www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 483-488

www.thepharmajournal.com
Received: 19-05-2023
Accepted: 21-06-2023

Kruti Dobariya
Department of Floriculture & Landscape Architecture, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

BV Thumar
College of Agriculture, Junagadh Agricultural University, Mota-Bhandariya, Amreli, Gujarat, India

Anamika Varma
Department of Floriculture & Landscape Architecture, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

JS Parasana
Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India

Corresponding Author:
Kruti Dobariya
Department of Floriculture & Landscape Architecture, College of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Effect of integrated nutrient management and pinching on growth and yield of annual chrysanthemum (*Chrysanthemum coronarium* L.)

Kruti Dobariya, BV Thumar, Anamika Varma and JS Parasana

Abstract
The present investigation was carried out at Instructional Farm, Jambuvadi, Department of Floriculture & Landscape Architecture, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) from October-2022 to March-2023. In the case of integrated nutrient management, the result revealed that the application of 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%) (I_5) was recorded highest for all the growth, flowering and yield parameters. In respect to pinching, maximum plant height (102.32 cm), minimum days to first flower bud appearance (25.58), maximum flower diameter (6.84 cm), fresh weight of flower (5.88 g) and fresh weight of hundred flowers (499.53 g) was observed in no pinching (P_1). While single pinching noted better results for leaf area (58.38 cm^2) and stem diameter (2.60 cm) (P_2). Whereas, the number of branches per plant (32.16), plant spread (E-W) & (N-S) (61.48 cm and 63.82 cm), the maximum number of flowers per plant (111.58), flowering span (53.66 days), flower yield per plant (351.12 g), flower yield per plot (3.16 kg) and flower yield per hectare (25.97 t) was observed in double pinching (P_3). In case of interaction, the highest number of flowers per plant (117.36), flower yield per plant (444.90 g), flower yield per plot (4.08 kg) and flower yield per hectare (33.61 t) were observed in a treatment combination of 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%) with double pinching (I_5P_3). From the present study, it can be inferred that an application of 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%) with double pinching (I_5P_3) increased flower yield in annual chrysanthemum.

Keywords: Integrated nutrient management, pinching, growth, yield

Introduction
Chrysanthemum is a member of the 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 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 chromosome number 2n=4x=34. It is a branching annual with finely cut foliage reaching a height up to a meter, size of flowers varies from 2.5 to 4 cm and the colour is usually in shades of yellow and white with a cream zone at the center (Vishnu, 1967) [24] and it is a fast-growing winter blooming annual. It is used as loose flowers, cut flowers, potted plants, decoration, preparation of bouquets and as borders in the garden. Its leaves are 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'. It is economically important as a natural source of insecticide, the flowers are pulverized and an active component called pyrethrin is extracted and used in insecticidal preparation.
Integrated nutrient management practices reduce the number of inorganic fertilizers, and control soil pollution in part at least caused due to use of high doses of fertilizers and protection of natural resources. Nitrogen, Phosphors and Potash are major elements essential for plant growth, flower yield and quality of annual chrysanthemum. Vermicompost is a rich mixture of major and minor plant nutrients. On average vermicompost contains 3% nitrogen, 1% phosphorus and 1.5% potassium. Vermicompost is an excellent base for the establishment of free-living and symbiotic microbes. Biofertilizers *viz*., *Azotobacter*, PSB and KSB are microbial inoculants of selective microorganisms that help in improving soil fertility.

Biostimulants *viz.*, seaweed extract and humic acid are products that reduce the need for fertilizers and increase plant growth, resistance to water and abiotic stresses.

Pinching is the process of removal of the terminal growing portion of the stem to encourage branching and boost bloom production. Because of apical dominance, a plant grows straight up, but if the growth tips are pinched out, assimilates are diverted into lateral buds and branching develops. It has a direct relationship with the regulation of flowering and the production of quality flowers.

