International Journal of Advanced Biochemistry Research

**ISSN Print:** 2617-4693
**ISSN Online:** 2617-4707
IJABR 2024; 8(1): 685-691
www.biochemjournal.com
Received: 05-11-2023
Accepted: 06-12-2023

**Veeresh**
College of Horticulture, Rajendranagar, Hyderabad, Telangana, India

**Seenivasan N**
Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

**Laxminarayana D**
Sri Konda Laxman Telangana State Horticultural University, Mulugu, Siddipet, Telangana, India

**Praneeth Kumar S**
Floricultural Research station Rajendranagar, Hyderabad, Telangana, India

**Corresponding Author:**
**Veeresh**
College of Horticulture, Rajendranagar, Hyderabad, Telangana, India

# Effect of biostimulants as a foliar spray on growth, flowering, and yield of China aster (*Callistephus chinensis* (L.) Nees) cv. Arka Kamini

**Veeresh, Seenivasan N, Laxminarayana D and Praneeth Kumar S**

**DOI:** https://doi.org/10.33545/26174693.2024.v8.i1i.479

**Abstract**
The present investigation carried out on China aster cv. Arka Kamini to know the effect of Biostimulants as a foliar spray on growth, flowering, yield, and quality. The result indicated that among the treatment plant sprayed with the interaction $T_3$ Seaweed extract (0.5%) combination with Phosphate solubilizing bacteria (PSB) 200 g/l of water + Potassium solubilizing bacteria (KSB) 200 g/l of water was recorded significantly maximum plant height (62.66 cm), number of leaves per plant (111.45), leaf area (1398.30 $cm^2$), number of primary branches per plant (10.28) and number of secondary branches per plant (12.80). minimum number of days to first flower bud initiation (60.41 days), minimum days to 50% flowering (71.76 days) and highest duration of flowering (69.67 days), flower diameter (7.20 cm), fresh weight of flower (2.53 g), total number of flowers per plant (65.38), flower yield per plant (270.31 g), flower yield per plot (18.35 kg), shelf life of loose flowers (40.53 hours) and vase life of cut flowers (7.16 days). Thus, combined application of biostimulants and biofertilizers could be considered as a suitable treatment for enhanced growth, flowering, yield, and quality of China aster.

**Keywords:** Biostimulants, biofertilizers, china aster, seaweed extract, vase life

## Introduction

China aster (*Callistephus chinensis* L. Nees.) is a semi-hardy, annual, and commercial-free blooming flower crop belonging to the family Asteraceae. The somatic chromosome number of the plant is (2n=18). It is one of the most important commercial annual flower crops grown in most parts of the world. Among annual flowers, it ranks third next to chrysanthemum and marigold. The deterioration of soil fertility through the use of chemical fertilizers and increasing production costs due to chemical fertilizers brought an urge for organic sources of nutrients as a part of nutrient requirements. Organic farming is one of the possible solutions for this problem, in recent days, biostimulants have emerged as a supplement to mineral fertilizers and hold a promise to improve yield as well as quality of the crop Sankari *et al*. [1]. Biofertilizers can improve soil health and enable protection against drought and some soil-borne diseases Sowmya and Prasad [2], They reduce per unit consumption of inorganic fertilizers and increase the quality and quantity of flowers Syamal *et al.* [3]. Biofertilizers have been found helpful in the proliferation and survival of beneficial microorganisms and improve soil properties leading to sustained soil fertility Harris *et al.* [4]. By the addition of PSB, the unavailable form of phosphorus is converted to the available forms, improving phosphorus absorption, and leading to enhanced yield. A widespread requirement for ecologically friendly agriculture is required to supply the rising demand for high-quality flowers. Thus, efforts are underway for a sustainable way of crop production with organic fertilizers and bio-stimulants from natural resources to enhance the production of commercially important flower crops. Seaweeds are green, brown, and red marine macroalgae. Extracts of brown seaweeds are widely used in horticulture crops largely for their plant growth-promoting effects and for their ameliorating effect on crop tolerance to abiotic stresses such as salinity, extreme temperatures, nutrient deficiency, and drought Battacharya *et al*. [5].

Bio-stimulants are materials other than fertilizers that promote plant growth when applied in minute quantities and are also referred to as metabolic enhancers. They promote plant growth besides improving yield and quality.

The use of bio-stimulants, which can beneficially modify plant growth, has grown dramatically over the past decade. However, to the best of our knowledge, there is no report on the "Effect of Biostimulants as a Foliar Spray on Growth, Flowering, Yield, and Quality of China Aster (*Callistephus chinensis* L. Nees) Cv. Arka Kamini." Therefore, the objective of this work was to assess the effect of the combination of biostimulants and biofertilizer as foliar spray, and soil drenching on growth, flowering, and yield of China aster.

