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RESEARCH PAPER

Influence of storage containers on storability of china aster genotypes

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SUMMARY : The storage experiment on storage potential of china aster varieties was conducted in the Department of Seed Science and Technology, AC, Dharwad. Among four china aster varieties, Kamini was found relatively better in storability with high germination and seedling vigour with low electrical conductivity up to six months of storage. Among containers, seeds stored in aluminium foil and polythene bags maintained higher germination and seedling vigour parameters compared to seeds stored in paper and cloth bag.

KEY **W**ORDS : Storage containers, Storability, China aster, Genotypes

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China aster [*Callistephus chinensis* (L.) Nees] belongs to the family Asteraceae native of china is an important commercial ornamental annual crop grown in many parts of the world for cut and stock flower. The wide spectrum of colour ranges of flowers *viz.*, pink, blue, violet, purple and white makes people more attractive which are used for garlands bouquets etc. Further, due to long shelf-life of cut flowers they are being wider decorative purpose. In India and Karnataka china aster is increasing every year but the availability of high quality seed in adequate quantity has become a major problem for cultivation of china aster crop. Further the china aster seeds are found to have lesser period of viability which also is a limiting factor for availability of quality seeds for sowing. Hence, there is need to extend the longevity of china aster seeds by storing in appropriate storage containers. Storage potential of seed is basically under genetic control and it differs with species and cultivars it is also influenced by number of other environmental factors *viz.*, moisture content, RH, temperature, storage containers, provinence etc. generally seeds stored in sealed moisture impervious containers store for longer period compared to those stored in moisture pervious containers as they act as effective barriers against moisture fluctuation (Thomson, 1979).

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EXPERIMENTAL METHODS

The storage experiment was conducted in the department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Dharwad involving four china aster varieties *viz.*, Kamini, Phule ganesh white, Phule ganesh purple and phule ganesh violet and four container *viz.*, cloth bag, paper bag, polythene bag and aluminium foil. The fresh seeds of china aster varieties with initial 8.0 per cent moisture content were stored in different containers. The polythene and aluminium foil containers were heat sealed. The seeds required for months observations were obtained from separate containers. The monthly observation were made on germination, speed of germination, shoot length, seedling dry weight, vigour index, moisture content and electrical conductivity as per ISTA rules (Anonymous, 1996).

EXPERIMENTAL FINDINGS AND ANALYSIS

The present study revealed significant variation among

Table 1: Effect of varieties and containers on germination percentage and speed of germination during storage of china aster

