Original Research Article

EFFECT OF FERTIGATION INTERVALS ON PLANT GROWTH AND FLOWER YIELD OF MULTIFLORA CHRYSANTHEMUM (*Chrysanthemum morifolium)* CV. BRANFOUNTAIN PURPLE

Follow the journal style for title

UNDER PEER REVIEW

Delete this page

ABSTRACT

Join the page with title page

Horticulture

This study was conducted in the horticulture Research Farm, Devolopment of Horticulture, Naini Agricultural institute, Institute Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (UP) from October 2021- March 2022 to investigate the Effect of Fertigation Intervals on Plant Growth and Flower Yield of Multiflora Chrysanthemum (*Chrysanthemum morifolium)* cv. Branfountain purple. Purple The experiment was laid out in RBD with nine treatments which was were replicated thrice. The results revealed that treatment T9 (19:19:19 NPK/m^2(4.6g @ 8 days interval)) + Foliage spray of 0.2% EDTA Chelated micronutrient mixture) – performed the best in terms of Plant Height (21), Number of Branches (53), Plant spread (27), Number of leaves (403), Number of flowers per plant (75), Chlorophyll content of leaves (31.9),Days to first flowering(130),Days 50% flowering(143), Flowering duration (days)(185), Flower diameter (cm)(4.0), Individual flower weight (10), Flower yield per plant(gm/plant) (0.78), Flower yield (q/ ha) (259.5). Therefore, the treatment T9(T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture) is the best when compared to other treatments..

Keywords:, Autumn Queen, EDTA Chelated micronutrient mixture Foliage spray, Guldaudi.

INTRODUCTION

Chrysanthemum (*Dendranthema grandiflora* L.) is one of the most important flower crops grown commercially in India for cut and loose flowers and is also used for garden display. It is commonly known as Guldaudi, Autumn Queen or Queen of the East (Koley and Sarkar, 2013). It belongs to the family Asteraceae. It is native to Northern Hemisphere. Chrysanthemum is popular flower meaning Chryos – golden, anthos – flower, a leading flower crop grown in many parts of the world, chiefly Europe and Asia with a few in other areas. It is one of the most beautiful flowering plant referred to as “Queen of the East” and “Autumn flower”. Its commercial cultivation is being done

in states viz., Maharashtra, Rajasthan, Madhya Pradesh and Bihar and in places viz., Delhi, Kolkata, Lucknow, Kanpur and Allahabad mainly for the sake of decoration and participating in flower shows, with the help of pot grown plants. Chrysanthemums are mainly classified under two categories: Large flowered (standard type) and small flowered (spray type). Large flowered chrysanthemums which produce long, sturdy stems and good keeping quality are further classified into 13 classes which make it suitable for flower arrangement, cut flower production and as potted flowering plant for exhibition and decoration. The extra-large bloomed cultivars are used for exhibition value, bouquets, vase etc, whereas small flowered are mostly grown for loose flower and are classified into 10 classes. The standard type flowers fetch higher prices though their share in export market is less but spray types have smaller flower size and have major share in the world market. In International cut flower trade, chrysanthemum ranks next to rose (Bhattacharjee and De, 2003). Pinching, desuckering and stacking in chrysanthemum/Guldaudi: Pinching is removal of tip of main branch and it is done to induce more lateral branches on plants and ultimately more flowers. Pinching is done 3-4 weeks after planting. Pinching may be done in end of August or beginning of September. Desuckering: Removal of side suckers is called disbudding. Remove the side suckers periodically .It is very important in standard varieties (large flower varieties).

Fertigation is a new concept, adapted in several parts of the world, in horticulture crops. Fertigation which combines irrigation with fertilizer application is well recognized as the most effective and convenient means of maintaining optimum fertility level and water supply according to the specific requirements of the crop and soil resulting in higher yield and better quality.

MATERIALS AND METHODS

The experiment was conducted at Experimental Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) in during 2021 during winter season in India. The experiment material consists of Branfountain Purple variety of Chrysanthemum. The soil of the experimental field was alkaline, with sandy loam and a pH of 7.2. The Length of Polybag is 6 inches and weight is 2kg and N, P, and K is 19kg, 19kg and 19kg/ ha-1, respectively. The experiment was laid out in randomized block design with three replications consisting of nine treatment combinations, by using of , some treatments are comprised of organic manures with biofertilizers and different quantity levels of

inorganic fertilizers. The plot size was 60cm×60cm spacing rows and plants. Statistical analysis of variance was performed on the data collected throughout the experiment. The observation was recorded for Plant height (cm), Number of Branches per plant, Plant Spread(cm), Number of leaves per plant, Chlorophyll content, Days to first flowering(days), Days 50% flowering(days), Flowering duration (days), Flower diameter (cm), Number of Flower per plant, Individual Flower weight(gm), Flower yield per plant(gm/plant), Flower yield(q/ha), economics were analyzed statistically. The significance of the treatments was determined using the 'F' test at a level of significance of 5%.

