

Effect of different sowing dates and planting distance on growth, yield and quality of China aster (*Callistephus chinensis* L.)

ABSTRACT

The present investigation was carried out to find out the best planting time and spacing in terms of growth and flower yield and quality of China aster during Rabi season 2022. The research was laid out in Randomized Complete Block Design, which had nine treatments replicated thrice. The dates of sowing were kept in the month of October at an interval of one week i.e., 2nd, 9th and 16th having different planting distance (30x20 cm, 30x30 cm, 30x40 cm). This experiment revealed that that Treatment T1 in which seed were sown in 1st week of October having planting distance of 30 x 20 cm performed best in with respect to growth, flower yield and quality of China aster.

Key words: *Different sowing dates, planting distance, China aster, RCBD.*



Introduction

China Aster is an important ornamental flowering plant that is widely cultivated for its attractive flowers in various parts of the world. It belongs to the family Asteraceae and is commonly known as the "annual chrysanthemum". The genus *Callistephus* derives its name from two Greek words: 'kalistos', meaning 'most beautiful', and 'stephos', meaning 'a crown', referring to the flowers. The development of central florets was the first change in the flower type, which ultimately led to the formation of quelled flowers. The cultivation of different varieties of China Aster is often associated with variations in their sowing dates, which ultimately affect the yield and quality of the flowers. The quality of China Aster flowers is mainly determined by the variety and the prevailing climatic conditions during the growing period. According to **Nagaraju et al. (2004)** optimal temperature and photoperiod are crucial factors in achieving blooms of good size and high quality. In South Indian conditions, the winter season is considered the most favorable for planting China Aster. In areas with less than

75 cm of rainfall and cool weather. The standardization of sowing dates for different varieties of China Aster is crucial for enhancing the production efficiency of the crop. It can also help in reducing the production costs and improving the overall profitability of the farmers. However, the optimum sowing dates of China Aster may vary depending on various factors such as climatic conditions, soil types, and the specific variety of China Aster being grown. The current research study aims to investigate the effects of different sowing dates on the vegetative growth, floral parameters, and vase life of China Aster

Plant density plays an important role in case of physiological functioning of plant. The planting distance affect the availability of nutrients, water, and light to plant which affect the photosynthetic activities which have ultimate effect on plant growth and yield. Thus, plant density at which a crop is planted has an immense role in growth, yield and flowering of crop. It has been reported by many workers that a close spacing has an adverse effect on the growth and quality of flowers even though the total yield increases, while wide spacing induces vigorous vegetative growth but yields are due to limited plant population.

Time of planting is the most important factor in influencing the yield of crop. performance of genotype entirely depends upon the time of planting. Delay in planting generally results in yield reduction which cannot be compensated by any other means. Timely transplanting seedlings results in earlier harvest than early transplanting Tender aged or over aged seedlings are not suitable for better yield. Medium aged seedlings result in greater leaf area, high yield.

Material and Method

The experiment was carried out at the Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj situated in the semi-arid agro climatic zone of Uttar Pradesh. Geographically, prayagraj is located at 25^o 45' North latitude, 81^o 85' East longitude and at an altitude of 98m(322ft) above mean sea level (MSL).

The different treatment combinations as follows T₁ (Oct -1st week 30×20cm), T₂ (Oct -1st week 30×30cm), T₃ (Oct -1st week 30×40cm), T₄ (Oct – 2nd week 30×20 cm), T₅ (Oct – 2nd week 30×30 cm), T₆ (Oct – 2nd week 30×40 cm), T₇ (Oct – 3rd week 30×20cm), T₈ (Oct – 3rd week 30×30cm), T₉ (Oct – 3rd week 30×40cm). The treatment were arranged in a Randomized

Complete Block Design(RCBD) with 9 treatment replicated thrice.