Treatments	Germination percentage						Speed of germination					
	Storage months						Storage months					
	1	2	3	4	5	6	1	2	3	4	5	6
Varieties (V)												
V_1 – Kamini	90.12 (71.71)*	88.00 (69.76)	84.37 (67.47)	81.62 (64.64)	76.50 (61.03)	70.87 (57.36)	16.17	15.64	14.92	14.12	13.66	12.45
V_2 – FG white	86.37 (68.36)	84.37 (66.74)	80.25 (63.64)	76.87 (61.28)	60.87 (57.36)	66.62 (54.73	15.78	15.30	14.66	13.70	12.87	11.94
V_3 – FG voilet	87.75 (69.54)	85.00 (67.24)	80.87 (64.09)	77.25 (61.54)	71.50 (57.76)	67.12 (55.03)	15.93	15.46	14.88	13.86	13.04	12.15
V_4 – FG purple	84.87 (67.14)	81.87 (64.83)	77.37 61.62)	74.50 (59.70)	69.25 (56.35)	64.37 (53.37)	15.65	15.14	14.44	13.42	12.66	11.70
Mean	87.28 (69.12)	84.01 (67.05)	80.84 (61.01)	77.56 (61.75)	72.03 (58.05)	67.25 (55.06)	15.88	15.38	14.73	13.78	13.06	12.06
S.E.±	0.36	0.34	0.43	0.36	0.76	0.47	0.05	0.04	0.08	0.04	0.12	0.06
C.D. at 5%	1.07	1.02	1.28	1.07	1.38	1.41	0.14	0.13	0.25	0.12	0.36	0.18
Containers (C)												
C_1 – Cloth bag	85.62 (67.74)	81.75 (64.74)	76.62 (61.11)	73.00 (58.72)	65.00 (53.75)	59.37 (50.42)	15.70	15.06	14.35	13.20	12.63	11.51
C_2 – Paper bag	86.62 (68.57)	85.72 (67.85)	79.62 (63.19)	75.37 (60.27)	67.75 (55.42)	62.62 (52.36)	15.81	15.25	14.52	13.49	12.81	11.77
C_3 – Polythene	87.62 (69.43)	85.87 (67.95)	82.25 (65.11)	79.62 (63.19)	76.12 (60.77)	71.50 (57.76)	16.00	15.58	14.73	14.20	13.31	12.40
C_4 – Aluminium foil	89.25 (70.89)	86.87 (68.79)	84.87 (67.14)	82.25 (65.11)	79.25 (62.96)	75.50 (60.36)	16.03	15.63	15.30	14.23	13.49	12.55
Mean	87.28 (69.12)	84.01 (67.05)	80.84 (61.01)	77.56 (61.75)	72.03 (58.05)	67.25 (55.06)	15.88	15.38	14.73	13.78	13.06	12.06
S.E.±	0.36	0.34	0.43	0.36	0.76	0.47	0.05	0.04	0.08	0.04	0.12	0.06
C.D. at 5%	1.07	1.02	1.28	1.07	1.38	1.41	0.14	0.13	0.25	0.12	0.36	0.18
Interactions (VxC)												
V_1C_1	88.50 (70.21)	84.50 (66.84)	80.50 (63.82)	76.50 (61.03)	69.50 (56.50)	63.50 (52.87)	16.05	15.37	14.37	13.55	13.80	11.85
V_1C_2	89.50 (71.12)	87.50 (69.33)	83.00 (65.68)	79.50 (63.11)	71.50 (57.76)	66.50 (54.66)	16.15	15.55	14.77	13.85	13.45	12.25
