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Screening of China Aster F_1 Hybrids for Growth and Yield Characters

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A B S T R A C T

Screening of 45 China aster hybrids and their parents developed by crossing in diallel mating (without reciprocals) for growth, flowering, yield and quality traits. Study revealed that all the hybrids out performed with their parents indicating high amount of heterosis present in them. The crosses *viz*., Local Pink × Local White and Local Violet × AAC-1 and PG Violet × ArkaPoornima were early with medium height with erect branching and stalk length (18.00, 23.50 and 32.50 cm). Same cross combinations recorded higher number of flowers per plant (71.20, 69.40, and 62.40 respectively), produced maximum number of primary branches (15.60, 14.50 and 12.60 respectively) and higher flower yield per plant (176.00, 200.50, 305.00 g) and these hybrids are suitable for cut flower purpose. The cross combinations *viz.* Arka Archana × AAC-1 and ArkaAadya × ArkaPoornimaare suitable for landscape gardening by witnessing more spreading habit of growth and maximum flowering duration.

Introduction

China aster [*Callistephus chinensis* (L.) Nees.] is winter annual and important commercial flower crop belonging to family Asteraceae and it is native to China. It is a commercial flower crop of Russia, Japan, North America, Switzerland and Europe. In India, it is being grown for its loose flowers for garland making, cut flowers for arranging

in vase, floral decorations, making garlands, venis and in landscape garden it ie suitable for rising in flower bed different types of boarders. In Karnataka the area under aster is 1693 ha with a productivity of 9.39 t/ha (Anan., 2016)covering major districts viz. Bengaluru, Chitradurga, Tumkur, Belagavi, Gadag, Bagalkot and Kolar (Ramya *et al*., 2019). In India, it is largely grown on commercial scale in states like Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra and West Bengal. It ranks third next to chrysanthemum and marigold among the traditional flowers (Sheela, 2008). China aster is one of the important cultivated flower crop in some of the dry pockets of Karnataka with protectective irrigation as a commercial crop among small and marginal farmers

Some of the important varieties grown by farmers are mainly Local Pink, Local White, Local Violet, ArkaKamini and PG series are old. Farmers generally grow China aster as a pure crop with single colour and mixing all colours by mixing the seeds of all colours. Among the various methods of breeding in China aster, hybridization is considered as most viable breeding method to improve the genotypes by adding new phenotypes with improved desired morphological and yield traits. Therefore, the present study was carried out to evaluate the 45 F_1 hybrids and their parents for various qualitative and quantitative traits.

Materials and Methods

The present field experiment was conducted at research block of Floriculture and Landscape Architecture, College of Horticulture, Mudigere during 2017-18. The experimental site was geographically located at 13°7´ North latitude, 75°57´ East longitude and is at an altitude of 982 m above the Mean Sea Level. The soil of experimental block was red sandy loam with pH 5.00 and E.C. of 0.26 dSm^{-1}. A total of 45 China aster F_1 hybrids were developed through diallel mating (without reciprocal) design (Table 1). Ten parents viz. ArkaKamini, ArkaAadya, Arka Archana, Local Pink, Local Violet, Local White, AAC-1, PG Purple, PG Violet and ArkaPoornima were used for crossing. All the 45 F_1 hybrids, along with the parents were evaluated in Randamized Complete Block Design with two replications.

Thirty two plants per genotype/hybrid per replication were planted during November 2017 with the spacing of 30 cm x 30 cm. In each plot, five plants were selected for recording observations. Uniform cultural practices were followed to raise the crop. The observation were recorded for analysing quantitative and qualitative traits *viz.* plant height (cm), plant spread (cm), number of primary branches per plant, number of florets per flower head, days to fifty per cent flowering, flowering duration (days), flower head diameter (cm),disc diameter (cm), flower stalk length (cm),vase life (days), Shelf life (days), number of flowers per plant, number of flowers per branch, individual flower weight, weight of 100 flowers (g), flower yield s per plant, per ha (g), seed yield per plant(g) and ha (kg). . Data recorded were subjected to analysis of variance (Singh and Chaudhary, 1977). Statistical analysis were done using WINDOSTAT version 8.6.

