International Journal of Environment and Climate Change

Volume 13, Issue 10, Page 726-731, 2023; Article no.IJECC.104914
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Response of China aster to Bio-inoculant Amendments under Pot Experiment

Suraj Singh [a*], Samir E. Topno [a] and V. M. Prasad [a++]

[a] Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P., India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i102709

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/104914

Original Research Article

Received: 11/06/2023
Accepted: 13/08/2023
Published: 21/08/2023

ABSTRACT

The present investigation was layout out in Completely Randomized design (CRD) to assess the impact of biofertilizers on China aster with total of nine treatments and each treatment replicated thrice. The treatments consist of different combinations of bio-inoculants (Azospirillum, PSB, VAM and KSB). The results revealed that the treatment T_8 (75%RDF+Azospirillum+PSB) was found significantly higher compared to other treatment combination, which recorded highest plant height (27.28 cm), Number of leaves (27.44), plant spread (15.28 cm^2), Days to bud emergence (47.11 days), days of first bud break (54.67 days), opening first flower (62.33 days),number of flowers per plant(14.12), stalk length (13.00 cm), flower dimeter (4.92cm),Vase life (12.22 days), Leaf area (14.11 cm^2).The economics viz. Gross return (Rs. 16,800), Net return (Rs. 8928) and Benefit cost ratio (2.13) was found highest in the same treatment.

Keywords: China aster; Azospirillium; PSB; KSB; VAM.

[++] *Professor;*
**Corresponding author: E-mail: suraj8737851307@gmail.com;*

1. INTRODUCTION

China aster (*Callistephus chinensis (L.) Nees*) belongs to family 'Asteraceae' and is native to China. The genus has only a single species, namely, *Callistephus chinensis* [1,2]. The genus derives its name from two Greek words 'kalistos', most beautiful, and 'stephos', a crown, referring to the flower. Cassini described the China aster as *Callistephus hortensis*. It was first named by Linnaeus as Aster chinensis, and Nees subsequently changed this name to *Callistephus chinensis* [3]. China aster plants range in height from 15 cm to about 1.0 m with pompon flowers about the size of a button to large flower heads having single, double, anemone-flowered, peony-flowered, incurved, quilled or shaggy flower types. The colour range is so great that today China aster is one of the most valuable garden flowers. In all the different types, the colours include pure white, many shades of pink, primrose, pale blue, mauve, purple, dark blue, and scarlet [1,2].

In view of China aster adapting well to varying soil and climatic conditions, it can be grown successfully under Indian climatic conditions [1]. China aster flowers last longer which are used as cut flower, loose flower, bedding plant, for flower decoration, preparation of bouquets and garlands [2,3]. In India, it is being grown in Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra and West Bengal.

Biofertilisers are defined as preparations containing living cells or latent cells of efficient strains of microorganisms that help crop plants' uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil [4,5]. They accelerate certain microbial processes in the soil, which augment the extent of availability of nutrients in a form easily assimilated by plants. Very often microorganisms are not as efficient in natural surroundings as one would expect them to be and, therefore, artificially multiplied cultures of efficient selected microorganisms play a vital role in accelerating the microbial processes in the soil [4-8].

China aster responds very well to the application of inorganic and organic fertilizers [3,5]. Bio-fertilizer usually consists of live or latent cells of microorganisms which include biological nitrogen fixers, P-solubilizing, mineralization of nitrogen and transformation of several elements into available forms. VAM, Azotobacter, Azospirillum and phosphate solubilizing bacteria are commonly applied biofertilizers in horticultural crops [4]. Use of bio-fertilizers reduces per unit consumption of inorganic fertilizers and increases the quality and quantity of flowers. Bioagents influences plant development by several mechanisms, such as production of growth hormones, solubilization of insoluble minor nutrients in soil and increased uptake and translocation of less available minerals [7, [4,5]. Bioinoculants are the microbial inoculants which can be usually defined as a preparation containing live or dormant cells of efficient strains of nitrogen fixing, phosphate solubilizing, and cellulytic microorganisms, etc. [7,4]. In contrast to chemical fertilizers, biofertilizers are viable microorganisms which are not the source of nutrients but provide help to plants in accessing the nutrient availability in rhizospheric region. These microbial formulations are used to enhance certain microbial process to increase the availability of nutrients in a form which can be assimilated by plant. Biofertilizers are low-cost, renewable sources of plant nutrients.

This study was aimed to evaluate the most suitable bio-inoculant for plant growth, yield and flower quality of China aster and estimate the economics of various treatments.

2. MATERIALS AND METHODS

The present investigation was carried out at Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P) in the month of November to March during the winter season of the year 2022.