V_1C_3	91.00 (72.57)	89.50 (71.12)	87.50 (69.33)	84.50 (66.84)	81.50 (64.55)	74.50 (59.70)	16.25	15.75	15.05	14.55	13.65	12.80
V_1C_4	91.50 (73.08)	90.50 (72.02)	88.50 (70.21)	86.00 (68.06)	83.50 (66.06)	79.00 (62.79)	16.25	15.90	15.50	14.55	13.75	12.90
V_2C_1	85.00 (67.24)	81.50 (64.55)	75.50 (60.36)	72.00 (58.08)	63.00 (52.56)	55.88 (50.21)	15.55	14.95	14.40	13.15	12.32	11.37
V_2C_2	85.50 (67.65)	85.00 (67.24)	80.50 (63.82)	75.50 (60.36)	68.50 (55.88)	62.50 (52.26)	15.72	14.11	14.42	13.47	12.60	11.65
V_2C_3	86.50 (68.47)	85.00 (67.24)	81.00 (64.19)	77.50 (61.71)	73.50 (59.04)	69.50 (56.50)	15.90	15.55	14.60	14.05	13.17	12.27
V_2C_4	88.50 (70.21)	86.00 (68.06)	84.00 (66.45)	82.50 (65.30)	78.50 (62.40)	75.50 (60.36)	15.95	15.57	15.22	14.15	13.40	12.47
V_3C_1	86.00 (68.06)	82.00 (64.92)	77.00 (61.37)	74.00 (59.37)	65.50 (54.05)	60.50 (51.08)	15.75	15.15	14.60	13.25	12.35	11.65
V_3C_2	87.50 (69.33)	86.00 (68.06)	80.50 (63.82)	75.50 (60.36)	67.00 (54.96)	62.00 (51.96)	15.85	15.35	14.62	13.60	12.75	11.90
V_3C_3	87.50 (69.33)	85.50 (67.65)	81.50 (64.55)	79.00 (62.75)	76.00 (60.69)	57.75 (71.50)	16.05	15.65	14.90	14.30	13.45	12.45
V_3C_4	90.00 (71.60)	86.50 (68.47)	84.50 (66.84)	80.50 (63.82)	77.50 (61.71)	74.50 (59.70)	16.00	15.70	15.42	14.32	13.62	12.60
V_4C_1	83.00 (65.68)	79.00 (62.75)	73.50 (59.04)	69.50 (56.50)	62.00 (51.96)	54.50 (47.60)	15.45	15.80	14.05	12.85	12.05	11.17
V_4C_2	84.00 (66.45)	80.50 (63.82)	74.50 (59.70)	71.00 (57.44)	64.00 (53.15)	59.50 (50.50)	15.55	15.00	14.27	13.05	12.45	11.30
V_4C_3	85.50 (67.65)	83.50 (66.06)	79.00 (62.75)	77.50 (61.71)	73.50 (59.04)	70.50 (57.13)	15.80	15.40	14.40	13.90	12.97	12.07
V_4C_4	87.00 (68.90)	84.50 (66.84)	82.50 (65.30)	80.00 (63.46)	77.50 (61.71)	73.00 (58.72)	15.82	15.37	15.05	13.90	13.20	12.25
Mean	87.28 (69.12)	84.01 (67.05)	80.84 (61.01)	77.56 (61.75)	72.03 (58.05)	67.25 (55.06)	15.88	15.38	14.73	13.78	13.49	12.06
S.E.±	0.72	0.68	0.86	0.73	1.52	0.93	0.09	0.08	0.17	0.08	0.24	0.12
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS – Non-significant * Figures in the parenthesis are arcsine transformed values

