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INFLUENCE OF INORGANIC AND ORGANIC NUTRIENTS ON FLOWERING AND QUALITY OF CHINA ASTER (*CALLISTEPHUS CHINENSIS* L. NEES) CV. KAMINI

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ABSTRACT

The experiment entitled "Influence of inorganic and organic nutrients on flowering and quality of China aster cv. Kamini" was carried out in a farmer's field at Nellur (village), Denkanikottai (Taluk), Krishnagiri district, Tamil Nadu during 2022 to 2023. The experiment was conducted by adopting inorganic nutrients (N, P and K) and various organic nutrients *viz.*, Farmyard manure @ 5 t ha^{-1} and 10 t ha^{-1}, Vermicompost @ 1.5 t ha^{-1} and 3 t ha^{-1}, Coirpith compost @ 1.5 t ha^{-1} and 3 t ha^{-1} along with foliar application of Micronutrient mixture @ 0.5 per cent and 1 percent at 60 days after planting and then foliar application of Jeevamrutham @ 5 per cent at 30 and 90 days after planting. This experimental study was carried out in the Randomized Block Design (RBD) with three replications comprising thirteen treatments. Among the various flowering parameters *viz.*, days taken for first flower appearance (days), days to first flowering (days), days taken to 50 percent flowering (days), duration of flowering (days) have been recorded maximum in the treatment T_{13} (50 percent RDF + Vermicompost @ 3 t ha^{-1} + Coir pith compost @ 3 t ha^{-1} along with foliar application of micronutrient mixture @ 1 percent at 60 DAP and foliar application of Jeevamrutham @ 5 percent at 30 and 90 DAP) and quality parameters *viz.*, flower diameter (cm), number of rows of ray florets, disc diameter (cm), ray floret length (cm), ray floret breadth (cm), shelf life (days) were performed best in the treatment T_{13} with the application of 50 percent RDF + Vermicompost @ 3 t ha^{-1} + Coir pith compost @ 3 t ha^{-1} along with foliar application of micronutrient mixture @ 1 percent at 60 DAP and foliar application of Jeevamrutham @ 5 percent at 30 and 90 DAP. This was followed by the treatment T_{12} consisting of 75 percent RDF + Vermicompost @ 1.5 t ha^{-1} + Coir pith compost @ 1.5 t ha^{-1} along with foliar application of micronutrient mixture @ 0.5 percent at 60 DAP and foliar application of Jeevamrutham @ 5 percent at 30 and 90 DAP.

Key words : China aster, Farmyard manure, Vermi compost, Coir pith, Jeevamrutham.

Introduction

Flowers are the innumerable creation of God to beautify the surroundings and flowers are a part of human society. Flowers have been an integral part of Indian society and are cultivated for various purposes ranging from aesthetic to social and religious purposes. The wonderful variety of colors, tones, textures, fragrances and shapes of flowers are truly inspirational and attract everyone. Among the various horticultural products, flowers highlight the key moments in our lives. The appreciation of the potential of commercial floriculture has resulted in the blossoming of this field into a viable horticultural business option. Floriculture is a multibillion-dollar global industry, that includes the production of cut flowers, traditional flowers, bedding plants, foliage plants, potted plants, cut greens, quality seed and planting materials, dry flowers and foliage, landscaping, post-harvest management and value - added products. The diverse agro-climatic conditions prevailing in India favours year-round production of ornamental crops. The Indian floriculture market reached INR 231.7 billion in 2022 with an expected compound annual growth rate (CAGR) of

