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# EFFECT OF SPACING AND PINCHING ON VEGETATIVE GROWTH IN CHINA ASTER (*CALLISTEPHUS CHINENSIS* L. NEES) cv. KAMINI

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## Abstract

To study the effect of spacing and pinching on growth parameters in China aster cv. Kamini an investigation was carried out at College of Horticulture, Rajendranagar, Hyderabad (Andhra Pradesh), India; during *rabi*, 2013-14. The experiment was laid out in Randomized Block Design with factorial concept and replicated thrice. The study consisted of 12 treatment combinations with three spacings (30 x 15 cm, 30 x 30 cm and 45 x 30 cm) and four levels of pinching (pinching at 20 DAT, 30 DAT and 40 DAT and no pinching). The results revealed that closer spacing of 30 x 15 cm ($S_1$) recorded significantly higher plant height at 90 DAT (54.08 cm). While wider spacing of 45 x 30 cm ($S_3$) recorded more number of primary branches per plant (27.51), number of secondary branches per plant (72.47) and plant spread (44.84 cm) at 90 DAT. Significantly higher plant height at 90 DAT (55.87 cm) was recorded in unpinched plants, while plants pinched at 20 DAT recorded significantly higher number of primary branches per plant (26.62), number of secondary branches per plant (71.83) and plant spread (44.52 cm) when compared to other pinching treatments.

***Key words :*** Spacing, pinching, plant height, plant spread.

## Introduction

China aster belongs to the family Asteraceae and is an important commercial ornamental annual grown in many parts of the world for cut flowers. It is a popular bedding plant and also used as herbaceous boarder. Dwarf types are highly suitable for edging and window boxes. Large compact flowers with straight stalks are considered ideal for cut flower and flowers with more number of petals are suitable as loose flower for garland making. The growing popularity of China aster in most of the major cities in India has led to its cultivation as annual commercial crop for cut flower. In floriculture industry, improvement of agro-techniques facilitates viability of floricultural products, making the flower industry highly competent since only quality produce can fetch a better price and consumer acceptability. The ultimate goal of improved agro-techniques is production of quality product whether it is a flower or seed. Basic aspects of production like planting geometry, pinching *etc.* are of utmost importance for improving productivity and quality of a crop with respect to an agro-climatic zone. There is lack of scientific information with respect to such aspects of production in China aster. With this background, the present investigation on China aster cv. Kamini has been undertaken with the objective of studying the effect of spacing and pinching on vegetative growth of China aster.

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## Materials and Methods

The experiment was laid out at College Farm, College of Horticulture, Hyderabad during *rabi*, 2013-14 in Randomized Block Design with factorial concept and replicated thrice. The study consisted of 12 treatment combinations with three spacings (30 cm × 15 cm, 30 cm × 30 cm and 45 cm × 30 cm) and four levels of pinching (no pinching, pinching at 20 DAT, pinching at 30 DAT and pinching at 40 DAT). The net plot size was 1.8 m × 1.8 m. Well decomposed FYM @ 20 t $ha^{-1}$ was incorporated during the last ploughing in the main field. Phosphorous and potassium @ 80 and 120 kg $ha^{-1}$ were applied in the form of single super phosphate and muriate of potash respectively as basal dose. Nitrogen @ 120 $kg^{-1}$ was applied in the form of urea in two split doses once at the time of planting and second one month after transplanting. Standard cultural practices were followed during the entire crop period. The observations on growth parameters were recorded at 30, 60 and 90 DAT and analysed statistically as per the procedure described by

Panse and Sukhatme (1978).

