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Impacts of different levels of NPK on flower yield of annual Chrysanthemum and soil nutrients status (*Chrysanthemum coronarium* L.)

Darshana V Patel, NS Joshi, Pooja V Maheta and Yukta Patel

Abstract

The investigation has been taken place at the Floriculture Farm, Jambuvadi, Department of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat). A Randomized Block Design with a factorial concept was employed, involving different twelve treatment combinations. These combinations consisted of three levels of nitrogen (100, 150, and 200 kg ha^{-1}), two levels of phosphorus (80 and 100 kg ha^{-1}), and two levels of potassium (70 and 100 kg ha^{-1}). On the other hand, the treatment with 200 kg ha^{-1} of nitrogen, 100 kg ha^{-1} of phosphorus, and 100 kg ha^{-1} of potassium demonstrated improved yield parameters, including the number of flowers per plant (104.06 g, 94.30 g, 95.18 g respectively), flower yield per plant (436.24 g, 350.21 g, 340.01 g, respectively), flower yield per plot (3926.24 g, 3151.92 g, 3060.09 g, respectively), flower yield per hectare (12.11 t, 9.70 t, 9.42 t, respectively) Furthermore, the soil nutrient status exhibited improvement as the availability of nitrogen, phosphorus, and potassium in the soil increased (244.86 kg ha^{-1}, 57.10 kg ha^{-1}, 226.09 kg ha^{-1} respectively).

Keywords: Annual chrysanthemum, nitrogen, phosphorus, potassium, interaction

Introduction

Chrysanthemum is a member of Asteraceae family. There are about 160 species of chrysanthemum among which the modern autumn flowering perennial (*Chrysanthemum morifolium*) is most common, usually propagated through suckers followed by annual chrysanthemums which are propagated through seeds. Annual chrysanthemum comprises of three species *viz., Chrysanthemum segtum* (corn marigold), *Chrysanthemum carinatum* (tricoloured chrysanthemum) and *Chrysanthemum coronarium* (crown daisy or garland chrysanthemum). The crown daisy or garland chrysanthemum

(*Chrysanthemum coronarium*) is a native to Southern Europe, with a signature properties of branching annual with finely cut foliage reaching a height up to a meter, size of flowers varies from 2.5 to 4 cm and colour is usually in shades of yellow and white with cream zone at the centre (Vishnu, 1967) [19] and it is a fast-growing winter blooming annual. In North India, it is one of the cheapest sources of floral material for worship and garland particularly in early summer months when flowers are inadequate in supply. Apart from this, it is also used in potted plants, vases, decoration, preparation of bouquets and as borders in the garden. It's leaves like steamed or boiled and used as greens, especially in Chinese cuisine, yellow and white chrysanthemum flowers are also boiled to make a sweet drink in some parts of Asia known as "chrysanthemum tea" which has many medicinal uses passes bioactive terpenes such as dihydro chrysanoride and cumambrin, contents essential oil which has been proven to have medicinal effect on cancer and blood pressure reduction in humans.

Among the flowers, annual chrysanthemum has its some own importance value. It was one of the most important flower crops grown in India. Maharashtra is one of the leading states in flower production. It has a greater demand during various functions, festivals, marriages for floral decorations. In Maharashtra, annual chrysanthemum was more popular among the farmers because of easy cultivation for cut as well as loose flowers. The growers get attracted towards annual chrysanthemum due to its short duration to produce marketable attractive yellow and white colour flowers with good keeping quality.

It is an economically important flowering plant as a natural source of insecticide, the flowers are pulverized and an active component called pyrethrin is extracted and used in insecticidal preparation and it is a good companion plant, protecting neighboring plants from caterpillars.

In few recent years, it has been introduced as a valuable source of feed for animals. Chrysanthemum plants have also been shown to reduce indoor air pollution by the National Aeronautics and Space Administration (NASA) in its clean air study (Wolverton *et al.*, 1989) [20]. Therefore, the growing popularity of annual chrysanthemum has lead to its cultivation as a commercial crop and the area under it is increasing year after year.

Nitrogen (N) play a vital nutrient role that significantly impacts on plant growth and yield. It also major crucial role in plant development by serving as a critical constituent of chlorophyll, which facilitates the process of photosynthesis and enables the conversion of water and carbon dioxide into sugars. Additionally, it also promotes the growth of vibrant and abundant foliage, stimulating vegetative growth in leaves and stems. Furthermore, it enhances the uptake of other important nutrients such as potassium and phosphorus, thus contributing to the overall nutritional status of the plant. Ultimately, nitrogen acts as a regulator, effectively governing the overall growth and development of plants (Leghari *et al.*, 2016) [7].

