Response of China aster to bio-inoculant amendments under pot experiment

A B S T R A C T

A field experiment wascarried outintheDepartmentofHorticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture,TechnologyandSciences,Prayagraj.Duringrabiseason(2022-2023). The aim of this study was determined to find out the most suitable bio-inoculant for plant growth, yield and flower quality of China aster and to estimate the economics of various treatments.This experiment was laid out in Completely Randomized design (CRD) with 09 treatments and each treatment replicated thrice. The treatments consist of different combinations of bio-inoculants (Azospirillum, PSB, VAM and KSB). 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.

Key words: China aster, Azospirillium, PSB, KSB, VAM.

Introduction

"China aster (*Callistephuschinensis (L.) Nees*) belongs to family 'Asteraceae' and is native to China. The genus has only a single species, namely, Callistephuschinensis. 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 Callistephushortensis. It was first named by Linnaeus as Aster chinensis, and Nees subsequently changed this name to Callistephuschinensis" (Janakiram, 2006).

"In view of China aster adapting well to varying soil and climatic conditions, it can be grown successfully under Indian climatic conditions. China aster flowers last longer which are used as cut flower, loose flower, bedding plant, for flower decoration, preparation of bouquets and garlands. In India, it is being grown in Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra and West Bengal" (Janakiram, 2006).

"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. 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" (Murugesan R and Prasad G, 2006).

"China aster responds very well to the application of inorganic and organic fertilizers. Bio-fertilizer usually consists of live or latent cells of microorganismswhich 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.Use of bio-fertilizers reduces per unit consumption of inorganic fertilizers and increases the quality and quantity of flowers" (Murugesan R and Prasad G, 2006).

"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.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" (Janakiram, 2006).

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 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.

Materials and Methods

The present investigation was carried out at Department of Horticulture, NainiAgricultural 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.

Results and Discussion

Growth attributes

Vegetative parameters viz., plant height, number of leaves per plant, plant spreadand 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.

Plant height (cm)

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).

Number of leaves per plant

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).

Plant spread(cm^2)

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).

Flowering attributes

Days taken for bud emergence

Significant difference was observed due to different combination of bioinoculants for days of bud emergence, at DAT. 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).

Days taken for bud break

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 forbud break (61.11 days) was recorded in T_1 (100%RDF).

Chart1: Various treatments of bud emergence, bud break,Plant height and plant spread.

Treatment Symbol	Treatments combination	Plant height (cm)	Plant Spread (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**

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**

Table.1 Response of bioinoculants on Growth, Flowering, yield and post-harvest attributes of china aster.

Flower stalk length (cm)

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 T8 (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).

Flower diameter (cm)

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.

Yield parameters

Number of flowers per plant

The treatments significantly influenced the number offlowers 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).

Number of buds fully opened

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).

Chlorophyll content

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).

Post-harvest attributes

Vase life of cut flower

Application of various dose of different combinations ofbiofertilizers 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).

"The possible reason for increase in plant height no. of leaves ,plant spread ,bud break, vase life,flowering, yieldand 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. 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. Similar results of increased plant height due to combined application of biofertilizers with reduced dose of NPK" have been reported by Chaitra and Patil (2007), Patil and Agasimani (2013) and Kirar et al.

Conclusion

According to the findings of the experiment, the treatments T8 (75% + Azospirillum + PSB) were the most effective treatment combinations for improving the development, flowering, and quality criteria of China asters.

The treatments aided in bud emergence, plant height, and vase life. Azospirillum and PSB led to improved nitrogen uptake, which improved China aster flower development, yield, and quality.

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