Results and Discussion

The data presented in Table 2 and 3 revealed that all 45 F_1 hybrids and their parents showed significant differences for plant height (cm), plant spread (cm), number of primary branches per plant, number of florets per flower head, days to 50 per cent flowering, flowering duration (days), flower head diameter (cm), disc diameter (cm), flower stalk length (cm), vase life (days), Shelf life (days), number of flowers per plant,

number of flowers per branch, individual flower weight, weight of 100 flowers (g), weight of flowers/plant (g), seed yield (g) and seed yield per plant (g). The cross between PG Purple and ArkaPoornima recorded maximum plant height of 97.90 cm followed by PG Violet × ArkaPoornima (97.35 cm) and PG Purple × PG Violet (77.60 cm) cross combinations , while lowest growth and yield performance was recorded in ArkaAadya × Local Pink (37.20 cm) and Local Violet × ArkaPoornima (37.80 cm) combinations. The variation in plant height among varieties and hybrids might be due to genotypic differences in phenotypic expression of plant height (Zosiamliana *et al*., 2013). Similar genotypic differences for plant height were also reported by Pratiksha *et al.,* (2017) and Bhargav *et al.,* (2018). Crosses between PG Violet × ArkaPoornima, AAC-1 × PG Purple and Local White × AAC-1 recorded the maximum plant spread towards North to South (66.00, 60.70 and 59.50 cm respectively) and East to West direction (69.80, 59.10 and 55.90). While, parent ArkaPoornima recorded least plant spread for NS and EW (35.00 and 29.70 cm respectively) which might be due to vigorous nature of the hybrids over their parents? Similar results were also reported earlier by Kumari *et al.,* (2017) and Bhargav *et al.,* (2018).

Production of higher number of primary branches per plant which decide the flower yield per plant, cross between ArkaAadya and Arka Archana produced maximum number of primary branches per plant (18.10) followed by ArkaAadya × Local White and Arka Archana × Local White (16.10 respectively). These findings are in line with the findings of Khangjarakpam *et al.,* (2014) and Rai and Chaudhary (2016). The crosses viz. Local Pink × Local Violet, Local Violet ×AAC-1 and Local Pink × Local White were early blooming types among hybrids and parents with 61.00, 61.50 and 62.00 days for 50 per cent flowering respectively. While, parent ArkaPoornima (79.00) and cross ArkaKamini × ArkaPoornima (73.50) were late. Flowering duration was maximum in crosses PG Violet × ArkaPoornima (37.50), ArkaKamini × PG Purple and ArkaKamini × PG Violet each (37.00 days).

Flowering parameters like flower head diameter and flower stalk length decide the suitability for cut flowers. Crosses viz., Local White ×ArkaPoornima, PG Violet × ArkaPoornima recorded 6.29 cm and 6.15 cm head diameter respectively. While, cross combination PG Violet × ArkaPoornima (32.50 cm) which was on par with PG Purple × ArkaPoornima (31.30 cm) followed by ArkaKamini × PG Purple (34.20 cm). Similar results were reported earlier by Khangjarakpam *et al.,* (2014); Rai and Chaudhary (2016) and Shankari *et al.,* (2019) in China aster

Quality parameters like Vase life and shelf life which decides the post harvest quality of flowers for cut and loose flower. Amoung the crossess higher vase life was recorded in crosses Local Violet × AAC-1, ArkaKamini × PG Purple and ArkaAadya × PG Violet (11.90, 11.80, 11.40 days respectively) in. While shelf life was maximum in crosses Local Violet × AAC-1 (3.95 days), ArkaAadya × AAC-1, Local Pink × PG Violet, PG Violet × ArkaPoornima each 3.75 days.

Flower yield parameters such as number of number of flowers per plant, flower weight per plant and seed yield are the yield contributing traits in China aster, the crosses between Local Pink × Local White (71.20) on par with Local Violet × AAC-1 (69.40).

Fig.1 Best performing F_1 hybrids

Local Pink **Local White** **Local Pink × Local White**

Local Pink		**ArkaPoornima**		**Local Pink × ArkaPoornima**

Local Violet **AAC-1** **Local Violet× AAC-1**

PG Violet		**ArkaPoornima**		**PG Violet × ArkaPoornima**

Table.1 Cross combinations generated through half diallel mating using ten parents (10 × 10) in China aster