Result and Discussion: -

An experiment was carried out in the Experimental field. Department of Horticulture, Sam Higginbottom University of Agriculture Technology and Science, Naini, Prayagraj, District, Uttar Pradesh. During Rabi season 2022 Observations were recorded at 30, 60 and 90 (DAT) days after transplanting on different vegetative, photosynthetic, floral and vase life characters. The entire data were subjected to statistical analysis to get information on the effect of different Sowing dates and Planting distance and their interactions on the above parameters. The results are presented in this chapter under the following subheads with appropriate discussion.

Plant height (cm)

Plant height of China aster under different treatment combinations is presented table (4.1.1) and graphically illustrated in fig 4.1.1.

The plant height of China aster at different sowing dates and planting distance found Significant at 30 DAT, with interaction found non-significant at 30 DAT however it was non-significant at other two intervals *i.e.* ,60,90 DAT.

In the different levels of sowing dates and planting distance, the maximum plant height was observed in T₁ (OCT 2nd week 30x20cm) with 8.51 cm at 30 DAT, 16.84 cm at 60 DAT ,55.67 cm at 90 DAT. Followed by T₄ (OCT 3rd week 30x20cm) with 8.52 cm at 30 DAT, 15.09 cm at 60 DAT, 54.78 cm at 90 DAT in and minimum plant height was observed in T₉ (OCT 4th week 30x40cm) with 5.60 cm at 30 DAT, 11.22 cm at 60 DAT, 40.56 cm at 90 DAT respectively.

The plant height of a crop is a direct index to measure growth and vigor. In general, plant height increases gradually with the advancement of age. Maximum plant height was recorded in OCT 2nd week with closer spacing (30x20cm) and the minimum were recorded in OCT 4th week with wider spacing (30x40cm), this might be because, at a closer planting distance, less space is available for the spread of the plant, and hence all the food material is utilized in erect growth of the plant, resulting in more plant height. While as planting distance increased, plants got more space for their spread and food material is used for the growth of spread as well as height, resulting in less height of the plant as compared to closer planting distance. The same result is reported by **Chaudhary *et al.* (2007)** in zinnia, **Karuppaiah *et al.* (2005)** in marigold.

Number of leaves

Number of leaves of China aster under different combinations is presented table (4.1.2) and graphically illustrated in fig 4.1.2. The number of leaves of China aster with different sowing dates found significant at 60 DAT, with spacing and their interaction found non-significant at 60DAT and non-significant at other two intervals i.e. ,30,90 DAT.

In the different levels of sowing dates and planting distance, the maximum number of leaves was observed in T1 (OCT 2nd week 30x20cm) with 7.78 at 30 DAT, 21.22 at 60 DAT ,172.89 at 90 DAT. Followed by T3 (OCT 2nd week 30x40cm) with 7.56 at 30 DAT, 20.22 at 60 DAT, 164.55 at 90 DAT and minimum number of leaves was observed in T9 (OCT 4th week 30x40cm) with 5.78 at 30 DAT, 14.78 at 60 DAT, 132.45 at 90 DAT respectively.

An increasing trend was observed in number of leaves from 30 DAT to 90 DAT till harvest. Here, in OCT 2nd week with closer spacing (30x20cm) resulted a greater number of leaves, while a lesser number of leaves per plant was recorded OCT 4th week with wider spacing (30x40 cm), this might be because, at a closer planting distance, less space is available for the spread of the plant, and hence all the food material is utilized in erect growth of the leaf, resulting in more plant leaf. While as planting distance increased, plants got more space for their spread and food material is used for the growth of leaf bud formation, resulting in less leaves of the plant as compared to closer planting distance. **Agarwal et al. (2016)** in golden rod and **Jain et al. (2018)** in static reported that maximum no of leaves was recorded in closer spacing.

Plant spread (cm²)

Plant spread of China aster under different combinations is presented table (4.1.3) and graphically illustrated in fig 4.1.3. The Plant spread of China aster with different sowing dates and planting distance their interaction found non-significant at all three intervals i, e,30,60,90 DAT.

