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Exploitation of Heterosis for Improvement of Economic Flower Quality and Yield Traits in China Aster [*Callistephus chinensis* (L.) Nees]

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ABSTRACT

The magnitude of heterosis for economic flower quality and yield traits in china aster (*Callistephus chinensis* (L.) Nees) was estimated from twenty seven F_1 hybrids, which were developed by involving nine lines and three testers in line x tester mating design during the year 2021-23 at Floriculture unit, Department of Horticulture, University of Agricultural Sciences, GKVK, Bengaluru. The twenty seven F_1 hybrids along with parents and standard check (Arka Kamini) were evaluated in RCBD design with two replications for different flower quality and yield traits. The results revealed that among twenty seven F_1 hybrids, majority of them exhibited significant average heterosis and heterobeltiosis for flower quality and yield traits. For flower diameter, hybrid, Miraj Local × AAC-1 (32.14 %) recorded maximum positive significant heterosis over standard check which was followed by Phule Ganesh White × AAC-1 (31.46 %). Similarly, the hybrid, Arka Poornima × Phule Ganesh Purple (33.23%) recorded maximum positive standard heterosis for flower stalk length while, Local White × Arka Kamini (-24.13) has least performed for this trait. The hybrid, Miraj Local × AAC-1 exhibited significant positive standard heterosis for vase life (39.41%) and shelf life (30.41%) which was followed by Phule Ganesh Pink × Phule Ganesh Purple. The maximum significant positive standard heterosis for flower yield per plant was recorded in Phule Ganesh Pink × AAC-1 (80.90%). From this experiment Miraj Local × AAC-1, Arka Poornima × Phule Ganesh Purple, Phule Ganesh Pink × AAC-1 and Arka Poornima × AAC-1 were identified as elite hybrids for flower quality and yield traits.

Keywords : Better parent, Heterosis, Mid parent, Standard check, Trait

CHINA aster [*Callistephus chinensis* (L.) Nees] is a commercially grown annual flower crop. It is diploid with chromosome number 2n = 18 and belongs to the family Asteraceae. It is primarily originated from China. During 18th century it spread to other tropical and subtropical countries including Europe. China aster has been developed from a single wild species Callistephus chinensis. Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra (Pune and Nasik) and West Bengal are the states which cultivate this crop commercially. It is cultivated in Karnataka in an area of 207 hectares, with a production of 1,448 metric tons and a productivity of 7.01 tons per hectare, with an annual income of 430 lakhs (Anonymous., 2021).

It is successfully cultivated under open conditions with a constant supply of flowers to the market year around in both *kharif* and *rabi* seasons. China aster is one of the most preferred flower crops, which is grown extensively due to it's wide spectrum of

appealing flower colours and relatively longer vase life. Hence they are utilized for preparing garlands, bouquet preparation, floral arrangements and flower exhibitions. Dwarf branching types are popular as bedding plants and are used in herbaceous gardens. Dwarf cultivars are also suitable for the edges. Further, it is a short duration crop acclimatized to varying agro-climatic conditions (Patil and Agasimani, 2013).

The exploitation of heterosis has proved to be one of the most viable method of breeding to increase productivity and production. Hybrids have distinct advantages over open pollinated varieties such as earliness, profuse and uniform flowering, increased flower weight, large flower size, elongated flower stalk, flower diameter longer flower duration, vase life, shelf life etc. The flower industry is highly dynamic and always demands constant novelties. The existing commercial cultivars in India have semi-double flowers with prominent disks and short flower stalks. Hence, development of china aster for both cut and loose flower needs improvement in quality and yield attributes such as flower yield per plant, flower diameter, flower stalk length, flower size and increased vase life and shelf life. In view of the above, the present experiment was conducted on 'Exploitation of heterosis for improvement of economic flower quality and yield traits in china aster (*Callistephus chinensis* (L.) Nees)'.