The different treatment manipulated as follows T_1- 100%RDF, T_2- 75%RDF + Azospirillum, T_3- 75%RDF + KSB, T_4- 75%RDF + VAM, T_5- 75%RDF + PSB, T_6- 75%RDF + Azospirillum + KSB, T_7- 75%RDF + Azospirillum + VAM, T_8- 75%RDF + Azospirillum + PSB, T_9- 75%RDF + Azospirillum + KSB + VAM. The treatments were arranged in a Completely Randomized Design (CRD) with 9 treatments in 3 replications.

3. RESULTS AND DISCUSSION

Vegetative parameters viz., plant height, number of leaves per plant, plant spread and leaf area were recorded at different stages of plant growth from 20, 40 and 60 days after transplanting and the results from the observations made are as follows (Table 1). Significant difference was observed due to different combination of

bioinoculants for plant height, at 60 DAT. The Maximum Plant height at 60 days (27.28 cm) was recorded in the T_8 (75%RDF+ Azospirillum + PSB), followed by T_6 (75%RDF+ Azospirillum + KSB) with (25.67 cm) and the minimum Plant Height at 60 days (23.78 cm) was recorded in T_1 (100%RDF). Significant difference was observed due to different combination of bioinoculants for number of leaves per plant, at 60 DAT. The Maximum number of leaves per plant at 60 days (27.44) was recorded in the T_8 (75%RDF+ Azospirillum + PSB), followed by T_4 (75%RDF+ VAM) with (26.11) and the minimum number of leaves per plant at 60 days (23.00) was recorded in T_1 (100%RDF). Significant difference was observed due to different combination of bioinoculants for plant spread (cm^2), at 60 DAT. The Maximum plant spread (cm^2) at 60 days (15.28 cm^2) was recorded in the T_8 (75%RDF+ Azospirillium + PSB), followed by T_9 (5%RDF+ Azospirillium +KSB +VAM) with (14.83 cm^2) and the minimum plant spread (cm^2) at 60 days (12.33 cm^2) was recorded in T_1 (100%RDF).

The deviation in leaf area due to different combination of bioinoculants was significant. The maximum leaf area was in (14.11 cm^2) T_8 (75% RDF + Azospirillum + PSB) which was statistically at par with the other treatments like (13.93 cm^2) T_9 (75% RDF + Azospirillum +KSB+VAM). However, minimum leaf area (10.67 cm^2) was recorded in T_1 (100% RDF). Significant difference was observed due to different combination of bioinoculants for days of bud emergence, at DAT. The results collaborate with those of Bose et al [9], Karuppaiah et al [10, 8], Munikrishnappa et al [11], Nandre et al [12]. The minimum days of bud emergence (47.11 days) was recorded in the T_8 (75%RDF+ Azospirillium + PSB), followed by T_2 (75%RDF+Azospirillum) with (47.56 days) and the Maximum days of first bud emergence (55.44 days) was recorded in T_1 (100%RDF). Significant difference was observed due to different combination of bioinoculants for days taken to bud break, at DAT. The minimum days taken for bud break (54.67 days) was recorded in the T_8 (75%RDF+ Azospirillium + PSB), followed by T_2 (75%RDF+Azospirillum) with (55.00 days) and the Maximum days taken for bud break (61.11 days) was recorded in T_1 (100%RDF).

Significant difference was observed due to different combination of bioinoculants for flower stalk diameter, at DAT. The Maximum flower stalk length (13.00 cm) was recorded in the T_8 (75%RDF+ Azospirillum + PSB), followed by T2 (75%RDF+Azospirillum) with (12.32 cm) and the minimum flower stalk length (11.30 cm) was recorded in T1 (100% RDF).

Significant influence of different treatments on flower diameter was observed. (Table 1). Highest Flower diameter was registered in T_3 (7.80 cm) and it was closely followed by T_1 (7.50 cm), T_6 (7.40 cm) and T_9 (7.10 cm). The treatment T_{10} (5.83) recorded lowest flower diameter. The results are in line with those of Kumar et al [13], Patil et al [14], Ravindra et al [15], Wani et al. [5]. The treatments significantly influenced the number of flowers per plant. Among the treatments, the maximum number of flowers per plant (14.12) were observed in T_8 i.e. 75% RDF + Azospirillum + PSB with other treatments like T_5 (100% RDF + PSB) with 14.00 number of flowers per plant, respectively. The minimum number of flowers per plant (22.51) was observed in the treatment T_1 (100%RDF).