Phosphorus (P) holds a significant importance as crucial nutrient for the growth of gomphrena. It serves as vital component of various structural compounds within plants and acts as catalyst in essential biochemical reactions. The addition of phosphorus to crops has been observed to have several beneficial effects, including the stimulation of root development, fortification of stalks and stems, enhancement of flower formation and seed production, facilitation of earlier and more uniform flower maturation, and improvement of flower quality (Razaq *et al.*, 2017) [12].

Potassium (K) plays a critical role as an essential activator for a multitude of vital enzymes involved in various plant processes. It is indispensable for crucial functions such as protein synthesis, sugar transport, nitrogen and carbon metabolism, as well as photosynthesis. The presence of potassium significantly impacts both yield formation and quality improvement in plants. By activating ATPase in the plasma membrane, potassium initiates acid stimulation, cell wall loosening, and hydrolase activation, thereby promoting cell growth and overall plant development (Hepler *et al.*, 2001) [6].

Materials and Methods

The present investigation was made on conducted an experiment at instructional farm, Jambuvadi, Department of Floriculture and Landscape Architecture, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during the seasonal year 2023. There were twelve different treatment combinations comprising three levels of nitrogen (N1 = 100 kg ha^{-1}, N2 = 150 kg ha^{-1} and N3 = 200 kg ha^{-1}), two levels of phosphorus (P1 = 80 kg ha^{-1} and P2 = 100 kg ha^{-1}) and two levels of potassium (K1 = 70 kg ha^{-1} and K2 = 100 kg ha^{-1}), which were applied in the form of urea, single super phosphate (SSP) and muriate of potash (MOP), respectively. Urea was applied in two equal split doses, along with full doses of SSP and MOP. The remaining dose of urea was applied a month later. The experiment was laid out in Factorial Randomised Block Design (FRBD) and replicated three times. Forty days old healthy seedlings of annual chrysanthemum were then transplanted with a spacing of 60 x 60 cm2.

Results and Discussion

Flower yield parameters Effect of nitrogen

Significantly maximum no. of flowers (104.06) was observed in treatment N3 (200 kg ha^{-1}), This might be due to the reason that nitrogen promotes the formation of amino acids and other compounds that are involved in flower formation. Meanwhile lowest no. of flowers (72.08) was found in treatment N1 (100 kg ha^{-1}). These results were in close similarity to work of Kejkar *et al*. (2014) [21] in spider lily and Sahu *et al.* (2021) [13] in chrysanthemum.

There was also significant effect of nitrogen on flower yield per plant. Significantly highest flower yield per plant (436.24 g) was observed in treatment N3 (200 kg ha^{-1}), which was followed by treatment N2 (150 kg ha^{-1}). Whereas minimum flower yield per plant (194.56 g) was recorded in treatment N1 (100 kg ha^{-1}). The reason attributed, these might be due to nitrogen increases the formation of branches, which produces more number of lateral buds, thereby increasing flower formation and flower yield. These results were in close relation with data recorded by Singh *et al.* (2017) [17] in China aster and Aremsungla and Topno (2022) [2] in zinnia.

As in plot wise data maximum significant flower yield per plot (3926.24 g) was observed in treatment N3 (200 kg ha^{-1}), which was followed by treatment N2 (150 kg ha^{-1}). Due to application of nitrogen, increases the branch formation, which ultimately produces more number of lateral buds, thereby increasing the flower formation and flower yield. While in case of minimum flower yield per plot (1751.05 g) was reported in treatment N1 (100 kg ha^{-1}). Similar trend were observed by Malani (2021) [8] in gomphrena, Singh *et al.* (2017) [17] in China aster and Aremsungla and Topno (2022) [2] in zinnia.

In terms of flower yield per hectare, higher flower yield per hectare (12.11 t) was recorded with nitrogen level @ 200 kg ha^{-1} (N3). In-spite of that lowest flower yield per hectare (5.37 t) was noted in treatment 100 kg ha^{-1} (N1) nitrogen. Its due to high dose of nitrogen accelerated the photosynthetic activities of plant and thus more assimilate available for flower to develop which resulted in increasing weight of single flower as well as number of flower per plant. Hence, flower yield per plant, plot and hectare were increases, respectively. Thess results were in confirmed the findings of Priyadarshini *et al.* (2018) [11] in marigold, Patel (2004) [10], Teja *et al.* (2017) [18] in chrysanthemum and Singh and Sangama (2000) [16] in China aster.