Material and Methods

The experiment was carried out in the Floriculture unit, Department of Horticulture, University of Agricultural Sciences, Gandhi Krishi Vigyana Kendra, Bengaluru, during 2021-23. Nine lines (Arka Poornima, Arka Archana, Phule Ganesh White, Phule Ganesh Pink, Miraj Local, Local Pink, Local White, Namdhari Pink and Namdhari White) were hand emasculated and pollinated from the pollens of three testers (AAC-1, Arka Kamini and Phule Ganesh Purple) in line × tester mating design to develop twenty seven F_1 hybrids of china aster. Arka Kamini was used as standard check. The parents, F_1 hybrids and standard check were planted in randomized complete block design (RCBD) with two replications at a spacing of 30 cm × 30 cm. Uniform cultural practices were followed for proper growth and development and five plants were tagged to record the observations on different flower quality and yield traits.

The observations were recorded on flower quality and yield parameters like, flower diameter (cm), flower stalk length (cm), vase life (days), shelf life (days), number of flowers per plant and flower yield per plant (g). Mid parent heterosis (MPH), better parent heterosis (BPH) and heterosis over standard check for each hybrids were calculated as percentage deviation from the mid parent (MP) and better parent (BP) values and commercial check (Arka Kamini), respectively and results are furnished in Table 1, 2, 3, 4, 5 to 6.

Results and Discussion

Magnitude of Heterosis over Mid Parent, Better Parent and Standard Check

Flower Stalk Length (cm)

Flower stalk length is a decisive trait in the cut flower industry, impacting the aesthetics, handling, versatility, vase life, market value and overall quality of cut flowers. Among twenty seven hybrids, all of them recorded positive significant mid parent heterosis. Similarly, nineteen hybrids over better parent and fifteen hybrids over standard check exhibited positive significant heterosis for flower stalk length.

The magnitude of mid parent heterosis has ranged from 1.46 per cent (Namdhari Pink × Phule Ganesh Purple) to 30.96 per cent (Phule Ganesh Pink × AAC-1), better parent heterosis ranged from -16.37 (Local White × Phule Ganesh Purple) to 20.95 per cent (Phule Ganesh Pink × AAC-1) and standard heterosis ranged from -24.13 (Local White × Arka Kamini) to 33.23 per cent (Arka Poornima × Phule Ganesh Purple) (Table 2). The similar results were reported by Rivera *et al.* (2019) in gerbera and Veluru *et al*. (2019) in china aster and Shwetha *et al*. (2022) chrysanthemum.

TABLE 1

Estimation of different heterosis for flower stalk length (cm) in china aster

Hybrids	MPH (%)	BPH (%)	SH (%)
Arka Poornima × AAC-1	17.94 **	12.01 **	14.48 **
Arka Poornima × Arka Kamini	14.37 **	5.08 *	7.40 *
Arka Poornima × Phule Ganesh Purple	22.96 **	16.37 **	33.23 **
Arka Archana × AAC-1	21.84 **	7.39 *	-1.28
Arka Archana × Arka Kamini	19.22 **	8.44 *	-7.18 **
Arka Archana × Phule Ganesh Purple	14.21 **	-7.92 **	5.41 *
Phule Ganesh White × AAC-1	17.52 **	12.98 **	12.56 **
Phule Ganesh White × Arka Kamini	9.76 *	2.03	1.65
Phule Ganesh White × Phule Ganesh Purple	19.09 **	11.36 **	27.49 **
Phule Ganesh Pink × AAC-1	30.96 **	20.95 **	31.26 **
Phule Ganesh Pink × Arka Kamini	19.83 **	7.17 *	16.31 **
Phule Ganesh Pink × Phule Ganesh Purple	12.11 **	9.19 *	25.01 **
Miraj Local × AAC-1	21.70 **	18.44 **	8.88 *
Miraj Local × Arka Kamini	18.11 **	17.16 **	1.92
Miraj Local × Phule Ganesh Purple	19.72 **	5.35 *	20.60 **
Local Pink × AAC-1	23.59 **	7.18 *	-1.47
Local Pink × Arka Kamini	17.11 **	4.74 *	-10.35 **
Local Pink × Phule Ganesh Purple	9.12 *	-13.27 **	-0.70
Local White × AAC-1	11.53 **	-8.98 **	-16.32 **
Local White × Arka Kamini	5.58 *	-11.36 **	-24.13 **
Local White × Phule Ganesh Purple	10.93 **	-16.37 **	-4.26 **
Namdhari Pink × AAC-1	15.00 **	10.93 **	1.97 *
Namdhari Pink × Arka Kamini	8.40 *	8.29 *	-7.31 **
Namdhari Pink × Phule Ganesh Purple	1.46 *	-11.42 **	1.41
Namdhari White × AAC-1	10.58 **	0.64	-7.48 **
Namdhari White × Arka Kamini	5.07 *	-1.18	-15.41 **
Namdhari White × Phule Ganesh Purple	4.65 *	-13.21 **	-0.64
S.Em ±	0.25	0.29	0.29
C.D at 5%	0.52	0.59	0.59
C.D at 1%	0.69	0.81	0.81