Material and Methods

This experiment was conducted during 2022-23 located at Instructional Farm, Jambuvadi, Department of Floriculture & Landscape Architecture, College of Horticulture, Junagadh Agricultural University, Junagadh (21.5^0 N, 70.5^0 E; 60 m). The trial used a factorial Randomized Block Design, in which Factor A had six integrated nutrient management treatments *i.e.* 100% RDF (150:100:100 kg NPK/ha + 10 t/ha FYM) (I_1), 80% RDF + Vermicompost (2 t/ha) + *Azotobacter* (2.5 ml/l) + PSB (2.5 ml/l) + KSB (2.5 ml/l) (I_2), 80% RDF + Vermicompost (2 t/ha) + *Azotobacter* (2.5 ml/l) + PSB (2.5 ml/l) + KSB (2.5 ml/l) + Seaweed extract (0.5%) (I_3), 80% RDF + Vermicompost (2 t/ha) + *Azotobacter* (2.5 ml/l) + PSB (2.5 ml/l) + KSB (2.5 ml/l) + Humic acid (0.2%) (I_4), 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%) (I_5), 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Humic acid (0.4%) (I_6) and Factor B had three pinching treatments *i.e.* no pinching (P_1), single pinching (P_2), double pinching (P_3) with three replications. The spacing was 45 cm × 30 cm.

In all cases, half dose of nitrogen was applied as a basal dose one day before transplanting and the remaining half dose was applied one month after transplanting. The entire dose of phosphorus, potassium and vermicompost as per the treatments was applied as a basal dose one day before transplanting. Biofertilizers were applied by the seedling dipping method. The roots of the seedlings were dipped for 30 minutes in the solution prepared before transplanting as per treatment allocation. Biostimulants were sprayed immediately after pinching. Single pinching is done 30 DAT in which removal of the apical portion of the plant with 2-3 leaves. In double pinching, first by doing a single pinch followed by another pinching of all the shoots after 15 days of single pinching.

Result and Discussion

The effect of different integrated nutrient management treatments and pinching with their interaction affect growth and yield are depicted in Tables 1, 2 and 3.

Growth parameters

Effect of integrated nutrient management

The effect of integrated nutrient management significantly improved the growth parameters such as plant height, number of branches per plant, plant spread (E-W and N-S), leaf area and stem diameter.

The maximum plant height (104.21 cm), number of branches per plant (29.60), plant spread (E-W and N-S) (62.58 cm and 64.57 cm), leaf area (59.02 cm^2) and stem diameter (2.67 cm) were observed in 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%) (I_6) at 90 DAT as compare to other treatments. This might be due to the combined effect of biostimulants, biofertilizers, inorganic fertilizers and vermicompost which enhanced the nutrient availability, resulted in better root and shoot growth and ultimately resulted in favouring plant growth, the proliferation of more branches per plant and causes more cell division and accumulated the carbohydrates resulting the thick stem. Similar findings were also reported by Kulkarni *et al.* (1996) [7] in China aster, Rathod *et al.* (2002) [17] in gaillardia, Chauhan (2005) [3] in chrysanthemum, Rathi *et al.* (2005) [16] and Sunitha *et al.* (2007) [20] in marigold, Chaitra and Patil (2007) [2] in China aster.

Table 1: Effect of integrated nutrient management and pinching on growth parameters of annual chrysanthemum

Treatments	Plant height (cm)	Number of branches per plant	Plant spread (cm)		Leaf area (cm^2)	Stem diameter (cm)
			E-W	N-S		
Factor A – Integrated nutrient management						
I_1	86.28	26.30	55.15	57.11	52.97	2.33
I_2	91.97	26.92	56.87	58.75	54.10	2.40
I_3	95.93	28.29	60.06	61.73	56.87	2.49
I_4	93.87	27.59	59.88	60.00	55.76	2.42
I_5	104.21	29.60	62.58	64.57	59.02	2.67
I_6	99.86	29.24	61.12	63.89	58.11	2.63
S.Em.±	2.761	0.817	1.749	1.847	1.450	0.072
C.D. at 5%	7.93	2.35	5.03	5.31	4.17	0.21
Factor B - Pinching						
P_1	102.32	22.28	57.00	58.29	53.97	2.38
P_2	96.51	29.53	59.35	60.91	58.38	2.60
P_3	87.22	32.16	61.48	63.82	56.07	2.48
S.Em.±	1.952	0.578	1.236	1.306	1.025	0.051
C.D. at 5%	5.61	1.66	3.55	3.75	2.95	0.15
Interaction: I × P						
S.Em.±	4.781	1.416	3.029	3.198	2.512	0.125
C.D. at 5%	NS	NS	NS	NS	NS	NS
C.V. %	8.69	8.76	8.85	9.08	7.75	8.69

Effect of pinching

The effect of pinching significantly improved the growth parameters such as plant height, number of branches per plant, plant spread (E-W and N-S), leaf area and stem diameter.

