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Effect of drying conditions and embedding materials on post-harvest quantitative parameters in China aster (*Callistephus chinensis*) flowers

M. A. Meman, A. V. Barad and L. J. Raval
Department of Horticulture
College of Agriculture, Junagadh Agricultural University
Junagadh, Gujarath, India
E-mail: asi07@rediffmail.com

ABSTRACT

The study was undertaken to optimize conditions for dry flower production in China aster flowers. The experiment was conducted with eight treatment combinations consisting of two drying conditions *viz.*, room drying (C_1) and sun drying (C_2) and four media *viz.* Sand (M_1), Sand:Borax (1:1) (M_2), Borax (M_3) and Silicagel (M_4) with factorial concept in completely randomized design. Per cent weight loss and moisture loss were significantly higher under sun drying and silicagel during the entire process of drying from first day to fourth day. Moisture content was higher under room drying and borax from first day to fourth day.

Key words: China aster, drying conditions, embedding media

INTRODUCTION

China aster, *Callistephus chinensis* is highly popular among the garden annuals cultivated throughout the world. Long cut asters are used in vase and floral decoration, but its potential in dry decoration has not been exploited widely. Dry flowers are gaining popularity amongst floriculturists and buyers as it is an inexpensive, everlasting and ecofriendly product. Therefore, a study was undertaken to standardize the technology for dry flower production in China aster.

MATERIAL AND METHODS

The experiment was conducted at the Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat), during the year 2005-2006. Junagadh is situated at an altitude of 60 m above the MSL 21.5 ^{0}N latitude and 70.5 ^{0}E longitude. In this study, eight treatment combinations, consisting of two drying conditions *viz.* room drying (C_1) and sun drying (C_2) and four media *viz.* Sand (M_1), Sand:Borax (1:1) (M_2), Borax (M_3) and Silicagel (M_4), were evaluated in factorial completely randomized design with three replications. Observations were recorded daily for five days during drying process. Plastic trays of 60 cm x 45 cm x 7.5 cm size were used as container in which embedding material was filled. The data were statistically analysed as described by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Weight loss and moisture loss

Per cent weight and moisture loss were significantly higher under sun drying than room drying from first day to fourth day of drying (Tables 1 and 3) while on fifth day, the effect was non significant. Both temperature and wind velocity were higher under sun drying than under room drying. At higher temperature, rate of moisture loss or liberation of moisture from flower tissues (transpiration) was more due to higher transfer of heat by conduction and convection. Brandenberg *et al* (1961) and Alka Singh *et al* (2003) also observed similar effect in case of seed and Zinnia flower drying, respectively.

Further, it was found that drying media had significant effect on per cent weight loss and moisture loss (Tables 1 and 3). Maximum per cent weight and moisture loss was recorded in silicagel and minimum in borax up to fourth day. Silicagel has a great capacity to absorb moisture up to 30-50 % of its own weight (Maureen, 1988 and Brandenberg *et al*, 1961).

Interaction effect of drying conditions and media on per cent weight and moisture loss were found significant (Tables 2 and 4). Sun drying and silicagel produced maximum weight loss up to fourth day and on fifth day it was found non significant while moisture loss was higher up to third day and on fourth and fifth day it was found non significant.

Table 1. Effect of drying on per cent weight loss in the flowers of China aster

Treatment	Per cent weight loss				
	1[st] day	2[nd] day	3[rd] day	4[th] day	5[th] day
(I) Condition (C)					
C_1	36.60	43.42	62.50	65.13	67.50
	(37.23)	(41.22)	(52.24)	(53.81)	(55.25)
C_2	47.19	49.22	64.94	66.43	67.91
	(43.39)	(44.55)	(53.69)	(54.59)	(55.49)
S.Em. ±	0.10	0.11	0.17	0.10	0.13
C.D. at 5 %	0.31	0.33	0.52	0.31	NS
(II) Media (M)					
M_1	42.66	50.93	65.27	66.01	66.66
	(40.66)	(45.53)	(53.89)	(54.34)	(54.73)
M_2	41.80	43.99	62.97	65.29	65.66
	(40.28)	(41.55)	(52.52)	(53.90)	(54.12)
M_3	32.18	35.99	60.27	64.98	71.08
	(34.56)	(36.86)	(50.92)	(53.72)	(57.47)
M_4	51.15	54.39	66.37	66.84	67.42
	(45.66)	(47.52)	(54.56)	(54.84)	(55.20)
S.Em.±	0.14	0.15	0.24	0.14	0.19
C.D. at 5 %	0.44	0.46	0.73	0.43	0.57
(III) Interaction (CX M)					
S.Em±	0.20	0.22	0.34	0.20	0.27
C.D. at 5 %	0.62	0.66	1.03	0.61	NS
CV %	0.88	0.88	1.12	0.65	0.83