*Significant at 5 per cent level **Significant at 1 per cent level
MPH- Mid Parent Heterosis BPH- Better Parent Heterosis SH- Standard Heterosis

Flower Diameter (cm)

In heterosis breeding, flower diameter is a trait of interest that can have important implications for the success and performance of hybrid varieties. It is an important trait that maximizes the utility as both cut and loose flower. Flower diameter is positively correlates with the aesthetic appeal, pollen production and crop yield (Sureshkumar *et al*., 2004).

Twenty six hybrids over mid parent, twenty five hybrids over better parent and twenty four hybrids over commercial check exhibited positive heterosis

Arka Poornima × PG Purple | PG Pink ×AAC-1 | PG White ×PG Purple

Plate 1 : Flower stalk length of promising hybrids

for flower diameter. The hybrid, Miraj Local × AAC-1 recorded maximum average heterosis (41.11%), heterobeltiosis (38.31%) and standard heterosis (32.14%) which was followed by Phule Ganesh White × AAC-1. Whereas, hybrid Local White × Phule Ganesh Purple recoded minimum average heterosis (-3.37%), heterobeltiosis (-17.45%) and standard heterosis (-10.87%) for this trait (Table 1). Similar variation in flower diameter was recorded by Bayat *et al*. (2012) in petunia, Veluru *et al.* (2019) in china aster and Azimi (2020) in gladiolus.

Miraj Local ×AAC-1 PG White ×AAC-1

Plate 2 : Flower diameter of promising hybrids in china aster

Vase Life (days)

Vase life is an important quality criterion since an improvement in vase life suggests an increase in cut flower usage. Twenty three hybrids over mid parent, thirteen hybrids over better parent and fourteen hybrids over standard check reported significant positive heterosis for vase life.

Among the twenty seven hybrids, Miraj Local × AAC-1 displayed the highest significant mid parent (57.01%), better parent (51.77%) and standard heterosis (39.41%) compared to the others. Conversely, the hybrid, Local White × Phule Ganesh Purple recorded the lowest mid parent (-9.05%) and better parent heterosis (-33.71%), while Local White × Arka Kamini exhibited the lowest standard heterosis (-29.51%) for this trait (Table 3).

Sureshkumar *et al.* (2004) observed positive and significant heterosis for vase life in china aster and Kispotta *et al.* (2017) found similar results in gladiolus. They concluded that hybrids displaying the highest levels of heterosis for vase life were well suited for cut flower production.

Shelf Life (days)

Shelf life is pivotal flower quality trait of loose flowers. The range of average heterosis varied from 10.01 per cent (Local White × Phule Ganesh Purple) to 44.16 percent (Miraj Local × AAC-1). Heterobeltiosis exhibited a range from -34.85 percent (Local White × Phule Ganesh Purple) to 33.99 percent (Miraj Local × AAC-1). Similarly, economic heterosis varied from -35.75 per cent (Local White × Arka Kamini) to 30.41 per cent (Miraj Local × AAC-1) (Table 4).

Twenty four hybrids over mid parent, twenty two hybrids over better parent and eighteen hybrids over standard check reported significant positive heterosis for shelf life. Similar results were recorded by Kumari *et al.* (2018) in china aster, Rivera *et al.* (2019) in gerbera and Lahkar *et al.* (2020) in marigold.