Table 2 : Effect of varieties and containers on seedling length, seedling vigour index and seedling dry weight during storage of china aster

Treatments	Seedling length (cm)						Seedling vigour index						Seedling dry weight (mg)					
	Storage months						Storage months						Storage months					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Varieties (V)																		
V_1 – Kamini	4.82	4.80	4.71	4.50	4.42	4.23	434	424	400	364	338	301	16.89	16.75	16.57	16.38	16.01	15.65
V_2 – PG white	4.65	4.61	4.51	4.30	4.17	4.03	408	388	362	338	296	270	15.81	15.61	15.44	15.15	14.73	14.42
V_3 – PG voilet	4.67	4.63	4.57	4.40	4.30	4.10	410	394	369	342	310	276	16.08	15.89	15.75	15.49	15.05	14.71
V_4 – PG purple	4.64	4.53	4.44	4.26	4.16	4.01	394	372	343	321	289	261	15.63	15.35	15.15	14.95	14.58	14.20
Mean	4.69	4.64	4.56	4.37	4.26	4.09	412	394	369	341	308	277	16.10	15.90	15.73	15.49	15.09	14.75
S.E.±	0.03	0.03	0.03	0.03	0.03	0.02	2.36	2.10	2.63	3.00	4.43	2.54	0.06	0.07	0.06	0.06	0.06	0.06
C.D. at 5%	0.08	0.10	0.08	0.08	0.07	0.07	7.07	6.30	7.90	9.00	13.58	7.58	0.17	0.18	0.19	0.18	0.19	0.18
Containers (C)																		
C_1 – Cloth bag	4.50	4.44	4.32	4.09	3.95	3.75	391	362	330	300	260	224	15.14	14.95	14.73	14.47	13.98	13.53
C_2 – Paper bag	4.66	4.56	4.44	4.25	4.10	3.87	404	389	353	321	276	242	15.43	15.16	14.92	14.63	14.12	13.72
C_3 – Polythene	4.75	4.71	4.66	4.44	4.40	4.25	416	405	384	361	335	304	16.40	16.21	16.06	15.84	15.51	15.24
C_4 – Aluminium foil	4.87	4.86	4.81	4.70	4.61	4.49	436	421	408	384	361	339	17.43	17.28	17.18	17.02	16.76	16.49
Mean	4.69	4.64	4.56	4.37	4.26	4.09	412	394	369	341	308	277	16.10	15.90	15.73	15.49	15.09	14.75
S.E.±	0.03	0.03	0.03	0.03	0.03	0.02	2.36	2.10	2.63	3.00	4.53	2.54	0.06	0.06	0.06	0.06	0.06	0.06
C.D. at 5%	0.08	0.10	0.08	0.08	0.07	0.07	7.07	6.30	7.90	9.00	13.58	7.58	0.17	0.18	0.19	0.18	0.19	0.18
Interactions (VxC)																		
V_1C_1	4.72	4.71	4.57	4.22	4.15	3.95	418	399	368	323	288	250	16.33	16.05	15.80	15.55	15.05	14.45
V_1C_2	4.75	4.72	4.62	4.45	4.32	4.05	425	415	383	353	303	269	16.37	16.15	15.85	15.67	15.17	14.70
V_1C_3	4.85	4.82	4.77	4.57	4.47	4.35	441	431	417	382	364	324	17.32	17.32	17.17	17.05	16.85	16.62
V_1C_4	4.97	4.97	4.90	4.77	4.75	4.60	455	450	433	397	396	363	17.52	17.50	17.47	17.25	17.00	16.85
V_2C_1	4.36	4.37	4.17	4.05	3.90	3.75	393	351	309	307	247	221	14.52	14.42	14.25	13.95	13.55	13.25
V_2C_2	4.65	4.52	4.42	4.22	4.00	3.82	399	386	357	322	276	239	15.15	14.90	14.70	14.25	13.67	13.32
V_2C_3	4.77	4.75	4.65	4.30	4.27	4.12	410	403	379	353	316	286	16.10	15.90	15.70	15.45	15.05	14.75
V_2C_4	4.82	4.82	4.80	4.65	4.52	4.45	431	412	402	370	346	336	17.47	17.22	17.12	16.95	16.67	16.37
V_3C_1	4.52	4.47	4.40	4.15	4.00	3.77	389	366	338	295	272	228	15.27	15.15	14.95	14.65	14.05	13.60
V_3C_2	4.62	4.57	4.50	4.27	4.17	3.85	404	395	360	320	278	238	15.55	15.22	15.07	14.75	14.20	13.82
V_3C_3	4.67	4.62	4.60	4.47	4.42	4.27	409	395	372	358	336	305	16.05	15.85	15.75	15.52	15.12	14.85
V_3C_4	4.87	4.85	4.80	4.72	4.60	4.50	438	419	405	393	256	335	17.45	17.35	17.22	17.05	16.82	16.57
V_4C_1	4.40	4.22	4.15	3.95	3.75	3.60	365	333	304	274	232	196	14.45	14.17	13.95	13.75	13.30	12.85
V_4C_2	4.62	4.42	4.22	4.05	3.90	3.77	388	358	311	287	350	224	14.65	14.40	14.07	13.85	13.45	13.05
V_4C_3	4.72	4.67	4.65	4.42	4.42	4.27	404	390	367	350	325	301	16.15	15.80	15.65	15.35	15.05	14.75
V_4C_4	4.82	4.80	4.75	4.65	4.57	4.42	419	405	391	374	347	323	17.30	17.05	16.92	16.85	16.55	16.17
Mean	4.69	4.64	4.56	4.37	4.26	4.09	412	394	369	341	308	277	16.10	15.90	15.73	15.49	15.09	14.75
S.E.±	0.03	0.07	0.06	0.05	0.05	0.05	4.72	4.20	5.27	6.01	9.06	5.08	0.12	0.12	0.13	0.12	0.13	0.12
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS – Non Significant