Effect of phosphorus

Significantly more number of flowers per plant (94.30) were observed in treatment P2 (100 kg ha^{-1}). Phosphorus enhances better vegetative growth responsible for more accumulation of food and dry matter which might be the reason for increase in number of flowers per plant. Meanwhile, the lowest number of flowers per plant (83.70) was found in treatment P1 (80 kg ha^{-1}). These results were in similar trends to Sahu *et al.* (2021) [13] in chrysanthemum.

There was also significant effect of phosphorus on flower yield per plant. Significantly maximum flower yield per plant (350.21 g) was observed in treatment P2 (100 kg ha^{-1}). Phosphorus enhances better vegetative growth and responsible for more accumulation of food and dry matter which might to be a reason for increase in no. of flowers per plant thereby increasing flower yield. While in case of minimum flower yield per plant (270.92 g) was found in treatment P1 (80 kg ha^{-1}). These results were in close similarity to that of Singh *et al.* (2017) [17] in China aster and Aremsungla and Topno (2022) [2] in zinnia.

Table 1: Effect of different level of NPK on flowering parameter

Treatment	Number of flowers per plant	Flower yield per plant (g)	Flower yield per plot (g)	Flower yield per hectare (g)
N1 = 100 kg ha^{-1}	72.08	194.56	1751.05	5.37
N2 = 150 kg ha^{-1}	90.85	300.89	2708.03	8.35
N3 = 200 kg ha^{-1}	104.06	436.24	3926.24	12.11
S.Em ±	2.88	11.16	100.48	0.31
C. D. @ 5%	8.44	32.74	294.74	0.92
P1 = 50 kg ha^{-1}	83.70	270.92	2438.29	7.52
P2 = 75 kg ha^{-1}	94.30	350.21	3151.92	9.70
S.Em ±	2.35	9.11	82.04	0.25
C. D. @ 5%	6.89	26.73	240.65	0.75
K1 = 75 kg ha^{-1}	82.81	281.12	2530.12	7.80
K2 = 100 kg ha^{-1}	95.18	340.01	3060.09	9.42
S.Em ±	2.35	9.11	82.04	0.25
C. D. @ 5%	6.89	26.73	240.65	0.75

Interaction			
N X P			
S.Em.±	4.07	15.79	142.11
C.D. at 5%	NS	NS	NS
N X K			
S.Em.±	4.07	15.79	142.11
C.D. at 5%	NS	NS	NS
P X K			
S.Em.±	3.32	12.89	116.03
C.D. at 5%	NS	NS	NS
N X P X K			
S.Em.±	5.76	22.33	200.97
C.D. at 5%	16.89	65.49	589.48
C.V.%	11.21	12.45	12.45

Significantly maximum flower yield per plot (3151.92 g) was observed in treatment P2 (100 kg ha^{-1}). Whereas in terms of minimum flower yield per plot (2438.29 g) was recorded with treatment P1 (80 kg ha^{-1}). Phosphorus increases better vegetative growth responsible for more accumulation of food and dry matter which increases ultimately in no. of flowers per plant thereby increasing flower yield. These results were in close similarity to that of Singh *et al.* (2017) [17] in China aster and Aremsungla and Topno (2022) [2] in zinnia.

Significantly higher flower yield per hectare (9.70 t) was observed in phosphorus level which was 100 kg ha^{-1} (P2). Lowest flower yield per hectare (7.52 t) was found in 80 kg ha^{-1} (P1). The improvement in flower yield ha^{-1} might be due to that in the presence of phosphorus, roots established very well and those roots absorb nutrients and water in better way and increased in vegetative growth like plant height and number of branches per plant, which are reason for increasing accumulation of photosynthates, hence, resulted in giving maximum flower yield. These findings regarding to flower size attributes are in agreement with the findings of Sajid and Amin (2014) [14], Dorajeerao *et al.* (2012) [5], in chrysanthemum.

Effect of potassium

Significantly maximum no. of flowers per plant (95.18) were observed in treatment K2 (100 kg ha^{-1}). This due to, potassium promotes flower bud development, thereby increasing the no. of flowers overall into the plant. Meanwhile, minimum no. of flowers per plant (82.81) was found in treatment K1 (70 kg ha^{-1}). These results were in close similarity to obtained values of Sahu *et al.* (2021) [13] in chrysanthemum and Singh *et al.* (2017) in China aster.