Number of Flowers Per Plant

The number of flowers in a plant is an essential factor in heterosis breeding as it influences the potential for

TABLE 2
Estimation of different heterosis for flower diameter (cm) in china aster

Hybrids	MPH (%)	BPH (%)	SH (%)
Arka Poornima × AAC-1	22.15 **	19.71 **	19.13 **
Arka Poornima × Arka Kamini	20.65 **	16.29 **	15.73 **
Arka Poornima × Phule Ganesh Purple	20.17 **	15.47 **	24.66 **
Arka Archana × AAC-1	19.39 **	15.14 **	10.00 **
Arka Archana × Arka Kamini	17.53 **	15.25 **	6.41 *
Arka Archana × Phule Ganesh Purple	3.16 *	-6.03 *	1.46
Phule Ganesh White × AAC-1	36.91 **	36.22 **	31.46 **
Phule Ganesh White × Arka Kamini	27.81 **	25.05 **	20.68 **
Phule Ganesh White × Phule Ganesh Purple	25.17 **	18.53 **	27.96 **
Phule Ganesh Pink × AAC-1	22.18 **	16.24 **	23.01 **
Phule Ganesh Pink × Arka Kamini	21.02 **	13.30 **	19.90 **
Phule Ganesh Pink × Phule Ganesh Purple	16.26 **	15.11 **	24.27 **
Miraj Local × AAC-1	41.11 **	38.31 **	32.14 **
Miraj Local × Arka Kamini	32.59 **	32.18 **	22.04 **
Miraj Local × Phule Ganesh Purple	18.91 **	9.98 *	18.74 **
Local Pink × AAC-1	20.52 **	13.72 **	8.64 *
Local Pink × Arka Kamini	17.00 **	12.20 **	3.59 *
Local Pink × Phule Ganesh Purple	16.27 **	3.78 *	12.04 **
Local White × AAC-1	12.53 **	1.32	-3.20 *
Local White × Arka Kamini	11.33 **	1.79	-6.02 *
Local White × Phule Ganesh Purple	-3.37 *	-17.45 **	-10.87 **
Namdhari Pink × AAC-1	20.83 **	17.89 **	12.62 **
Namdhari Pink × Arka Kamini	19.66 **	18.72 **	9.61 *
Namdhari Pink × Phule Ganesh Purple	15.62 **	6.47 *	14.95 **
Namdhari White × AAC-1	16.19 **	12.30 **	7.28 *
Namdhari White × Arka Kamini	16.00 **	13.99 **	5.24 *
Namdhari White × Phule Ganesh Purple	15.27 **	5.22 *	13.59 **
S.Em±	0.07	0.09	0.09
C.D at 5%	0.16	0.18	0.18
C.D at 1%	0.22	0.25	0.25

*Significant at 5 per cent level **Significant at 1 per cent level
MPH- Mid Parent Heterosis BPH- Better Parent Heterosis SH- Standard Heterosis

genetic recombination, seed production and overall yield. Among twenty seven hybrids, twenty five hybrids over mid parent, eighteen hybrids over better parent and twenty hybrids over standard check recorded positive significant heterosis for number of flowers per plant.

The hybrid Arka Poornima × AAC-1 displayed the highest heterosis over the mid parent (56.87%) and the standard check (66.69%). Additionally, Phule Ganesh Pink × Arka Kamini exhibited the highest heterosis over mid parent (47.06%). In contrast, Namdhari White × Phule Ganesh Purple had the