## Materials and Methods

### Raw material, biostimulants, and biofertilizers preparation and treatments

The pure, bold, and disease-free seeds of the China aster cultivar 'Arka Kamini' were used for conducting the studies which have been procured from the Indian Institute of Horticultural Research, Bangalore (Karnataka). Its brief description is given below: The China aster cultivar 'Arka Kamini' produces deep pink color flowers that are more attractive than other cultivars. It takes about 120-140 days to flower production and attain a height of 60 cm. Its flowers are 5.5-6.5 cm in diameter and the weight of each flower is about 2 g. Each plant produces about 40-50 flowers.

**Seaweed extract (0.5%):** To prepare 0.5 percent seaweed extract, 5 mL of humic acid was dissolved in distilled water and the volume made up to 1000 ml. The biostimulant solutions were applied two times. The first spray was given at 40 days after transplanting (DAT) and the second spray was given at 20 days intervals after the first spray. The solutions were applied uniformly to the subtending leaves and buds till they were wet with the help of a hand sprayer (one-liter sprayer).

**PSB 200 g per l of water:** For the application of PSB biofertilizer, a slurry was prepared by mixing 200 g PSB culture in one liter of water and it was applied two times. The first soil drenching was given at 40 days after transplanting (DAT) and the second was given at 20-day intervals after the first drenching was applied to the root portion.

**KSB 200 g per l of water:** For the application of KSB biofertilizer, a slurry was prepared by mixing 200 g KSB culture in one liter of water and it was applied two times. The first soil drenching was given at 40 days after transplanting (DAT) and the second was given at 20-day intervals after the first drenching was applied to the root portion. The experiment was carried out at PG Students Research Farm, College of Horticulture, Rajendranagar, Hyderabad situated at an altitude of 536 m above mean sea level on 78 °.40' East longitude and 17 °.32' North latitude. The experiment was laid out in Fac Randomized Block Design with three replicates as follows, Factor A-(Biostimulants) $A_1$. Seaweed extract - 0.5% $A_2$. No spray (water) Factor B-(Biofertilizers) $B_1$. PSB 200 g per l of water $B_2$. KSB 200 g per l of water $B_3$. PSB + KSB 200 g per l of water $B_4$. No Drench (water). The plants were given the following combination treatments *viz.*, Treatments combinations: $T_1$- Seaweed extract (0.5%) + PSB 200 g per l of water. $T_2$- Seaweed extract (0.5%) + KSB 200 g per l of water. $T_3$- Seaweed extract (0.5%) + PSB 200 g per l of water KSB 200 g per l of water. $T_4$- Seaweed extract (0.5%). $T_5$- PSB 200 g per l of water. $T_6$- KSB 200 g per l of water. $T_7$- PSB 200 g per l of water + KSB 200 g per l of water. $T_8$- Control (No spray). Among the plants of the experimental plot, five plants were selected randomly and tagged for the collection of data on all the vegetative and yield parameters. The detailed observations were grouped into growth, flowering yield, and quality of flower.

### Vegetative Parameter

#### Plant height

Plant height was measured from the base of the plant at ground level to the tip of the plant at 60, 75, 90, and 105 DAT with the help of a standard metric scale and the mean value of five tagged plants was expressed in centimeters (cm).

#### Number of leaves per plant

The total number of leaves per plant was counted in each treatment from the selected five plants at 60, 75, 90, and 105 DAT and expressed in number.

#### Leaf area ($cm^2$)

The leaf area of five tagged plants at 60,75, 90, and 105 DAT was measured by using a CI- 202 Laser area meter (USA) and expressed in square centimeters.

#### Number of primary branches per plant

The total number of primary at 75, 90, and 105 DAT of five tagged plants per plot were counted and their averages were expressed in numbers.

#### Number of Secondary branches per plant

The total number of primary at 75, 90, and 105 DAT of five tagged plants per plot were counted and their averages were expressed in numbers.

### Flowering Parameters

#### Days to first flower bud initiation

The number of days taken for the first flower opening was recorded by counting the number of days taken from the date of transplanting to the stage at which the first flower bud bloomed. This was recorded from the tagged five plants and the average was worked out.

#### Days to 50% flowering

The average number of days taken for 50 percent of the plants to reach for flowering stage was recorded from five tagged plants and expressed in days.

#### Duration of flowering

Duration of flowering was measured by counting the average number of days from the date of flower bud initiation up to the end of the flowering of five tagged plants.

#### Total number of flowers per plant

The total number of healthy flowers per plant was counted for five tagged plants and averages were worked out and presented as the total number of flowers per plant.