There was also significant effect of potassium on flower yield per plant. Significantly maximum flower yield per plant (340.01 g) was observed in treatment K2 (100 kg ha^{-1}). The increase in flower yield might be due to the reason that potassium improved formation of branches in plant, which resulted in more number of lateral buds forming into flowers. Meanwhile minimum flower yield per plant (281.12 g) was found in treatment K1 (70 kg ha^{-1}). Trends of data matched with recorded data by Sahu *et al.* (2021) [13] in chrysanthemum and Singh *et al.* (2017) in China aster.

Significantly maximum flower yield per plot (3060.09 g) was observed in treatment K2 (100 kg ha^{-1}). The increase in flower yield might be due to the reason that potassium improved formation of branches in plant, which resulted in more number of lateral buds forming into flowers. Meanwhile minimum flower yield per plot (2530.12 g) was found in treatment K1 (70 kg ha^{-1}). Same the response obtained by Sahu *et al.* (2021) [13] in chrysanthemum and Singh *et al.* (2017) in China aster.

Highest flower yield per hectare (9.42 t) was observed in potassium level which was 100 kg h^{-1} (K2). lowest flower yield per hectare (7.80 t) was found in 70 kg ha^{-1} (K1).Increase in flower yield ha^{-1} might be the due to potassium regulates water condition within the plant cell and water loss from the plant by maintaining the balance between respiration and transpiration. Thus reducing the tendency to wilt and helps in better utilization of water and helps in photosynthesis and thereby improving vegetative growth and ultimately improving the flower yield. Similar result obtained by Teja *et al.* (2017) [18], Sajid and Amin (2014) [14] in chrysanthemum, Pal and Ghosh (2010) in marigold.

Interaction effect of N, P and K

The number of flowers were recorded significantly maximum (111.97) in treatment combination of N3:P2:K2 (200:100:100 kg ha^{-1}), which was found statistically at par with treatments N3:P2:K1 (200:100:70 kg ha^{-1}) and N3:P1:K2 (200:80:100 kg ha^{-1}), The interaction effect of nitrogen, phosphorus and potassium was found to be significant because in terms of number of flowers, these nutrients play an important role. However, minimum number of flowers (46.13) were observed in treatment combination N1:P1:K1 (100:80:70 kg ha^{-1}). Same trend were matched with Sahu *et al.* (2021) [13] in chrysanthemum and Singh *et al.* (2017) [17] in China aster.

Significantly maximum flower yield per plant (538.79 g) was found in treatment combination N3:P2:K2 (200:100:100 kg ha^{-1}), This might be due to the nitrogen, phosphorus and potassium at the above rate contributed more towards yield parameters, hence flower yield per plant was found maximum. Whereas, minimum flower yield per plant (111.93 g) was found in treatment combination N1:P1:K1 (100:80:70 kg ha^{-1}). Sahu *et al.* (2021) [13] in chrysanthemum and Singh *et al.* (2017) [17] in China aster reported the same results as recorded with the following mentioned data treatment interactions.

Flower yield per plot (4849.11 g) was recorded maximum in treatment combination N3:P2:K2 (200:100:100 kg ha^{-1}). Whereas, minimum flower yield per plot (1007.34 g) was found in treatment combination N1:P1:K1 (100:80:70 kg ha^{-1}). This might be due to the nitrogen, phosphorus and potassium at the above rate contributed more towards yield parameters, hence flower yield per plot was found maximum. These results were in close similarity to that of Sahu *et al.* (2021) [13] in chrysanthemum and Singh *et al.* (2017) [17] in China aster.

Table 2: Interaction effect of different levels of NPK on yield parameters

Treatment (N: P: K kg ha^{-1})	Number of flowers per plant	Flower yield per plant	Flower yield per plot	Flower yield per hectare (t)
100: 80: 70	46.13	111.93	1007.34	3.10
100: 80: 100	79.80	209.97	1889.73	5.83
100:100:70	79.37	220.66	1985.97	6.12
100:100:100	83.03	235.57	2121.18	6.43
150: 80: 70	86.05	253.23	2279.04	7.03
150: 80: 100	88.20	267.81	2410.26	7.44
150: 100: 70	87.60	306.81	2761.29	8.52
150: 100: 100	101.57	375.73	3381.54	10.43
200: 80: 70	95.50	370.52	3334.65	10.28
200: 80: 100	106.53	412.08	3708.75	11.23
200: 100: 70	102.27	423.61	3812.46	11.76
200: 100: 100	111.97	538.79	4849.11	14.96
S. Em +	5.76	22.33	200.97	0.63
C. D @ 5 %	16.89	65.49	589.48	1.85
C. V. %	11.21	12.45	12.45	12.70

