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Effect of planting dates on growth and flowering of China aster *Callistephus chinensis* (L) Nees

SAPNA KAUSHAL, BS DILTA, SVS CHAUDHARY, BP SHARMA and YC GUPTA

Department of Floriculture and Landscaping
Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan 173230 HP
Email for correspondence: balbirsinghdilta@gmail.com

ABSTRACT

The present investigations were carried out at the experimental farm of Department of Floriculture and Landscaping, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during 2012. The experiment was laid out in a Randomized Block Design (factorial) consisting of 21 treatment combinations of seven planting dates viz 6 April (D_1), 16 April (D_2), 26 April (D_3), 6 May (D_4), 16 May (D_5), 26 May (D_6) and 5 June (D_7) and three varieties namely Kamini (B_1), Shashank (B_2) and Violet Cushion (B_3). Among different planting dates D_1 ie 6 April gave best results for plant height (88.10 cm), plant spread (47.44 cm), number of flowering stems per plant (7.91), number of flowers per plant (37.58) and yield of flower cut stems per plot (158.10). However D_7 ie 5 June gave best results for flower size (5.51 cm) and vase life (10.12 days). Among the varieties Kamini gave best results for plant height (83.87 cm), plant spread (46.07 cm), number of flowering stems per plant (8.17), number of flowers per plant (41.97), flower size (5.79 cm) and yield of cut flower stems per plot (163.20). However Shashank took minimum days to first flower bud formation (91.67) and first flowering (103.70). Voilet Cushion recorded longest vase life (10.14 days). Hence it is concluded that planting of China aster on 6 April is the most suitable date that gives best results for most of the desirable growth and flowering parameters especially the Kamini variety.

Keywords: Planting dates; varieties; China aster

INTRODUCTION

China aster, *Callistephus chinensis* (L) Nees belongs to family Asteraceae and is a native of China and Europe. The genus *Callistephus* derived its name from two greek words Kalistos and Stephos meaning 'most beautiful' and 'a crown' respectively. Cassini described the China aster as *Callistephus hortensis*. It was first named by Linnaeus as *Aster chinensis* and Nees changed this name to *Callistephus chinensis*. China aster is a very popular annual flower crop and is mainly cultivated for production of cut flowers, loose flowers, as pot plant and for bedding plant purposes in landscape. It is gaining fast popularity in India because of its easy cultural practices, diversity of colours and varied uses. Evolution of aster flowers brought a new range of colours starting from white, rose, red, lavender, magenta and

blue to their innumerable variations (Desai 1967). The plants of China aster are erect and attain a maximum height of 60-80 cm depending upon the genotypes. There is a vast scope of growing China aster in Himachal Pradesh throughout the year except in severe winters and scorching summer months for the purpose of cut flowers and loose flower production. Since there is scanty information on the effect of cultivars and date of planting on China aster particularly in North Indian conditions hence need was felt to standardize the suitable planting time for cultivation of its varieties in the mid hill conditions of HP for the commercialization of this crop owing to the reason that planting time and varieties play a vital role in obtaining the better growth and flowering. Keeping in view the above facts the present study was planned with the objective to find out optimum time of planting for better growth and flowering of China aster.

MATERIAL AND METHODS

The present investigations were carried out at the experimental farm of the Department of Floriculture and Landscaping, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during February to December 2012. The experiment was laid out in a Randomized Block Design (factorial) consisting of 21 treatment combinations of seven planting dates viz 6 April (D_1), 16 April (D_2), 26 April (D_3), 6 May (D_4), 16 May (D_5), 26 May (D_6) and 5 June (D_7) and three varieties namely Kamini, Shashank and Violet Cushion replicated thrice.

Observations were recorded on plant height (cm), plant spread (cm), days to first flower bud formation, days to first flowering, number of flowering stems per plant, number of flowers per plant, flower size (cm), duration of flowering (days), yield of cut flower stems per plot and vase life (days).

To accomplish the study healthy, disease free and stocky seedlings of Kamini, Shashank and Violet Cushion varieties of China aster were planted on the above cited planting dates. To raise a successful China aster crop all the standard cultural practices were followed.

