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ORIGINAL ARTICLE **OPEN ACCESS**

Study on the performance of some Genotypes of China aster [*Callistephus chinensis* (L.) Ness] under Shade net Conditions in Rayalaseema Region of Andhra Pradesh

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ABSTRACT
The present investigation was carried out during the year 2017-18 at College of Horticulture, Dr. Y.S.R Horticultural University, Anantharajupeta, Y.S.R. Kadapa Dist. of Andhra Pradesh. The experiment consisted of 7 China aster genotypes, laid out in randomized block design with four replications under 50 per cent shade net condition. The data recorded on biometric observations revealed that, significantly taller plant (86.15 cm), higher leaf count plant^{-1} (180.30) at the time of first harvest, higher number of branches plant^{-1} at full bloom (13.15) and maximum plant spread (1330.67 cm^2) were recorded in genotype Arka Archana. Among flowering attributes, the genotype Arka Archana took minimum duration for days to first flower opening after flower initiation (6.00), 50 per cent flowering advancement was observed in Arka Shashank (92.70 days), while the genotype Arka Aadya arrived for days to first harvesting of mature flower by taking limited period (69.25 days). Larger flower head circumference (16.12 cm) and flower diameter (5.13 cm) was found in Arka Aadya, while longest flower stalk (19.88 cm) and longer duration of vase life (7.70 days) in normal tap water was recorded in genotype Arka Shashank.
Key words: *China aster, genotypes, biometrical attributes, flowering attributes and shade net house.*

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INTRODUCTION

China aster [*Callistephus chinensis* (L.) Ness] belongs to one of the largest families of flowering plants, Asteraceae possessing chromosome number 2n=18. It is one of the most important annual flower crops grown in most parts of the world. Among annuals, it is claimed to rank third for popularity, after chrysanthemum and marigold [17]. China aster is commercially grown by marginal and small farmers in Karnataka, Tamil Nadu, Telangana, Andhra Pradesh, Maharastra and West Bengal [10]. China aster can be grown throughout the year under Bengaluru conditions. In scenario of Andhra Pradesh state, it has a great demand in local market as cut flower and potted plants, previously local varieties producing inferior flower quality were grown and the consumers were not satisfied due to lack of selection of varieties as well as improper use of agro-techniques. Though many genotypes of China aster can be grown in any agro-climatic region, all of them are not suited for cut flower purpose, garden display and exhibition purpose. So, there is a need to evaluate hybrids and varieties in any particular agro-climatic region.
Increased flower quantity and quality with perfection in the form of plants are important objectives to be reckoned in commercial flower production. Although, there are sufficient number of cultivars under cultivation but their performance are region specific and varies from place to place, information on best China aster cultivar for loose flower production and cut flower production is lacking under the tropical conditions of semi-arid zone of Southern Andhra Pradesh. Hence, the present investigation was designed to determine the best suitable China aster cultivars for quality cut flower and loose flower production which is important to select cultivars for fetching high market prices.

MATERIAL AND METHODS

The present investigation on China aster [*Callistephus chinensis* (L.) Ness] genotypes was conducted during *Rabi* season of 2017-2018 under shade net condition at College of Horticulture, Anantharajupeta,

