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Performance of different varieties of China aster [*Callistephus chinensis* (L.) Nees] for North eastern dry zone of Karnataka

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Abstract
The study was conducted on performance of different genotypes of China aster under north eastern dry zone of Karnataka. The experiment was carried out at Department of Horticulture, College of Agriculture, UAS, Raichur during the year 2016-17. The experiment was laid out using Randomized Block Design with three replications of twelve genotypes. All the genotypes showed significant Difference among themselves for vegetative and yield parameters. The genotype Phule Ganesh Violet expressed highest plant height, plant spread, number of leaves, number of primary branches, number of secondary branches and leaf area, followed by Phule Ganesh white at 120 days after transplanting. The genotype Phule Ganesh White expressed highest flower diameter and yield plant^{-1}. the genotype Poornima expressed highest number of flowers per plant followed by Arka Archana. The highest flower weight was observed in genotype Phule Ganesh Pink. The overall study revealed that the genotype Phule Ganesh Violet found promising for this zone.

Keywords: China aster, evaluation, genotypes, vegetative parameters, yield parameters

Introduction
China aster (*Callistephus chinensis* Nees) belongs to one of the largest families of flowering plants, 'Asteraceae'. The present day asters have been developed from a single form of wild species known as, *Callistephus chinensis*. The name of the genus '*Callistephus*' is derived from two Greek words 'kalistos' meaning 'most beautiful' and 'stephos', a crown, referring to the flower head. The genus *Callistephus* has only a single species, namely, *Callistephus chinensis.* It is native to China and has spread to European countries and other tropical countries during 1731 AD (Desai, 1967) [1]. China aster is one of the most important annual flower crops grown in most parts of the world.

The evolution of China aster has a history of remarkable variations. According to Emsweller *et al.* (1937) [2], the original plant had single flowers with two or four rows of blue, violet or white ray florets. The stature was medium tall and height of the plant ranged from 18 to 24 inches. The first change in the flower type had been the prolongation or development of central florets and the production of quilled flowers. Germans developed double forms in aster during 18th century. Hence, asters are also called as German asters. Advancement of the aster evolution and large scale seed production by Germans led to the introduction of branching types, tall types, medium tall and dwarf types and this contributed for great evolutionary improvement in China aster.

Fleming (1937) [3] estimated approximately 10 per cent natural crossing in China aster. Strube (1965) [11] described floral biology of China aster and according to him, its flower head consists of both pistillate ray florets and perfect disc florets. The proportion of ray florets and disc florets is a measure of double ness of the flower. As a rule, the stamens and pistils do not mature simultaneously in the individual flower. The stigma of the individual flower unfolds after the pollen is discharged from the flower. However, sufficient pollen remains in the capitulum. The China aster is therefore, in geitenogamous condition. In some varieties, they mature together leading to self-fertilization. There is a possibility of some amount of cross pollination as well. North (1979) [7] and Watts (1980) [13] grouped China aster under self-pollinated crops.

China aster is a free blooming half hardy, easy growing winter annual crop grown for cut flower as well as loose flower. The bloom type depends mainly upon the relative number of the two kinds of florets and their shapes. The most suitable character for the classification of China aster is the shape of ray florets.

The present day varieties are available in diverse forms, different types and a wide spectrum of colour ranges *viz*., pink, primrose, pale blue, mauve, purple, scarlet, creamy white, pure white, violet etc.

Materials and Methods

Geographical Location of the Experimental Site

The experiment was conducted at Herbal garden of Department of Horticulture, College of Agriculture Raichur, UAS, Raichur which is at an elevation of 389 meters above mean sea level. Raichur lies between 16° 15' N latitude and 77° 21' E longitude in the North Eastern dry zone (Zone 2) of Karnataka.

Climatic Conditions

The meteorological data during the period of investigation as recorded at meteorological observatory, Main Agricultrural Research Station, UAS, Raichur. During the year of experiment a total rainfall of 628 mm was received through South-West and North-East monsoon. The maximum rainfall of 292.5 mm was received during the month of September. The monthly highest mean maximum temperature of 34.2˚C and lowest of 16.2˚C were recorded during November and January, respectively.

Soil Properties of Experimental Site

The experiment was laid out in red sandy clay loam soil of Herbal garden of Department of Horticulture, College of Agriculture, Raichur.

Varietal Description

A total of 12 China aster varieties were collected and used for present investigation *viz.* Kamini, Shashank, Poornima, Arka Aadya, Arka Archana, Phule Ganesh White, Phule Ganesh Pink, Phule Ganesh Purple, Phule Ganesh Violet, Mudigere Local (considered as check variety), Namdhari Pink and Namdhari White.

Observations on Growth and Parameters

The observations on various vegetative and flowering parameters were recorded at four stages of plant growth *viz*., 30, 60, 90 and 120 days after transplanting. Various biometric observations was recorded on five tagged plants at random from the net plot and plant height, plant spread, number of leaves, number of branches, leaf area, number of flowers per plant, flower diameter and flower yield per plant were recorded.