TABLE 3
Estimation of different heterosis for vase life (days) in china aster

Hybrids	MPH (%)	BPH (%)	SH (%)
Arka Poornima × AAC-1	38.42 **	29.08 **	37.07 **
Arka Poornima × Arka Kamini	20.29 **	10.92 **	17.79 **
Arka Poornima × Phule Ganesh Purple	17.27 **	12.51 **	30.03 **
Arka Archana × AAC-1	17.21 **	6.74	-1.95
Arka Archana × Arka Kamini	-4.97	-12.50 **	-21.56 **
Arka Archana × Phule Ganesh Purple	9.82 **	-9.24 **	4.89
Phule Ganesh White × AAC-1	18.58 **	11.57 **	16.22 **
Phule Ganesh White × Arka Kamini	12.40 **	4.57	8.93 *
Phule Ganesh White × Phule Ganesh Purple	19.30 **	13.42 **	31.07 **
Phule Ganesh Pink × AAC-1	23.77 **	12.85 **	25.86 **
Phule Ganesh Pink × Arka Kamini	22.93 **	10.86 **	23.65 **
Phule Ganesh Pink × Phule Ganesh Purple	21.97 **	19.84 **	38.50 **
Miraj Local × AAC-1	57.01 **	51.77 **	39.41 **
Miraj Local × Arka Kamini	23.03 **	20.35 **	7.88 *
Miraj Local × Phule Ganesh Purple	33.72 **	16.46 **	34.59 **
Local Pink × AAC-1	36.10 **	11.49 **	2.41
Local Pink × Arka Kamini	26.89 **	4.94	-5.93
Local Pink × Phule Ganesh Purple	38.82 **	4.62	20.91 **
Local White × AAC-1	3.87	-18.16 **	-24.82 **
Local White × Arka Kamini	-1.10	-21.37 **	-29.51 **
Local White × Phule Ganesh Purple	-9.05 *	-33.71 **	-23.39 **
Namdhari Pink × AAC-1	28.61 **	13.19 **	3.97
Namdhari Pink × Arka Kamini	20.67 **	7.34	-3.78
Namdhari Pink × Phule Ganesh Purple	24.39 **	-0.23	15.31 **
Namdhari White × AAC-1	19.87 **	3.55	-4.89
Namdhari White × Arka Kamini	1.42	-11.48 **	-20.65 **
Namdhari White × Phule Ganesh Purple	14.50 **	-9.64 **	4.43
S.Em ±	0.22	0.25	0.25
C.D at 5%	0.45	0.52	0.51
C.D at 1%	0.60	0.69	0.69

*Significant at 5 per cent level **Significant at 1 per cent level
MPH- Mid Parent Heterosis BPH- Better Parent Heterosis SH- Standard Heterosis

lowest mid parent heterosis (-4.14%), while Local White × Phule Ganesh Purple showed the lowest heterosis over the better parent (-19.82%) and the standard check (-14.71%) (Table 5). Similar observations were made by Deepti and Misra (2012) in marigold and Bhargav *et al.* (2019) in china aster.

Flower Yield Per Plant (g)

The flower yield per plant is an important trait in heterosis breeding as it directly impacts the potential seed production, overall productivity and success of hybridization. Positive heterosis is desirable for the

TABLE 4

Estimation of different heterosis for shelf life (days) in china aster

Hybrids	MPH (%)	BPH (%)	SH (%)
Arka Poornima × AAC-1	22.17 **	16.65 **	24.81 **
Arka Poornima × Arka Kamini	23.05 **	10.46 **	18.19 **
Arka Poornima × Phule Ganesh Purple	7.85 **	4.09 **	19.72 **
Arka Archana × AAC-1	13.38 **	0.78 **	-1.91 **
Arka Archana × Arka Kamini	12.18 **	5.98 **	-9.80 **
Arka Archana × Phule Ganesh Purple	4.74 **	-13.16 **	-0.13
Phule Ganesh White × AAC-1	24.58 **	22.69 **	23.16 **
Phule Ganesh White × Arka Kamini	20.85 **	11.66 **	12.09 **
Phule Ganesh White × Phule Ganesh Purple	8.33 **	1.44 **	16.67 **
Phule Ganesh Pink × AAC-1	17.63 **	10.59 **	22.26 **
Phule Ganesh Pink × Arka Kamini	24.19 **	9.90 **	21.50 **
Phule Ganesh Pink × Phule Ganesh Purple	11.56 **	9.40 **	25.83 **
Miraj Local × AAC-1	44.16 **	33.99 **	30.41 **
Miraj Local × Arka Kamini	32.28 **	31.09 **	11.58 **
Miraj Local × Phule Ganesh Purple	18.00 **	1.88 **	17.18 **
Local Pink × AAC-1	22.57 **	3.66 **	0.89 **
Local Pink × Arka Kamini	21.70 **	8.97 **	-7.25 **
Local Pink × Phule Ganesh Purple	27.98 **	1.44 **	16.67 **
Local White × AAC-1	-7.52 **	-29.28 **	-31.17 **
Local White × Arka Kamini	-5.96 **	-24.51 **	-35.75 **
Local White × Phule Ganesh Purple	-10.01 **	-34.85 **	-25.06 **
Namdhari Pink × AAC-1	21.35 **	5.49 **	2.67 **
Namdhari Pink × Arka Kamini	20.75 **	11.36 **	-5.22 **
Namdhari Pink × Phule Ganesh Purple	24.30 **	1.00 **	16.16 **
Namdhari White × AAC-1	33.17 **	4.97 **	2.16 **
Namdhari White × Arka Kamini	28.47 **	6.58 **	-9.29 **
Namdhari White × Phule Ganesh Purple	22.38 **	-8.96 **	4.71 **
S.Em ±	0.04	0.05	0.05
C.D at 5%	0.08	0.09	0.99
C.D at 1%	0.11	0.13	0.13

