling length (7.03 cm), seedling dry weight (16.05 mg) and seedling vigour index (465) at the end of nine months of storage. With respect to packing materials, the seeds packed in polythene bag (700 gauge) recorded higher germination percentage, shoot length, root length, seedling length, seedling dry weight, seedling vigour index and lower moisture content of seed at the end of nine months of storage (71.78%, 2.34cm,4.52cm, 6.80 cm, 15.86 mg, 495 and 6.18%, respectively). Similarly the seeds stored in refrigerated condition (S_2) recorded significantly higher germination percentage (69.78%), shoot length (2.36cm), root length (4.56cm), seedling length (6.92 cm) and seedling vigour index (486) at the end of ninth months of storage. Seedling dry weight had no significant effect on storage condition at the end of ninth months of storage. The treatment combinations T x P, T x S, P x S and T x P x S showed significant effect only for seedling vigour index

Key words: China aster, *Callistephus chinensis*, Captan, Bavistin, Seed storage

China aster (*Callistephus chinensis*) is a semi hardy commercial flower crop belonging to the family *Asteraceae*. It is an important seed propagated annual flower crop. The non-availability of quality seeds is one of the major constraints in cultivation of this crop. The seeds of China aster are known to lose viability rapidly in storage leading to poor emergence in the field [1]. Seed storage will facilitate the maintenance of viability especially under local conditions with the use of readily available seed treatment chemicals and packaging materials. After packaging, the seeds will be stored under proper condition to maintain seed viability and vigour for long time. In storage, the seeds are to be protected against the pests and pathogens. The seeds can be treated with fungicides, packed in appropriate container and stored in proper condition for maintaining seed quality until planting. Keeping this in mind, the study was conducted to know the effect of seed treatment chemicals, packing material and storage condition on seed quality of China aster cv. Kamini.

MATERIALS AND METHODS

The experiment was conducted at post graduate laboratory, Department of Crop Improvement and Biotechnology, Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot during 2012-13. The experiment consisted of 12 treatment combinations involving three factors *viz.*, three seed treatment chemicals, Captan (T_1), Bavistin (T_2) and control (no seed treatment) as first factor, two packing materials *viz.*, paper bag (P_1), 700 gauge polythene bag (P_2) as second factor and two storage environments as third factor [ambient (S_1) and cold storage at 2-4°C (S_2)].

The seeds were treated with Captan @ 2.0 g

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per kg and Bavistin @ 1.0 g per kg of seed and the treated seeds were packed in polythene bag of 700 gauges and in paper bag. Ten grams of seeds were drawn from each treatment for recording monthly observations up to nine months storage period (May 2012 to February 2013). The paper bag was tightly closed. Polythene bags were closed by heat sealing. Both paper bags and polythene bags were placed under ambient and cold storage conditions in the laboratory. The observations of moisture content of seed, seed germination (%), shoot length, root length, seedling length (cm), seedling dry weight (mg) and seedling vigour index were recorded at the end of test period. The laboratory germination test was conducted as per ISTA procedure [2]. Vigour index was calculated as per [3] by using the formula, VI = Germination per cent (%) x Total seedling length (cm). The ten normal seedlings used for measuring seedling length were dried in a hot air oven at 70±1°C temperature for 24 hours. Then the seedlings were cooled in desiccators for 30 minutes and weight was recorded and expressed in milli grams.

RESULTS AND DISCUSSIONS

Influence of seed treatment chemicals on seed quality

Among the seed treatments, seeds treated with Bavistin (T_2) recorded significantly lowest moisture content (6.26%) compared to other treatments. The highest moisture content was recorded in control (6.31%) at the end of nine months of storage period (Table 1).