#### Flower diameter (cm)

The size of randomly selected flowers in each plot was recorded in centimeters at the time of peak flowering as the average distances in East-West and North-South directions.

#### Fresh weight of flowers (g)

The weight of individual, fully opened flowers was recorded and their average was calculated to get the fresh weight of individual flower heads.

#### Flower yield per plant (g)

The total weight of fresh flowers was recorded separately from the five tagged plants and their mean values were worked out and expressed in grams.

**Flower yield per plot (kg):** Flower yield per plot was computed based on the pooled fresh weight of flowers plucked from plants of the plot at different times and expressed in kilograms.

## Quality Parameters

### Shelf life of loose flowers at room temperature

Five randomly selected flowers in each treatment were kept under open conditions in a 150-gauge thick polythene bag (having 5-6 holes for the aeration). The number of hours at which flowers in different treatments were found unfit for use was recorded as the shelf life of loose flowers.

### Vase life of cut flowers (days)

The point of termination of vase life varied from the first sign of wilting or fading to the death of flowers. The wilting of one or two petals was taken as the end of the vase's life. The number of days at which flowers in different treatments were found unfit for continuing in the vase was recorded as vase life. For this purpose, flowers were harvested at a half-open stage. The stalks were cut to a uniform length and lower leaves were removed leaving only a few upper leaves then the flowers were placed in 500 ml of tap water in conical flasks separately.

### Statistical analysis

The experimental data on all vegetative growth, flowering yield, and quality parameters were tabulated and subjected to analysis of variance (ANOVA) using the module of ICAR CCARI WASP for Factorial Randomized Block Design (FRBD). Whenever the 'F' test was found significant, for comparing the means of two treatments, critical difference (CD at 5%) was used to analyses, and results were presented accordingly.

## Results and discussions

### Plant height (cm)

Plant height is an important growth parameter and contributes much towards the vigor of the plant. The height of the plant was recorded at 60, 75, 90, and 105 days after transplanting (DAT) and recorded a significant effect (Table 1). Among the treatment significant maximum plant height of 29.16 cm, 53.28 cm, 59.97 cm, and 62.66 cm was recorded in $T_3(A_1B_3)$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water at 60, 75, 90 and 105 DAT and minimum plant height of 20.27 cm, 31.18 cm, 32.55 cm and 36.00 cm was recorded at 60, 75, 90 and 105 DAT in $T_8$ control (no spray and no drenching). The results of the present study are in close conformity with the findings of Karthiraj *et al.* [6] in China aster, Sridhar and Rengasamy [7] in marigold, and Hegde *et al.* [8] in Chrysanthemum.

### Number of leaves per plant

The data recorded the number of leaves per plant of China Aster at 60, 75, 90, and 105 days after transplanting (DAT) as affected by biostimulants and biofertilizers with its interactions and recorded significant effect (Table 1). Among the treatment significantly maximum number of leaves per plant of 58.41, 77.79, 86.19 and 111.45 was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water at 60, 75, 90 and 105 DAT and minimum number of leaves per plant of 32.73, 49.47, 60.85 and 71.31 was recorded at 60, 75, 90 and 105 DAT in $T_8$ control (no spray and no drenching). A similar result was found in Hegde *et al*. [9] in Chrysanthemum.

### Leaf area (cm$^2$)

The data recorded the number of leaves per plant of China Aster at 60, 75, 90, and 105 days after transplanting (DAT) as affected by biostimulants and biofertilizers with its interactions and recorded significant effect (Table 1). Among the treatment significant maximum leaf area of 346.16 cm$^2$, 667.47 cm$^2$, 1016.43 cm$^2$, and 1398.3 cm$^2$ was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water at 60, 75, 90 and 105 DAT and minimum leaf area of 211.84 cm$^2$, 440.00 cm$^2$, 642.64 cm$^2$ and 1119.78 cm$^2$ was recorded at 60, 75, 90 and 105 DAT in $T_8$ control (no spray and no drenching). Similar results were found in Hegde *et al*. [9] in Chrysanthemum and Karthiraj *et al*. [6] in China aster.

### Number of primary branches per plant and Number of Secondary branches per plant

The data recorded on stem girth of China Aster at 75, 90, and 105 days after transplanting (DAT) as affected by biostimulants and biofertilizers with its interactions and recorded significant effect (Table 2). Among the treatment significant maximum number of primary branches per plant of 8.03, 9.55, and 10.28 was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water at 75, 90 and 105 DAT and minimum number of primary branches per plant of 3.10, 3.69 and 4.26 was recorded at 75, 90 and 105 DAT in $T_8$ control (no spray and no drenching).