Sl. No.	Cross number	Cross combinations
1	$P_1 \times P_2$	ArkaKamini × ArkaAadya
2	$P_1 \times P_3$	ArkaKamini × Arka Archana
3	$P_1 \times P_4$	ArkaKamini × Local Pink
4	$P_1 \times P_5$	ArkaKamini × Local Violet
5	$P_1 \times P_6$	ArkaKamini × Local White
6	$P_1 \times P_7$	ArkaKamini × AAC-1
7	$P_1 \times P_8$	ArkaKamini × PG Purple
8	$P_1 \times P_9$	ArkaKamini × PG Violet
9	$P_1 \times P_{10}$	ArkaKamini × ArkaPoornima
10	$P_2 \times P_3$	ArkaAadya × Arka Archana
11	$P_2 \times P_4$	ArkaAadya × Local Pink
12	$P_2 \times P_5$	ArkaAadya × Local Violet
13	$P_2 \times P_6$	ArkaAadya × Local White
14	$P_2 \times P_7$	ArkaAadya × AAC-1
15	$P_2 \times P_8$	ArkaAadya × PG Purple
16	$P_2 \times P_9$	ArkaAadya × PG Violet
17	$P_2 \times P_{10}$	ArkaAadya × ArkaPoornima
18	$P_3 \times P_4$	Arka Archana × Local Pink
19	$P_3 \times P_5$	Arka Archana × Local Violet
20	$P_3 \times P_6$	Arka Archana × Local White
21	$P_3 \times P_7$	Arka Archana × AAC-1
22	$P_3 \times P_8$	Arka Archana × PG Purple
23	$P_3 \times P_9$	Arka Archana × PG Violet
24	$P_3 \times P_{10}$	Arka Archana × ArkaPoornima
25	$P_4 \times P_5$	Local Pink × Local Violet
26	$P_4 \times P_6$	Local Pink × Local White
27	$P_4 \times P_7$	Local Pink × AAC-1
28	$P_4 \times P_8$	Local Pink × PG Purple
29	$P_4 \times P_9$	Local Pink × PG Violet
30	$P_4 \times P_{10}$	Local Pink × ArkaPoornima
31	$P_5 \times P_6$	Local Violet × Local White
32	$P_5 \times P_7$	Local Violet × AAC-1
33	$P_5 \times P_8$	Local Violet × PG Purple
34	$P_5 \times P_9$	Local Violet × PG Violet
35	$P_5 \times P_{10}$	Local Violet × ArkaPoornima
36	$P_6 \times P_7$	Local White × AAC-1
37	$P_6 \times P_8$	Local White × PG Purple
38	$P_6 \times P_9$	Local White × PG Violet
39	$P_6 \times P_{10}$	Local White × ArkaPoornima
40	$P_7 \times P_8$	AAC-1 × PG Purple
41	$P_7 \times P_9$	AAC-1 × PG Violet
42	$P_7 \times P_{10}$	AAC-1 × ArkaPoornima
43	$P_8 \times P_9$	PG Purple× PG Violet
44	$P_8 \times P_{10}$	PG Purple× ArkaPoornima
45	$P_9 \times P_{10}$	PG Violet × ArkaPoornima