An inspection of the data presented in Table 1 reveals the significant results for number of buds fully opened. The maximum number of buds fully opened (14.00) were observed in T_8 i.e. 75% RDF + Azospirillum + PSB with other treatments like T_7 (75%RDF+ Azospirillum + VAM) with (13.44) number of buds fully opened, respectively. The minimum number of buds fully opened (11.11) was observed in the treatment T_1 (100%RDF).

Significant difference was observed due to different combination of bioinoculants for chlorophyll content (days), at DAT. The Maximum chlorophyll content (12.22 days) was recorded in the T_8 having (75% + Azospirillum + PSB) and it was found at par with T_7 (75% RDF + Azospirillum + KSB+VAM), was (11.89 days) while, the minimum chlorophyll content (3.89 cm) was noticed in T_1 (100%RDF) (Table 2).

Application of various dose of different combinations of biofertilizers produced significant effects on the vase life of China aster cut flowers (Table 1). Significant difference was observed due to different combination of bioinoculants for vase life (days), at DAT. The Maximum vase life (12.22 days) was recorded in the T_8 having (75% + Azospirillum + PSB) and it was found at par with T_7 (75% RDF + Azospirillum + KSB+VAM), was (11.89 days) while, the minimum vase life (3.89 cm) was noticed in T_1 (100%RDF).

Table 1. Various treatments of bud emergence, bud break, plant height and plant spread

Treatment Symbol	Treatments combination	Plant height (cm)	Plant pread (cm)	Leaf area per plant (cm^2)	Number of Leaves per plant	Days taken for bud emergence	Days taken for bud break	Days taken for opening first flower
T_1	100%RDF	23.28	12.33	10.67	23.00	55.44	61.11	69.22
T_2	75%RDF+ Azospirillum	25.22	13.67	11.88	24.44	47.56	55.00	64.00
T_3	75%RDF+ PSB	24.28	13.56	13.72	23.67	51.44	58.44	66.67
T_4	75%RDF+ VAM	25.06	12.33	12.73	26.11	48.44	55.67	65.33
T_5	75%RDF+ KSB	24.89	14.03	12.28	25.33	53.89	60.44	68.33
T_6	75%RDF+ Azospirillum + PSB	25.67	13.23	13.33	24.11	49.56	57.11	67.33
T_7	75%RDF+ Azospirillum + VAM	24.67	13.57	13.32	25.44	51.33	56.11	65.56
T_8	75%RDF+ Azospirillum + KSB	27.28	15.28	14.11	27.44	47.11	54.67	62.33
T_9	75%RDF+ Azospirillum + PSB+VAM	25.56	14.83	13.93	26.00	48.44	55.44	63.00
S. Ed. (±)		1.427	0.792	1.205	2.359	3.592	3.81	3.731
C. D. at 5 %		N/A	1.677	N/A	N/A	N/A	N/A	N/A

Table.2 Response of bioinoculants on growth, flowering, yield and post-harvest attributes of china aster

Treatment Symbol	Treatments combination	Stalk length (cm)	Flower diameter (cm)	Number of flowers per plant	Number of buds fully opened	Chlorophyll content	Vase life (days)
T_1	100%RDF	11.3	3.89	11.56	11.11	40.98	11.11
T_2	75%RDF+ Azospirillum	12.3	4.36	13.67	13.00	40.32	11.56
T_3	75%RDF+ PSB	12.1	4.48	12.56	11.78	40.79	11.56
T_4	75%RDF+ VAM	11.8	4.29	12.78	12.11	39.11	11.78
T_5	75%RDF+ KSB	11.6	4.63	14.00	12.67	39.72	11.67
T_6	75%RDF+ Azospirillum + PSB	11.7	4.07	12.89	11.67	43.43	11.56
T_7	75%RDF+ Azospirillum + VAM	11.7	4.07	13.78	13.44	44.12	11.89
T_8	75%RDF+ Azospirillum + KSB	13.0	4.92	14.56	14.00	46.99	12.22
T_9	75%RDF+ Azospirillum + PSB+VAM	11.4	4.68	13.11	12.44	41.73	11.33
	S. Ed. (±)	0.570	0.227	1.079	0.796	2.549	0.343
	C. D. at 5 %	N/A	0.481	N/A	N/A	N/A	N/A

The possible reason improved vegetative growth, flower attributes and economics is that combined application of biofertilizers with 75% of recommended dose of RDF and resulted in better nutrition which leads to increased photosynthesis activity, enhanced cell division and enlargement as nitrogen is important constituent of nucleic acid and it might have increased the synthesis of carbohydrate, amino acids etc. from which the phytohormones like auxins, gibberellins, cytokines have been synthesized and phosphorus being an essential component of protoplasm and chlorophyll, caused conversion of photosynthates into phospholipids resulting in adequate vegetative growth thus increased plant height [9, 5]. Biofertilizers produce several growth promoting hormones (auxins, cytokinins and gibberellins etc.) in addition to increasing the availability of nitrogen and phosphorus to the plants resulting in better plant growth [4]. Similar results with the application of biofertilizers with reduced dose of NPK have been reported by Ahmad et al. [6], Chaitra and Patil (2007), Patil and Agasimani [14], Wani et al. [5] Munikrishnappa et al [11].