Y.S.R Kadapa Dist. The experiment was conducted to study the performance of China aster (*Callistephus chinensis* L.) genotypes under shade net house conditions in Rayalaseema conditions of Andhra pradesh. The experiment was laid-out in Randomized Block Design, replicated quadruple. The trail consist of seven genotypes *viz.,* G1- Arka Aadya, G2- Arka Shashank, G3- Arka Archana, G4- Arka Poornima, G5- Arka Kamini, G6- Local pink and G7- Local violet (check). The seeds of five genotypes were collected from IIHR, Bengaluru, Local Pink from ARI, Rajendranagar, Hyderabad and Local Violet (check) from Mydukur area of Y.S.R Kadapa Dist. Ploughing and digging of the land was done and brought to fine tilth under shade net. All weeds were completely removed from the field. All the stubbles of previous crop were removed from the field and burnt. The required numbers of plots (28) were prepared of size (1.80 m × 1.80 m) with bunds of 60 cm between plots. The length of experimental field was 12.60 m and width was 9.00 m. Well decomposed farm yard manure was applied uniformly to all the experimental plots at 25 t ha-1 and mixed well. Nitrogen (180 kg ha-1), phosphorus (120 kg ha-1) and potassium (60 kg ha-1) (Dr.Y.S.R.H.U, Andhra Pradesh recommendation) were applied. The entire quantities of phosphorus, potash and 50 per cent of nitrogen were applied as basal dose and remaining 50 per cent nitrogen was applied as a top dressing at forty days after transplanting in all the experimental plots. The seedlings required were obtained from seven raised nursery beds of size 3.0 m x 1.0m.

The beds were first drenched with captan (0.2%) and seeds were sown thinly and uniformly in lines and covered with a mixture of well rotten FYM and top soil. Seeds of different varieties were also treated with captan (2 g / kg seeds) for five minutes and then sown in lines. The nursery beds were watered daily twice, once in the morning and again during evening for the first 10 days and thereafter once daily for the remaining period. Hand weeding was done as and when weeds were noticed. Forty five days old healthy seedlings of uniform growth were used for transplanting. Transplanting was done in the evening at the rate of one seedling per hill and light irrigation was given immediately after planting. Necessary plant protection measures were followed to prevent insect pest incidence. At initial stages of growth, chlorpyriphos @ 2-3 ml litre-1 of water was sprayed to control *Spodoptera litura* and disease incidence was not noticed during period of investigation.

Five plants were selected per each plot at random and were labeled properly for recording observations. The data on various biometrical and flowering attributes were recorded with using meter scale and vernier callipers.

RESULTS AND DISCUSSION

Plant height

Plant height of China aster exposed statistically significant variation among seven genotypes at the time of first harvest (Table 1). The genotype Arka Archana recorded the maximum plant height (86.15 cm) which was significantly superior over other genotypes. The genotype Local Violet (check) recorded shorter plant (47.93 cm) which was on par with Local Pink (49.20 cm).

Plant height is an important varietal character that depends upon the genetic constitution. The variation among different genotypes may be attributed to genetic makeup of the genotypes and the increase in plant height was associated with rapid meristamatic activity probably due to rapid cell division and elongation during the tender growth period. The plant height was recorded maximum in genotype Arka Archana due to genetically controlled factors. The reason for higher plant height may also be ascribed to a varietal character. Above results were in conformity with the findings of Poornima *et al*. [14], Chavan *et al.* [3], Zosiamliana *et al.* [22], Munikrishnappa *et al.* [12], Tirakannanavar *et al.* [19], Kumar *et al.* [8] and Bhargav *et al.* [1] in China aster.

Number of leaves plant^{-1}

Number of leaves plant^{-1} during different growth periods varied significantly among the multiple genotypes studied (Table 2). The genotype Arka Archana produced highest number of leaves plant^{-1} (180.30) at the time of first harvest which was significantly superior to all remaining genotypes and which was followed by Arka Aadya (163.50). The lowest leaf count of 136.25 was recorded in genotype Local Violet (check) which differed significantly among all genotypes studied.

The production of more number of leaves plant^{-1} in genotype Arka Archana might be due to vigorous growth, more number of primary and secondary branches and more plant spread which in turn facilitates better harvest of sunshine by the plant to produce more number of leaves. Trends observed in the present trial confirm the results obtained by Zosiamliana *et al.* [21] in China aster. The variation in number of leaves among different genotypes at different growth stages might also be due to the distinguished varietal genetic makeup of a particular genotype as a result of variations in phenotypic expression under prevailing environmental condition [9] in China aster. Number of leaves plant^{-1} depends on the efficiency of photosynthetic activity which contributes towards better growth and yield [11] in anthurium.