*Significant at 5 per cent level **Significant at 1 per cent level
MPH- Mid Parent Heterosis BPH- Better Parent Heterosis SH- Standard Heterosis

trait. Twenty four hybrids over mid parent, sixteen hybrids over better parent and twenty four hybrids over standard check recorded significant heterosis in positive direction.

The magnitude of average heterosis was from -14.85 per cent (Local White × Phule Ganesh Purple) to 58.56 per cent (Arka Poornima × Arka Kamini), heterobeltiosis ranged from -19.75 per cent (Local White × AAC-1) to 52.03 per cent (Arka Poornima × Arka Kamini) and standard heterosis ranged from -9.48 per cent (Local White × Phule Ganesh Purple) to 80.90 per cent (Phule Ganesh Pink × AAC-1)

TABLE 5

Estimation of different heterosis for number of flowers per plant in china aster

Hybrids	MPH (%)	BPH (%)	SH (%)
Arka Poornima × AAC-1	56.87 **	41.29 **	66.69 **
Arka Poornima × Arka Kamini	40.21 **	36.39 **	36.39 **
Arka Poornima × Phule Ganesh Purple	8.30 *	2.28	8.81 *
Arka Archana × AAC-1	4.15 *	-14.18 **	1.25
Arka Archana × Arka Kamini	19.29 **	5.24 *	5.24 *
Arka Archana × Phule Ganesh Purple	2.28	-12.11 **	-6.50 *
Phule Ganesh White × AAC-1	27.08 **	11.79 **	31.88 **
Phule Ganesh White × Arka Kamini	34.32 **	27.32 **	27.32 **
Phule Ganesh White × Phule Ganesh Purple	19.67 **	10.22 **	17.25 **
Phule Ganesh Pink × AAC-1	43.24 **	31.99 **	55.72 **
Phule Ganesh Pink × Arka Kamini	47.46 **	47.06 **	47.06 **
Phule Ganesh Pink × Phule Ganesh Purple	13.60 **	9.90 *	16.91 **
Miraj Local × AAC-1	16.86 **	1.14	19.33 **
Miraj Local × Arka Kamini	9.14 *	1.63	1.63
Miraj Local × Phule Ganesh Purple	17.46 **	6.34 *	13.13 **
Local Pink × AAC-1	41.48 **	5.75 *	24.76 **
Local Pink × Arka Kamini	40.50 **	11.27 **	11.27 **
Local Pink × Phule Ganesh Purple	13.44 **	-12.14 **	-6.54 *
Local White × AAC-1	16.81 **	-16.50 **	-1.49
Local White × Arka Kamini	21.38 **	-8.55 *	-8.55 *
Local White × Phule Ganesh Purple	8.60 *	-19.82 **	-14.71 **
Namdhari Pink × AAC-1	20.22 **	6.15 *	25.23 **
Namdhari Pink × Arka Kamini	11.60 **	6.21 *	6.21 *
Namdhari Pink × Phule Ganesh Purple	-1.31	-8.74 *	-2.92
Namdhari White × AAC-1	16.30 **	-1.34	16.39 **
Namdhari White × Arka Kamini	14.22 **	4.05 *	4.05 *
Namdhari White × Phule Ganesh Purple	-4.14 *	-15.05 **	-9.62 *
S.Em ±	0.65	0.75	0.75
C.D at 5%	1.34	1.55	1.55
C.D at 1%	1.82	2.09	2.09

*Significant at 5 per cent level **Significant at 1 per cent level
MPH- Mid Parent Heterosis BPH- Better Parent Heterosis SH- Standard Heterosis

(Table 6). These results are inline with the earlier findings of Gupta *et al.* (2001) in African marigold and Kayalvizhi *et al*. (2017) in tuberose.