In the nine treatment of different sowing dates and planting distance the maximum Plant spread (cm²) was recorded in T₃ (OCT 2nd week 30x40cm) with 10,27 cm² at 30 DAT, 18.86 cm² at 60 DAT ,25.33 cm² at 90 DAT. Followed by T₄ (OCT 3rd week 30x20cm) with 9.66 cm² at 30 DAT, 18.28 cm² at 60 DAT, 25.22 cm² at 90 DAT, and minimum number of leaves was observed in T₉ (OCT 4th week 30x40cm) with 6.78 cm² at 30 DAT, 13.52 cm² at 60 DAT, 18.28 cm² at 90 DAT respectively.

The plant spread was recorded maximum in OCT 2nd week with wider spacing (30x40cm) where

there is rapid decrease in OCT 2nd week with closer spacing (30x20cm) to spread the plant, it needs to have more spacing. **Pratibha et al. (2018)** reported that maximum plant spread was observed in wider spacing.

Chlorophyll content.

Chlorophyll content (SPAD UNITS) of China aster under different combinations is presented table (4.2.3) and graphically illustrated in fig 4.2.3. The chlorophyll content of China aster with different sowing dates and planting distance their interaction found non-significant at all three interval 30,60,90 DAT.

In the Nine treatments of different sowing dates and planting distance the maximum chlorophyll content was recorded in T₈ (OCT 4th week 30x30cm) with 42.65 SPAD UNITS at 30 DAT, 47.46 SPAD UNITS at 60 DAT, 46.54 SPAD UNITS at 90 DAT. Followed by T₆ (OCT 3rd week 30x40cm) with 41.82 SPAD UNITS at 30 DAT, 45.84 SPAD UNITS at 60 DAT, 45.02 SPAD UNITS at 90 DAT, and minimum chlorophyll content was recorded in T₇ (OCT 4th week 30x20cm) with 40.02 SPAD UNITS at 30 DAT, 43.15 SAPD UNITS at 60 DAT, 45.00 SAPD UNITS at 90 DAT.

It is observed from the data that the total chlorophyll content of China aster plants was recorded maximum in OCT 4th week with wider spacing (30x30cm) and found minimum in OCT 4th week with closer spacing (30x20cm). Similarly (**Ahirwar et al., 2012**) reported that with the wider spacing the chlorophyll content was also increased in African marigold cv.Pusa Narangi Gainda under Jabalpur condition.

Day taken from planting to bud emergence.

Number of days required for flower bud emergence in China aster under different combinations is presented table (4.3.1) and graphically illustrated in fig 4.3.1

The Number of days required for flower bud emergence in China aster with different sowing dates and planting distance their interaction found non-significant.

In the Nine treatment of different sowing dates and planting distance the minimum days required for flower bud emergences was observed in T₃ (OCT 2nd week 30x40cm) with 77.33 days, followed by T₆ (OCT 3rd week 30x40cm) with 77.80 days and maximum days required for flower bud emergences is observed in T₁ (OCT 2nd week 30x20cm) with 85.11 days

Transplanting at OCT 2nd week with closer (30x20cm) spacing showed early flower bud due to less space all the food material is utilized in erect growth of the plant, resulting in early flower

bud than wider planting distance. While planting distance increased, plants got more space for their spread and food material is used for vegetative growth. **Kaur et al. (2009)** reported the similar results in chrysanthemum. And **Jadhav et al. (2014)** reported that minimum days to first flower bud emergences.

Days taken for buds break from planting.

Days taken for buds break from planting in China aster under different combinations is presented table (4.3.2) and graphically illustrated in fig (4.3.2) Days taken for buds break from planting in China aster with different sowing dates and planting distance their interaction found non-significant.

In the Nine treatment of different sowing dates and planting distance the minimum days required for flower bud break from planting was observed in T₃ (OCT 2nd week 30x40cm) with 87.26 days, followed by T₂ (OCT 2nd week 30x30cm) with 96.45days and maximum days required for flower bud break from planting was observed in T₁ (OCT 2nd week 30x20cm) with 97.78days.