Table.2 Performance of China aster hybrids for growth and flowering traits

Crosses/ Characters	Plant height (cm)	Plant spread (cm)		No. of primary branches	Days to 50% flowering	No. of florets/ flower head	Flowering duration	Flower Head diameter(cm)	Disc diameter(cm)	Flower stalk length(cm)
		NS	EW							
ArkaKamini × ArkaAadya	59.40	45.50	47.50	16.20	66.50	107.05	36.00	4.77	0.89	14.60
ArkaKamini × Arka Archana	46.00	41.60	44.50	14.40	65.00	109.20	28.50	5.36	0.93	16.40
ArkaKamini × Local Pink	42.80	36.40	37.40	8.40	66.50	85.90	29.00	5.00	0.79	13.00
ArkaKamini × Local Violet	42.00	38.10	31.10	9.50	67.00	137.80	37.00	4.79	0.83	13.20
ArkaKamini × Local White	57.40	59.50	53.40	13.85	70.50	127.40	31.50	4.94	0.76	19.40
ArkaKamini × AAC-1	59.40	44.10	46.40	13.10	68.00	95.10	30.00	5.30	0.82	11.20
ArkaKamini × PG Purple	64.40	46.00	51.10	12.70	69.00	131.90	37.00	5.95	1.29	34.20
ArkaKamini × PG Violet	60.50	58.20	57.00	13.90	63.50	131.90	37.00	4.70	0.73	17.60
ArkaKamini × ArkaPoornima	44.20	46.60	49.65	11.20	73.50	132.40	32.50	4.32	0.66	12.20
ArkaAadya × ArkaArchana	74.50	38.30	40.30	18.10	70.00	136.80	32.00	5.51	2.07	19.80
ArkaAadya × Local Pink	37.20	30.00	30.10	15.30	72.50	128.40	29.00	5.22	0.86	19.50
ArkaAadya × Local Violet	41.60	51.50	51.60	13.40	68.50	125.90	32.00	5.08	0.93	12.40
ArkaAadya × Local White	38.10	41.00	45.00	16.10	67.50	110.90	31.00	4.84	0.95	12.70
ArkaAadya × AAC-1	42.60	37.10	44.30	13.70	68.00	92.10	33.00	5.27	1.41	15.10
ArkaAadya × PG Purple	41.75	37.80	38.50	14.70	69.00	125.90	35.00	4.57	1.20	17.00
ArkaAadya × PG Violet	63.10	37.80	42.50	11.40	67.50	134.20	34.00	5.88	1.23	14.30
ArkaAadya × ArkaPoornima	58.40	45.90	50.40	13.20	66.50	138.80	35.50	4.57	0.82	16.90
Arka Archana × Local Pink	48.60	33.90	36.00	8.70	71.00	125.30	33.50	4.97	0.73	14.10
Arka Archana × Local Violet	56.20	47.35	52.00	10.70	69.50	123.80	32.00	4.44	0.67	13.20
Arka Archana × Local White	54.85	37.80	40.80	16.10	66.00	124.10	35.00	4.34	0.62	11.80
Arka Archana × AAC-1	41.10	40.60	42.30	12.50	66.00	120.70	36.50	4.77	0.77	19.90
Arka Archana × PG Purple	39.30	42.30	43.40	12.10	66.50	127.70	34.00	4.78	0.81	14.76
Arka Archana × PG Violet	52.90	42.30	48.60	12.10	70.50	133.40	31.50	6.06	0.82	18.50
Arka Archana × ArkaPoornima	45.60	44.70	49.60	14.50	68.00	132.80	33.50	5.37	1.02	15.10
Local Pink × Local Violet	53.60	44.20	44.40	12.80	61.00	82.20	28.50	5.08	0.90	14.20
Local Pink × Local White	59.60	47.80	57.20	15.60	62.00	121.00	36.00	4.97	0.85	18.00

Crosses/ Characters	Plant height (cm)	Plant spread NS (cm2)	Plant spread EW (cm2)	No. of primary branches	Days to 50% flowering	No. of florets/ flower head	Flowering duration (Days)	Flower Head diameter (cm)	Disc diameter (cm)	Flower stalk length (cm)
Local Pink × AAC-1	48.70	38.60	39.80	11.80	64.50	90.00	33.50	5.19	0.80	15.10
Local Pink × PG Purple	55.90	56.10	57.20	10.90	73.50	116.50	33.00	4.79	1.00	15.50
Local Pink × PG Violet	65.60	53.20	57.00	10.20	69.00	161.40	32.50	4.76	0.99	19.90
Local Pink × ArkaPoornima	61.90	37.10	35.50	13.00	64.50	169.10	32.00	4.71	0.76	20.90
Local Violet × Local White	54.50	33.90	35.20	12.00	69.50	169.10	32.50	4.66	1.36	13.60
Local Violet × AAC-1	63.60	28.85	24.10	14.50	61.50	107.70	36.50	5.16	0.79	23.50
Local Violet × PG Purple	62.20	33.90	30.50	10.00	64.00	108.40	33.50	5.38	0.78	14.80
Local Violet × PG Violet	56.00	55.85	57.50	12.65	70.00	118.00	31.00	5.11	0.96	19.00
Local Violet × ArkaPoornima	37.80	30.55	25.90	9.00	68.00	116.70	31.00	4.08	0.84	14.10
Local White × AAC-1	55.10	59.50	55.90	12.70	71.00	138.40	34.00	5.26	0.83	16.20
Local White × PG Purple	62.35	24.60	49.30	11.00	68.00	115.60	36.50	4.81	0.76	19.25
Local White × PG Violet	45.65	34.70	60.05	10.80	66.00	139.00	31.00	5.03	1.13	20.10
Local White × ArkaPoornima	58.80	44.70	49.70	6.35	68.50	112.80	36.00	6.29	1.14	15.40
AAC-1 × PG Purple	68.70	60.70	59.10	9.15	69.00	138.60	33.00	5.14	0.83	18.60
AAC-1 × PG Violet	66.80	49.40	62.00	10.30	69.50	141.30	35.50	5.26	0.70	16.00
AAC-1 × ArkaPoornima	66.00	42.50	45.60	12.20	69.50	116.80	33.50	5.42	1.40	13.50
PG Purple× PG Violet	77.60	52.95	64.60	9.80	71.00	137.80	32.50	5.30	1.20	23.40
PG Purple× ArkaPoornima	97.90	42.30	53.00	11.20	68.50	133.90	31.50	5.66	1.28	31.30
PG Violet × ArkaPoornima	97.35	66.00	69.80	12.60	64.50	132.30	37.50	6.15	1.21	32.50
S.Em±	1.7622	1.9111	2.0955	1.1345	1.0201	2.6267	1.3967	0.1239	0.0354	0.9806
CD @ 5%	4.9964	5.4187	5.9414	3.2168	2.8924	7.4476	3.9600	0.3512	0.1004	2.7803
CV%	4.4693	6.2560	6.5396	13.2701	2.1276	3.0357	5.9105	3.4441	4.8739	8.2028