The data recorded the number of secondary branches per plant of China Aster at 75, 90, and 105 days after transplanting (DAT) as affected by biostimulants and biofertilizers with its interactions and recorded significant effect (Table 2). Among the treatment significant maximum number of secondary branches per plant of 10.39, 11.38, and 12.80 was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water at 75, 90 and 105 DAT and minimum number of secondary branches per plant of 5.60, 6.81 and 7.59 was recorded at 75, 90 and 105 DAT in $T_8$ control (no spray and no drenching). The results of the present study are in close conformity with the findings of Karthiraj *et al*. [6] in China aster, Sridhar and Rengasamy [7] in marigold, and Hegde *et al*. [8] in Chrysanthemum.

## Flowering Parameters

### Days to first flower bud initiation, Days to 50% flowering, and Duration of flowering

The data concerning the number of days to first flower bud initiation was influenced by biostimulants and biofertilizers with their interactions and recorded significant effects (Table 3). Among the treatments significant minimum number of days to first flower bud initiation (59.92 days) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and a maximum number of days to first flower bud initiation (60.41 days) was recorded in $T_8$ control (no spray and no drenching).

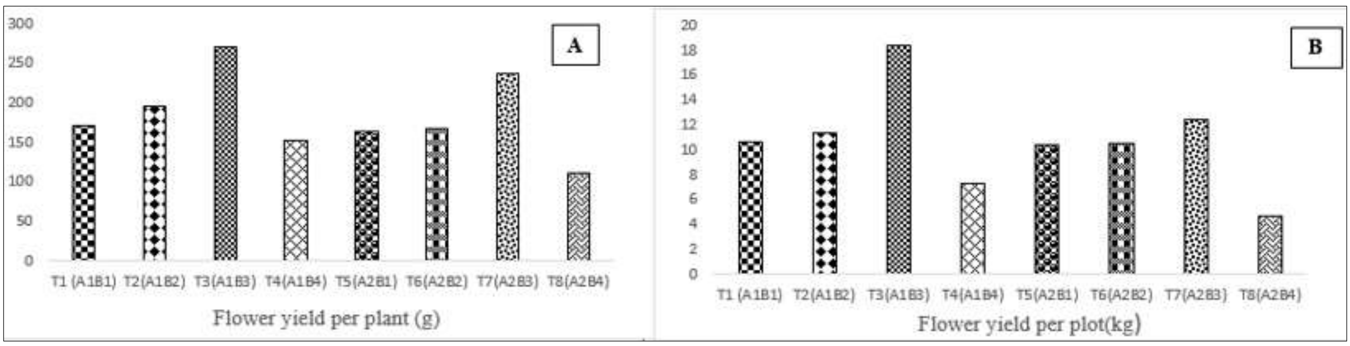
The data concerning the number of days to 50% flowering was influenced by biostimulants and biofertilizers with their interactions and recorded significant effects (Table 3). Among the treatments significant minimum number of days to 50% flowering (71.76 days) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and a maximum number of days to

50% flowering (89.48 days) was recorded in $T_8$ control (no spray and no drenching).
The data for several durations of flowering was influenced by biostimulants and biofertilizers with its interactions and recorded significant effect (Table 3). Among the treatments significant maximum duration of flowering (69.67 days) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and a minimum duration of flowering (50.84 days) was recorded in $T_8$ control (no spray and no drenching). Similar results were found in Hegde *et al.* [8] in Chrysanthemum, Karthiraj *et al.* [6] in China aster, and Chaitra and Patil [10] in China aster.

**Flower diameter (cm) and Fresh weight of flower (g)**
The data concerning flower diameter was influenced by biostimulants and biofertilizers with their interactions and recorded significant effects (Table 4). Among the treatments, the highest flower diameter (7.2 cm) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water, and the lowest flower diameter (5.60 cm) was recorded in $T_8$ control (no spray and no drenching).
The data concerning the fresh weight of the flower was influenced by biostimulants and biofertilizers with its interactions and recorded significant effects (Table 4). Among the treatments, the highest fresh weight of the flower (2.53 g) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and the lowest fresh weight of the flower (1.32 g) was recorded in $T_8$ control (no spray and no drenching). Similar results were found in Hegde *et al.* [9] in Chrysanthemum, Karthiraj, *et al.* [6] in China aster, Kirar *et al.* [11] in China aster, Sharma *et al.* [12] in China aster.