4. CONCLUSION

On the basis of present investigation, it is concluded that the treatments T_8 (75% + Azospirillum + PSB) was found best treatment combinations which were significantly increased growth, flowering and quality parameters of China aster. The treatments promoted the plant height, bud emergence and for vase life. Azospirillum and PSB resulting in enhanced nutrient uptake which led to increased growth, yield and quality of China aster flowers.

ACKNOWLEDGEMENT

We authors are greatly thankful to other professors and members, Department of Horticulture for their guidance and support during the research trail and also thankful to Department of Soil science and Department of Agro-meteorology for their information.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Wani MA, Khan F, Din A, Banday N, Malik SA, Nazki IT, Bhat ZA, Wani FJ. Identifying the combined effect of special horticulture techniques and frequency of nutrient sprays on seed quality of China aster (*Callistephus chinensis*). Vegetos. 2022a; 1-13.
2. Wani, MA, Khan FU, Din A, Nazki IT, Iqbal S, Banday N. Influence of priming treatments on germination, seedling growth and survival of China aster [*Callistephus chinensis* (L.)]. Vegetos, 2022b;1-10.
3. Wani MA, Khan FU, Nazki IT, Khan SH, Ali T, Neelofar. Phytomorphology of Callistephus chinensis as influenced by differential planting geometry, pinching and compound nutrient sprays. Current Journal of Applied Science and Technology. 2018;29;26(4):1-1.
DOI: 10.9734/CJAST/2018/40510.
4. Wani SA, Chand S, Wani MA, Ramzan M, Hakeem KR. Azotobacter chroococcum–a potential biofertilizer in agriculture: An overview. Soil science: Agricultural and environmental prospectives. 2016;333-348.
5. Wani MA, Wani SA, Ahmad MS, Lone RA, Gani G, FU K. Integrated Nutrient Management (INM) approaches in flower crops. Int. J. Curr. Microbiol. App. Sci. 2017;6(3):254-265.
6. Ahmad MS, Beigh MA, Nanda AB, Lone RA, Hussain K. Effect of Azospirillum, VAM and inorganic fertilizers on growth and yield of African marigold cv. 'Pusa Narangi'. Journal of Plant Science Research. 2007;23(1/2):51- 53.
7. Almeida EFA. Soil Sustainable management in rose integrated production. Acta Horticulturae. 2013;970:355-360.
8. Mogal SA, Khiratkar SD, Chopde NK, Dalvi AM, Kuchanwar OD, Khobragade YR. Effect of organic manures and biofertilizers with reduced doses of nitrogen on growth, yield and quality of China aster. Journal of Soils and Crops. 2006;16(1):180-185.
9. Bose B. Subash, Chanda. Effect of integrated nutrient management on yield and quality of China aster (*Callistephus chinensis* (L.) Nees) cv. Pit and Pot. Plant Archives. 2019;19 (1):518- 520.
10. Karuppaiah P. Effect of Azospirillum, phosphobacteria and organic manures on growth and yield of French marigold (*Tagetes patula* L.). Plant Archives. 2005;5(2):661-664.
11. Munikrishnappa PM. Integrated nutrient management studies in China aster

(*Callistephus chinensis* (L.) Nees) - A review. Trends in Biosciences. 2014; 7(12):1217-1221.

12. Nandre DR, Jogdande ND, Dalal SR, Bansode AB, Chaudhale BS. Effect of Azotobacter on growth and yield of China aster under reduced nitrogen doses. Crop Research Hisar. 2005;29(2):272-274.
13. Kumar V, Singh A. Effect of vermicompost and VAM inoculation on vegetative growth and floral attributes in China aster (*Callistephus chinensis* (L.) Nees). Journal of Ornamental Horticulture. 2007;10(3): 190-192
14. Patil VS, Agasimani AD. Effect of Integrated nutrient management on growth and yield parameters in China aster (*Callistephus chinensis*). Mysore Journal of Agricultural Sciences, 2013;47(2):267-272.
15. Ravindra SP, Hanumanth Appa 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. Environment and Ecology. 2013;31(2C):1104-1106.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/104914