Significantly highest plant height (102.32 cm) was observed in no pinching (P_1) at 90 DAT. The maximum number of branches per plant (32.16) and plant spread (E-W and N-S) (61.48 cm and 63.82 cm) were observed in double pinching (P_2) at 90 DAT. This might be due to the diversion of carbohydrates or food material toward the auxiliary bud below the pinched portion and neutralized the effect of apical dominance which caused a reduction in plant height, an increase in the number of primary branches as well as plant spread. This conformed with the findings of Rathi *et al.* (2005) [16] and Suthar (2005) [21] in marigold and Panchal (2009) [12] in chrysanthemums. Significantly highest leaf area (58.38 cm^2) and stem diameter (2.60 cm) were observed in single pinching (P_1). This might be due to a reduction in vertical growth by removal of apical dominance which causes cell division and cell elongation and accumulated carbohydrates in branches resulting in thicker stems. Similar results were reported by Pawar (2001) [15] in chrysanthemum and Shivankar (2010) [18] in annual chrysanthemum.

Fig 1: Effect of integrated nutrient management and pinching on plant height (cm)

Fig 2: Effect of integrated nutrient management and pinching on number of branches per plant

Interaction effect of integrated nutrient management and pinching

The interaction effect of integrated nutrient management and pinching was observed as non-significant for all growth parameters.

Fig 3: Effect of integrated nutrient management and pinching on stem diameter (mm)

Flowering & yield parameters

Effect of integrated nutrient management

The data from the investigation revealed that the application of integrated nutrient management treatments exerted to be a significant influence on flowering and yield parameters *viz*., flower diameter, fresh weight of flower, fresh weight of hundred flowers, number of flowers per plant, flowering span, flower yield per plant, flower yield per plot and flower yield per hectare. While the first flower bud appearance was found non-significant.

Significantly maximum flower diameter (6.11 cm), fresh weight of flower (5.09 g), fresh weight of hundred flowers (442.28 g), number of flowers per plant (88.39), flowering span (52.63 days), flower yield per plant (391.74 g), flower yield per plot (3.57 kg) and flower yield per hectare (29.36 t) were observed in 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%) (I_6) at 90 DAT as compare to other treatments. Is might be because the balanced application of fertilizers resulted in increased carbohydrate assimilation leading to increased vegetative growth. These carbohydrates when translocated to reproductive organs underwent hydrolysis and got converted into reducing sugars which ultimately helped in increasing flower size, weight and number of flowers per plant. These findings corroborate results obtained by Nethra *et al.* (1999) [11] and Kumar *et al.* (2009) [8] in China aster and Gadagi *et al.* (2004) [4] and Parmar (2006) [13] in gaillardia, Kapadiya *et al.* (2008) [5] in marigold, Parsana *et al*. (2023) [14] in custard apple.

Effect of pinching

The variation due to different treatments of pinching was found significant in flowering and yield parameters such as days to first flower bud appearance, flower diameter, fresh weight of flower, fresh weight of hundred flowers, number of flowers per plant, flowering span, flower yield per plant, flower yield per plot and flower yield per hectare.

Table 2: Effect of integrated nutrient management and pinching on flowering parameters of annual chrysanthemum

Treatments	Days to first flower bud appearance	Flower diameter (cm)	Fresh weight of flower (g)	Fresh weight of hundred flowers (g)	Flowering span (days)
Factor A – Integrated nutrient management					
I_1	30.69	5.42	4.46	369.26	44.60
I_2	30.31	5.54	4.56	384.50	49.36
I_3	29.32	5.80	4.81	410.36	50.87
I_4	29.67	5.65	4.68	396.25	48.00
I_5	28.61	6.11	5.09	442.28	52.63
I_6	28.87	5.97	4.96	426.19	47.20
S.Em.±	0.615	0.164	0.137	11.969	1.369
C.D. at 5%	NS	0.47	0.39	34.40	3.93
Factor B - Pinching					
P_1	25.58	6.84	5.88	499.53	43.76
P_2	29.56	5.87	4.78	407.08	48.92
P_3	33.59	4.54	3.61	307.81	53.66
S.Em.±	0.435	0.116	0.097	8.463	0.968
C.D. at 5%	1.25	0.33	0.28	24.32	2.78
Interaction: I × P					
S.Em.±	1.066	0.284	0.237	20.731	2.371
C.D. at 5%	NS	NS	NS	NS	NS
C.V. %	6.24	8.55	8.63	8.87	8.42