Table.2a Performance of parents of China aster for growth and flowering parameters

Sl. No.	Genotypes	Plant height (cm)	Plant Spread (cm)		Number of primary branches per plant	Days to 50 % flowering (days)	Number of florets/ Flower head	Flowering duration (days)	Flower head diameter (cm)	Disc diameter (cm)	Flower stalk length (cm)
			NS	EW							
1	AAC-1	63.10	35.00	39.10	11.10	72.50	84.40	31.00	5.41	1.39	19.20
2	ArkaAadya	44.00	54.20	58.50	14.60	69.00	135.40	35.50	5.39	1.36	14.90
3	Arka Archana	40.90	45.50	45.60	14.40	60.50	117.90	40.50	4.45	1.17	7.70
4	ArkaKamini	56.75	34.60	36.15	12.40	71.50	92.90	32.00	5.05	1.28	17.50
5	ArkaPoornima	53.20	35.00	32.70	6.90	79.50	142.10	33.50	4.46	1.92	10.80
6	Local Pink	48.90	44.10	49.30	13.10	68.00	91.20	32.50	4.91	1.45	18.40
7	Local Violet	59.50	24.90	26.50	11.80	70.50	92.30	27.00	4.40	1.08	13.10
8	Local White	51.60	61.50	49.30	15.00	69.50	113.90	35.00	5.27	1.05	12.60
9	PG Purple	62.90	36.60	37.50	7.00	69.50	146.00	36.00	5.58	1.33	19.10
10	PG Violet	60.40	68.20	62.10	9.80	62.50	121.60	38.50	5.64	1.17	14.50
	S.Em±	0.94	1.12	2.56	0.32	0.77	0.80	4.93	0.06	0.04	0.70
	CD @ 5%	2.77	3.32	7.53	0.95	2.28	2.37	2.81	0.17	0.12	2.08
	CV%	2.82	4.90	11.27	5.28	6.63	4.19	4.31	5.90	4.52	6.38

Table.3a Performance of parents of China aster for yield and quality parameters

Sl. No.	Genotypes	Vase life (Days)	Shelf life (Days)	Number of flowers/ plants	Number of flowers/ branch	Individual flower weight (g)	Weight of 100 flowers (g)	Flowers weight / plant (g)	Seed yield/ plant (g)	1000 seed weight (g)
1	AAC-1	9.80	2.70	54.70	7.50	4.05	256.68	142.18	5.87	2.38
2	ArkaAadya	10.40	3.50	53.80	12.20	3.64	319.07	176.05	7.25	2.21
3	Arka Archana	7.86	3.47	53.80	12.40	2.11	232.69	137.77	6.75	2.08
4	ArkaKamini	8.00	3.05	55.05	8.40	3.05	270.05	148.50	7.75	2.67
5	ArkaPoornima	9.00	3.90	41.50	8.20	2.79	290.50	123.55	3.75	2.23
11	Local Pink	5.90	2.50	55.60	6.30	2.83	287.73	172.41	6.25	2.28
12	Local Violet	6.90	2.30	43.40	7.10	2.02	227.56	100.38	5.75	2.61
13	Local White	7.75	3.25	54.50	10.80	2.35	289.66	160.03	6.75	2.43
24	PG Purple	10.30	3.50	52.75	6.40	2.55	407.58	233.15	7.75	2.32
26	PG Violet	9.50	3.50	49.00	6.50	2.85	267.66	133.65	7.75	1.91
	S.Em±	0.36	0.12	1.06	0.34	0.04	6.16	1.86	0.26	0.04
	CD @ 5%	1.06	0.36	3.12	1.01	0.13	18.12	5.49	0.76	0.13
	CV %	6.85	6.00	3.63	7.98	2.62	3.64	2.39	6.19	3.20