RESULTS AND DISCUSSION

Plant height

The plant height has been influenced significantly by the planting dates and varieties of China aster alone and in combination. The height of aster plants was more in earlier planting dates than the later plantings and decreased with the corresponding delay in planting time in all the varieties. The tallest plants (88.10 cm) were produced when planting was accomplished on 6 April 2012 which may be ascribed to the fact that these plants could get sufficient time for putting up more vegetative growth. They grew comparatively

much longer than the later planted crops. The smallest plants were observed in 5 June 2012 planting for all the varieties of China aster which may be due to the reason that comparatively June planted crop could not get sufficient time to put up requisite vegetative growth. These results are in close agreement with the earlier findings of Mishra (1997) and Kumar and Kaur (2000). Similar results have also been reported by Dilta et al (2007).

The plants of Kamini attained more height (83.87 cm) than Shashank and Violet Cushion which may be due to the superiority of Kamini over other varieties. Similar results have also been reported earlier by Kumar (2005) and Dilta et al (2007).

The interactive effects of planting dates and varieties revealed maximum plant height (97.38 cm) in the treatment combination D_1 x V_1 ie planting of Kamini on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop got maximum time to put up sufficient vegetative growth which was further catalyzed by the superior genotype of Kamini. On the contrary shorter plants (68.55 cm) were observed in the treatment combination D_7 x V_2 ie when planting of Shashank was done on 5 June 2012 which may be ascribed to the reason that June planted crop failed to attain sufficient vegetative growth particularly in Shashank variety of China aster. These results are in close agreement with the earlier work of Dilta et al (2007).

Plant spread

The spread of aster plants was more in plantings raised earlier than the later plantings and decreased with the corresponding delay in planting time in all the varieties. The plants with more spread (47.44 cm) were produced when planting was accomplished on 6 April 2012 which may be ascribed to the fact that these plants could get sufficient time for putting up more vegetative growth. They attained comparatively wider plant spread than the later planted crops. Minimum plant spread (32.18 cm) was observed in 5 June 2012 planting for all the varieties of China aster which may be due to the reason that comparatively June planted crop could not get sufficient time to put up requisite vegetative growth. Hence plant spread was less in comparison to the earlier planting dates for all varieties of China aster. These results are in close agreement with the findings of Mishra (1997) and Dilta et al (2007).

The plants of Kamini attained more spread (46.07 cm) than Shashank and Violet Cushion which may be due to the superiority of Kamini over other varieties. These results are also in close agreement with the earlier findings of Dilta et al (2007). Similar results have also been documented by Kumar (2005).

The interactive effects of planting dates and varieties revealed maximum plant spread (56.08 cm) in D_1 x V_1 ie planting of Kamini on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop got maximum time to put up sufficient vegetative growth particularly the more number of branches which was further catalyzed by the superior genotype of Kamini. On the contrary plants with less spread (20.30 cm) were observed in the treatment combination D_7 x V_2 ie when Shashank was planted on 5 June 2012 which may be ascribed to the reason that June planted crop failed to attain sufficient vegetative growth particularly in terms of more number of shoots per plant. These results are in close agreement with the earlier work of Dilta et al (2007) under Bhota (Hamirpur, HP) conditions.

Days to flower bud formation

The maximum days to flower bud formation were observed in earlier planting dates than the later plantings and decreased with the corresponding delay in planting time in all varieties. The maximum time (111.90 days) was taken when planting was accomplished on 6 April 2012 which may be ascribed to the fact that these plants could get sufficient time for putting up more vegetative growth. They took comparatively more time than the later planted crop. The minimum days to first flower bud formation (94.49 days) were observed in 5 June 2012 planting for all the varieties of China aster which may be due to the reason that comparatively June planted crop could not get sufficient time to put up requisite vegetative mass. These results are in close agreement with the earlier findings of Gowda (1990) and Dilta et al (2007) who reported similar results in China aster.

The plants of Kamini took maximum days for flower bud formation (107.90 days) than Shashank and Violet Cushion which may be due to the effect of genotype of Kamini. In contrast minimum time (94.49 days) taken for first flower bud formation was observed in Shashank. Similar inference was drawn by Kumar (2005) in China aster.