Plant Height

The plant height was measured from the ground level to the tip of the plant at 30, 60, 90 and 120 days after transplanting and was expressed in centimeters.

Plant Spread

It was measured by adding the North-South and East –West directions of tagged plants and the mean of plant spread was worked out.

Number of Leaves Per Plant

The total numbers of leaves produced in each plant at different growth stages were counted and average was worked out.

Number of Primary and Secondary Branches per Plant

The numbers of primary as well as secondary branches were counted from individual plant and the average was worked out.

Leaf Area per Plant

Leaf area was estimated by using punch method at peak stage of plant growth. From each replication, 25 leaves were randomly selected and with the help of punch 25 bits were removed from them. These bits and entire foliage was oven dried separately at 60^0C till constant weight was obtained. The weight of the dried bits and the foliage was noted separately. The area of each leaf bit was calculated by using the formula πr^2. Based on the weight and area of leaf bits and weight of the entire dried foliage, the leaf area was expressed (in sq. cm) and calculated by using the formula (Johnson, 1967).

$$LA = \frac{W_a}{W_d} x\ A$$

Where,
LA = Leaf area (cm^2)
W_a = Weight of foliage (inclusive of the weight of 25 discs in grams)
W_d = Weight of 25 discs in grams
A = Area of 25 discs (cm^2)

Flower size

Size of the flower was measured at the point of maximum breadth. This was measured by using scale and average diameter in centimeters was computed.

Number of flowers per plant

Number of flowers produced from the five tagged plants was recorded and the average number of flowers produced per plant was worked out.

Flower yield per plant

After recording the number of flowers per plant, all the flowers were weighed separately at every harvest till the final harvest and the average flower yield per plant was calculated and expressed in grams per plant.

Results

Performance of genotypes for various growth and yield parameters

Growth parameters of China aster such as plant height, plant spread, number of leaves, number of primary and secondary branches and leaf area, of the plant were measured at monthly intervals from date of planting to 120 days after transplanting. These parameters are analyzed and presented below.

Plant height

The perusal of data presented in Table 1 revealed that the plant height varied significantly among genotypes at various stages of crop growth (*viz.*, 30, 60, 90 and 120 DAT).

The range for plant height of China aster varieties at 30 DAT was between 7.83 cm to 17.22 cm. Variety Phule Ganesh White recorded the highest plant height (17.22 cm), which was at par with varieties Phule Ganesh Violet (16.69 cm) and Poornima (16.01 cm). These varieties were found to be significantly superior over check var. Kamini (10.82 cm), whereas, the least plant height was noticed in var. Mudigere Local (7.83 cm).

At 60 DAT, var. Phule Ganesh Violet had recorded maximum plant height (43.31 cm), and it was statistically par with var.

Phule Ganesh White (42.42 cm) and these varieties were found to be significantly superior over var. Kamini (32.13) whereas, var. Arka Archana recorded minimum plant height (27.10 cm).

There was significant increase in the plant height at 90 days after transplanting. Var. Phule Ganesh Violet recorded maximum plant height (64.92 cm) followed by Phule Ganesh White (61.09 cm), which was significantly superior over check variety Kamini (36.95 cm). Lowest plant height was observed in var. Arka Archana (34.36 cm).

At 120 DAT, maximum plant height was recorded in var. Phule Ganesh Violet (69.40 cm), which was significantly superior among all the varieties except Phule Ganesh White (67.01 cm) and Phule Ganesh Purple (51.61 cm). The var. Shashank recorded least plant height (35.23 cm). Var. Phule Ganesh violet, Phule Ganesh White and Phule Ganesh Purple were found to be significantly superior over check variety Kamini (37.54 cm) in terms of plant height (Fig. 1).

Plant spread

The data pertaining to plant spread recorded at different stages of crop growth are presented in Table 2. As the growth stages advanced, the plant spread increased continuously from 30 to 120 DAT. There was significant variation in plant spread at all the stages except 30 DAT (*viz.,* 60, 90 and 120 DAT) of crop growth among the varieties of China aster.

At 30 days after transplanting, var. Phule Ganesh Violet recorded maximum plant spread (17.02 cm) but it was on par with var. Phule Ganesh White (16.20 cm). Poornima recorded minimum plant spread (11.62 cm). No significant difference was observed among the varieties.

At 60 DAT, Phule Ganesh Violet (27.31 cm) registered significantly maximum plant spread as compared to other varieties, which was at par with Phule Ganesh White (26.85 cm). Plant spread was minimum in Shashank (15.42 cm). Phule Ganesh Violet and Phule Ganesh White were recorded to be significantly superior over Kamini (22.43 cm).

The plant spread ranged from 16.61 cm to 32.00 cm at 90 days after transplanting. Maximum plant spread was noticed in var. Phule Ganesh Violet (32.00 cm) followed by Phule Ganesh White (30.88 cm) and Phule Ganesh Pink (29.76 cm) which were found significantly superior over check variety Kamini (23.80 cm). Minimum plant spread was observed in var. Shashank (16.61 cm).