## Results and Discussion

The data recorded on plant height at 30, 60 and 90 DAT indicated that different levels of planting distances and pinching showed significant effect on plant height (table 1). At 30 DAT, the maximum plant height of 16.86 cm was noticed in $S_1$ (30 × 15 cm) and was followed by $S_2$ (30 × 30 cm) level of planting distance (16.03 cm). The lowest plant height was recorded at the spacing of $S_3$ (45 × 30 cm) with the plant height 14.64 cm. The unpinched plants ($P_0$) recorded significantly higher plant height (17.57 cm) followed by pinching at 40 DAT ($P_3$) with the plant height 16.40 cm and pinching at 30 DAT ($P_2$) with 15.78 cm plant height. The minimum plant height of 13.63 cm was noticed with pinching at 20 DAT ($P_1$). Among the interactions, the treatment combination $S_1P_0$ recorded significantly the highest plant height of 18.47 cm and was found on par with $S_2P_0$ (17.67 cm). The lowest plant height was recorded at treatment combination of $S_3P_1$ (11.27 cm). At 60 DAT, maximum plant height of 33.64 cm was noticed in $S_1$ (30 X 15 cm) and was followed by $S_2$ (30 x 30 cm) level of planting distance (29.81cm). The lowest plant height was recorded at planting distance of $S_3$ (45 x 30 cm) with the plant height 26.41 cm. The unpinched plants ($P_0$) recorded significantly higher plant height (33.33 cm) followed by ($P_1$) pinching at 20 DAT (31.04 cm) which was on par with pinching at 30 DAT ($P_2$) with 29.12 cm plant height. The minimum plant height of 26.42 cm was noticed with pinching at 40 DAT ($P_3$). The treatment combination $S_1P_0$ recorded significantly highest plant height of 38.80 cm. The lowest plant height was recorded at treatment combination of $S_3P_1$ (25.33 cm). At 90 DAT stage of plant growth maximum plant height of 54.08 cm was noticed in $S_1$ (30 X 15 cm) and it was followed by $S_2$ (30 x 30 cm) level of planting distance (50.96 cm). The lowest plant height was recorded at planting distance of $S_3$ (45 x 30 cm) with the plant height of 43.09 cm. The unpinched plants ($P_0$) resulted significantly higher plant height (55.87cm) followed by pinching at 20 DAT ($P_1$) with 49.50 cm plant height and pinching at 30 DAT ($P_2$) with a plant height of 47.41 cm.The minimum plant height of 44.74 cm was noticed with pinching at 40 DAT. Interaction of spacing and pinching showed significant effect on plant height at 90 DAT. The treatment combination $S_1P_0$ recorded the highest plant height of 59.75 cm at 90 DAT followed by $S_2P_0$ (56.63cm) combination. The minimum plant height was recorded at treatment combination of $S_3P_3$ at 90 DAT (38.28 cm).

The data from table 1 indicated that the plant height decreased significantly with increase in spacing level. The closer spacing of $S_1$ (30x15 cm) recorded significantly more plant height at all stages of plant growth. The increased plant height in closer spacing might be due to intra plant competition for light, moisture, space and aeration resulting in elongation of main stem and also might be due to the fact that the plants tend to grow vertically when they are crowded owing to shadowing effect of the plants on one another. Similar observations were also recorded by Srivastava *et al*. (2002) and Anju and Pandey (2007) in marigold, The higher plant height noticed with no pinching ($P_0$) treatment was mainly due to the fact that plants were not pinched and grew to their original height without reduction. The reduction in plant height in pinched plants is mainly due to elimination of apical dominance and diversion of the plant metabolites from vertical growth to horizontal growth and recording more branches per plant. As the apical dominance is removed usually the plant itself adjusts to encourage the growth of auxiliary buds which may be converted intobranches. Similar results were reported by Sen and Naik (1977) in chrysanthemum. The reduction in plant height due to pinching may be due to neutralization of apical dominance by way of pinching which stopped further plant growth and produced more number of branches. Decrease in plant height with increased number of branches due to pinching was reported by Rakesh *et al.* (2005) and Ravneet Kour *et al.* (2012) in marigold.

Number of primary branches per plant at 30, 60 and 90 DAT (table 2) was significantly influenced by spacing and pinching and their interactions. At 30 DAT, among the different spacing levels $S_3$ (45x30 cm) recorded significantly maximum number of primary branches per plant (7.45) and was found on par with $S_2$ level of spacing (30x30 cm) while $S_1$ level of spacing recorded the minimum number (5.16) of primary branches per plant. The pinching at 20 DAT ($P_1$) was found significantly superior (12.67) over other pinched plants and unpinched plants. The pinching treatments $P_0$ and $P_3$ were on par with each other (2.41 and 2.80 respectively). Among the interactions, the treatment combination of $S_3P_1$ recorded the highest number of primary branches (15.61) followed by $S_3P_2$ (8.26). The lowest number of primary branches was recorded at treatment combination of $S_1P_0$ (2.26). At 60 DAT, maximum number of primary branches per plant (18.80) was noticed in $S_3$ (45x 30 cm) followed by $S_2$ (30 x 30 cm) level of planting distance. The minimum number of primary branches (8.10) per plant was recorded at planting distance of $S_1$ (30 x 15 cm). With regard to pinching treatments, the 20 DAT pinched plants ($P_1$) significantly shown maximum number of primary