The interactive effect of planting dates and varieties revealed maximum days taken for flower bud formation (117.50 days) in treatment combination D_1 x V_1 ie planting of Kamini on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop got maximum time to put up sufficient vegetative growth which was further delayed by the genotypic behaviour of Kamini. On the contrary minimum time taken for flower bud formation (80.52 days) was observed in the treatment combination D_7 x V_2 ie when planting of Shashank was done on 5 June 2012 which may be ascribed to the reason that June planted crop failed to attain sufficient vegetative growth particularly in Shashank variety of China aster. These results are in concurrence with the report of Kumar (2005).

Days taken for flowering

The maximum days taken for first flowering were recorded in earlier planting dates than the later plantings and decreased with the corresponding delay in planting time in all varieties. The maximum time was taken (123.50 days) when planting was accomplished on 6 April 2012 which may be ascribed to the fact that these plants could get sufficient time for gaining more vegetative growth particularly under long day conditions. These took comparatively more time than the later planted crops. The minimum days to first flowering (105.80 days) were observed in 5 June 2012 planting for all the varieties which may be due to the reason that comparatively June planted crop could not get sufficient time to put up requisite vegetative growth. These results are in close agreement with the findings of Gowda (1990) and Dilta et al (2007).

The plants of Kamini took more days for first flowering (119.20 days) than Shashank and Violet Cushion which may be due to the genetic behaviour of Kamini to take more time for flowering than other varieties. On contrary minimum time taken for first flowering (103.70) was observed in Shashank. The results are also in close agreement with the findings of Kumar (2005).

The interactive effects of planting dates and varieties revealed maximum days taken for first flowering (128.60 days) in $D_1 \times V_1$ ie planting of Kamini on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop got maximum time to put sufficient vegetative growth which was further catalyzed by the effect of genotype of Kamini. On the contrary minimum time taken for first flowering (91.49 days) was observed under the treatment combination $D_7 \times V_2$ ie when planting of Shashank was done on 5 June 2012 which may be ascribed to the reason that June planted crop failed to attain sufficient vegetative growth particularly in Shashank variety. These results are in close agreement with the earlier work of Kumar (2005).

Number of flowering stems per plant

The number of flowering stems per plant was more in earlier planting dates than the later plantings and decreased with the corresponding delay in planting time in all varieties. The more number of flowering stems (7.91) was produced when planting was accomplished on 6 April 2012 which may be ascribed to the fact that these plants could get sufficient time for putting up more vegetative growth particularly the production of more number of shoots which later on became reproductive. The minimum number of flowering stems per plant (6.12) was observed in 5 June 2012 planting for all the varieties which may be due to the reason that comparatively June planted crop could not get sufficient time to put up requisite vegetative growth and resulted in less production of shoots per plant because of the fact that flowering was hastened as China aster is basically a short day plant.

Hence number of flowering stems was less in comparison to the earlier planting dates in the all varieties. The results are in confirmation with the findings of Dhatt and Kumar (2010).

The plants of Kamini produced more number of flowering stems per plant (8.17) than Shashank and Violet Cushion which may be due to the superiority of Kamini over other varieties in producing higher number of flowering shoots. However minimum number of flowering stems per plant (5.73) was produced in Shashank and may be ascribed to the effect of genotype.

The interactive effects of planting dates and varieties revealed maximum number of flowering stems (9.23) in D_1 x V_1 ie planting of Kamini on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop got maximum time to put up sufficient vegetative growth especially the higher number of shoots per plant which was further catalyzed by the superior genotype of Kamini. Contrary to it minimum number of flowering stems per plant (5.73) was observed in the interaction D_7 x V_2 ie when planting of Shashank was done on 5 June 2012 and may be ascribed to the reason that June planted crop failed to attain sufficient vegetative growth particularly in Shashank variety. The results are in confirmation with the findings of Dhatt and Kumar (2010)

Number of flowers per plant

Maximum flowers (37.58) per plant were produced when planting was accomplished on 6 April 2012 which may be ascribed to the fact that these plants could get sufficient time for putting up more vegetative and reproductive growth particularly the more number of flowering shoots. These produced comparatively more number of flowers than the later planted crop. The minimum number of flowers per plant (30.71) was observed in 5 June 2012 planting for all the varieties of China aster which may be due to the reason that comparatively June planted crop could not get sufficient time to put up requisite vegetative and reproductive growth. The results are also in confirmation with the findings of Kumar (2005) and Mishra (1997). The present results are also in agreement with the earlier findings of Dilta et al (2007).