At 120 DAT, there was significant increase in plant spread of var. Phule Ganesh Violet (33.36 cm) followed by Phule Ganesh White (31.11 cm), Phule Ganesh pink (30.81 cm) and Phule Ganesh Purple (29.95 cm). Lowest spread was recorded in Shashank (17.10 cm). Among all the twelve varieties studied, four varieties recorded significant difference for plant spread over the check variety Kamini (24.21 cm) (Fig. 2).

Number of leaves per plant

The results on number of leaves per plant presented in Table 3 reveals that at 30 DAT it varied from 9.91 to 14.53. Var. Shashank recorded maximum number of leaves (14.53) followed by varieties Phule Ganesh Violet (14.13) and Arka Archana (13.30), whereas var. Mudigere Local recorded minimum number of leaves (9.91). There was no significant difference observed among the varieties.

At 60 DAT, maximum number of leaves was recorded in var. Phule Ganesh Violet (49.94), which was significantly superior over Kamini (31.30). Minimum number of leaves was recorded in var. Mudigere Local (27.53).

Number of leaves produced per plant at 90 days after transplanting in different China aster varieties varied significantly from a minimum of 129.11 to a maximum of 182.06. The number of leaves produced per plant was maximum (182.06) in var. Phule Ganesh Violet, which was on par with the varieties Phule Ganesh White (175.33) and Phule Ganesh Purple (168.05). The minimum number of leaves was recorded in var. Arka Aadya (129.11). Three varieties were observed to be significantly superior over Kamini (149.01).

At 120 days after transplanting, var. Phule Ganesh Violet (192.05) recorded maximum number of leaves, which was on par with Phule Ganesh White (183.02) and Phule Ganesh Purple (178.01). The minimum number of leaves recorded in Arka Aadya (136.40). Three varieties were noticed to be significantly superior over Kamini (156.15).

Number of primary branches per plant

The data recorded on number of primary branches per plant at different stages of crop growth in China aster varieties are presented in Table 4.

At 30 DAT, there was significant difference among different China aster varieties for number of primary branches per plant. However, maximum number of primary branches per plant was recorded in var. Phule Ganesh Violet (4.65) followed by Phule Ganesh White (4.21), Phule Ganesh Purple (3.98), Phule Ganesh Pink (3.90) and Arka Aadya (3.80). The minimum number of primary branches per plant was recorded in var. Shashank (2.05). Among all the twelve genotypes, five genotypes had shown significant difference over the check variety Kamini (2.97).

At 60 DAT, var. Phule Ganesh Violet recorded significantly highest number of primary branches per plant (15.90), which was on par with var. Phule Ganesh White (14.53). Lowest number of primary braches per plant was recorded in the var. Shashank (7.27). Varieties Phule Ganesh Violet and Phule Ganesh White had shown significant superiority over check variety Kamini (10.80).

There was significant difference observed among the varieties with respect to number of primary branches produced per plant at 90 days after transplanting. Var. Phule Ganesh Violet recorded maximum number of primary branches per plant (19.16), which was on par with var. Phule Ganesh White (18.41) and significantly superior over Kamini (16.93). The var. Mudigere Local recorded significantly minimum number of primary branches (11.05).

At 120 days DAT, there was more significant difference recorded among the varieties with respect to number of primary branches. Var. Phule Ganesh Violet had recorded maximum number of primary branches (22.05), which was on par with var. Phule Ganesh White (22.04). Phule Ganesh Violet was found to be significantly superior over check variety Kamini (18.55). Minimum number of primary branches was observed in var. Mudigere Local (12.90).

Number of secondary branches per plant

Significant difference was found among the varieties with respect to number of secondary branches produced per plant at various growth stages (Table 5).

At 60 DAT, var. Phule Ganesh Violet recorded significantly maximum number of secondary branches per plant (28.25), which was on par with varieties Phule Ganesh White (26.10), Phule Ganesh Purple (22.71) and Phule Ganesh Pink (22.03) and superior over check var. Kamini (13.42). The lowest

number of secondary branches per plant was recorded in the var. Shashank (12.13).

The var. Phule Ganesh Violet recorded highest number of secondary branches (37.21) per plant at 90 days after transplanting, which was on par with Phule Ganesh White (34.13), Phule Ganesh Purple (32.76), Namdhari White (31.00) and Phule Ganesh Pink (31.05). The least number of secondary branches per plant was recorded in the var. Shashank (19.20). Five varieties were noticed to be significantly superior over check var. Kamini (22.41).

At 120 DAT, var. Phule Ganesh Violet recorded significantly highest number of secondary branches (38.60) per plant, which was on par with varieties Phule Ganesh White (37.13), Phule Ganesh Purple (34.73), Phule Ganesh Pink (34.00) and Namdhari White (34.00) and these had shown significant superiority over Kamini (25.41), whereas, minimum number of secondary branches per plant was recorded in var. Mudigere Local (21.64).