As in case of per hectare flower yield, maximum flower yield (14.96 t) was found in treatment combination N3:P2:K2 (200:100:100 kg ha^{-1}), whereas, minimum flower yield per hectare (3.10 t) was found in N1:P1:K1 (100:80:70 kg ha^{-1}). This might be due to applied chemical fertilizer it increased the concentration of N, P and K in soil, which increases it's contributed more vegetative and reproductive organs development and hence photosynthetic activity also increases so the ultimately enhancing the yield. The similar results are agreement with the findings of Saud and Sarmah (1995) [15] and Priyadarshini *et al.* (2018) [11] in marigold.

Soil analysis Available nitrogen Effect of nitrogen

Effect of applied nitrogen on soil available nitrogen status was found to be significant. Significantly more available nitrogen in soil (244.86 kg ha^{-1}) was observed in treatment N3 (200 kg ha^{-1}), which was statistically at par with treatment N2 (150 kg ha^{-1}). The increase in soil nitrogen level may be attributed to more level of urea application. Minimum available soil nitrogen (223.36 kg ha^{-1}) was found in treatment N1 (100 kg ha^{-1}). This finding was found to be in agreement with Divyashree *et al.* (2021) [4] in gaillardia.

Available phosphorus Effect of phosphorus

Applied phosphorus residual positive impact on soil available phosphorus that was found to be significant. Significantly highest level of available phosphorus in soil (54.21 kg ha^{-1}) was observed in treatment P2 (100 kg ha^{-1}). This increase in phosphorus content may be because of the higher level of phosphatic fertilizer application. Whereas, minimum soil available phosphorus (54.70 kg ha^{-1}) was observed in treatment P1 (80 kg ha^{-1}) after harvest of season. This finding was found to be similar in agreement with Divyashree *et al.* (2021) [4] in gaillardia.

Table 3: Effect of different levels of NPK on soil nutrient status

Treatment	Nitrogen in soil (kg ha^{-1})	Phosphorus in soil (kg h^{-1})	Potassium in soil (kg h^{-1})
Nitrogen (N)			
N1: 100 kg/ha	223.36	54.70	213.35
N2: 150 kg/ha	234.18	54.28	218.78
N3: 200 kg/ha	244.86	54.21	220.96
S.Em.±	3.90	0.86	5.17
C.D. at 5%	11.46	NS	NS
Phosphorus (P)			
P1: 80 kg/ha	234.10	51.69	215.65
P2: 100 kg/ha	234.17	57.10	219.74
S.Em.±	3.19	0.70	4.22
C.D. at 5%	NS	2.07	NS
Potassium (K)			
K1:70 kg/ha	235.24	54.32	209.30
K2: 100 kg/ha	233.03	54.46	226.09
S.Em.±	3.19	0.70	4.22
C.D. at 5%	NS	NS	12.39

Available potassium Effect of potassium

Effect of potassium on soil available potassium was found to be significant. Significantly maximum available potassium in soil (220.96 kg ha^{-1}) was observed in treatment K2 (100 kg ha^{-1}). Due to higher level of MOP application, there might have been an increase in soil potassium. Likewise, minimum available potassium in soil (213.35 kg ha^{-1}) was observed in treatment K1 (70 kg ha^{-1}). This finding was found to be in agreement with Divyashree *et al.* (2021) [4] in gaillardia.

Conclusion

On the basis of experimental data results, it can be concluded that from present findings of investigation, the application of NPK (200:100:100 kg ha^{-1}) was significantly superior in terms of number of flower per plant, flower yield per plant, flower yield per plot, flower yield per hectare and nutrient content in soil and nutrient uptake by plants. Hence, application of NPK (200:100:100 kg ha^{-1}) on annual chrysanthemum plant can be recommended for better growth, flowering and flower yield.