Table 1. Effect of seed treatment, packing material, storage condition and their interaction on moisture content of China aster seeds during storage

Treatments	Moisture content (%)			
	1	3	6	9
T_1	6.04	6.23	6.26	6.29
T_2	6.06	6.25	6.29	6.26
T_3	6.10	6.23	6.32	6.31
S.Em. ±	0.05	0.02	0.02	0.01
CD at 1%	0.16	0.06	0.06	0.04
P_1	6.13	6.36	6.42	6.40
P_2	5.99	6.11	6.15	6.18
S.Em. ±	0.04	0.01	0.02	0.01
CD at 1%	0.13	0.04	0.05	0.04
S_1	6.10	6.37	6.42	6.39
S_2	6.03	6.10	6.17	6.18
S.Em. ±	0.04	0.01	0.02	0.01
CD at 1%	0.13	0.04	0.05	0.04

For comparing the means of	S.Em±	C.D at 5%	S.Em±	C.Dat 5%	S.Em±	C.Dat 5%	S.Em±	C.Dat 5%
TP	0.08	0.23	0.02	0.07	0.02	0.07	0.02	0.06
TS	0.08	0.23	0.02	0.07	0.02	0.07	0.02	0.06
PS	0.06	0.19	0.02	0.06	0.02	0.06	0.02	0.05
TPS	0.11	0.32	0.03	0.10	0.03	0.10	0.03	0.10

Treatments (T) : T_1-Captan, T_2-Bavistin, T_3-Control, Packing material (P) : P_1-Paper bag, P_2-Polythene bag (700 gauge); Storage condition (S) : S_1-Ambient condition, S_2-Cold storage; NS- Non Significant

The variation in seed germination percentage due to seed treatment was significant in six and nine months of storage (Table 2). In all the treatments, the germination was decreased with an increase in storage period. Among the treatments, seeds treated with Bavistin recorded higher germination (65.50%) and which was on par with seeds treated with Captan (63.83%) at the end of nine months of storage. Significantly lower germination (51.33%) was recorded in control at the end of nine months of storage. The highest germination could be due to effective control of storage diseases. These chemicals acted as antioxidant to counteract the release of free radicals during the storage. China aster seeds treated with Bavistin and Captan as dry treatment were protectedfrom the surrounding moisture, as compared to untreated seeds and these fungicides helped against storage microflora and also acted as a barrier for moisture entry to some extent. This is in accordance with the findings of [4] in cabbage and [5] in onion.

Significant variation in shoot and root length, seedling length, seedling dry weight and vigour index were observed due to seed treatments, in all the months of storage (Tables 2, 3 & 4). A gradual decrease in these parameters was noticed with increase in storage period. Bavistin treated seeds maintained the highest shoot length (2.58cm) and root length (4.56cm), seedling length (7.03cm), seedling dry weight (16.05mg) and vigour index (465) and which was on par with Captan treatment at the end of nine months of storage period. The lowest seed quality was recorded in control (2.06cm, 4.02cm, 6.08cm, 13.70 mg and 319, respectively) at the end of nine months of storage. Seeds treated with Bavistin and Captan recorded higher germination percentage, seedling characters and vigour index, which have played significant role in inhibition of storage fungi. This is accordance with the findings of [4] in cabbage, [6] in cucumber, pumpkin, watermelon and muskmelon and [7] in onion.

Influence of packing materials on seed quality

Seeds packed in polythene bag recorded significantly lower moisture content of seed (6.18%) and higher germination per cent (71.78%), seedling length (6.80 cm), seedling dry weight (15.86 mg) and vigour index (495) at the end of nine months storage as compared to paper bag (6.40%, 48.67%, 6.45 cm, 13.92 mg and 322, respectively). Polythene bag (700 gauge) acted as a moisture barrier. The low seed moisture content controlled the respiration rate, metabolic activity and maintained higher seed viability and vigour during storage. The result of present investigation were in accordance with findings of [8] in field bean, [9] and [7] in onion and [10] in brinjal.

Influence of storage conditions on seed quality

The China aster seeds stored in cold storage (S_2) recorded lower moisture content of seed (6.18%) and higher germination (69.78%), seedling length (6.92 cm) and vigour index (486) at the end of nine months storage compared to ambient condition (6.39%, 50.67%, 6.33 cm, and 331, respectively). Seeds preserved in the cold storage maintained higher seed quality because of lower respiration rate and metabolic activity, as evidenced by higher germination, seedling length, seedling dry weight and vigour index at the end of nine months of storage period. These results are in agreement with the findings of [11] in onion seeds, [12] in marigold and [13] in China aster seeds.