Leaf area

Leaf area per plant varied significantly in different varieties of China aster at all the stages of plant growth, which is presented in Table 6. Among different varieties, Phule Ganesh Violet was found superior which had exhibited maximum leaf area per plant (9.66 cm^2, 26.30 cm^2, 36.32 cm^2 and 42.38 cm^2 at 30, 60, 90 and 120 DAT, respectively). It was on par with Phule Ganesh White (7.79 cm^2, 24.50 cm^2, 34.50 cm^2 and 40.50 cm^2 at 30, 60, 90 and 120 DAT, respectively) and Phule Ganesh Purple (19.21 and 30.21 cm^2 at 60 and 90 DAT, respectively). Minimum leaf area was recorded in var. Mudigere Local (5.10 cm^2, 9.80 cm^2, 18.87 cm^2 and 23.58 cm^2 at 30, 60, 90 and 120 DAT, respectively). Three varieties had recorded significantly more leaf area over check variety Kamini (5.60 cm^2, 11.83 cm^2, 20.85 cm^2 and 25.83 cm^2 at 30, 60, 90 and 120 days, respectively) (Fig.3).

Number of flowers per plant

Maximum numbers of flowers per plant were recorded in var. Poornima (68.53), which was on par with the varieties Arka Archana (66.67), Phule Ganesh Purple (60.15) and Phule Ganesh Violet (60.01). These varieties were significantly superior over check var. Kamini (51.80), whereas, var. Namdhari White had minimum number of flowers per plant (39.00) (Table.8) (Fig.4).

Flower diameter

Significant difference was observed among the varieties of China aster with respect to flower diameter. It was maximum in var. Phule Ganesh White (6.35 cm) followed by var. Phule Ganesh Purple (6.10 cm), Phule Ganesh Violet (6.01 cm) and Phule Ganesh Pink (5.55 cm). These varieties were also recorded to be superior over check var. Kamini (4.90 cm), whereas minimum flower diameter (3.77 cm) was observed in var. Shashank (Table.8)

Flower yield per plant

The data on flower yield of different varieties of China aster presented in Table 8. Exhibited significant differences. The maximum flower yield per plant (214.67 g) was recorded in the var. Phule Ganesh White followed by varieties Phule Ganesh Violet (197.20 g), Phule Ganesh Pink (189.27 g), Arka Archana (186.13 g), Poornima (180.50 g) and Phule Ganesh Purple (176.33 g), whereas, var. Shashank (88.01 g) recorded minimum flower yield per plant. Among the twelve genotypes, six had exhibited significantly higher yield per plant over check var. Kamini (123.6 g)

Discussion

China aster is one of the most important annual and commercial flower crops gaining importance in the country particularly in Karnataka state. Both marginal and small farmers in various parts of our country are largely cultivating it as traditional crop. The crop growth and flower yield is influenced by various factors like genotype of the crop, season, environment *etc*. Among these factors, varieties themselves contribute much to the evolution of any flower crop. However, the performance of varieties of any crop differs from one region to another region under a given set of agro-climatic conditions. Hence, selection of cultivar is an important criterion for successful cultivation of flowers.

Evaluation of high yielding genotypes is essential since a superior genotype may exhibit its potentiality when grown under a given set of agro climatic conditions. Vegetative growth is measured in a better way in terms of plant height, plant spread, and number of leaves per plant, number of branches per plant, leaf area, leaf area index and chlorophyll content of leaves. These parameters play an important role in deciding the quality and productivity of China aster.

These variations in the plant height were due to the fact that the plant height was being a genetically controlled factor. Similar variation in plant height among different varieties was also observed previously in China aster by Kulkarni *et al.* (2004) [5], Poornima *et al*. (2006) [8] and in marigold by Singh *et al.* (2004) [10].

The better performance of the var. Phule Ganesh Violet might be due to its genetic makeup and its better adaptability to the prevailing environmental conditions. These results are in conformity with the results reported earlier in China aster by Ravikumar (2002) [9], Munikrishnappa (2011) [6] and Zosiamliana *et al*. (2012).

The production of more number of leaves per plant in these varieties was due to increased plant height. Such variations in number of leaves among the varieties were also observed by earlier workers Poornima *et al.* (2006) [8] and Zosiamliana *et al*. (2012) [6] in China aster.

The difference in number of primary branches could be attributed to the genetic makeup of the varieties. As far as secondary branches are concerned, var. Phule Ganesh Violet recorded maximum secondary branches followed by Phule Ganesh White and Phule Ganesh Purple. Secondary branches were minimum in var. Mudigere Local and Shashank. The difference in branches among the varieties could be due to the influence of genetic makeup of the varieties. Similar variations for number of branches were also observed in China aster (Ravikumar, 2002) [9].