The plants of Kamini produced more number of flowers per plant (41.97) than Shashank and Violet Cushion which may be due to the superiority of Kamini over other varieties. Minimum number of flowers per plant (23.04) was produced in Shashank and may be ascribed to the effect of genotype. The results are in confirmation with the findings of Kumar (2005).

The interactive effects of planting dates and varieties revealed maximum number of flowers per plant (45.07) in D_1 x

V_1 ie planting of Kamini on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop got maximum time to put up sufficient vegetative and reproductive growth which was further catalyzed by the superior genotype of Kamini. As against it minimum number of flowers per plant (19.87) was observed in the interaction D_7 x V_2 ie when planting was done on 5 June 2012 which may be ascribed to the reason that June planted crop failed to attain sufficient vegetative growth particularly in Shashank variety. These results are in close agreement with the earlier findings of Kumar (2005).

Flower size

The flower size was more in later planting dates than the early plantings. The plants with more flower size (5.51 cm) were produced when planting was accomplished on 5 June 2012 which may be ascribed to the fact that comparatively June planted crop could not get sufficient time to put up requisite vegetative and reproductive growth particularly the flowering stems and flower yield per plant. The smallest flower size (5.13 cm) was observed in 6 April 2012 planting for all the varieties which may be due to the reason that comparatively these plants could get sufficient time for putting up more vegetative growth and producing higher flowering stems and more number of flowers per plant. Hence size was comparatively less. These results are in close agreement with the earlier findings of Dhawle et al (2003).

The plants of Kamini attained more flower size (5.79 cm) than Shashank and Violet Cushion which may be due to the superiority of Kamini over other varieties. The results are also in close agreement with the earlier findings of Kumar (2005).

The interactive effects of planting dates and varieties revealed maximum flower size (6.10 cm) in D_7 x V_1 ie planting of Kamini on 5 June 2012 which may be ascribed to the reason that in the June planted crop number of flowers per plant was comparatively less and more size of flowers. Minimum flower size (4.80 cm) was observed in the interaction D_1 x V_2 ie when planting of Shashank was done on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop produced more number of flowering shoots as well as higher number of flowers per plant hence less flower size especially in Shashank. These results are in close agreement with the earlier work of Dilta et al (2007).

Duration of flowering

The duration of flowering was more in earlier planting dates than the later plantings and decreased with the corresponding delay in planting time in all varieties. The maximum duration of flowering (62.42 days) was found when planting was accomplished on 6 April 2012 which may be ascribed to the fact that these plants could get sufficient time for putting up more vegetative and reproductive growth. These had maximum duration of

flowering than the later planted crops. The minimum duration of flowering (41.07 days) was observed in 5 June 2012 planting for all the varieties which may be due to the reason that comparatively June planted crop could not get sufficient time to put up requisite vegetative growth. These results are in close agreement with the earlier findings of Ghosh and Pal (2008)

The plants of Shashank exhibited maximum duration of flowering (49.91 days) than Kamini and Violet Cushion which may be due to the effect of genotype. On the contrary minimum duration of flowering (48.19 days) was reported in Violet Cushion. These results are in close agreement with the earlier findings of Kumar (2005).

The interactive effects of planting dates and varieties revealed maximum duration of flowering (63.56 days) in D_1 x V_2 ie planting of Shashank on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop got maximum time to put up sufficient vegetative and reproductive growth which was further catalyzed by the superior genotype of Shashank. However minimum duration of flowering (40.41 days) was observed in the interaction D_7 x V_1 ie when planting of Kamini was done on 5 June 2012 which may be ascribed to the reason that June planted crop failed to attain sufficient vegetative growth particularly in Kamini variety. These results are in close agreement with the earlier findings of Kumar (2005).