Significantly minimum days to first flower bud appearance (25.58), maximum flower diameter (6.84 cm), fresh weight of flower (5.88 g) and fresh weight of hundred flowers (499.53 g) were observed in no pinching (P_1). The decrease in flower diameter in pinched plants might be attributed to the fact that in pinched plants energy was shared by the developing side branches, while in the case of unpinched plants, the energy sharing was limited to the flower developing in the main branch only. That is why un-pinched plants have a fresh weight of flowers. Similar findings have been reported by Khobragade *et al.* (2012) [6] in China aster and Nain *et al.* (2017) [10] in marigold. However, a significant maximum number of flowers per plant (111.58), flowering span (53.66 days), flower yield per plant (351.12 g), flower yield per plot (3.16 kg) and flower yield per hectare (25.97 t) were observed in double pinching (P_3). The increase in the number of flowers due to the pinching treatment may be correlated with vegetative growth characteristics like characteristics of a number of branches. Due to the pinching treatment, more side branches were formed below the pinched portion of the main stem of the plant. This more vegetative growth obtained in pinched plants resulted in the production of a maximum number of flowers per plant. A similar result was also recorded by Maharnor *et al.* (2011) [9] in African marigold, Akshay *et al.* (2020) [1] in annual chrysanthemum and Vasava *et al.* (2023) [23].

Table 3: Effect of integrated nutrient management and pinching on yield parameters of annual chrysanthemum

Treatments	Number of flowers per plant	Flower yield per plant (g)	Flower yield per plot (kg)	Flower yield per hectare (t)
Factor A – Integrated nutrient management				
I_1	73.25	251.66	2.30	18.91
I_2	78.33	282.09	2.57	21.11
I_3	82.23	321.28	2.93	24.08
I_4	80.69	301.23	2.74	22.55
I_5	88.39	391.74	3.57	29.36
I_6	85.96	349.02	3.14	25.87
S.Em.±	2.124	7.967	0.072	0.596
C.D. at 5%	6.10	22.90	0.21	1.71
Factor B - Pinching				
P_1	55.46	277.55	2.55	21.02
P_2	77.38	319.84	2.91	23.95
P_3	111.58	351.12	3.16	25.97
S.Em.±	1.502	5.634	0.051	0.421
C.D. at 5%	4.32	16.19	0.15	1.21
Interaction: I × P				
S.Em.±	3.689	13.800	0.125	1.032
C.D. at 5%	10.60	39.66	0.36	2.97
C.V. %	7.82	7.56	7.56	7.56

Interaction effect of integrated nutrient management and pinching

The result revealed that the interaction effect of integrated nutrient management and pinching was reported significant in the number of flowers per plant, flower yield per plant, flower yield per plot and flower yield per hectare. While, it was noted as non-significant for days to first flower bud appearance, flower diameter, fresh weight of flower, fresh weight of hundred flowers and flowering span.

The highest number of flowers per plant (117.36), flower yield per plant (444.90 g), flower yield per plot (4.08 kg) and flower yield per hectare (33.61 t) were observed in treatment

combination of 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%) with double pinching. This might be because proper nutrient management and double pinching were more effective in bringing improvement in the number of primary and secondary branches as well as leaves per plant which might have increased the flower production per plant. This result is in close approximately with the finding of Singh *et al.* (2010) [19] in marigold and Tanzeela *et al.* (2021) [22] in Gomphrena.