Higher leaf area in these varieties was due to the increased number of leaves. Lesser number of leaves resulted in minimum leaf area since the varieties varied for their number of leaves. Variations in leaf production could be expected among the varieties due to genetic character. Variation in leaf area among varieties was also observed in China aster by Ravikumar (2002) [9] and Munikrishnappa (2011) [6].

Highest number of flowers per plant was produced in the vars. Poornima, Arka Archana, Phule Ganesh Purple and Phule Ganesh Violet, while 'Namdhari White' and 'Namdhari Pink' produced the least number of flowers per plant. The number of flowers produced per plant might be directly related to production of more plant height, number of leaves, plant spread, More number of branches per plant with good number

of developed flower buds on the branch, thereby synthesis of more photosynthates resulted in production of good number of developed flower buds on the branches. The similar results were observed in China aster by Munikrishnappa (2011) [6] and Zosiamliana *et al*. (2012) [6]. Maximum number of flowers per plant was produced in the vars. Poornima, Arka Archana, Phule Ganesh Purple and Phule Ganesh Violet, while 'Namdhari White' and 'Namdhari Pink' produced the least number of flowers per plant. The number of flowers produced per plant might be directly related to production of more plant height, number of leaves, plant spread, and more number of branches per plant with good number of developed flower buds on the branch, thereby synthesis of more photosynthates resulted in production of good number of developed flower buds on the branches. The similar results were observed in China aster by Munikrishnappa (2011) [6] and Zosiamliana *et al*. (2012) [6]. Flower yield per plant, yield per plot and yield per hectare was maximum in var. Phule Ganesh White. The increased flower yield was because of increased weight of flower and number of flowers per plant as in case of var. Phule Ganesh White, Phule Ganesh Pink and Phule Ganesh Violet. The flower yield was less in var. Shashank and Namdhari Pink. Variation in flower yield was also observed previously in China aster (Munikrishnappa, 2011 [6] and Zosiamliana *et al*., 2012) [6].

Conclusion

The China aster varieties showed variation in growth, yield and quality among the different varieties. The mean plant height varied significantly for the varieties evaluated. Though the 'Phule Ganesh' series showed increase in plant height at all the growth stages i.e. 30, 60, 90 and 120 days after transplanting, the variety Phule Ganesh Violet attained maximum plant height. The plant spread varied significantly among the varieties. The maximum plant spread was recorded in Phule Ganesh Violet, Phule Ganesh White Phule Ganesh Pink and purple. Minimum plant spread was recorded in var. Shashank. Phule Ganesh Violet and Phule Ganesh White recorded maximum number of leaves during their growth period. The number of primary and secondary branches was also recorded maximum in Phule Ganesh Violet and Phule Ganesh White. The leaf area was significantly different among the cultivars studied. Var. Phule Ganesh Violet had maximum leaf area and leaf area index, while the var. Mudigere Local recorded minimum leaf area and leaf area index.

Table 1: Variation in plant height of China aster varieties at various growth stages

Variety	Plant height (cm)			
	Days after transplanting			
	30	60	90	120
Kamini	10.82	32.13	36.95	37.54
Shashank	12.95	29.42	34.70	35.23
Poornima	16.01	37.65	42.51	44.52
Arka Aadya	13.90	37.97	38.20	39.51
Arka Archana	11.83	27.10	34.36	36.22
Phule Ganesh White	17.22	42.42	61.09	67.01
Phule Ganesh Pink	12.81	32.47	44.03	47.90
Phule Ganesh Purple	13.95	37.90	47.12	51.61
Phule Ganesh Violet	16.69	43.31	64.92	69.40
Mudigere Local	7.83	27.33	36.26	38.15
Namdhari Pink	10.21	34.21	36.94	37.80
Namdhari White	12.86	32.82	43.33	45.26
Mean	13.15	34.55	43.33	45.83
S.Em. ±	0.95	2.40	1.77	1.72
CD at 5%	2.78	7.03	5.19	5.03

Table 2: Variation in plant spread in China aster varieties at various growth stages

Variety	Plant spread (cm)			
	Days after transplanting			
	30	60	90	120
Kamini	13.33	22.43	23.80	24.21
Shashank	12.55	15.42	16.61	17.10
Poornima	11.62	16.81	26.30	28.25
Arka Aadya	15.29	19.99	29.02	28.73
Arka Archana	15.56	22.52	27.83	28.52
Phule Ganesh White	16.20	26.85	30.88	31.11
Phule Ganesh Pink	15.61	24.86	29.76	30.81
Phule Ganesh Purple	14.46	24.46	29.01	29.95
Phule Ganesh Violet	17.02	27.31	32.00	33.36
Mudigere Local	14.03	15.61	23.61	24.30
Namdhari Pink	14.65	24.63	24.02	25.31
Namdhari White	15.31	22.72	25.42	26.72
Mean	14.59	21.92	26.48	27.38
S.Em. ±	1.14	1.55	0.97	0.83
CD at 5%	NS	4.54	2.85	2.42

Table 3: Variation in number of leaves per plant in China aster varieties at various growth stages