Table.3b Performance of China aster hybrids for quality and yield traits

Crosses/ Characters	Vase life(days)	Shelf life (days)	No. of flowers/ plant	No. of flowers/ branch	Individual flower weight (g)	Weight of 100 flowers (g)	Weight of flowers/ plant (g)	Seed yield (g)	1000 seed weight (g)
ArkaKamini × ArkaAadya	8.00	3.05	55.50	8.40	3.05	270.05	148.50	7.75	2.67
ArkaKamini × Arka Archana	11.70	2.95	64.70	16.70	2.99	285.50	137.50	8.50	2.70
ArkaKamini × Local Pink	11.90	3.05	57.90	15.90	3.00	304.00	146.00	8.75	2.78
ArkaKamini × Local Violet	10.50	3.10	51.40	8.90	2.66	274.00	114.00	7.85	2.74
ArkaKamini × Local White	11.00	2.95	63.10	10.50	3.04	298.00	132.50	7.90	2.95
ArkaKamini × AAC-1	9.50	3.40	47.30	14.60	3.07	315.50	136.50	7.90	2.75
ArkaKamini × PG Purple	11.80	3.45	49.90	14.60	2.89	277.50	139.00	8.80	3.20
ArkaKamini × PG Violet	10.75	2.75	46.40	14.20	3.43	313.50	159.00	8.70	3.35
ArkaKamini × ArkaPoornima	11.25	2.55	48.00	11.70	2.91	286.00	120.50	7.75	3.55
ArkaAadya × Arka Archana	11.25	2.95	52.55	16.60	4.08	404.50	141.00	6.75	2.65
ArkaAadya × Local Pink	10.75	3.40	50.50	15.80	3.53	332.00	154.50	9.75	2.25
ArkaAadya × Local Violet	10.50	3.10	48.20	13.40	3.29	298.50	139.00	10.75	2.55
ArkaAadya × Local White	10.70	2.60	50.30	17.40	3.33	324.00	143.50	9.75	2.65
ArkaAadya × AAC-1	10.50	3.75	52.20	14.50	2.92	294.00	154.00	7.25	2.75
ArkaAadya × PG Purple	10.75	2.25	47.40	15.20	3.03	296.50	138.00	8.75	3.25
ArkaAadya × PG Violet	11.40	3.10	59.20	11.90	2.96	2888.00	173.00	7.75	2.95
ArkaAadya × ArkaPoornima	10.70	3.25	53.10	14.20	2.92	279.00	162.50	7.75	2.65
ArkaArchana × Local Pink	8.50	2.60	52.90	9.70	2.29	231.50	128.50	7.75	2.55
ArkaArchana × Local Violet	10.20	2.95	60.20	11.70	3.06	295.00	124.00	7.75	2.70
ArkaArchana × Local White	9.40	2.55	60.60	16.10	3.18	316.50	179.00	8.75	2.75
ArkaArchana × AAC-1	10.75	3.35	67.70	13.00	2.69	291.50	180.00	8.75	2.95
ArkaArchana × PG Purple	9.50	2.10	52.80	13.10	3.09	284.00	164.00	8.25	3.25
ArkaArchana × PG Violet	10.50	2.65	51.70	13.10	3.25	325.50	155.00	7.75	3.10