13 percent during 2023-2028. The government of India has identified floriculture as a sunrise industry and accorded it 100% export-oriented status. Owing to the steady increase in demand for flowers, floriculture has become one of the most important commercial trades in agriculture. Floriculture in India is being viewed as a high-growth industry. Commercial floriculture is becoming important from an export angle. The liberalization of industrial and trade policies paved the way for the development of export-oriented production of cut flowers. It has been found that commercial floriculture has higher potential per unit area than most field crops and is, therefore, a lucrative business. Among the loose flowers China aster is one of the most important flower crops due to its varied range of colours and ease of cultivation. China aster [*Callistephus chinensis* L. Nees] is a member of the Asteraceae family. 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 the chrysanthemum and marigold. Application of inorganic amendments *viz*., nitrogen, phosphorus and potassium to supply enough of these elements for the rapid growth of crop plants during their early growth and economic production. Application of organic amendments like farmyard manure, vermicompost and coir pith compost as organic nutrients improves the soil texture, soil porosity, and water retention capacity and maintains a congenial microbial population, which increases soil nutrition. micronutrients must be taken up by the plants supplemented through foliar spray might basically enhance photosynthetic and other metabolic activities related to cell division and elongation (Hatwar *et al.*, 2003). Jeevamrutham is a liquid organic manure and is considered to be an excellent source of natural carbon, biomass, nitrogen, phosphorous, potassium and other micronutrients required for the crop. In this study attempt is made to find out the influence of inorganic and organic nutrients on performance of China aster and find out the best treatment combination for maximizing growth and yield of China aster.

Materials and Methods

The present experiment on ‘‘Influence of inorganic and organic nutrients on flowering and quality of China aster [*Callistephus chinensis* (L.) Nees] cv. Kamini’’ was carried out in a farmer’s field at Nellur village, Denkanikottai taluk in Krishnagiri district during the year 2022–2023. The experiment was laid out in randomized block design with a plant spacing of about 30 cm × 30 cm containing 9 plants experimental per plot. The experiment conducted by using different inorganic fertilizers *viz*., nitrogen, phosphorus and potassium and organic manures *viz*., farmyard manure, vermicompost, coir pith compost and foliar application of micro nutrient mixture and jeevamrutham. The observations are recorded on the selected five plants for a treatment in each replication and the mean data is statistically analyzed. The plots were kept free from weeds by periodic hand weeding. Earthing up operations was done whenever found necessary. Pests

Table 1 : Treatment details of the experiment.

T_1	Control - 100 % RDF (180: 60: 60 kg of NPK ha^{-1})
T_2	75 % RDF + Farm yard manure @ 5 t ha^{-1}
T_3	75 % RDF + Vermicompost @ 1.5 t ha^{-1}
T_4	50 % RDF + Farm yard manure @ 10 t ha^{-1}
T_5	50 % RDF + Vermicompost @ 3 t ha^{-1}
T_6	75 % RDF + Farm yard manure @ 5 t ha^{-1} + Coir pith compost @ 1.5 t ha^{-1}
T_7	50 % RDF + Farm yard manure @ 10 t ha^{-1} + Coir pith compost @ 3 t ha^{-1}
T_8	75 % RDF + Vermicompost @ 1.5 t ha^{-1} + Coir pith compost @ 1.5 t ha^{-1}
T_9	50 % RDF + Vermicompost @ 3 t ha^{-1} + Coir pith compost @ 3 t ha^{-1}
T_{10}	75 % RDF + Farm yard manure @ 5 t ha^{-1} + Coir pith compost @ 1.5 t ha^{-1} + foliar application of Micronutrient mixture @ 0.5 % at 60 DAP + Jeevamrutham @ 5 % at 30 and 90 DAP
T_{11}	50 % RDF + Farm yard manure @ 10 t ha^{-1} + Coir pith compost @ 3 t ha^{-1} + foliar application of Micronutrient mixture @ 1 % at 60 DAP + Jeevamrutham @ 5 % at 30 and 90 DAP
T_{12}	75 % RDF + Vermicompost @ 1.5 t ha^{-1} + Coir pith compost @ 1.5 t ha^{-1} + foliar application of Micronutrient mixture @ 0.5 % at 60 DAP + Jeevamrutham @ 5% at 30 and 90 DAP
T_{13}	50% RDF + Vermicompost @ 3 t ha^{-1} + Coir pith compost @ 3 t ha^{-1} + foliar application of Micronutrient mixture @ 1% at 60 DAP + Jeevamrutham @ 5% at 30 and 90 DAP

and diseases were controlled periodically during the entire crop period. The data were subjected to statistical analysis as suggested by Panse and Sukhatme (1985). Data of three replications were tabulated and recorded. The treatment details are shown in the Table 1.