Number of branches plant^{-1}

Seven China aster genotypes showed statistically significant difference at full bloom stage for number of branches plant^{-1}.The branch count plant^{-1} at full bloom stage was recorded maximum in genotype Arka Archana (13.15) which was on par to Arka Aadya (12.90) and Arka Kamini (12.10). The fewer branches plant^{-1} (7.45) was recorded in genotype Local Violet (check) which was on par with Local Pink (7.85) and Arka Shashank (8.15).

The difference in production of branches among the genotypes could be due to influence of the genetical makeup of the cultivars. These results are in agreement with the findings in China aster by Poornima *et al.* [14], Zosiamliana *et al.* [21], Munikrishnappa *et al.* [12] and Rai and Chaudhary [15]. Increased number of branches plant^{-1} leads to production of more number of leaves in turn it will enhance the yield of flowers by increasing source and sink relationship. Similar trend was noticed by Gupta *et al.* [6], Verma and Kulkarni [20] in dahlia and Munikrishnappa *et al*. [12] and Chowdhuri *et al.* [4] in different China aster genotypes. Possible reason for production of higher number of branches may also be due to the combined effect of congenial climate inside shade net house and the characteristic feature of the genotype (Appendix-I).

Plant spread

A perusal of the data presented in the Table 3 showed significant influence of different genotypes on plant spread at full bloom. Among the genotypes, at full bloom stage, wider plant spread (1330.67 cm^2) was recorded in genotype Arka Archana which was on par with Arka Aadya (1197.60 cm^2) and Arka Kamini (1058.88 cm^2). The genotype Local Pink recorded the narrow plant spread (560.14 cm^2) which was on par with Local Violet (594.71 cm^2) and Arka Poornima (739.02 cm^2).

Probable reason for increase in plant spread might be due to production of higher number of branches and wider angles with point of origin. Greater plant spread shows better vegetative growth of plant. The increasing plant spread due to increased number of branches was reported earlier by Swaroopini (2013) in chrysanthemum. Plant spread is an important growth factor for flower crops. It helps to utilize the sunlight to maximum extent. It is varietal trait and variations among the genotypes are attributed to the genetic makeup of the plant. Variation in plant spread due to varieties has been reported by Pandey and Rao [13] in China aster; Sharma [16] in French marigold. Favourable micro-climate inside shade net house during the period of investigation was also possible reason for obtaining satisfactory growth in genotype Arka Archana (Appendix: I).

Days to first flower bud initiation from the day of transplanting

Significant variation was found among seven China aster genotypes for the number of days to the emergence of flower bud. A perusal of data from the Table 1 indicated that the number of days to first flower bud initiation varied significantly in various genotypes. The genotype Arka Aadya took minimum duration to first flower bud initiation from the day of transplanting (58.70 days) which was statistically on par to Arka Shashank (59.05 days). Significantly longer time of 87.90 days to first flower bud initiation from the day of transplanting was noticed in Arka Poornima which was found independent from other genotypes.

The probable reason for the above finding might be due to genetical makeup of the cultivars. This signifies the earliness of a cultivar as reported by Zosiamliana *et al.* [21] and Munikrishnappa *et al.* [12] in China aster. Another reason for early flower bud initiation in genotype Arka Aadya could be attributed to higher capacity of plants to make available assimilates to the reproductive site during sensitive phase before initiation.

Days to 50% flowering

Various genotypes had significant influence on days to 50 per cent flowering (Table 1).

Among genotypes, advancement in 50 per cent flowering (92.70 days) was recorded in Arka Shashank which was found significantly superior to rest of genotypes and which was followed by Arka Aadya (96.05 days). The genotype Arka Poornima showed 50 per cent flowering by taking longer period (121.15 days) and found significantly different from other genotypes.