Transplanting at 35 days old seedlings with closer spacing showed maximum length of stalk were transplanted at 25 days old seedlings with wider spacing showed minimum length of stalk. which might be attributed to a more vertical growth of the plant under dense spacing which in turn might be the effect of competition for space and light. **Deshpande et al. (2001)** in statice and **Khobragade et al. (2012)** observed the similar result in China aster.

No. of flower buds per plant

No. of flower buds per plant in China aster under different combinations is presented table (4.3.3) graphically illustrated in fig (4.3.3). No. of flower buds per plant with different sowing dates and planting distance their interaction found non-significant.

In the Nine treatments of different sowing dates and planting distance in the maximum No. of flower buds per plant was observed in T₁ (OCT 2nd week 30x20cm) with 13.22 days, followed by T₂ (OCT 2nd week 30x30cm) 12.22 buds and minimum No. of flower buds per plant was observed in T₈ (OCT 3rd week 30x30cm) with 9.00 buds.

Transplanting 42 days old seedlings with wider spacing showed minimum days where transplanting 30 days old seedlings with closer spacing showed maximum days. It was evident from the data that closer spacing showed early flowering than wider planting distance while flowering was late in wider planting distance. Similarly, the duration required for harvesting from the appearance of flower stalk was less in more plant spacing and a longer period was

required for harvesting from the appearance of the flower stalk in closer planting distance. **Jadhav *et al.* (2014)** observed in calendula that minimum days required for flower opening from bud initiation in closer spacing.

Stalk length

Stalk length in China aster under different combinations is presented table (4.1.1) and graphically illustrated in fig 4.4.1. Stalk length in China aster with different sowing dates and planting distance their interaction found non-significant.

In Nine treatments of different sowing dates and planting distance the maximum stalk length was observed in T₁ (OCT 2nd week 30x20cm) with 16.44cm, followed by T₄ (OCT 3rd week 30x20cm) with 15.67cm and minimum stalk length was observed in T₉ (OCT 4th week 30x40cm) with 14.78cm.

Transplanting at OCT 2nd week with closer spacing (30x20cm) showed maximum length of stalk were transplanted at OCT 4th week with wider spacing (30x40cm) showed minimum length of stalk. which might be attributed to a more vertical growth of the plant under dense spacing which in turn might be the effect of competition for space and light. **Deshpande *et al.* (2001)** in static and **Khobragade *et al.* (2012)** observed the similar result in China aster.

Number of flowers per plants

Number of flowers per plant in China aster under different combinations is presented table (4.4.2) and graphically illustrated in fig 4.4.2. Number of flowers per plant in China aster with different sowing dates and planting distance their interaction found non-significant.

In the Nine treatments of different sowing dates and planting distance the maximum number of flowers per plant was observed in T₁ (OCT 2nd week 30x20cm) with 14.55, followed by T₂ (OCT 2nd week 30x30cm) with 13.22 and minimum number of flowers per plant was observed in T₈ (OCT 4th week 30x30cm) with 10.55.

Earlier sowing dates in China Aster resulted in a higher number of flowering stems per plant compared to later sowing dates. This is attributed to the plants having more time for vegetative growth, allowing for the production of additional shoots that later develop into reproductive stems. The presence of more branches also contributes to an increased number of potential flower-bearing stems. Consequently, early sowing promotes greater vegetative growth and enhances flower production in China Aster. **Singh *et al.* (2018), Dhatt and Kumar (2010)**

Shelf life of individual flower

Shelf life of individual flower in China aster under different combinations is presented table (4.4.3) and graphically illustrated in fig 4.4.3. Shelf life of individual flower in China aster with different sowing dates and planting distance their interaction found non-significant.

In the Nine treatments of sowing dates and planting distance the maximum days of shelf life was observed in T5 (OCT 3rd week 30x30cm) with 23.67 days, followed by T1 (OCT 2nd week 30x20cm) with 23.56 days and minimum shelf life of individual flower is observed in T6 (OCT 3rd week 30x40cm) with 21.67 days.