Results and Discussion

Application of inorganic and organic nutrients significantly influenced the flowering and quality parameters. Plant nutrition is of unique importance and is known to play a decisive role in the growth and all-round development of the crop. Nitrogen, phosphorus, potassium of the key nutrient elements for enhancing for productivity of plants. The use of organic constituents increases productivity, improves soil fertility and reduces the use of hazardous fertilizers. Nutrient management techniques in the field after planting through integrated approaches have claimed to be a beneficial method of improving crop growth, physiology, flowering and yield. Organic nutrients *viz*., farmyard manure, vermicompost and coir pith compost are important organic resources that contain plant nutrients in their available form. It maintains soil productivity better than inorganic fertilizers. Therefore, the use of both inorganic and organic nutrients in appropriate quantities are very useful for sustainable flower crop productivity. The production of economical yield and better quality of China aster flowers requires proper crop management techniques. Therefore, retaining the production of China aster it requires adequate amount of readily available macro and micro nutrients, which support production of more photosynthates required for good quality flowers. Regulation of growth can be influenced by balanced nutrients supplied in the form of inorganic (macro and micro nutrients) and organic nutrients *viz.*, farmyard manure, vermicompost and coir pith compost along with foliar application of a micronutrient mixture and Jeevamrutham. It is therefore important to optimize the efficiency with which fertilizers are used in crop production. Increased fertilizer use efficiency can be achieved through the foliar application of nutrients *viz*., micronutrient mixture, which enhances the performance of China aster. Adding organic substances to the plant, especially like Jeevamrutham in the form of foliar application improves the growth, flowering, flower yield and qualities of China aster. It contains macronutrients, vital micronutrients, numerous vitamins, essential amino acids, growth promoters, and helpful microbes for plant growth. The result of the precent study entitled "Influence of inorganic and organic nutrients on flowering and quality of China aster [*Callistephus chinensis* (L.) Nees.] cv. kamini" are discussed hereunder.

The data and their results are present in Tables 2 and 3 on flowering parameters *viz*., Days taken to first flower bud appearance (days), Days to first flowering, Days taken to 50 percent flowering (days), Duration of flowering (days) and quality parameters *viz*., Flower

Table 2 : Influence of inorganic and organic nutrients on Days taken to first flower bud appearance (days), Days to first flowering, Days taken to 50 percent flowering (days), Duration of flowering (days) of China Aster [*Callistephus chinensis* (L.) Nees].

Treatments	Days taken for first flower bud appearance (Days)	Days to first flowering (days)	Days taken to 50 percent flowering (days)	Duration of flowering (days)
T_1	69.77	81.87	82.93	30.49
T_2	67.53	79.19	80.25	32.29
T_3	65.31	76.52	77.56	34.07
T_4	63.08	73.86	74.85	35.86
T_5	60.86	71.18	72.16	37.64
T_6	58.64	68.51	69.05	39.43
T_7	55.91	65.41	66.36	41.61
T_8	58.13	68.08	49.45	39.82
T_9	53.69	62.75	63.65	43.39
T_{10}	51.45	59.98	60.76	45.17
T_{11}	51.18	59.67	60.23	45.54
T_{12}	48.95	57.01	57.25	47.33
T_{13}	46.72	54.34	54.47	49.11
S.Ed.	1.07	1.25	1.27	0.82
C.D (p=0.05)	2.21	2.59	2.62	1.71

diameter (cm), Number of rows of ray floret, Disc diameter (cm), Ray floret length (cm), Ray floret breadth (cm), Single flower weight (g), Shelf life (days).

Flowering parameters

Flowering parameters include days taken for first bud appearance, days to first flowering, days taken to 50 percent flowering and duration of flowering.

Different treatment has exhibited a significant response to the initiation of flower bud in China aster. The results of present investigation indicated that the minimum days taken for bud initiation were observed in the best treatment T_{13} days (46.72 days), which had an optimum combination of both inorganic and organic nutrients. Whereas in the control the treatment (T_1) showed the maximum of 69.77 days for flower bud initiation. Application of proper and balanced nutrients influences the crop directly on every phase of growth.