Crosses/ Characters	Vase life (days)	Shelf life (days)	No. of flowers/ plant	No. of flowers/ branch	Individual flower weight(g)	Weight of 100 flowers (g)	Weight of flowers/ plant (g)	seed yield (g)	1000 seed weight (g)
Arka Archana × ArkaPoornima	10.50	3.00	56.30	14.50	2.80	273.50	121.50	7.25	3.10
Local Pink × Local Violet	8.50	2.65	56.00	14.00	3.20	315.50	146.50	8.25	2.75
Local Pink × Local White	10.40	3.60	71.20	16.90	3.00	324.00	176.00	8.85	2.90
Local Pink × AAC-1	9.50	2.40	59.70	12.30	2.97	284.00	161.00	9.25	2.75
Local Pink × PG Purple	9.75	2.60	57.60	10.90	2.91	291.00	120.50	8.25	3.20
Local Pink × PG Violet	9.50	3.75	50.30	10.20	2.84	270.50	111.00	7.25	3.15
Local Pink × ArkaPoornima	9.90	3.65	63.40	16.10	3.19	324.00	175.50	7.00	3.00
Local Violet × Local White	9.00	3.10	57.20	13.00	3.28	282.00	177.00	7.75	2.75
Local Violet × AAC-1	9.25	3.95	69.40	15.50	2.81	328.50	200.50	8.75	2.80
Local Violet × PG Purple	8.50	2.85	54.50	10.50	3.18	215.50	123.00	7.25	3.05
Local Violet × PG Violet	8.50	2.50	58.40	13.30	2.31	278.00	133.00	7.75	2.60
Local Violet × ArkaPoornima	8.50	2.65	48.70	9.50	2.77	293.50	123.00	7.25	3.00
Local White × AAC-1	9.00	3.00	57.80	12.70	2.84	308.00	132.50	7.75	2.70
Local White × PG Purple	8.50	2.90	61.10	11.00	3.09	335.00	133.00	6.75	2.85
Local White × PG Violet	8.50	2.95	52.40	10.80	3.48	351.50	144.50	7.75	2.97
Local White × ArkaPoornima	8.50	2.50	53.30	6.50	3.54	307.50	117.50	7.25	2.85
AAC-1 × PG Purple	9.50	3.35	56.10	9.40	3.11	280.50	138.00	7.75	3.25
AAC-1 × PG Violet	9.50	3.15	52.20	11.40	2.95	508.00	176.50	7.25	3.10
AAC-1 × ArkaPoornima	8.00	2.45	52.70	12.70	3.51	359.00	205.50	7.75	3.25
PG Purple× PG Violet	10.75	2.60	51.70	10.30	4.06	378.00	213.50	7.25	3.35
PG Purple× ArkaPoornima	11.25	3.00	54.20	11.70	4.45	440.50	328.50	7.75	3.20
PG Violet × ArkaPoornima	10.75	3.75	62.40	13.40	4.30	420.50	305.00	9.50	3.20
S.E.m	0.4087	0.2150	1.0523	0.4127	0.0874	19.6593	3.5384	0.2672	0.0857
CD @ 5%	1.1589	0.6096	2.9836	1.1701	0.2479	55.7406	10.0325	0.7575	0.2430
CV	5.9494	10.0937	2.7143	4.7854	3.9930	9.0169	3.2197	4.8381	4.3043

Higher number of flowers per plant recorded in cross between ArkaKamini × ArkaAadya (64.70) and weight of flowers per plant was higher in crosses PG Purple × ArkaPoornima (328.50 g) followed by PG Violet × ArkaPoornima (305.00 g) and PG Purple × PG Violet (213.50 g) . Similarly, Seed yield per plant was higher in cross combination ArkaAadya × Local Violet (10.75 g) followed by ArkaAadya × Arka Archana (9.75 g) and Local Pink × AAC-1 (9.25 g). The higher number of flowers per plant than parents is due to heterosis and influence of environment, the crosses which had higher weight of flowers per plant expressed higher individual weight which resulted in higher yield on weight basis; the higher seed yield per plant due to bolder seeds and it indicates the seed setting per cent. These differences are also noted earlier by Khangjarakpam *et al.,* (2014), Rai and Chaudhary (2016); Kumari *et al.,* (2017); Bhargav *et al.,* (2018) and Shankari *et al.,* (2019) in China aster

In conclusion, the cross combinations like Local Pink × Local White, Local Violet × AAC-1 and PG Violet × ArkaPoornima were promising hybrids for flower stalk length , higher yield on weight for cut flower. ArkaAadya × ArkaPoornima and Arka Archana × Local White had spreading branches, longer flowering duration making them for suitable to Landscaping.

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