Estimation of heterosis revealed that hybrids exhibited heterosis in desired direction for most of the characters studied. In the present study, the estimates of heterosis over mid parent, better parent and standard check were found to be highly variable in both directions among the hybrids for all the characters under study. Flower quality is decided by flower diameter,

TABLE 6

Estimation of different heterosis for flower yield per plant(g) in china aster

Hybrids	MPH (%)	BPH (%)	SH (%)
Arka Poornima × AAC-1	49.50 **	38.22 **	77.38 **
Arka Poornima × Arka Kamini	58.56 **	52.03 **	65.67 **
Arka Poornima × Phule Ganesh Purple	14.70 **	1.78	43,17 **
Arka Archana × AAC-1	23.17 **	1.02	29.64 **
Arka Archana × Arka Kamini	32.00 **	20.23 **	20.23 **
Arka Archana × Phule Ganesh Purple	17.91 **	-6.61 *	31.37 **
Phule Ganesh White × AAC-1	29.59 **	17.34 **	50.59 **
Phule Ganesh White × Arka Kamini	38.63 **	35.93 **	41.45 **
Phule Ganesh White × Phule Ganesh Purple	20.23 **	4.59	47.11 **
Phule Ganesh Pink × AAC-1	39.61 **	38.29 **	80.90 **
Phule Ganesh Pink × Arka Kamini	48.63 **	31.13 **	71.53 **
Phule Ganesh Pink × Phule Ganesh Purple	28.22 **	23.72 **	74.03 **
Miraj Local × AAC-1	42.59 **	27.62 **	63.78 **
Miraj Local × Arka Kamini	47.11 **	36.05 **	58.20 **
Miraj Local × Phule Ganesh Purple	28.42 **	10.50 *	55.43 **
Local Pink × AAC-1	41.10 **	13.38 *	45.51 **
Local Pink × Arka Kamini	31.90 **	17.33 *	17.33 **
Local Pink × Phule Ganesh Purple	11.64 **	-13.27 **	22.00 **
Local White × AAC-1	2.84	-19.75 **	3.00
Local White × Arka Kamini	11.20 *	-4.40 *	-4.40 *
Local White × Phule Ganesh Purple	-14.85 **	-35.64 **	-9.48 *
Namdhari Pink × AAC-1	22.00 **	6.96 *	37.27 **
Namdhari Pink × Arka Kamini	36.23 **	33.99 **	33.99 **
Namdhari Pink × Phule Ganesh Purple	7.31 *	-9.46 **	27.35 **
Namdhari White × AAC-1	12.74 *	-2.65 *	24.93 **
Namdhari White × Arka Kamini	33.49 **	29.00 **	29.00 **
Namdhari White × Phule Ganesh Purple	5.66	-12.14 *	23.58 **
S.Em ±	1.25	1.44	1.44
C.D at 5%	2.57	2.97	2.97
C.D at 5%	3.48	4.02	4.02

*Significant at 5 per cent level **Significant at 1 per cent level
MPH- Mid Parent Heterosis BPH- Better Parent Heterosis SH- Standard Heterosis

flower stalk length, vase life and shelf life. In this context, Miraj Local × AAC-1, Phule Ganesh Pink × Phule Ganesh Purple and Arka Poornima × AAC-1 recorded maximum heterosis for flower quality parameters over standard check. Likewise, the enhancement of yield through heterosis plays a pivotal role to meet the increasing market demand. Phule Ganesh Pink × AAC-1, Arka Poornima × AAC-1 (77.38%) and Phule Ganesh Pink × Phule Ganesh Purple (74.03%) were the top

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three performing hybrids over standard check for flower yield per plant which are highly suitable for commercial cultivation.

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