Fresh weight of flower (g).

Fresh weight of flower in China aster under different combinations is presented table (4.4.3) and graphically illustrated in fig 4.4.3

Fresh weight of flower in China aster with different sowing dates and planting distance their interaction found non-significant.

In the Nine treatments of sowing dates and planting distance the maximum weight of flower of China aster was observed in T7 (OCT 4th week 30x20cm) with 8.81 gram, followed by T6 (OCT 2nd week 30x40cm) with 8.60 gram and minimum fresh weight of flower is observed in T1 (OCT 2nd week 30x20cm) with 5.10 gram.

Vase life of different levels of sorbitol of China aster.

Vase life of different levels of sorbitol of China aster under different combinations is presented table (4.5.1) and graphically illustrated in fig 4.5.1. Vase life of different levels of sorbitol of China aster with different sowing dates and planting distance their interaction found non-significant. In the Nine treatments of different sowing dates and planting distance the maximum days for vase life of different levels of sorbitol was observed in T5 (OCT 3rd week 30x30cm) with 16.44 days, and followed by days of vase life of different levels of sorbitol was observed in T4 (OCT 3rd week 30x20cm) with 14.78 days and minimum days of vase life of different levels of sorbitol was observed in T7 (OCT 4th week 30x20cm) with 14.78 days.

Table 2: Effect of different sowing dates and planting distance on Flowering characteristics and Quality parameters of China aster

Treatment	Flowering characteristics				Quality parameters
	Stalk length	No. of flower per plant	Shelf life of individual flower	Fresh weight of flower	Vasa life (Sorbitol-different levels)
T1	16.44	14.55	23.56	5.10	15.11
T2	15.56	13.78	23.00	7.07	15.56
T3	15.44	13.22	23.45	7.25	15.44
T4	15.67	11.89	23.11	8.60	15.67
T5	15.11	12.22	23.67	8.26	16.44
T6	15.67	12.78	21.67	8.60	15.32
T7	15.63	10.78	22.89	8.81	14.78
T8	15.44	10.55	23.44	8.08	15.44
T9	14.78	10.67	22.78	8.03	15.20
SPACING					
F-test	NS	NS	NS	NS	NS
S(Ed.)	0.235	2.269	0.79	0.797	0.332
CD	N/A	N/A	N/A	N/A	N/A
DIFFERENT SOWING DATES					
F-test	NS	NS	NS	NS	NS
S(Ed.)	0.235	2.269	0.79	0.797	0.332
CD	N/A	N/A	N/A	N/A	N/A
Spacing x sowing dates					
F-test	NS	NS	NS	NS	NS
S(Ed.)	0.407	3.93	1.369	1.381	0.575
CD	N/A	N/A	N/A	N/A	N/A

Table 3: Economics of various treatment in China aster cultivation

Treatment	Cost of cultivation (Rs/ha)	Total yield (Flower/plots)	Selling (Rs)	Gross Return (Rs/plots)	Net return (Rs/plots)	Benefit cost return
T1	12,460	1260	25	31,500	19040	2.53
T2	12,460	840	25	21,000	8,540	1.68
T3	12,460	675	25	16,875	4,415	1.36
T4	12,460	1224	25	30600	18140	2.46
T5	12,460	900	25	22500	10040	1.81
T6	12,460	702	25	17550	5090	1.41
T7	12,460	1152	25	28800	16340	2.31
T8	12,460	864	25	21600	9140	1.74
T9	12,460	657	25	16425	3965	1.32

Conclusion

From the present investigation it is concluded that treatment (T1) performed best in terms of plant growth (plant height (cm), Plant Spread (cm), number of Leaves/plant after 90 days, flower yield and quality (color, self-life, and vase life)

The highest benefit cost ratio was found in Treatment (T1) with (2.53)

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