Yield of cut flower stems per plot

The yield of cut stems per plot was more in earlier planting dates than the later plantings and decreased with the corresponding delay in planting time in all the varieties. The more number of cut stems per plot (158.1) was produced when planting was accomplished on 6 April 2012 which may be ascribed to the fact that these plants could get sufficient time for putting up more vegetative and reproductive growth particularly the higher number of branches per plant later on which became reproductive. The minimum yield of cut stems per plot (121.70) was observed in 5 June 2012 planting for all the varieties of China aster which may be due to the reason that comparatively June planted crop could not get sufficient time to put up requisite vegetative growth and producing more number of flowering shoots per plant. Hence yield of cut stems per plot was less in comparison to the earlier planting dates for all varieties. These results are in confirmation with the findings of Kumar (2005) and Sreekanth et al (2006).

The plants of Kamini produced maximum yield of cut stems per plot (163.2) than Shashank and Violet Cushion which may be due to the superiority of Kamini over other varieties whereas minimum yield of cut stems per plot (114.6) was produced in Shashank. These results are in conformity with the earlier findings of Kumar (2005).

The interactive effects of planting dates and varieties revealed maximum yield of cut stems per plot (184.7) in D_1 x V_1 ie when planting of Kamini was accomplished on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop got maximum time to put up sufficient vegetative growth and produced higher number of flowering shoots per plant which was further catalyzed by the superior genotype of Kamini. On the contrary minimum yield of cut stems per plot (101.7) was observed in the interaction D_7 x V_2 ie when planting of Shashank was done on 5 June 2012 which may be ascribed to the reason that June planted crop failed to attain sufficient vegetative growth and produce more flowering shoots particularly in Shashank variety. These results are in close agreement with the earlier findings of Kumar (2005) and Dilta et al (2007).

Vase life

The vase life of aster cut stems was more in later planting dates than the early plantings. The plants with maximum vase life (10.12 days) were produced when planting was accomplished on 5 June 2012 which may be ascribed to the fact comparatively June planted crop flowered during the period when climatic conditions particularly the temperature was not so scorching and hence less utilization of synthesized photosynthates. Hence vase life was more in comparison to the earlier planting dates for all varieties. They exhibited more vase life than the earlier planted crops in which flowering was commenced during light temperature conditions. The minimum vase life (8.49 days) was observed in 6 April 2012 planting for all the varieties of China aster which may be due to the fact that flowering occurred during high temperature conditions leading to more utilization of food reserves. They had comparatively less vase life than the later planted crops. Hence vase life was less in comparison to the later planting dates for all varieties.

The plants of Violet Cushion had maximum vase life (10.14 days) than Kamini and Shashank which may be due to the effect of superiority of genotypes. These results are in close agreement with the earlier findings of Kumar (2010). Minimum vase life was observed in Shashank (8.26 days). These results are in close agreement with the earlier findings of Singh et al (2003).

The interactive effects of planting dates and varieties revealed maximum vase life (11.33 days) in D_7 x V_3 ie when planting of Violet Cushion on 5 June 2012 which may be ascribed to the reason that the cut flowers produced in June planted crop did not utilize reserved food reserves under comparatively low temperature conditions. On the contrary cut flowers with minimum vase life (7.57 days) were observed in the interaction D_1 x V_2 ie when planting was done on 6 April 2012 which may be due to the reason that 6 April 2012 planted crop

Table 1. Effect of planting dates on growth and flowering of China aster *Callistephuschinensis* (L) Nees