Interaction effects on seed quality during storage

The interaction effects of seed treatment chemicals and packing materials (T x P), seed treatment chemicals and storage conditions (T x S) and packing material and storage condition (P x S) and seed treatment chemicals, packing materials and storage conditions (T x P x S) for germination per cent, shoot length, seedling length and seedling dry weight showed non- significant results at the end of nine months of storage. The interaction effect of P x S showed significant effect on germination per cent at the end of nine months of storage. The maximum germination per cent was recorded with the treatment combination of P_2S_2 (polythene bag x cold storage). The interaction effects of T x P, T x S, P x S and T x P x S for moisture content showed significant results at the end of nine months of storage period.

Table 2. Effect of seed treatment, packing material and storage condition on germination (%) and seedling length (cm) of China aster seeds during storage

Treatment	Storage period (Months)							
	Germination (%)				Seedling length (cm)			
	1	3	6	9	1	3	6	9
T_1	86.50	81.40	71.25	63.83	7.60	7.49	7.11	6.76
T_2	87.70	82.13	73.25	65.50	7.64	7.55	7.40	7.03
T_3	86.95	77.15	62.50	51.33	7.36	7.04	6.63	6.08
S.Em. ±	2.11	1.90	1.88	1.59	0.04	0.06	0.09	0.09
CD at 1%	NS	NS	5.63	4.77	0.11	0.19	0.26	0.28
P_1	86.54	76.91	61.11	48.67	7.33	7.14	6.85	6.45
P_2	87.56	83.54	76.89	71.78	7.73	7.60	7.25	6.80
S.Em. ±	1.72	1.55	1.53	1.30	0.21	0.46	0.40	0.35
CD at 1%	NS	4.65	4.59	3.89	0.09	0.15	0.21	0.23
S_1	86.67	77.99	64.66	50.67	7.31	7.11	6.80	6.33
S_2	87.43	82.46	73.33	69.78	7.75	7.63	7.30	6.92
S.Em. ±	1.72	1.55	1.53	1.30	0.03	0.05	0.07	0.08
CD at 1%	NS	NS	4.59	3.89	0.09	0.15	0.21	0.23

For comparing the means of	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%
TP	2.98	NS	2.69	6.17	2.66	NS	2.25	NS	0.05	0.16	0.09	0.26	0.12	NS	0.13	NS
TS	2.98	NS	2.69	NS	2.66	NS	2.25	NS	0.05	0.16	0.09	NS	0.12	NS	0.13	NS
PS	2.43	NS	2.19	NS	2.17	NS	1.83	5.49	0.04	NS	0.07	NS	0.10	NS	0.11	NS
TPS	4.21	NS	3.80	NS	3.75	NS	3.17	NS	0.08	NS	0.12	NS	0.17	NS	0.19	NS

Treatment (T) : T_1-Captan, T_2-Bavistin, T_3-Control, Packing material (P): P_1-Paper bag, P_2-Polythene bag (700 gauge); Storage condition (S): S_1-Ambient condition, S_2-Cold storage; NS- Non Significant

Table 3. Effect of seed treatment, packing material and storage condition on shoot length and root length of China aster seeds during storage

Table 3. **Effect of seed treatment, packing material and storage condition on shoot length and root length of China aster seeds during storage**

Treatment	Storage period (Months)							
	Germination (%)				Seedling length (cm)			
	1	3	6	9	1	3	6	9
T_1	2.79	2.74	2.54	2.41	4.81	4.75	4.57	4.44
T_2	2.62	2.61	2.58	2.48	5.01	4.95	4.83	4.56
T_3	2.48	2.36	2.18	2.06	4.88	4.69	4.45	4.02
S.Em. ±	0.02	0.04	0.07	0.06	0.03	0.04	0.05	0.05
CD at 1%	0.07	0.11	0.22	0.19	NS	0.12	0.14	0.14
P_1	2.55	2.49	2.39	2.29	4.77	4.65	4.46	4.16
P_2	2.70	2.65	2.48	2.34	5.02	4.94	4.77	4.52
S.Em. ±	0.02	0.03	0.06	0.05	0.02	0.03	0.04	0.04
CD at 1%	0.06	0.09	NS	NS	NS	0.10	0.12	0.11
S_1	2.59	2.53	2.41	2.27	4.72	4.58	4.38	4.12
S_2	2.67	2.61	2.45	2.36	5.07	5.01	4.85	4.56
S.Em. ±	0.02	0.03	0.06	0.05	0.02	0.03	0.04	0.04
CD at 1%	0.06	NS	NS	NS	NS	0.10	0.12	0.11