Earliness (or) lateness in flowering of plants could be due to the growing environment (Appendix: I) as well as varietal character. This might be due to the genetic trait and the genetic constituents of the plant that play an important role in this attribute [9]. A wide variation in number of days to 50 per cent flowering has also been reported by Zosiamliana *et al*. [22], Tirakannanavar *et al*. [19] and Rai and Chaudhary [15] in China aster. Environment that prevails under growing system during study made the genotype Arka Shashank plants for arriving to 50 per cent flowering in minimum duration.

Days to first harvesting of mature flower

The data recorded on the days to first harvesting of mature flower due to the influence of various genotypes are furnished in Table 1 and shows significant influence. The genotype Arka Aadya was the earliest to flower (69.25 days) and this was on par with Arka Shashank (70.10 days) and Arka Archana

(71.75 days). Maximum duration of 101.65 days to first harvesting of mature flower was recorded in Arka Poornima and found significantly independent from other genotypes.

The above finding could be due to the fact that genotype Arka Aadya came to flower bud initiation in time very early compared to other genotypes (Table 1) and in the same corollary the genotype gave first harvest of the mature flower in shortest duration. These results have substantiated the findings of Swaroopini [18] in chrysanthemum. Both earliness and lateness were helpful in determining the market availability of flowers for a longer period. Nevertheless, earliness in flowering was more suitable for farmers, to fetch early market [1].

Primarily, it is a varietal trait, but is positively correlated to the number of flowers plant^{-1} and flowering duration. More is the flowering duration, there will be more non-synchronous maturity among the flowers i.e. flowers reaching the harvesting stage at the same time will be less. Although, there exist several number of varieties under cultivation, their performance are region specific, which varies with location and climate. In addition, nutritional and climatic conditions that prevail during the growing period also determine the flowering characters [2].

Flower head circumference (cm)

Significant variation was observed among the genotypes for flower head circumference and presented in Table 2. Among the genotypes studied under the attribute flower head circumference, the genotype Arka Aadya has larger flower head circumference (16.12 cm) which was on par with Arka Archana (15.57 cm). The genotype Arka Shashank produced lowest flower head circumference (11.63 cm) and is an independent genotype to all others.

Variation in flower head circumference among the genotypes observed was because of the changes in number of petals, ray florets and flower capitulam size. The present finding was parallel with the reports of Kaushal *et al.* (2014) in China aster genotypes studied.

Length of flower stalk (cm)

The data in Table 2 indicated that length of flower stalk differed significantly due to the influence of multiple genotypes investigated. Significantly longest flower stalk of 19.88 cm was recorded in genotype Arka Shashank which was at par with Arka Aadya (18.18 cm) and Arka Kamini (18.04 cm). The genotype Local Violet (check) gave shorter flower stalk (14.85 cm) which was on par with Local Pink (15.25 cm) and Arka Archana (16.09 cm).

More the flower stalk length, more the reserve food stored in the stalk and available to the flower and extend the shelf life of cut flowers. Significant variation for stalk length in China aster had been reported by Zosiamliana *et al.* [21]. Similar results have also observed by Chowdhuri *et al.* [4] in China aster.

Flower diameter (cm)

The data presented in Table 2 showed significant variation in genotypes for the attribute flower head diameter. The flower diameter was maximum (5.13 cm) in genotype Arka Aadya and was significantly superior to remaining genotypes, which was followed by Arka Archana (4.95 cm). The flower diameter recorded was smaller (3.70 cm) in Arka Shashank which differed significantly from other genotypes.

Variation in flower diameter among the genotypes observed was because of the changes in number of petals, ray florets and flower capitulam size. The genetic makeup of the genotypes which might have been further modified by prevailing environmental condition and temperature during the time of experiment could be the reason for variation (Appendix: I). The results were in substantiation with the reports of Zosiamliana *et al.* [22], Rai and Chaudhary [15], Kumar *et al.* [8] and Bhargav *et al.* [1] in China aster, Dewan *et al.* (2016) in gerbera.