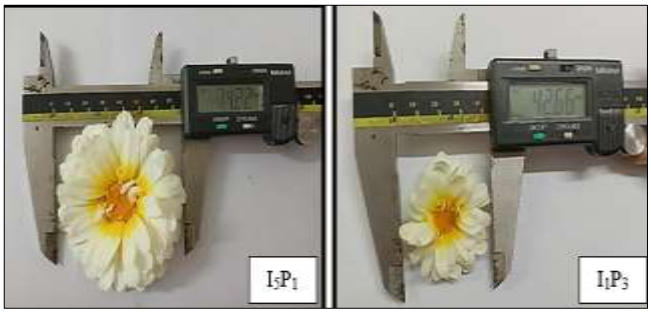

Fig 4: Effect of integrated nutrient management and pinching on flower diameter (mm)

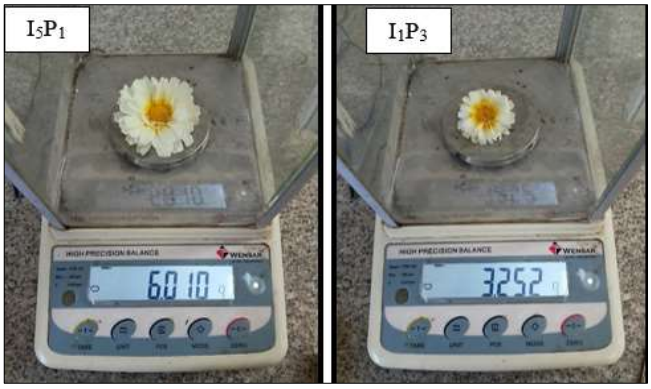

Fig 5: Effect of integrated nutrient management and pinching on fresh weight of flower (g)

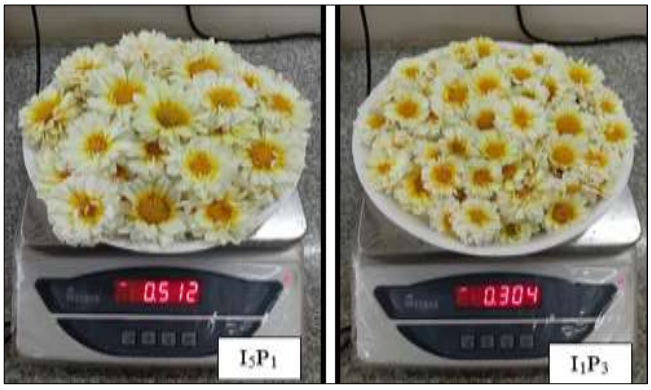

Fig 6: Effect of integrated nutrient management and pinching on fresh weight of hundred flowers (kg)

Conclusion

From the result of the field experiment, it appears reasonable to infer that there were notable differences in the outcomes of various treatments for growth and yield parameters. All the growth, flowering and yield parameters were found to the maximum with the application of 60% RDF + Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%). While the maximum value of flowering parameters is noted in no pinching and all the yield parameters were influenced by double pinching. From the present investigation, it is concluded that application of Vermicompost (3 t/ha) + *Azotobacter* (5 ml/l) + PSB (5 ml/l) + KSB (5 ml/l) + Seaweed extract (1%) with double pinching is a successful strategy for enhancing the yield of flowers.