branches (19.07) per plant and was on par with $P_2$ *i.e.*, pinching at 30 DAT (18.21). The minimum number of primary branches (7.20) per plant was noticed in unpinched plants ($P_0$). The treatment combination $S_3P_1$ recorded the maximum number (24.33) of primary branches per plant. The minimum number of primary branches per plant (6.03) was recorded at treatment combination of $S_1P_0$. The data at 90 DAT showed that the maximum number of primary branches per plant (27.51) was noticed in $S_3$ (45x 30 cm) followed by $S_2$ (30 x 30 cm) level of planting distance. The minimum number of primary branches per plant (10.01) was recorded at planting distance of $S_1$ (30 x 15 cm). Among pinching treatments the 20 DAT pinched plants ($P_1$) significantly shown maximum number of primary branches (26.62) per plant and was on par with pinching at 30 DAT ($P_2$). The minimum number of primary branches per plant (10.66) was noticed in unpinched plants ($P_0$). The treatment combination $S_3P_1$ recorded the maximum number of primary branches per plant (35.01). Minimum number of primary branches (8.73) per plant was recorded at treatment combination of $S_1P_0$ (8.73).

The number of primary branches decreased linearly with decreased level of spacing at all stages of growth. The closer spacing of 30x15 cm ($S_1$) produced significantly less number of branches per plant (5.16, 8.10 and 10.01 at 30, 60 and 90 DAT respectively). The few branches at closer spacing may be due to more competition for light, space and nutrients among the plants which resulted in vertical growth of the plant rather than horizontal growth. These results are in conformity with the findings of Shiva Kumar (2000) and Srivastava *et al.* (2002) in marigold. Similar results were obtained by Rajesh *et al.* (2012) in China aster. Number of branches was at maximum levels in those plants pinched at 20 DAT. This treatment was on par with the plants pinched at 30 DAT. Delay in taking up pinching up to 40 DAT reduced the number of branches per plant. Thus it is inferred that pinching the apical bud after 30 DAT suppressed the vertical growth as well as horizontal spread so significantly that the plants could not recover till the final stages. Plants put up maximum vegetative growth before 40 DAT, by which time even flower bud appearance also might had completed. Any attempt to suppress the apical dominance after this point of time by pinching might had altered the plant metabolism in such a way that instead of initiating floral buds it had to continue shoot growth from lateral buds. Similar results were obtained by Sharma *et al.* (2006) in African marigold.

The data recorded on number of secondary branches at 30, 60 and 90 DAT as influenced by spacing, pinching and their interaction is presented in table 3. At 30 DAT, among the spacing levels, $S_3$ (45 X 30 cm) was found superior by recording maximum number (8.28) of secondary branches per plant which was followed by $S_2$ (30 x 30 cm) level of spacing. The minimum number (4.54) of secondary branches per plant was recorded with spacing level of 30 x 15 cm. Among the different pinching treatments, $P_1$ (pinching at 20 DAT) recorded significantly highest number of secondary branches (9.65) per plant followed by $P_2$ (pinching at 30 DAT). The lowest number of secondary branches was observed in $P_0$ (2.27). Result on interaction effect of spacing and pinching indicated that the combination $S_3$ x $P_1$ produced maximum number of secondary branches (11.90) followed by $S_3P_2$ combination (9.95). Minimum number (1.65) of secondary branches per plant was recorded at treatment combination of $S_1P_0$. At 60 DAT stage of plant growth, among the spacing levels, $S_3$ (45 X 30 cm) was found superior by recording maximum number (41.71) of secondary branches per plant at 60 DAT followed by $S_2$ (30 x 30 cm) level of spacing. Minimum number (18.58) of secondary branches per plant was recorded with spacing level of 30 x 15 cm. Among the different pinching treatments, $P_1$ (pinching at 20 DAT) recorded significantly maximum number (40.37) of secondary branches per plant which was on par with $P_2$ (pinching at 30 DAT). Minimum number (11.32) of secondary branches was observed in $P_0$ (no pinching). The result indicated that in interaction, the combination $S_3$ x $P_1$ recorded maximum number of secondary branches (49.07) which was on par with $S_3P_2$ and $S_2P_1$ combination. The minimum number (6.90) of secondary branches per plant was recorded at treatment combination of $S_1P_0$. At 90 DAT, the spacing level $S_3$ (45 X 30 cm) was found superior by recording maximum number (72.47) of secondary branches per plant and was followed by $S_2$ (30 x 30 cm) level of spacing. The minimum number (30.46) of secondary branches per plant was recorded with spacing level of 30 x 15 cm. Among the different pinching treatments, $P_1$ (pinching at 20 DAT) recorded significantly maximum number (71.83) of secondary branches per plant followed by $P_2$. The minimum number of secondary branches (27.80) was observed in $P_0$. The interaction data indicated that in interaction, the combination $S_3$ $P_1$ recorded maximum number of secondary branches (92.37), which was on par with $S_3P_2$ combination (88.78). The minimum number (24.96) of secondary branches per plant was recorded at treatment combination of $S_1P_0$. This was on par with $S_2P_0$, $S_3P_0$ and $S_1P_3$ (28.70, 29.72 and 26.44).