For comparing the means of	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%
TP	0.03	NS	0.05	NS	0.10	NS	0.09	NS	0.04	NS	0.06	0.18	0.07	NS	0.07	NS
TS	0.03	NS	0.05	NS	0.10	NS	0.09	NS	0.04	NS	0.06	0.18	0.07	NS	0.07	NS
PS	0.03	0.09	0.05	NS	0.10	NS	0.09	NS	0.04	NS	0.06	0.18	0.07	NS	0.07	NS
TPS	0.05	NS	0.07	NS	0.15	NS	0.12	NS	0.05	NS	0.08	NS	0.01	NS	0.09	0.18

Treatment (T) : T_1-Captan, T_2-Bavistin, T_3-Control, Packing material (P): P_1-Paper bag, P_2-Polythene bag (700 gauge); Storage condition (S): S_1-Ambient condition, S_2-Cold storage; NS- Non Significant

Table 4. Effect of seed treatment, packing material and storage condition on seedling dry weight (mg) and vigour index of China aster seeds during storage

Treatment	Storage period (Months)							
	Germination (%)				Seedling length (cm)			
	1	3	6	9	1	3	6	9
T_1	16.26	16.03	15.65	14.93	658	612	509	441
T_2	17.67	17.43	16.85	16.05	670	622	545	465
T_3	15.13	14.97	14.50	13.70	640	545	418	319
S.Em. ±	0.37	0.51	0.57	0.45	1.07	0.98	0.98	0.84
CD at 1%	1.12	1.53	1.71	1.36	3.22	2.94	2.94	2.52
P_1	15.48	15.22	14.72	13.92	635	550	422	322
P_2	17.22	17.05	16.63	15.86	677	635	559	495
S.Em. ±	1.75	1.83	1.91	1.93	0.88	0.80	0.80	0.69
CD at 1%	0.91	1.25	1.39	1.11	2.63	2.40	2.40	2.06
S_1	15.73	15.54	15.11	14.35	634	556	443	331
S_2	16.97	16.73	16.23	15.43	678	629	538	486
S.Em. ±	0.30	0.42	0.46	0.37	0.88	0.80	0.80	0.69
CD at 1%	0.91	NS	NS	NS	2.63	2.40	2.40	2.06

For comparing the means of	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%	S.E m±	C.D at 5%
TP	0.53	NS	0.72	NS	0.80	NS	0.64	NS	1.521	4.55	1.39	4.16	1.39	4.16	1.19	3.57
TS	0.53	NS	0.72	NS	0.80	NS	0.64	NS	52	4.55	1.39	4.16	1.39	4.16	1.19	3.57
PS	0.43	NS	0.59	NS	0.66	NS	0.53	NS	1.24	3.71	1.13	3.39	1.13	3.40	0.97	2.91
TPS	0.74	NS	1.02	NS	1.14	NS	0.91	NS	2.14	6.43	1.96	5.88	1.96	5.89	1.68	5.04

Treatment (T) : T_1-Captan, T_2-Bavistin, T_3-Control, Packing material (P): P_1-Paper bag, P_2-Polythene bag (700 gauge); Storage condition (S): S_1-Ambient condition, S_2-Cold storage; NS- Non Significant

Vigour index differed significantly due to the interactions of T x P (seed treatment chemicals x packing materials), T x S (Seed treatment chemicals and storage conditions), P x S (Packing materials and storage conditions) and T x P x S (seed treatments, packing materials and storage conditions). The treatment combination T_2P_2, T_2S_2, P_2S_2 and $T_2P_2S_2$ recorded the highest vigour index. Higher vigour index in the treatment combination $T_2P_2S_2$ was mainly due to treating the seeds with compatible fungicide and it played an effective role in inhibiting the storage microflora. Packing material such as polythene bag acted as moisture entry barrier and also maintained the lower moisture content in the seeds. In the treatment combination $T_2S_2P_2$, Bavistin proved to be effective fungicide and prevalence of low temperature in cold storage might have attributed to lower respiration rate and metabolic activity of seeds. This is evidenced by higher germination and vigour index during the storage period. This is in accordance with the findings of [13] in China aster and [14] in onion.

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