Variety	Number of leaves per plant			
	Days after transplanting			
	30	60	90	120
Kamini	10.12	31.30	149.01	156.15
Shashank	14.53	35.31	137.72	145.02
Poornima	12.15	30.62	156.03	163.01
Arka Aadya	11.51	35.55	129.11	136.40
Arka Archana	13.30	35.59	146.30	155.25
Phule Ganesh White	11.61	43.06	175.33	183.02
Phule Ganesh Pink	12.92	29.77	163.01	172.71
Phule Ganesh Purple	10.15	30.25	168.05	178.01
Phule Ganesh Violet	14.13	49.94	182.06	192.05
Mudigere Local	9.91	27.53	134.02	142.02
Namdhari Pink	10.79	33.73	136.01	144.03
Namdhari White	12.63	37.91	142.00	150.73
Mean	11.94	34.99	151.53	159.83
S.Em. ±	0.81	3.60	4.42	4.68
CD at 5%	NS	10.55	12.95	13.72

Table 4: Variation in number of primary branches per plant in China aster varieties at various growth stages

Variety	Number of primary branches per plant			
	Days after transplanting			
	30	60	90	120
Kamini	2.97	10.80	16.93	18.55
Shashank	2.05	7.27	11.71	15.62
Poornima	2.40	9.30	13.11	15.01
Arka Aadya	3.80	12.07	14.82	18.70
Arka Archana	3.58	12.47	15.40	18.46
Phule Ganesh White	4.21	14.53	18.41	22.04
Phule Ganesh Pink	3.90	13.96	16.10	18.42
Phule Ganesh Purple	3.98	11.52	13.62	15.43
Phule Ganesh Violet	4.65	15.90	19.16	22.05
Mudigere Local	2.50	8.45	11.05	12.90
Namdhari Pink	2.89	11.90	13.80	16.81
Namdhari White	3.29	13.62	15.15	17.01
Mean	3.35	11.77	14.90	17.59
S.Em. ±	0.12	0.94	0.95	1.09
CD at 5%	0.36	2.74	2.79	3.19

Table 5: Variation in number of secondary branches per plant in China aster varieties at various growth stages

Variety	Number of secondary branches per plant		
	Days after transplanting		
	60	90	120
Kamini	13.42	22.41	25.41
Shashank	12.13	19.20	22.00
Poornima	16.01	24.90	27.85
Arka Aadya	18.11	26.12	28.13
Arka Archana	18.90	27.91	30.88
Phule Ganesh White	26.10	34.13	37.13
Phule Ganesh Pink	22.03	31.05	34.00
Phule Ganesh Purple	22.71	32.76	34.73
Phule Ganesh Violet	28.25	37.21	38.60
Mudigere Local	12.81	19.62	21.64
Namdhari Pink	18.02	27.00	29.00
Namdhari White	20.03	31.00	34.00
Mean	19.03	27.76	30.28
S.Em. ±	0.9	0.82	1.00
CD at 5%	2.65	2.40	2.93

Table 6: Variation in leaf area of China aster varieties at various growth stages

Variety	Leaf area (cm^2)			
	Days after transplanting			
	30	60	90	120
Kamini	5.60	11.83	20.85	25.83
Shashank	5.40	10.02	20.03	26.02
Poornima	6.18	12.84	23.83	29.84
Arka Aadya	7.50	13.30	24.30	30.30
Arka Archana	7.66	12.83	21.70	25.83
Phule Ganesh White	7.79	24.50	34.50	40.50
Phule Ganesh Pink	6.61	14.28	23.28	28.28
Phule Ganesh Purple	7.44	19.21	30.21	36.21
Phule Ganesh Violet	9.66	26.30	36.32	42.28
Mudigere Local	5.10	9.80	18.87	23.58
Namdhari Pink	5.40	10.60	22.60	28.60
Namdhari White	7.77	12.30	21.30	27.30
Mean	6.85	14.81	24.81	30.38
S.Em. ±	0.21	0.61	0.76	0.92
CD at 5%	0.62	1.80	2.23	2.71

Table 7: Variation in number of flowers $plant^{-1}$, yield $plant^{-1}$ China aster varieties

Variety	Flower Diameter(cm)	No. of flowers/ plant	Yield/plant (g)
Kamini	4.90	51.80	123.60
Shashank	3.77	54.53	88.01
Poornima	4.90	68.53	180.50
Arka Aadya	5.00	57.00	117.03
Arka Archana	4.30	66.67	186.13
Phule Ganesh White	6.35	46.80	214.67
Phule Ganesh Pink	5.55	40.76	189.27
Phule Ganesh Purple	6.10	60.15	176.33
Phule Ganesh Violet	6.01	60.01	197.20
Mudigere Local	3.90	52.00	102.43
Namdhari Pink	4.68	44.33	98.37
Namdhari White	4.51	39.00	154.47
Mean	5.00	53.45	152.33
S.Em. ±	0.15	1.82	4.56
CD at 5%	0.45	5.3	13.37