Vase life (days)

Response of vase life was significant among genotypes (Table 2). A critical examination of data pertaining to vase life of genotypes revealed that the genotype Arka Shashank had the longer vase life (7.70 days) which was followed by Arka Kamini (6.30 days). The shorter vase life (4.15 days) was recorded in genotype Local Violet (check).

The longevity of cut flower was maintained by good water uptake, low transpiration rate and low ethylene production. For a cut flower, vase life was an important factor. The consumer's preference for good cut flowers depends on the vase life along with the attractive color of floret, stalk length and the number of petals per flower. It is one of the important traits that determine the economic value of cut flowers. Variations in vase life can also be attributed to the differential accumulation of carbohydrates due to varied leaf production and sensitivity of cultivars to ethylene. This can also be attributed to the varied uptake of nutrients and water through xylem and phloem vessels by the genotypes. This may be due to the fact that it inherits the trait and also it may be due to that it has a better storage of photosynthates as it produces more number of leaves in its growth periods. The results were in line with the findings of Zosiamliana *et al.* [21] and Rai and Chaudhary [15] in China aster. The varietal variations

in vase life among genotypes of China aster have also been reported by Chowdhuri *et al.* [4] and Bhargav *et al.* [1] in China aster.

Table 1: Evaluation of China aster genotypes for various biometrical and flowering attributes

Genotypes		Plant height (cm)	Number of leaves plant^{-1}	Number of branches	Plant spread (cm^2)	Days to first flower bud initiation from day of transplanting	Days to 50% flowering	Days to first harvesting of mature flower
G_1	Arka Aadya	59.83	12.90	12.90	58.70	96.05	69.25	7.60
G_2	Arka Shashank	79.07	8.15	8.15	59.05	92.70	70.10	8.05
G_3	Arka Archana	86.15	13.15	13.15	62.75	100.00	71.75	6.00
G_4	Arka Poornima	77.29	8.75	8.75	87.90	121.15	101.65	10.80
G_5	Arka Kamini	54.52	12.10	12.10	69.65	98.50	80.80	8.15
G_6	Local Pink	49.20	7.85	7.85	71.40	104.70	83.65	9.75
G_7	Local Violet (check)	47.93	7.45	7.45	72.00	103.05	83.35	8.35
SEM ±		2.06	1.95	0.36	61.03	0.60	1.04	0.56
CD (*P*= 0.05)		6.18	5.85	1.09	182.73	1.79	3.12	1.69

Table 2: Evaluation of China aster genotypes for various flower quality parameters

Genotypes		Flower head circumference (cm)	Length of flower stalk (cm)	Flower diameter (cm)	Vase life (days)
G_1	Arka Aadya	16.12	18.18	5.13	5.45
G_2	Arka Shashank	11.63	19.88	3.70	7.70
G_3	Arka Archana	15.57	16.09	4.95	5.60
G_4	Arka Poornima	13.48	17.17	4.29	5.15
G_5	Arka Kamini	13.39	18.04	4.26	6.30
G_6	Local Pink	14.18	15.25	4.51	5.20
G_7	Local Violet (check)	12.95	14.85	4.12	4.15
SEM ±		0.35	0.62	0.11	0.20
CD (*P*= 0.05)		1.06	1.84	0.336	0.58

Appendix I

Monthly mean temperature (^{0}C), relative humidity (%) and light intensity (lux) during the investigation period

Month	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)	Light intensity (lux)
	Max.	Min.	8.00 am	2.00 pm		
January, 2018	29.5	15.1	72.8	56.7	0.0	28921
February,2018	31.3	16.9	70.9	54.7	3.0	30896
March, 2018	34.3	20.0	68.8	52.7	25.4	32921
April, 2018	36.4	22.1	66.4	51.1	24.0	34397
May,2018	38.6	24.3	63.6	49.9	0.0	36021

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