The results showed that number of secondary

**Table 1:** Effect of spacing and pinching on plant height (cm) at different growth stages of China aster cv. Kamini.

| Spacing | Plant height (cm) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | | | | | 60 DAT | | | | | 90 DAT | | | | |
| | Pinching | | | | | | | | | | | | | | |
| | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean |
| $S_1$ | 18.47 | 15.57 | 16.27 | 17.13 | 16.86 | 38.80 | 35.93 | 31.46 | 28.40 | 33.64 | 59.75 | 54.60 | 52.35 | 49.62 | 54.08 |
| $S_2$ | 17.67 | 14.06 | 16.06 | 16.33 | 16.03 | 33.53 | 30.40 | 29.80 | 25.53 | 29.81 | 56.63 | 51.55 | 49.37 | 46.31 | 50.96 |
| $S_3$ | 16.58 | 11.27 | 15.00 | 15.73 | 14.64 | 27.67 | 26.80 | 25.86 | 25.33 | 26.41 | 51.25 | 42.35 | 40.51 | 38.28 | 43.09 |
| Mean | 17.57 | 13.63 | 15.78 | 16.40 | | 33.33 | 31.04 | 29.04 | 26.42 | | 55.87 | 49.50 | 47.41 | 44.74 | |
| | SEm± | | | CD at 5% | | SEm± | | | CD at 5% | | SEm± | | | CD at 5% | |
| Spacing (S) | 0.14 | | | 0.42 | | 0.56 | | | 1.66 | | 0.29 | | | 0.88 | |
| Pinching (P) | 0.16 | | | 0.48 | | 0.65 | | | 1.92 | | 0.34 | | | 1.02 | |
| S × P | 0.28 | | | 0.84 | | 1.12 | | | 3.32 | | 0.59 | | | 1.76 | |

$S_1$: 30 x 15 cm
$S_2$: 30 x 30 cm
$S_3$: 45 x 30 cm
$P_3$: Pinching at 40 DAT
$P_0$: no pinching
$P_1$: Pinching at 20 DAT
$P_2$: Pinching at 30 DAT

**Table 2:** Effect of spacing and pinching on number of primary branches per plant at different growth stages of China aster cv. Kamini.

| Spacing | Number of primary branches per plant | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | | | | | 60 DAT | | | | | 90 DAT | | | | |
| | Pinching | | | | | | | | | | | | | | |
| | Pinching | $P_1$ | $P_2$ | $P_3$ | Mean | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean |
| $S_1$ | 2.26 | 9.46 | 6.53 | 2.40 | 5.16 | 6.03 | 10.10 | 9.80 | 6.68 | 8.10 | 8.73 | 12.03 | 10.26 | 8.76 | 10.01 |
| $S_2$ | 2.44 | 12.93 | 7.53 | 2.60 | 6.40 | 7.53 | 22.8 | 20.60 | 13.75 | 16.42 | 9.70 | 32.84 | 31.00 | 23.73 | 24.31 |
| $S_3$ | 2.53 | 15.61 | 8.26 | 3.40 | 7.45 | 8.03 | 24.33 | 22.13 | 19.67 | 18.80 | 11.56 | 35.01 | 32.50 | 28.00 | 27.51 |
| Mean | 2.41 | 12.67 | 7.44 | 2.80 | | 7.20 | 19.07 | 18.21 | 13.37 | | 10.66 | 26.62 | 24.60 | 20.16 | |
| | SEm± | | | CD at 5% | | SEm± | | | CD at 5% | | SEm± | | | CD at 5% | |
| Spacing (S) | 0.40 | | | 1.18 | | 0.58 | | | 1.73 | | 0.67 | | | 2.00 | |
| Pinching (P) | 0.46 | | | 1.30 0. | | 68 | | | 2.00 | | 0.78 | | | 2.31 | |
| S x P | 0.80 | | | 2.30 | | 1.17 | | | 3.50 | | 1.35 | | | 4.19 | |