**Total number of flowers per plant, Flower yield per plant (g), and Flower yield per plot (kg)**
The data concerning the total number of flowers per plant was influenced by biostimulants and biofertilizers with their interactions and recorded significant effects (Table 4). Among the treatments, the significantly highest number of flowers per plant (65.38) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and the lowest number of flowers per plant (51.31) was recorded in $T_8$ control (no spray and no drenching).
The data concerning flower yield per plant was influenced by biostimulants and biofertilizers with their interactions and recorded significant effects (Figure A). Among the treatments, the highest flower yield per plant (270.31 g) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and the lowest flower yield per plant (110.73 g) was recorded in $T_8$ control (no spray and no drenching).
The data concerning flower yield per plot was influenced by biostimulants and biofertilizers with their interactions and recorded significant effects (Figure B). Among the treatments, a significant flower yield per plot (18.35 kg) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and the lowest flower yield per plot (4.70 kg) was recorded in $T_8$ control (no spray and no drenching). The results of the present study are in close conformity with the findings of Karthiraj *et al.* [6] in China aster, Sridhar and Rengasamy [7] in marigold and Hegde *et al.* [8] in Chrysanthemum, Ravindra *et al.* [13] in China aster, Geeta *et al.* [14] in China aster.

**Quality Parameters**
**Shelf life of loose flowers at room temperature (hours) and Vase life of cut flowers (days)**
The data concerning the shelf life of loose flowers was influenced by biostimulants and biofertilizers with their interactions and recorded significant effects (Figure C). Among the treatments significantly, the maximum shelf life of loose flowers (40.53) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and the minimum shelf life of loose flowers (51.31) was recorded in $T_8$ control (no spray and no drenching).
The data on the vase life of cut flowers was influenced by biostimulants and biofertilizers with their interactions and recorded significant effects (Figure D). Among the treatments significantly, the maximum vase life of cut flowers (7.16 days) was recorded in $T_3$ Seaweed extract (0.5%) combination with PSB 200 g/l of water + KSB 200 g/l of water and the minimum vase life of cut flowers (51.31) was recorded in $T_8$ control (no spray and no drenching). The results of the present study are in close conformity with the findings of Karthiraj *et al.* [6] in China aster, Sridhar and Rengasamy [7] in marigold and Hegde *et al.* [8] in Chrysanthemum, Ravindra *et al.* [13] in China aster, Geeta *et al.* [14] in China aster, Singh *et al.* [15] in China aster.



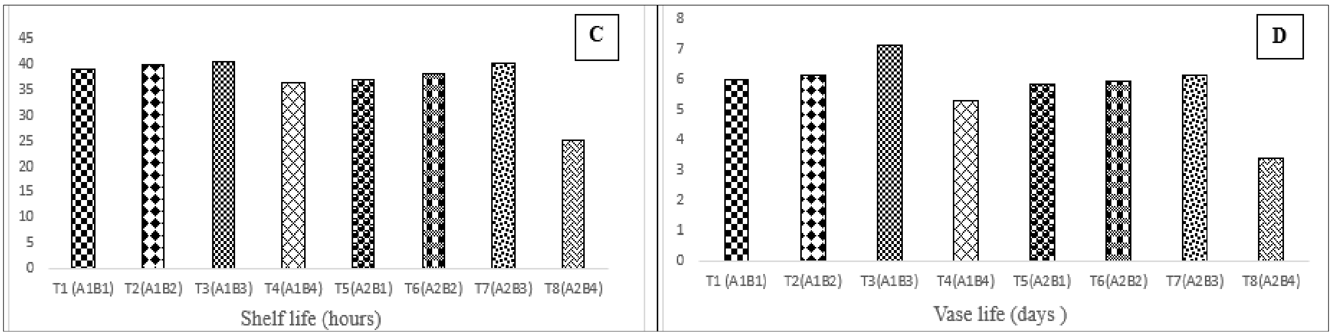



**Fig 1:** A) Flower yield per plant, B) Flower yield per plot, C) Shelf life and D) Vase life in China aster cv. Arka Kamini

**Table 1:** Effect of biostimulants and biofertilizers on plant height (cm), number of leaves per plant and leaf area per plant (cm$^2$) of China aster cv. 'Arka Kamini'