Figures in parentheses are arcsine transformed values

Table 3. Effect of drying on per cent moisture loss in the flowers of China aster

Treatment	Per cent moisture loss				
	1[st] day	2[nd] day	3[rd] day	4[th] day	5[th] day
(I) Condition (C)					
C_1	17.96	24.14	49.63	55.17	61.41
	(25.07)	(29.43)	(44.79)	(47.97)	(51.60)
C_2	27.38	29.30	54.14	57.21	60.97
	(31.55)	(32.77)	(47.38)	(49.15)	(51.34)
S.Em.±	0.13	0.15	0.27	0.28	0.33
C.D. at 5 %	0.39	0.45	0.81	0.83	NS
(II) Media (M)					
M_1	23.82	31.59	57.00	58.91	60.62
	(29.22)	(34.19)	(49.03)	(50.13)	(51.13)
M_2	23.06	24.88	51.74	56.94	57.87
	(28.70)	(29.92)	(46.00)	(48.99)	(49.53)
M_3	12.38	14.67	39.58	48.44	64.24
	(20.60)	(22.52)	(38.98)	(44.11)	(53.27)
M_4	31.41	35.75	59.23	60.46	62.03
	(34.09)	(36.72)	(50.32)	(51.04)	(51.96)
S.Em.±	0.18	0.21	0.38	0.39	0.47
C.D. at 5 %	0.55	0.64	1.14	1.18	1.43
(III) Interaction (CX M)					
S.Em.±	0.25	0.30	0.53	0.55	0.67
C.D. at 5 %	0.77	0.91	1.61	NS	NS
CV %	1.58	1.69	2.00	1.97	1.43

Figures in parentheses are arcsine transformed values

Table 2. Interaction effect of different drying conditions (C) and media (M) on per cent weight loss in the flowers of China aster

Treatment	Per cent weight loss				
	1[st] day	2[nd] day	3[rd] day	4[th] day	5[th] day
C_1M_1	32.95	48.52	64.26	65.19	66.42
	(35.03)	(44.15)	(53.29)	(53.84)	(54.59)
C_1M_2	32.52	35.93	60.81	65.04	65.37
	(34.77)	(36.83)	(51.24)	(53.76)	(53.95)
C_1M_3	31.67	34.99	60.04	64.76	71.53
	(34.25)	(36.27)	(50.79)	(53.58)	(57.75)
C_1M_4	49.27	54.26	64.89	65.53	66.69
	(44.58)	(47.44)	(53.66)	(54.05)	(54.75)
C_2M_1	51.97	53.32	66.27	66.83	66.90
	(46.13)	(46.90)	(54.49)	(54.84)	(54.88)
C_2M_2	51.09	52.05	65.22	65.53	65.94
	(45.62)	(46.17)	(53.80)	(54.05)	(54.30)
C_2M_3	32.69	36.98	60.49	65.21	70.64
	(34.87)	(37.46)	(51.06)	(53.85)	(57.19)
C_2M_4	53.04	54.52	67.86	68.15	68.15
	(46.74)	(47.59)	(55.46)	(55.65)	(55.65)
CxM					
S.Em	0.20	0.22	0.34	0.20	0.27
CD at 5%	0.62	0.66	1.03	0.61	NS
CV %	0.88	0.88	1.12	0.65	0.83

Figures in parentheses are arcsine transformed values

Table 4. Interaction effect of different drying conditions (C) and media (M) on percent moisture loss in the flowers of China aster

Treatment	Per cent moisture loss				
	1st day	2nd day	3rd day	4th day	5th day
C_1M_1	14.94 (22.73)	28.65 (32.36)	54.66 (47.67)	56.95 (49.00)	60.18 (50.87)
C_1M_2	14.65 (22.51)	17.06 (24.39)	47.22 (43.41)	56.59 (48.79)	57.39 (49.25)
C_1M_3	12.15 (20.40)	14.11 (22.06)	39.40 (38.88)	48.25 (43.99)	66.05 (54.36)
C_1M_4	30.08 (33.26)	36.74 (37.31)	57.26 (49.17)	58.89 (50.12)	62.02 (51.96)
C_2M_1	32.71 (34.89)	34.52 (35.99)	59.35 (50.39)	60.87 (51.28)	61.06 (51.39)
C_2M_2	31.47 (34.12)	32.70 (34.88)	56.27 (48.60)	57.29 (49.19)	58.34 (49.80)
C_2M_3	12.60 (20.79)	15.23 (22.97)	39.75 (39.09)	48.66 (44.23)	62.43 (52.20)
C_2M_4	32.74 (34.90)	34.76 (36.12)	61.20 (51.47)	62.04 (51.97)	62.04 (51.97)
CxM					
S.Em	0.25	0.30	0.53	0.55	0.67
CD at 5%	0.77	0.91	1.61	NS	NS
CV %	1.58	1.69	2.00	1.97	1.43