References

1. Akshay AT, Megha HD, Atul SD, Aishwarya RI, Ekta PN. Effect of pinching and nitrogen on growth and flower yield of annual chrysanthemum. Journal of Pharmacognosy and Phytochemistry. 2020;9(6):945-949.
2. Chaitra R, Patil VS. Integrated nutrient management studies in China aster (*Callistephus chinensis* L.) cv. Kamini. Karnataka Journal of Agricultural Sciences. 2007;20(3):689-690.
3. Chauhan PA. Effect of biofertilizers and chemical nitrogenous fertilizer on growth and flower yield of chrysanthemum (*Chrysanthemum morifolium*). M.Sc. Thesis (Unpublished). AAU, Anand; c2005.
4. Gadagi RS, Krishnaraj PU, Kulkarni JH, Sa-TongMin. The effect of combined *Azospirillum inoculation* and nitrogen fertilizer on plant growth promotion and yield response of the blanket flower Gaillardia pulchella. Horticulture Science. 2004;100(1-4):323-332.
5. Kapadiya D, Desai JR, Singh A, Nannavare PV. Effect of bioinoculants on growth and yield of African marigold (*Tagetes erecta* L.) cv. Pusa Narangi Gainda. In: Symposium on Recent Advances in Floriculture, Navsari; c2008. p. 61.
6. Khobragade RK, Bisen S, Thakur RS. Effect of planting distance and pinching on growth, flowering and yield of China aster (*Callistephus chinensis*) cv. Poornima. Indian Journal of Agricultural Sciences. 2012;82(4):334-9.
7. Kulkarni BS, Nalwadi UG, Giraddy RS. Effect of vermicompost and vermiculture on growth and yield of China aster. South Indian Horticulture. 1996;44(1-2):33-35.
8. Kumar J, Chauhan SS, Singh PV. Response of N and P fertilization on China aster. Journal of Ornamental Horticulture. 2009;6(1):82.
9. Maharnor SI, Chopde N, Thakre S, Raut PD. Effect of nitrogen and pinching on growth and yield of African marigold. Asian Journal of Horticulture. 2011;6(1):43-45.
10. Nain S, Beniwal BS, Dalal RP, Sheoran S. Effect of pinching and spacing on growth, flowering and yield of African marigold (*Tagetes erecta* L.) under semi-arid conditions of Haryana. Journal of Applied and Natural Science. 2017;9(4):2073-2078.
11. Nethra NN, Jayaprasad KV, Kale RD. China aster (*Callistephus chinensis* L.) cultivation using vermicompost as an organic amendment. Crop Research. 1999;17(2):209-215.
12. Panchal RV. Effect of biofertilizers and chemical nitrogenous fertilizer on growth, flowering and yield of annual white chrysanthemum (*Chrysanthemum coronarium* L.) under middle Gujarat condition. M.Sc. (Agri.). Thesis (Unpublished). AAU, Anand; c2009.
13. Parmar VR. Influence of biofertilizers and nitrogenous fertilizer on growth, and flower yield of gaillardia (*Gaillardia pulchella*) cv. Local. M.Sc. (Agri.) Thesis (Unpublished). AAU, Anand; c2006.

14. Parsana JS, Varu DK, Parmar VM, Shivani Patel, Kanzaria DR, Mishra S. Influence of Pruning and integrated nutrient management on Custard Apple (*Annona squamosa* L.) Agricultural Mechanization in Asia, Africa and Latin America. 2023;54(04):12865-12874.
15. Pawar SP. Effect of pinching on growth and flowering in chrysanthemum (*Dendranthema indicum*) cv. PKV Subhara. M.Sc. Thesis (Unpublished). Dr. PDKV; Akola; c2001.
16. Rathi SS, Parmar PB, Parmar BR. Influence of biofertilizers on growth and yield of African marigold (*Tagetes erecta* L.). Gujarat Agriculture University Research Journal. 2005;30(1-2):50-52.
17. Rathod NG, Narwadkar PR, Sajindranath AK, Prabhu T. Effect of integrated nutrient management on growth and yield of gaillardia. Journal Maharashtra Agricultural University. 2002;27(3):318-319.
18. Shivankar SK. Effect of pinching and cycocel on growth, yield and quality of annual chrysanthemum. M.Sc. Thesis (Unpublished). Dr. PDKV, Akola; c2010.
19. Singh SM, Gupta NK, Singh BS. Effect of planting distance, pinching and biofertilizers on growth and flower yield of African marigold (*Tagetes erecta* L.) cv. Sierra Orange. Current Horticulture. 2010;3(2):32-34.
20. Sunitha HM, Hunje R, Vyakaranahal BS, Bablad HB. Effect of plant spacing and integrated nutrient management on yield and quality of seed and vegetative growth parameters in African marigold (*Tagetes erecta* L.). Journal of Ornamental Horticulture. 2007;10(4):245-249.
21. Suthar JB. Influence of biofertilizers and chemical nitrogenous fertilizer on growth and flower yield of African marigold (*Tagetes erecta* L.) cv. Local. M.Sc. (Agri.) Thesis (Unpublished). AAU, Anand; c2005.
22. Tanzeela Y, Khan FU, Irfan G, Mohd A, Iqra G. Response of globe amaranth (*Gomphrena globosa* L.) to pinching and biofertilizer application. International Journal of Horticulture and Food Science. 2021;3(1):1-5.
23. Vasava HV, Tejal M Chaudhari, Parasana JS, Varu DK, Shivani Patel, Mishra S. Performance of different grafted varieties and mulching in brinjal (*Solanum melongena* L). Agricultural Mechanization in Asia, Africa, and Latin America. 2023;54(04):12981-12988.
24. Vishnu S. Garden Flower, National Book Trust, New Delhi; c1967.