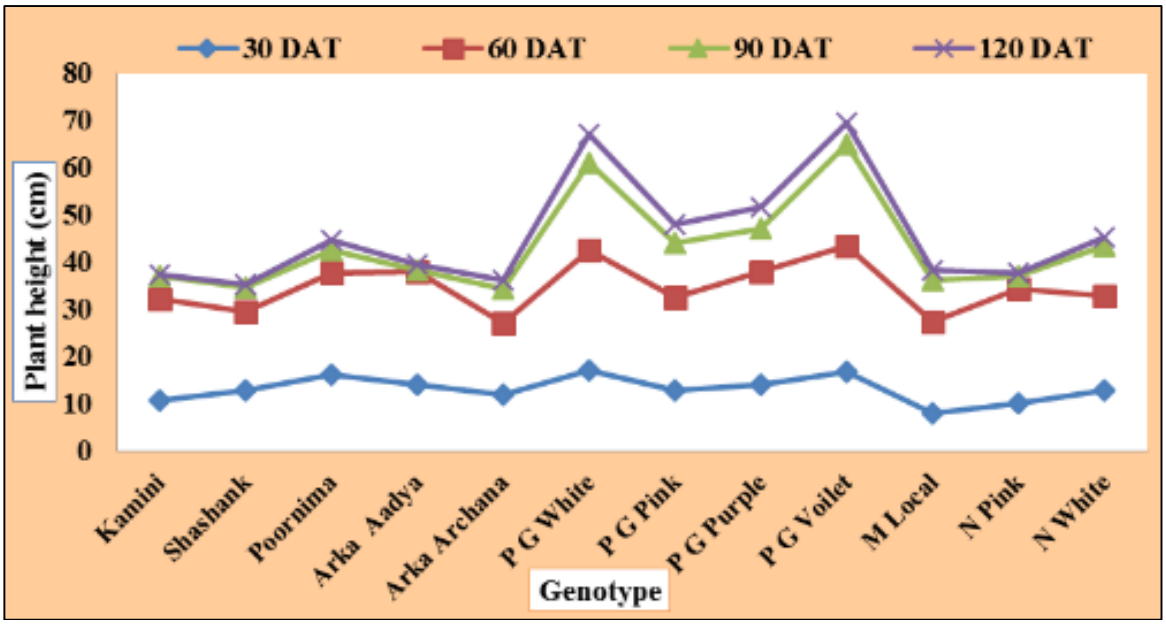

Fig 1: Variation in plant height of China aster varieties at various growth stages

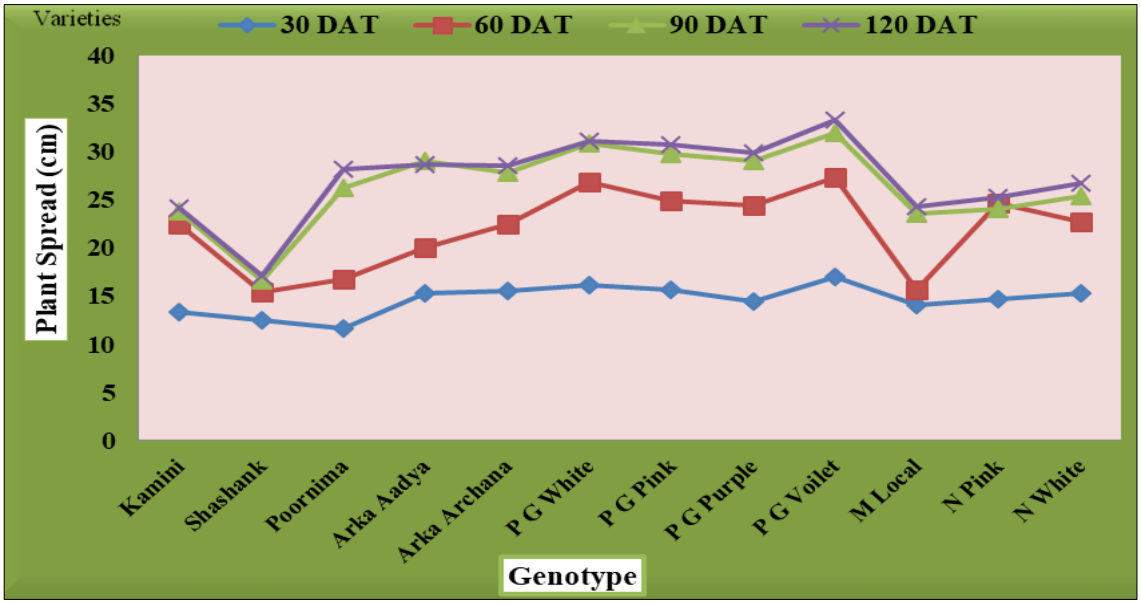

Fig 2: Variation in plant spread in China aster varieties at various growth stages