Treatment	Plant height (cm)	Plant spread (cm)	Days to flower bud formation	Days to flowering	No of flowering stems/plant	No of flowers/ plant	Flower size (cm)	Duration of flowering	Yield of cut flower stems /plot	Vase life (days)
Planting date										
April 6 (D_1)	88.10	47.44	111.90	123.50	7.91	37.58	5.13	62.42	158.1	8.49
April 16 (D_2)	82.33	42.18	105.40	117.60	7.56	36.60	5.26	55.52	151.2	8.62
April 26 (D_3)	83.33	40.46	100.90	113.00	7.45	35.57	5.20	50.68	148.5	9.10
May 6 (D_4)	79.14	39.31	103.20	114.50	7.14	34.41	5.29	46.12	142.7	9.21
May16 (D_5)	77.21	37.30	100.10	111.20	7.28	33.33	5.37	43.85	145.7	9.28
June 5 (D_7)	73.32	32.18	94.49	105.80	6.12	30.71	5.51	41.07	121.7	10.12
$CD_{0.05}$	2.54	0.30	0.27	0.22	0.29	2.86	0.02	0.31	5.98	0.27
Variety										
Kamini (V_1)	83.87	46.07	107.90	119.20	8.17	41.97	5.79	48.43	163.2	9.16
Shashank (V_2)	76.21	27.66	91.67	103.70	5.73	23.04	4.92	49.91	114.6	8.26
Violet Cushion (V_3)	81.25	43.65	105.50	116.63	7.48	37.98	5.22	48.19	149.6	10.14
$CD_{0.05}$	1.67	0.19	0.18	0.15	0.19	1.87	0.01	0.20	3.91	0.17
Planting date x Variety										
$D_1 \times V_1$	97.38	56.08	117.50	128.60	9.23	45.07	5.50	61.41	184.7	8.46
$D_1 \times V_2$	80.64	38.57	101.50	113.50	6.27	26.45	4.80	63.56	125.4	7.57
$D_1 \times V_3$	86.29	47.68	116.60	128.30	8.22	41.24	5.10	62.29	164.3	9.42
$D_2 \times V_1$	86.09	50.43	109.20	121.60	8.80	44.61	5.74	54.74	176.0	8.60
$D_2 \times V_2$	79.98	29.79	96.45	109.70	5.90	25.00	4.89	56.20	118.1	7.82
$D_2 \times V_3$	82.61	46.32	110.60	121.50	7.97	40.18	5.15	55.63	159.5	9.44

$D_3 \times V_1$	86.44	46.22	106.60	117.50	8.73	43.96	5.61	51.25	174.6	9.12
$D_3 \times V_2$	80.50	29.20	93.92	106.40	5.86	23.48	4.84	52.41	117.1	8.15
$D_3 \times V_3$	83.04	45.97	102.60	115.20	7.69	39.28	5.15	48.37	153.7	10.04
$D_4 \times V_1$	80.27	45.60	109.00	120.10	8.40	42.29	5.74	46.45	168.0	9.21
$D_4 \times V_2$	77.88	27.64	95.54	107.60	5.67	22.94	4.93	46.46	113.5	8.21
$D_4 \times V_3$	79.27	44.70	105.20	115.70	7.34	38.00	5.20	45.45	146.7	10.20
$D_5 \times V_1$	77.47	44.44	105.50	116.60	8.55	40.75	5.90	43.50	170.9	9.26
$D_5 \times V_2$	74.93	25.83	92.45	104.50	5.78	22.43	4.96	44.36	115.6	8.37
$D_5 \times V_3$	79.24	41.63	102.40	115.40	7.52	36.80	5.25	43.69	150.5	10.21
$D_6 \times V_1$	77.13	41.31	104.10	115.40	6.87	39.17	5.95	41.24	137.4	9.37
$D_6 \times V_2$	71.00	22.32	81.60	92.69	5.54	21.08	4.98	44.08	110.8	8.59
$D_6 \times V_3$	83.17	41.35	102.10	112.10	6.98	36.11	5.32	41.43	139.6	10.35
$D_7 \times V_1$	76.32	38.37	103.80	114.60	6.63	37.97	6.10	40.41	130.6	9.93
$D_7 \times V_2$	68.55	20.30	80.52	91.49	5.09	19.87	5.07	42.32	101.7	9.11
$D_7 \times V_3$	75.11	37.87	99.16	111.20	6.63	34.28	5.37	40.49	132.7	11.33
$CD_{0.05}$	4.41	0.51	0.46	0.38	0.50	NS	0.03	0.54	10.35	0.46

resorted into flowering under high temperature conditions and consequently there was more breakdown of photosynthates hence leading to reduction in vase life particularly in Shashank due to the effect of genotype.

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