$S_1$: 30 x 15 cm
$S_2$: 30 x 30 cm
$S_3$: 45 x 30 cm
$P_0$: no pinching
$P_1$: Pinching at 20 DAT
$P_2$: Pinching at 30 DAT
$P_3$: Pinching at 40 DAT

branches per plant were more in case of pinched plants. This may be due to pinching effect of apical buds which resulted in production of more secondary branches owing to cessation of vertical growth. Decrease in plant height with increased number of branches due to pinching was reported by Grawal *et al.* (2004) in chrysanthemum. More secondary branches at wider spacing might be due to horizontal growth of the plant. The similar results were obtained by Rajanna (2001) in China aster. The few branches at closer spacing might be due to vertical growth of the stem. The results are in line with the findings of Rajesh Kumar *et al.* (2012) in China aster and Sharma *et al.* (2012) in marigold.

The data recorded on plant spread (table 4) revealed that different levels of planting distances brought significant variation in plant spread at 30, 60 and 90 DAT stages of plant growth. Among the different planting distances, $S_3$ (45 x 30 cm) level significantly increased the plant spread (17.43 cm) followed by $S_2$ (30 x 30 cm) level of planting distance at 30 DAT. The minimum plant spread was recorded at spacing level of 30 x 15 cm (15.01 cm). Among different pinching treatments, $P_1$ (pinching at 20 DAT) recorded significantly highest plant spread

**Table 3:** Effect of spacing and pinching on number of secondary branches per plant at different growth stages of China aster cv. Kamini.

| Spacing | Number of secondary branches per plant | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | | | | | 60 DAT | | | | | 90 DAT | | | | |
| | Pinching | | | | | | | | | | | | | | |
| | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean |
| $S_1$ | 1.65 | 6.75 | 5.46 | 4.30 | 4.54 | 6.90 | 27.18 | 24.68 | 15.56 | 18.58 | 24.96 | 37.13 | 33.33 | 26.44 | 30.46 |
| $S_2$ | 2.15 | 10.30 | 8.70 | 7.61 | 7.19 | 10.21 | 44.86 | 43.26 | 27.20 | 31.38 | 28.70 | 86.01 | 81.19 | 67.82 | 65.93 |
| $S_3$ | 3.01 | 11.90 | 9.95 | 8.40 | 8.28 | 16.85 | 49.07 | 46.10 | 41.71 | 38.43 | 29.72 | 92.37 | 88.78 | 79.02 | 72.47 |
| Mean | 2.27 | 9.65 | 8.03 | 6.77 | | 11.32 | 40.37 | 38.01 | 28.15 | | 27.80 | 71.83 | 67.76 | 57.76 | |
| | SEm± | | | CD at 5% | | SEm± | | | CD at 5% | | SEm± | | | CD at 5% | |
| Spacing (S) | 0.11 | | | 0.32 | | 0.97 | | | 2.86 | | 0.85 | | | 2.50 | |
| Pinching (P) | 0.12 | | | 0.37 | | 1.12 | | | 3.31 | | 1.06 | | | 3.50 | |
| S x P | 0.22 | | | 0.65 | | 1.16 | | | 5.73 | | 1.70 | | | 5.01 | |

$S_1$: 30 x 15 cm
$S_2$: 30 x 30 cm
$S_3$: 45 x 30 cm

$P_0$: no pinching
$P_1$: Pinching at 20 DAT
$P_2$: Pinching at 30 DAT
$P_3$: Pinching at 40 DAT