The vigorous growth of the plant due to application of organic and inorganic nutrients, resulting in rapid uptake of nutrients and water has a significant effect on the early production of the first flower bud appearance. This is also attributed to the accumulation of more photosynthates in vermicompost and coir pith compost on combination with right quantity of recommended dose of fertilizers and foliar application of nutrients, might have induced early flowering. The required quantity of organic nutrients enriched with sufficient organic matter leads to early flower bud initiation. Here, a new technology involves an aspect involving the use of vermicompost and coir pith compost to effectively harness beneficial soil microbes, destroy soil pathogens and convert organic waste into valuable products such as biofertilizers, biopesticides, vitamins, enzymes, antibiotics and growth hormones. This was in line with the results reported by Shilpa Shree *et al*. (2023) in chrysanthemum, Rajkumar Sahu *et al*. (2022) in Calendula and Sendhilnathan and Balaraman *et al*. (2021) in Celosia. Knowing these three phases of cell growth *viz.,* cell division, cell enlargement and differentiation are the different processes that occur in these phases. The first two phases are leading to an increase in plant height, while as the third phase results in bringing maturity to the cells. The right time for foliar application of the micronutrient mixture at the right interval minimized the days taken for flower bud initiation. Karuppaiah (2019) has reported that the use of foliar applications of micronutrient spray led to an increase in the amount of chlorophyll in plant leaves.

These responses of foliar application of micronutrient mixtures that encourage the growth and development of China aster could be related to a constitutive increased net photosynthetic rate due to the high content of chlorophyll and the improved chloroplast ultrastructure. The maximum yield is obtained due to the foliar application of organic liquid from Jeevamrutham, which plays a key role in promoting growth and providing immunity to the plant system. It also promotes immense physiological activity in the plant. Simultaneously, the application of a micronutrient mixture as a foliar spray is also enhanced, resulting in improved flowering parameters. These results are in conformity with the findings of Harshavardhan *et al.* (2016) in Carnation and Pathania *et al*. (2023) in China aster.

The minimum days to first flowering (54.34 days) and maximum duration of flowering (47.33 days) were observed in treatment T_{13} with the application of balanced nutrients and foliar application of micronutrients and Jeevamrutham. The increase in early flowering and maximum duration of flowering is due to the fact that application of vermicompost and coir pith compost along with the 50 percent recommended dose of fertilizer induces early flowering and maximum duration. Hence, application of both organic and inorganic nutrients with into the soil enhanced the uptake of nutrients, thereby resulting in the development of shoots with vigorous growth with that accumulation of carbohydrates and the evolution of a greater number of flowers with more petals. Application of a micronutrient mixture induces a greater number of branches in the plants with this spraying of Jeevamrutham at the right intervals, which activates the vegetative growth and produce new shoots, thereby taking the minimum number of days to first flowering and the maximum duration of flowering. Similar results were reported by Thakare *et al.* (2020) in Chrysanthemum and Swetha *et al.* (2022) in Gaillardia.

Flower quality parameters

The quality parameters observed for this experimental study are flower diameter (cm), number of rows of ray florets, disc diameter (cm), ray floret length (cm), ray floret breadth (cm), single flower weight (g) and shelf life (days). Significant differences were observed among all the combination treatments. The data pertaining to the flower diameter (6.28 cm) and single flower weight (3.87 g) were found to be superior with the application of a 50 percent recommended dose of inorganic fertilizer with a combination of organic fertilizer *viz.,* vermicompost @ 3 t ha^{-1} and coir pith compost @ 3 t ha^{-1}, which are very efficient in increasing the flower quality. Here, vermicompost act as an alternative source of nutrition in crop production for enhancing plant root initiation, improvement in root biomass, plant growth enhancement,

Table 3 : Influence of inorganic and organic nutrients on Flower diameter (cm), Number of rows of ray floret, Disc diameter (cm), Ray floret length (cm), Ray floret breadth (cm), Single flower weight (g), Shelf life (days) of China Aster [*Callistephus chinensis* (L.) Nees].