Figures in parentheses are arcsine transformed values

Table 5. Effect of drying on per cent moisture content in the flowers of China aster (*Callistephus chinensis*)

	Per cent moisture content				
Treatment	1st day	2nd day	3rd day	4th day	5th day
(I) Condition (C)					
C_1	52.55 (46.46)	46.36 (42.91)	20.84 (27.16)	15.29 (23.02)	8.99 (17.44)
C_2	43.80 (41.44)	41.87 (40.32)	17.03 (24.38)	13.96 (21.94)	10.20 (18.63)
S.Em.±	0.14	0.17	0.32	0.40	0.58
C.D. at 5 %	0.43	0.52	0.97	1.20	NS
(II) Media (M)					
M_1	45.86 (42.63)	38.11 (38.12)	12.67 (20.87)	10.7 (19.15)	69.04 (17.50)
M_2	46.67 (43.09)	44.85 (42.04)	17.96 (25.08)	12.78 (20.95)	11.85 (20.15)
M_3	61.54 (51.67)	59.25 (50.33)	34.33 (35.87)	25.40 (30.27)	9.51 (17.96)
M_4	38.61 (38.42)	34.27 (35.83)	10.77 (19.16)	9.55 (18.00)	7.99 (16.42)
S.Em.±	0.20	0.24	0.46	0.56	0.81
C.D. at 5 %	0.61	0.73	1.38	1.69	2.46
(III) Interaction (CX M)					
S.Em.±	0.28	0.34	0.64	0.79	1.15
C.D. at 5 %	0.86	1.03	1.95	NS	NS
CV %	1.12	1.42	4.43	6.21	11.10

Figures in parentheses are arcsine transformed values

Moisture content

Drying conditions showed a significant influence on per cent moisture content in the flower during entire process (Table 5) from first to fourth day while on fifth day it was found non significant. From first to fourth day, moisture content was higher in room dried flowers as compared to sun dried flowers. Under sun drying condition, moisture loss from flowers was higher due to increase in temperature during the day time as compared to room drying. This result is in conformity with the findings of Pandey (2001) in spices and Pandey *et al* (2000) in coriander and fenugreek leaves.

Similarly, media showed significate effect on moisture content (Table 5). Per cent moisture content was maximum in borax up to fourth day and minimum in silicagel throughout the drying process. The per cent moisture loss was higher in silicagel dried flowers due to its strong hygroscopic nature, as compared to borax treatment.

Interaction effect of drying conditions and media on moisture content was found significant (Table 6). Room drying and borax medium showed higher moisture content whereas in silicagel and sun drying treatment there was low moisture content up to three days.

Results from the present study showed that sun drying was better than room drying condition whereas

Table 6. Interaction effect of different drying condition (C) and media (M) on per cent moisture content in the flowers of China aster

Treatment	Per cent moisture content				
	1st day	2nd day	3rd day	4th day	5th day
C_1M_1	54.67	40.96	14.93	12.59	9.35
	(47.68)	(39.79)	(22.73)	(20.79)	(17.81)
C_1M_2	54.94	52.53	22.33	12.99	12.18
	(47.84)	(46.45)	(28.20)	(21.12)	(20.42)
C_1M_3	61.64	59.68	34.38	25.45	7.41
	(51.73)	(50.58)	(35.90)	(30.30)	(15.80)
C_1M_4	38.94	32.28	11.73	10.13	7.00
	(38.61)	(34.62)	(20.03)	(18.56)	(15.35)
C_2M_1	37.06	35.26	10.44	8.920	8.72
	(37.50)	(36.43)	(18.85)	(17.38)	(17.18)
C_2M_2	38.40	37.17	13.60	12.58	11.52
	(38.29)	(37.56)	(21.64)	(20.78)	(19.84)
C_2M_3	61.44	58.81	34.28	25.36	11.60
	(51.62)	(50.08)	(35.84)	(30.24)	(19.91)
CxM					
S.Em	0.28	0.34	0.64	0.79	01.15
CD at 5%	0.86	1.03	1.95	NS	NS
CV %	1.12	1.42	4.43	6.21	11.10

Figures in parentheses are arcsine transformed values

among the various embedding materials, silicagel was the best to dry China aster. Silica gel was found to be the best material for embedding as it can be handled easily and shows a great capacity to absorb moisture.

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