**Table 4:** Effect of spacing and pinching on plant spread (cm) at different growth stages of China aster cv. Kamini.

| Spacing | Plant spread (cm) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | | | | | 60 DAT | | | | | 90 DAT | | | | |
| | Pinching | | | | | | | | | | | | | | |
| | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean | $P_0$ | $P_1$ | $P_2$ | $P_3$ | Mean |
| $S_1$ | 9.52 | 18.67 | 17.50 | 14.37 | 15.01 | 12.58 | 23.41 | 19.44 | 17.60 | 18.25 | 16.68 | 33.63 | 32.47 | 25.15 | 26.98 |
| $S_2$ | 10.29 | 21.51 | 18.42 | 15.28 | 16.37 | 15.47 | 31.68 | 30.43 | 27.13 | 26.17 | 19.60 | 47.71 | 45.46 | 43.77 | 39.13 |
| $S_3$ | 11.51 | 22.26 | 18.54 | 17.44 | 17.43 | 16.28 | 40.31 | 39.37 | 34.84 | 32.70 | 28.84 | 52.22 | 50.23 | 48.09 | 44.84 |
| Mean | 10.44 | 20.81 | 18.15 | 15.69 | | 14.77 | 31.80 | 29.74 | 26.52 | | 21.70 | 44.52 | 42.72 | 39.00 | |
| | SEm± | | | CD at 5% | | SEm± | | | CD at 5% | | SEm± | | | CD at 5% | |
| Spacing (S) | 0.07 | | | 0.23 | | 0.30 | | | 1.03 | | 0.39 | | | 1.14 | |
| Pinching (P) | 0.09 | | | 0.27 | | 0.34 | | | 1.01 | | 0.45 | | | 1.32 | |
| S x P | 0.15 | | | 0.46 | | 0.60 | | | 1.76 | | 0.78 | | | 2.33 | |

$S_1$: 30 x 15 cm
$S_2$: 30 x 30 cm
$S_3$: 45 x 30 cm

$P_0$: no pinching
$P_1$: Pinching at 20 DAT
$P_2$: Pinching at 30 DAT
$P_3$: Pinching at 40 DAT

(20.81 cm) followed by $P_2$ (pinching at 30 DAT) (18.15 cm). The lowest plant spread per plant was observed in $P_0$ (no pinching) (10.44 cm). The interaction between spacing and pinching showed that significantly maximum plant spread (22.26 cm) was observed in $S_3P_3$ treatment combination followed by $S_2P_1$ treatment combination (21.51 cm) and the minimum was with $S_1P_0$ (9.52 cm). At 60 DAT, among the different planting distances $S_3$ (45 x 30 cm) level significantly increased the plant spread (32.70 cm) followed by $S_2$ level of planting distance (30 x 30 cm). The minimum plant spread was recorded at spacing level of 30 x 15 cm (18.25 cm). Among pinching treatments, $P_1$ (pinching at 20 DAT) recorded significantly highest plant spread (31.80 cm) followed by pinching at 60 DAT (29.74 cm). The lowest plant spread per plant was observed in $P_0$ (no pinching) at 60 DAT (14.77 cm). The results on interaction effects showed that maximum plant spread (40.31 cm at 60 DAT) was observed in $S_3$ $P_1$ treatment combination, which was found on par with $S_3P_2$ treatment combination (39.37 cm) and $S_2P_1$. The minimum was with $S_1P_0$ (12.58 cm). Different levels of planting distances brought significant variation in plant spread at 90 DAT stages of plant growth. Among the different planting distances $S_3$ (45 x 30 cm) level

significantly increased the plant spread (44.84 cm) followed by $S_2$ level of planting distance (30 x 30 cm). The minimum plant spread at the spacing level of 30 x 15 cm was 26.98 cm. Among different pinching treatments, $P_1$ (pinching at 20 DAT) recorded significantly highest plant spread at 90 DAT (44.52 cm) followed by $P_2$ level (pinching at 30 DAT) with 42.72 cm. The lowest plant spread per plant was observed in $P_0$ (no pinching) at 90 DAT (21.70 cm). Maximum plant spread (52.22 cm) was observed in $S_3$ $P_1$ treatment combination and was found on par with $S_3P_2$ treatment combination (50.23 cm). The minimum was with $S_1P_0$ (16.68 cm).

The plant spread varied significantly at all the stages of plant growth, wherein the wider spacing 45 x 30 cm ($S_3$) recorded significantly more plant spread than closer spacings of 30 x 15 cm and 30 x 30 cm ($S_1$ and $S_2$) at 30, 60 and 90 DAT. Similar increase in plant spread was also noticed by Barman and Pal (1999) in chrysanthemum. The increasing values of plant spread when the plants were spaced at relatively wider intervals might be due to increased number of branches per plant recorded at these spacing levels (table 3). The data on number of branches per plant obtained in the present study is in conformity with this. Similar result of increasing plant spread and number of branches per plant coupled with decrease in plant height was also reported by Vasudev *et al.* (2006) in marigold. Plant spread was at maximum levels in those plants pinched at 20 DAT. Sharma *et al.* (2006) also found that early pinching in marigold resulted in more plant spread compared to late pinching.

On the basis of present research findings it was concluded that for obtaining higher vegetative growth in China aster cv. Kamini planting at a closer spcacing of 30 cm x 15 cm and pinching at 20 DAT could be recommended.

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