Treatments	Flower diameter (cm)	Number of rows of ray floret	Disc diameter (cm)	Ray floret length (cm)	Ray floret breadth (cm)	Single flower weight (g)	Shelf life (days)
T_1	3.64	2.14	1.02	1.04	0.17	1.56	3.39
T_2	3.93	2.46	1.13	1.29	0.21	1.77	3.75
T_3	4.16	2.63	1.23	1.43	0.24	1.96	4.09
T_4	4.40	2.78	1.32	1.57	0.28	2.17	4.41
T_5	4.63	2.96	1.42	1.73	0.31	2.41	4.74
T_6	4.87	3.12	1.51	1.87	0.35	2.67	5.12
T_7	5.25	3.34	1.64	2.10	0.41	2.97	5.66
T_8	4.99	3.19	1.55	1.95	0.36	2.75	5.31
T_9	5.48	3.51	1.75	2.24	0.45	3.15	6.02
T_{10}	5.72	3.67	1.84	2.39	0.50	3.36	6.39
T_{11}	5.81	3.73	1.88	2.46	0.51	3.44	6.54
T_{12}	6.04	3.88	1.99	2.61	0.54	3.63	6.86
T_{13}	6.28	4.04	2.08	2.75	0.58	3.87	7.21
S.E.D	0.10	0.06	0.03	0.04	0.009	0.06	0.12
C.D (p=0.05)	0.21	0.13	0.07	0.09	0.01	0.12	0.24

increase in flower quality and yield. Besides that, vermicompost has enough major and minor nutrients, which help in enhancing plant growth and flower yield along with good shelf life. With this application of sufficient quantity of coir pith compost plays a major role in production of good-quality flowers and it also serves as a reservoir to provide support for plant growth by holding water for the exchange of gases between roots and the atmosphere above the root medium. Application of a foliar spray of a micronutrient mixture and Jeevamrutham at various stages influenced greater performance in attaining maximum yield. This Jeevamrutham is a liquid organic nutrient that act as an excellent nutrient-rich organic fertilizer and supplies sufficient nutrition, thereby increasing shoot growth, which ultimately leads to an increase in flower diameter, number of rows of ray florets, disc diameter, ray floret length, ray floret breadth and single flower weight. As a result, the increase in flower quality parameters may be due to the cumulative effect of various nutrients in appropriate quantity and application of nutrient in a right time, which produced luxuriant vegetative growth that resulted in more availability of primary and secondary metabolites. A higher source-to-sink ratio represented the maximum flower quality parameters. Similar results were reported by, Chauhan *et al.* (2014) and Swarupa *et al.* (2019) in Gerbera and Abhishek Kumar Upadhya *et al*. (2022) in marigold. Shelf life is one of the important traits that determines its economic value. In this study, shelf life was significantly influenced by the various treatments. But the flowers, which are produced by the influence of various nutrients, showed maximum shelf life in treatment T_{13} (7.21 days) when compared to other treatments and it was significantly less in control (3.39 days). On the other hand, variation in shelf life might also be due to the application of effective inorganic and organic nutrients, which were supplied both in soil and through foliar application to the plants. This variation in shelf life among the flowers of different treatments might be due to variations in the accumulation of carbohydrates since these plants of different treatments could produce a greater number of leaves indicating a positive and significant correlation between all these quality parameters. These results are in conformity with the findings of Thakare *et al.* (2020) in Chrysanthemum and Harshavardhan *et al.* (2016) in Carnation.

Conclusion

Based on the present investigation it can be concluded that the treatment combination of 50 percent RDF + Vermicompost @ 3 t ha^{-1} + Coir pith compost @ 3 t ha^{-1} along with foliar application of micronutrient mixture @ 1 percent at 60 DAP and foliar application of Jeevamrutham @ 5 percent at 30 and 90 DAP is best suited to grow China aster [*Callistephus chinensis* (L.) Nees] in open field condition to achieve increasing the flowering and quality of the crop.

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