| Parameter | Biofertilizer / Biostimulants | Transplanting intervals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 60 DAT | | | 75 DAT | | | 90 DAT | | | 105 DAT | | |
| | | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean |
| Plant height (cm) | $B_1$ | 25.73 | 24.81 | 25.27 | 40.97 | 38.96 | 39.96 | 45.46 | 43.56 | 44.51 | 50.32 | 44.78 | 47.55 |
| | $B_2$ | 25.88 | 25.23 | 25.55 | 44.2 | 40.46 | 42.33 | 49.09 | 44.57 | 46.83 | 51.89 | 50.71 | 51.3 |
| | $B_3$ | 29.16 | 27.61 | 28.38 | 53.28 | 46.25 | 49.76 | 59.97 | 58.27 | 59.12 | 62.66 | 59.5 | 61.08 |
| | $B_4$ | 23.16 | 20.27 | 21.71 | 32.37 | 31.18 | 31.77 | 33.38 | 32.55 | 32.96 | 36.44 | 36 | 36.22 |
| | Mean | 25.98 | 24.48 | | 42.70 | 39.21 | | 46.97 | 44.737 | | 50.32 | 47.75 | |
| | CD at 5% | Biostimulant (A) = 0.219<br>Biofertilizer (B) = 0.253<br>A X B = 0.438 | | | Biostimulant (A) = 0.527<br>Biofertilizer (B) = 0.609<br>A X B = 1.055 | | | Biostimulant (A) = 0.755<br>Biofertilizer (B) = 0.872<br>A X B = 0.515 | | | Biostimulant (A) = 0.833<br>Biofertilizer (B) = 0.961<br>A X B = 1.665 | | |
| Number of leaves per plant | $B_1$ | 51.72 | 50.49 | 51.10 | 70.92 | 66.99 | 68.95 | 82.26 | 81.48 | 81.87 | 93 | 84 | 88.5 |
| | $B_2$ | 50.49 | 51 | 50.74 | 72.93 | 69.06 | 70.99 | 83.31 | 81.87 | 82.59 | 100.98 | 88.98 | 94.98 |
| | $B_3$ | 58.41 | 56.54 | 57.47 | 77.79 | 75.99 | 76.89 | 86.19 | 84.75 | 85.47 | 111.45 | 106.98 | 109.21 |
| | $B_4$ | 39.18 | 32.73 | 35.95 | 57.66 | 49.47 | 53.56 | 64.65 | 60.85 | 62.75 | 78 | 71.31 | 74.65 |
| | Mean | 49.95 | 47.69 | | 69.82 | 65.38 | | 79.10 | 77.24 | | 95.85 | 87.82 | |
| | CD at 5% | Biostimulant (A) = 0.602<br>Biofertilizer (B) = 0.696<br>A X B = 0.411 | | | Biostimulant (A) = 0.740<br>Biofertilizer (B) = 0.854<br>A X B = 1.479 | | | Biostimulant (A) = 0.626<br>Biofertilizer (B) = 0.722<br>A X B = 1.251 | | | Biostimulant (A) = 0.821<br>Biofertilizer (B) = 0.948<br>A X B = 1.642 | | |
| Leaf Area per plant (cm$^2$) | $B_1$ | 297.03 | 286.13 | 291.58 | 615 | 503.33 | 559.16 | 922.45 | 899.02 | 910.73 | 1329.25 | 1286.91 | 1308.08 |
| | $B_2$ | 304.14 | 292.63 | 298.38 | 628.33 | 561.11 | 594.72 | 963.22 | 917.82 | 940.52 | 1350.85 | 1319.48 | 1335.16 |
| | $B_3$ | 346.16 | 325.33 | 335.74 | 667.47 | 665.89 | 666.68 | 1016.43 | 999.53 | 1007.98 | 1398.3 | 1369.09 | 1383.69 |
| | $B_4$ | 229.29 | 211.84 | 220.56 | 448.89 | 440 | 444.44 | 700.26 | 672.64 | 686.45 | 1136.45 | 1119.78 | 1128.11 |
| | Mean | 294.15 | 278.98 | | 589.92 | 542.88 | | 900.59 | 872.25 | | 1303.71 | 1273.82 | |
| | CD at 5% | Biostimulant (A) = 1.198<br>Biofertilizer (B) = 1.383<br>A X B = 2.396 | | | Biostimulant (A) = 0.038<br>Biofertilizer (B) = 0.044<br>A X B = 0.077 | | | Biostimulant (A) = 0.381<br>Biofertilizer (B) = 0.440<br>A X B =0.763 | | | Biostimulant (A) = 0.667<br>Biofertilizer (B) = 0.771<br>A X B =1.335 | | |