References

1. Ahmed L, Ahmed T, Azbar N. Response of elite cultivar of Zinnia giant to varying levels of nitrogen fertilizer. Sarhad Journal of Agriculture. 2007;23(2):309-312.
2. Aremsungla, Topno SE. Effect of N, P, K on plant growth and flower yield of zinnia (*Zinnia elegans*). The Pharma Innovation Journal. 2022;11(1):80-83.
3. Chopde N, Gore KS, Kuchanwar O, Bhande MH. Response of annual chrysanthemum (*Chrysanthemum coronarium*) genotypes to different levels of nitrogen, Plant Archive. 2015;15(2):801-804.
4. Divyashree MS, Munikrishnappa PM, Seetharamu GK, Anilkumar S, Ramegowda GK, Basavara G. Effect of spacing and NPK levels on yield, cost economics, nutrient uptake and soil nutrient status in gaillardia (*Gaillardia pulchella*). Environment and Ecology, 2021;39(1A):287-291.
5. Dorajeerao AVD, Mokashi AN, Patil VS, Venugopal K, Lingaraju S, Koti RV. Effect of plant spacing on yield and quality of garland chrysanthemum (*Chrysanthemum coronarium* L.). Karnataka Journal of Agriculture Science. 2012;25(2):30-45.
6. Hepler P, Holdaway K, Joseph G. Cellular oscillations

and the regulation of growth: the pollen tube paradigm. Bioessays. 2001;23(1):86-94.

7. Leghari SJ, Wahocho NA, Laghari GM, Talpur KH, Wahocho SA, Lashari AA. Role of nitrogen for plant growth and development: A review. Advances in Environmental Biology (Jordon). 2016;10(9):209-218.
8. Malani B. Effect of spacing and nitrogen on growth and yield of gomphrena (*Gomphrena globosa*). M.Sc. (Horti.) thesis (Unpublished) Junagadh Agricultural University, Junagadh (Gujarat); c2021.
9. Pal P, Ghosh P. Effect of different sources and level of potassium on growth, flowering and yield of African marigold (*Tagetes erecta* L.). cv. 'Siracole'. Indian Journal of Natural Products and Resources. 2010;1:371-375.
10. Patel AP. Effect of nitrogen through urea and castor cake on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ram.) cv. IIHR-6. M.Sc. (Horti.) Thesis (Unpublished) Junagadh Agricultural University, Junagadh (Gujarat); c2004.
11. Priyadarshini P, Palai SK, Nath MR. Effect of source of nitrogen on growth and yield of African marigold (*Tagetes erecta* L.). The Pharma Innovation Journal. 2018;7(7):917-921.
12. Razaq M, Zhang P, Shen H. Salahuddin. Influence of nitrogen and phosphorus on the growth and root morphology of Acer mono. PLOS One. 2017;12:1-13.
13. Sahu JK, Tamrakar SK, Tiwari A, Lakpale R. Effect of nitrogen, phosphorus and potassium on growth and flowering of chrysanthemum (*Chrysanthemum morifolium*). The Pharma Innovation Journal. 2021;10(7):1289-1292.
14. Sajid M, Amin N. Effect of various combinations of nitrogen, phosphorus and potash on enhancing the flowering time in chrysanthemum (*Chrysanthemum morifolium*). International Journal of Biosciences. 2014;4(10):99-108, 2222-5234.
15. Saud BK, Sarmah AC. Effect of spacing and fertilizer on French marigold. Paper presented in National Symposium on Indian Floriculture in the New Millennium, 25-27 February, Bangalore; c1995.
16. Singh KP, Sangama. Effect of graded level of N and pruning on china aster (*Callistephus chinensis*) cv. "Kamini". Indian Journal of Horticulture. 2000;57(1):87-89.
17. Singh M, Sharma BP, Gupta YC. Response of china aster (*Callistephus chinensis* L.) cv. 'Kamini' to different combinations of NPK and biofertilizers. Indian Journal of Horticulture. 2017;74(3):458-461.
18. Teja PR, Bhaskar VV, Dorajeerao AVDP. Effect of graded levels of nitrogen and potassium on growth and flower yield of annual chrysanthemum (*Chrysanthemum coronarium* L.). Plant Archives. 2017;17(2):1371-1376.
19. Vishnu, Swarup. Garden flower, National Book Trust, India. New Delhi; c1967.
20. Wolverton BC, Douglas WL, Bounds K. Interior landscape plant for indoor air pollution abatement (Report). NASA. NASA-TM-101766; c1989. Available at https://en.m.wikipedia.org/wiki/NASA- clean-Air-study, accessed on 12 August 2012.
21. Gheware SD, Kejkar AS, Tondare SM. Data mining: Task, tools, techniques and applications. International Journal of Advanced Research in Computer and Communication Engineering. 2014 Oct, 3(10):8095-8098