varieties for per cent germination and other seed quality parameters at first and subsequent months of storage. The germination percentage of china aster seeds declined progressively with increase in storage period in all the varieties irrespective of containers. The mean germination gradually decreased from 87.28 to 67.25 per cent, speed of germination from 15.88 to 12.6 (Table 1), seedling length from 4.69 to 4.09, vigour index from 412 to 277, seedling dry weight 16.10 to 14.75 mg (Table 2) while EC increased from 1.48 to 2.34 dSm-1, moisture content varied between 8.14 to 8.02 from first month after storage to end of six month of storage, respectively. Such varietal differences on storability of seeds and other seedling parameters may be attributed mainly to genetic differences of china aster varieties and due to storage environments (Roberts, 1972; Agarwal, 1974 and Bharati, 2002).

Among china aster varieties Kamini recorded significantly maximum (70.87%) germination while it was less (64.37%) in PG purple irrespective of container. All the varieties were found to maintain satisfactory germination (60%) above the minimum seed certification standards up to end of six months of storage.

Table 3: Effect of varieties and containers on electrical conductivity and moisture content during storage of china aster

Treatments	Electrical conductivity (dSm^{-1})						Moisture content (%)					
	Storage months						Storage months					
	1	2	3	4	5	6	1	2	3	4	5	6
Varieties (V)												
V_1 – Kamini	1.38	1.50	1.65	1.83	2.02	2.17	8.08	8.03	7.86	7.79	7.82	8.00
V_2 – PG white	1.46	1.56	1.78	2.04	2.20	2.43	8.10	8.05	7.90	7.80	7.78	8.06
V_3 – PG voilet	1.44	1.55	1.69	1.91	2.10	2.25	8.11	8.10	7.98	7.91	7.85	8.01
V_4 – PG purple	1.66	1.67	1.81	2.13	2.37	2.53	8.18	8.13	8.01	7.91	7.86	8.01
Mean	1.48	1.57	1.73	1.98	2.17	2.34	8.14	8.08	7.90	7.89	8.03	8.02
S.E.±	0.02	0.02	0.02	0.01	0.02	0.03	0.02	0.01	0.02	0.02	0.01	1.02
C.D. at 5%	0.05	0.06	0.07	0.04	0.06	0.08	0.06	0.03	0.06	0.06	0.03	NS
Containers (C)												
C_1 – Cloth bag	1.58	1.72	1.93	2.19	2.41	2.62	8.20	8.18	7.95	7.85	7.82	8.24
C_2 – Paper bag	1.52	1.63	1.81	2.06	2.25	2.48	8.17	8.09	7.94	7.84	7.83	8.21
C_3 – Polythene	1.44	1.50	1.66	1.89	2.16	2.25	8.06	8.02	7.90	7.83	7.78	7.87
C_4 – Aluminium foil	1.39	1.44	1.53	1.77	1.87	2.03	8.02	8.01	7.96	7.90	7.87	7.80
Mean	1.48	1.57	1.73	1.98	2.17	2.34	8.10	8.06	7.94	7.85	7.83	8.01
S.E.±	0.02	0.02	0.02	0.01	0.02	0.03	0.02	0.01	0.02	0.02	0.01	0.02
C.D. at 5%	0.05	0.06	0.07	0.04	0.06	0.08	0.06	0.03	NS	NS	0.03	0.06
Interactions (VxC)												
V_1C_1	1.47	1.67	1.87	2.05	2.27	2.47	8.21	8.17	7.87	7.77	7.90	8.25
V_1C_2	1.37	1.55	1.77	1.87	2.10	2.22	8.12	7.99	7.85	7.77	7.85	8.22
V_1C_3	1.37	1.42	1.55	1.77	2.00	2.12	8.00	7.98	7.80	7.72	7.67	7.87
V_1C_4	1.30	1.36	1.43	1.62	1.72	1.87	8.00	8.00	7.95	7.90	7.87	7.89
V_2C_1	1.35	1.72	1.95	2.27	2.45	2.70	8.22	8.17	7.82	7.72	7.67	8.27
V_2C_2	1.50	1.62	1.85	2.15	2.27	2.65	8.15	8.05	7.85	7.77	7.77	8.30
V_2C_3	1.42	1.47	1.75	1.92	2.22	2.27	8.05	7.97	7.92	7.85	7.82	7.88
V_2C_4	1.37	1.45	1.57	1.82	1.87	2.10	8.00	8.00	8.00	7.87	7.85	7.87
V_3C_1	1.57	1.67	1.87	2.12	2.37	2.55	8.20	8.17	8.07	8.00	7.87	8.20
V_3C_2	1.50	1.62	1.77	2.00	2.15	2.35	8.17	8.12	8.00	7.87	7.82	8.15
V_3C_3	1.37	1.50	1.62	1.82	2.12	2.17	8.05	8.05	7.95	7.87	7.82	7.91
V_3C_4	1.32	1.42	1.50	1.72	1.77	1.95	8.05	8.05	7.92	7.90	7.87	7.88
V_4C_1	1.75	1.82	2.02	2.32	2.57	2.77	8.027	8.22	8.06	7.92	7.85	8.25
V_4C_2	1.72	1.75	1.87	2.22	2.47	2.70	8.25	8.00	8.07	7.95	7.90	8.17
V_4C_3	1.60	1.60	1.72	2.05	2.32	2.42	8.15	8.10	7.95	7.85	7.90	7.83
V_4C_4	1.57	1.52	1.62	1.92	2.12	2.22	8.05	8.00	8.00	7.92	7.90	7.90
Mean	1.48	1.57	1.73	1.98	2.17	2.34	8.12	8.07	7.94	7.85	7.83	8.02
S.E.±	0.04	0.04	0.04	0.03	0.04	0.05	0.03	0.03	0.04	0.04	0.03	0.04
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS = Non-significant * Figures in the parenthesis are arcsine transformed values

Most of the previous studies on influence of containers on storage potential have indicated the beneficial influence of moisture impervious containers over pervious containers in the present study also. Among the containers significantly maximum germination (75.5%) was seen in aluminium foil followed by polythene bag (71.50%) and was minimum (59.37%) in cloth bag at the end of six months of storage. The seed viability was maintained as per seeds standards in all the containers except in cloth bag. The results of the present study are in conformity with the reports of Kumbar (1999) and Bharati (2002). Likewise, containers also showed significant differences on speed of germination, seedling length, seedling vigour index, seedling dry weight which were found to decrease with the increase in storage period except electrical conductivity on account of age induced deterioration (Roberts, 1972 and Delouche, 1973).

The interaction effect due to varieties and containers though not differed significantly, all the china aster varieties stored in different containers maintained satisfactory germination (60%) except PG white and PG purple stored in cloth bag and P.G purple stored in paper bag.

Likewise, the various seedling parameters such as speed of germination. Seedling length, seedling dry weight, seedling vigour index also did not show any significant differences due to the interaction effects based on the results of the study, it may be concluded that china aster seeds may be stored in aluminium foil or polythene bag containers satisfactorily above six months of storage without any loss of germination and seedling vigour parameters.

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