**Table 2:** Effect of biostimulants and biofertilizers on number of primary and secondary branches per plant of China aster cv. 'Arka Kamini'

| Parameter | Biofertilizer / Biostimulants | Transplanting intervals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 75 DAT | | | 90 DAT | | | 105 DAT | | |
| | | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean |
| Number of Primary branches per plant | $B_1$ | 5.37 | 4.96 | 5.17 | 6.62 | 4.96 | 5.79 | 7.96 | 6.64 | 7.3 |
| | $B_2$ | 6.08 | 5.22 | 5.65 | 7.24 | 5.22 | 6.23 | 8.82 | 7.56 | 8.19 |
| | $B_3$ | 8.03 | 6.42 | 7.23 | 9.55 | 6.42 | 7.99 | 10.28 | 9.18 | 9.73 |
| | $B_4$ | 4.22 | 3.1 | 3.66 | 4.83 | 3.1 | 3.97 | 4.86 | 4.26 | 4.56 |
| | Mean | 5.93 | 4.93 | | 7.06 | 4.93 | | 7.98 | 6.91 | |
| | CD at 5% | Biostimulant (A) = 0.423<br>Biofertilizer (B) = 0.488<br>A X B = 0.846 | | | Biostimulant (A) = 0.242<br>Biofertilizer (B) = 0.280<br>A X B = 0.485 | | | Biostimulant (A) = 0.136<br>Biofertilizer (B) = 0.157<br>A X B = 0.271 | | |
| Number of Secondary branches per plant | $B_1$ | 8.43 | 7.62 | 8.03 | 9.68 | 8.76 | 9.22 | 9.92 | 9.6 | 9.76 |
| | $B_2$ | 9.18 | 8.26 | 8.72 | 10.26 | 9.15 | 9.71 | 11.26 | 9.75 | 10.51 |
| | $B_3$ | 10.39 | 9.36 | 9.88 | 11.38 | 10.55 | 10.97 | 12.8 | 12.07 | 12.44 |
| | $B_4$ | 7 | 5.6 | 6.30 | 7.14 | 6.81 | 6.98 | 8.25 | 7.59 | 7.92 |
| | Mean | 8.75 | 7.71 | | 9.62 | 8.82 | | 10.56 | 9.75 | |
| | CD at 5% | Biostimulant (A) = 0.157<br>Biofertilizer (B) = 0.182<br>A X B = 0.315 | | | Biostimulant (A) = 0.142<br>Biofertilizer (B) = 0.164<br>A X B = 0.284 | | | Biostimulant (A) = 0.107<br>Biofertilizer (B) = 0.124<br>A X B = 0.214 | | |

**Table 3:** Effect of biostimulants and biofertilizers on Flowering parameters of China aster cv. 'Arka Kamini'

| Parameters | Days to first flower bud initiation | | | Days to 50% flowering | | | Duration of flowering | | |
|---|---|---|---|---|---|---|---|---|---|
| Biofertilizer Biostimulant | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean |
| $B_1$ | 61.66 | 65.54 | 63.60 | 76.1 | 77.63 | 76.87 | 63.99 | 63.12 | 63.56 |
| $B_2$ | 63.65 | 65.18 | 64.42 | 74.54 | 75.66 | 75.10 | 65.01 | 63.65 | 64.33 |
| $B_3$ | 60.41 | 61.05 | 60.73 | 71.76 | 74.32 | 73.04 | 69.67 | 66.98 | 68.33 |
| $B_4$ | 69.85 | 71.64 | 70.75 | 82.31 | 89.48 | 85.90 | 56.99 | 50.84 | 53.92 |
| Mean | 63.89 | 65.85 | | 76.18 | 79.27 | | 63.92 | 61.15 | |
| CD at 5% | Biostimulant (A) = 0.707<br>Biofertilizer (B) = 0.816<br>A X B = 1.413 | | | Biostimulant (A) = 0.678<br>Biofertilizer (B) = 0.783<br>A X B = 1.357 | | | Biostimulant (A) = 0.754<br>Biofertilizer (B) = 0.870<br>A X B = 1.508 | | |

**Table 4:** Effect of biostimulants and biofertilizers on Flowering parameters of China aster cv. 'Arka Kamini'

| Parameters | Flower diameter (cm) | | | Fresh weight of flower (g) | | | Total number of flowers per plant | | |
|---|---|---|---|---|---|---|---|---|---|
| Biofertilizer Biostimulant | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean | $A_1$ | $A_2$ | Mean |
| $B_1$ | 6.2 | 5.63 | 5.92 | 1.94 | 1.92 | 1.93 | 53.41 | 52.99 | 53.2 |
| $B_2$ | 6.6 | 6.12 | 6.36 | 2.52 | 1.94 | 2.23 | 57.21 | 53.02 | 55.12 |
| $B_3$ | 7.2 | 7 | 7.10 | 2.53 | 2.19 | 2.36 | 65.38 | 59.21 | 62.30 |
| $B_4$ | 5.61 | 5.6 | 5.61 | 1.5 | 1.32 | 1.41 | 51.49 | 51.31 | 51.4 |
| Mean | 6.40 | 6.09 | | 2.12 | 1.84 | | 56.87 | 54.13 | |
| CD at 5% | Biostimulant (A) = 0.126<br>Biofertilizer (B) = 0.146<br>A X B = 0.253 | | | Biostimulant (A) = 0.123<br>Biofertilizer (B) = 0.142<br>A X B = 0.246 | | | Biostimulant (A) = 0.720<br>Biofertilizer (B) = 0.831<br>A X B = 1.440 | | |