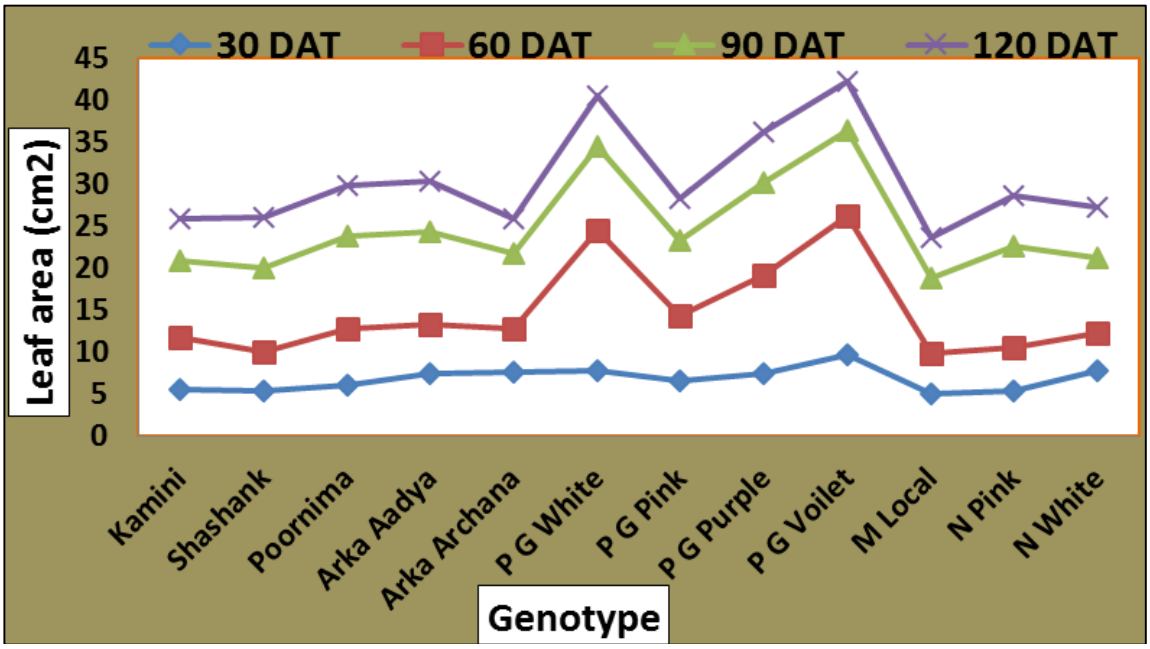

Fig 3: Variation in leaf area of China aster varieties at various growth stages

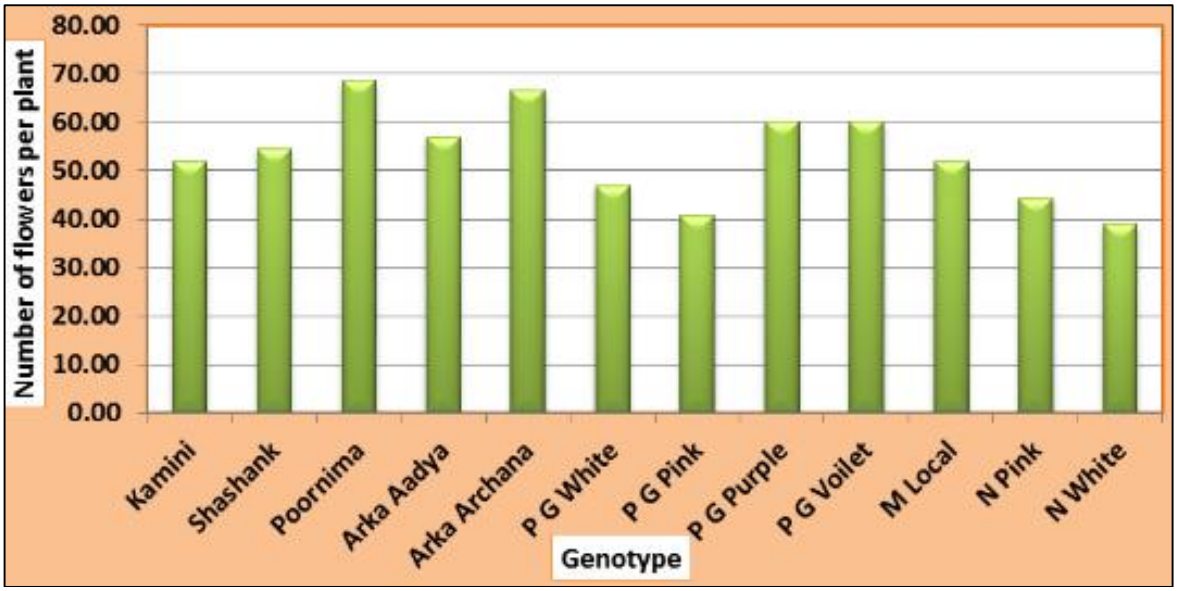

Fig 4: Variation in number of flowers per plant of China aster varieties

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