## Conclusion

Bio-stimulants and bio-fertilizers are being widely used to enhance the overall quality of vegetative growth and flowers with extended shelf life. It could be concluded from the present investigation that, $T_3$ treatment sprayed with a combined application of Seaweed extract 0.5% with PSB @ 200 g + KSB @ 200 g at first spray at 40 DAT and second spray at 60 DAT of biostimulants (Seaweed extract 0.5%) and soil application of biofertilizers (PSB @ 200 g + KSB @ 200 g) at the time of 40 days and 60 days after transplanting recorded highest vegetative growth, flowering, yield, and quality in China Aster cv. Arka Kamini.

## References

1. Sankari Anand A, Arulmozhiyan. Effect of biostimulants on yield and post-harvest quality of *Gladiolus* cv. White prosperity. Asian J. Hort. 2015;10:86-94.
2. Sowmya KA, Prasad VM. Effect of NPK and Bio-Fertilizers on Growth, Yield, Quality of *China Aster* (*Callistephus chinensis*) cv. Shashank for Cut Flower Production under Agro Climatic Conditions of Allahabad, India. Int. J. Curr. Microbiol. Appl. Sci. 2017;6(10):3204–3210.
3. Syamal MM, Dixit SK, Kumar S. Effect of bio-fertilizers on growth and yield in *marigold*. J. Ornam. Hortic. 2006;9(4):304-305.
4. Harris RF, Chester G, Allen ON. Dynamics of soil aggregation. Adv. Agron. 1966;18(2):105-107.
5. Bhattacharyya D, Babgohari MZ, Rathor P, Prithiviraj B. Seaweed extracts as biostimulants in horticulture. Scientia horticulturae. 2015;196:39-48.
6. Karthiraj K, Patil RF, Vasmate SD, Digrase SS, Manolikar RR. Effect of bioenzyme on growth, flower yield and vase life of China Aster. The Asian J. Hort. 2008;3(1):178-179.
7. Sridhar S, Rengasamy R. Effect of seaweed liquid fertilizer on the growth, biochemical constituents, and yield of *Tagetes erecta*, under field trial. Journal of Phytology. 2010, 2(6).
8. Hegde PP, Naik BH, Beeraligappa. Growth, yield, quality, and economics of *chrysanthemum* as influenced by foliar application of biostimulants under naturally ventilated polyhouse. Int. J Curr. Res. 2016;8(11):41552-41555.
9. Hegde PP, Shivaprasad M, Ganapathi M, Chandrashekar SY. Influence of Biostimulants on Growth and Physiology of *chrysanthemum* (*Dendranthema grandiflora*) var. Kolar Local under Protected Cultivation. Int. J of Pure and Applied Biosci. 2018;6(2):1259–1264.
10. Chaitra R, Patil VS. Integrated nutrient management studies in *China Aster* (*Callistephus chinensis (L.) Nees*). Karnataka J of Agricultural Sciences. 2007;20(3):689-690.
11. Kirar KPS, Lekhi R, Sharma S, Sharma R. Effect of Integrated Nutrient Management Practices on Growth and Flower Yield of *China Aster* (*Callistephus chinensis* (L.) *Nees*) cv Princess. Agriculture: Towards a new paradigm of sustainability ISBN. 2009:9789383083640. 234–237.
12. Sharma U, Chaudhary SVS, Chauhan J. Effect of sources of applied nutrients on the growth, flowering, and seed production of *China Aster* under protected conditions. Har. J Hortic. Sci. 2009;38(3/4):189-190.
13. Ravindra SP, Hanumanthappa M, Hegde JN, Maheshwar KJ, Nagesha L. Effect of integrated nutrient management on growth, yield and vase life of *China Aster* (*Callistephus chinensis* (L.) Nees) for coastal Karnataka. J Ecol Environ. 2013;31(2C):1104-1106.
14. Geeta BL, Mahadevamma M, Raj L, Totad M. Influence of NPK and biofertilizers on growth, yield, and quality of *China Aster* (*Callistephus chinensis L.*

*Nees*) for cut flower production. Res. in Environ and Li. Sci. 2016;9(10):1236-38.
15. Singh M, Sharma BP, Gupta YC. Response of *China Aster* (*Callistephus chinensis* (L.) Nees) cv. Kamini to different combinations of NPK and biofertilizers. Ind. J. of Horticulture. 2017;74(3):458–461.