No reference in the chapter

Put the treatment table (Table 1) in material and method

3. RESULTS AND DISCUSSION

Growth Parameters

The data on growth parameters in different treatment combinations were recorded (Table 1). Maximum Plant Height (21.00 cm) was recorded in treatment T_9 (T_5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture) and Minimum Plant Height (16.00 cm) was obtained with treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval). It might be due to Nitrogen which is a constituent of protein and nucleic acid, which is helpful in plant growth **(Haque, 2001)** and also promotes rapid growth.

The Maximum number of branches (53.00) was recorded in treatment T_9 (T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture) and Minimum number of branches (42.00) was obtained with treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval). An Increase in the number of branches per plant may be due to split application of fertilizers which increases growth and quality as observed with the present investigation, are in close conformity with the findings of **Chaudhary *et al.* (2016) [8]** in Rose.

Maximum number of leaves per plant (403.33) was recorded in treatment T_9 (T_5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture) and Minimum number of leaves per plant (214.66) was obtained with treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval). An Increase in number of leaves per plant could be because of optimum nutrients provided to plants, which might have accelerated rate of photosynthesis thereby enhancing the vegetative growth of plants, as reported by **Parya *et al.*, (2010)** in golden rod.

Maximum Plant spread (27.00 cm) was recorded in treatment T_9 (T_5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture) and Minimum Plant spread (22.00 cm) was obtained with treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval). An increase in plant spread may be due to potassium which enhances the synthesis and translocation of carbohydrate. Potassium has also been reported to be involved in the synthesis of peptide bond, and protein and carbohydrate metabolism, and also participates in rapid cell division and differentiation **(Belorkar *et al.*, 1992).** Nitrogen is a constituent of protein and nucleic acid, which is helpful in plant growth **(Haque, 2001)** and also promotes rapid growth.

Flower Parameters

The days to first flower bud initiation (days) was found to be minimum (128.00 days) in the treatment T_9 (T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture). And maximum days to first flower bud initiation (days) (138.00 days) was obtained in the treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval).The probable reason for early first flower bud initiation (days) may be contributed by meristematic activity of metabolites from vegetative growth of plants. Nitrogen and Phosphorus also resulted in maximum increase in nutrient uptake and stimulates blooming resulting in early flower bud development. Similar result was reported by **Mohariya *et al.* (2004)** in Gerbera.

The Days taken to 50% flowering (days) was found to be minimum (143) in the treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval)). And maximum Days taken to 50% flowering (152) was obtained in the treatment T_9 (T_5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture). The Days taken to 50% flowering (days) was found to be maximum because the potassium dissolves in the soil water is taken up by the plant roots and the exchang eable K is released into the soil solution to maintain equilibrium between the two forms. Potassium has also been reported to be involved in the synthesis of peptide bond, and protein and carbohydrate metabolism, and also participates in rapid cell division and differentiation **(Belorkar *et al.*, 1992).**

The duration of flower (days) was found to be minimum (185.00) in the treatment T_9 (T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture). And maximum duration of flower (days) (210.00) was obtained in the treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days

interval). The duration of flower (days) was found to be minimum due to Potassium which is a major osmotically active component in plant cells contributing to cell turgor and enhancing the capacity of plant cell to retain water and nutrients. Nitrogen and Phosphorus also resulted in maximum increase in nutrient uptake and stimulates blooming resulting in early duration of flower (days). Similar result was reported by **Mohariya *et al.* (2004)** in Gerbera.

The flower diameter (cm) was found to be minimum (3.2 cm) in the treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval). And maximum flower diameter (4.0 cm) was obtained in the treatment T_9 (T_5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture). Maximum flowers diameter may be due to the high level of potassium which had pronounced effect on flower diameter among the macro nutrients. Balanced dose of nitrogen, phosphorus and potassium seemed to have increased the vegetative growth favorable for the synthesis of peptide bond, protein and carbohydrate metabolism that are essential for flower development. High potassium with appropriate dose of nitrogen and phosphorus seemed to have increased the number of flowers bud diameter in gerbera **(Ayemi *et al.*, 2017).** Similar result was obtained by **Nayak *et al.*, (2005).**

Yield Parameters

Maximum number of flowers per plant (75) T_9 (T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture) was recorded in treatment and minimum number of flowers per plant (42) was obtained with treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval).

High potassium with appropriate dose of nitrogen and phosphorus seemed to have increased the number of flowers per plant in gerbera **(Ayemi *et al.*, 2017).** Similar result was obtained by **Nayak *et al.*, (2005).** Maximum flower weight (10 g) T_9 (T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture) was recorded in treatment and minimum weight of single flower bud (5 g) was obtained with treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval).The reason for flower weight is due to the fact that the amount of applied nitrogen significantly increased the growth parameter like number of branches, plant height which have synthesized more plant metabolites and ultimately led to increased weight of single flower bud **(Chan, 1995).**

The flower yield per plant was found to be maximum (78 g/plant) in the treatment T_9 (T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture). The flower yield per ha was found to be minimum (0.19 g/plant) in the treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval).The reason for maximum number of flower is due to the fact that the amount of applied nitrogen significantly increased the growth parameter like number of branches, plant height which have synthesized more plant metabolites and ultimately led to increased number of flowers **(Chan, 1995).**

Maximum flower weight (10 g) T_9 (T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture) was recorded in treatment and minimum weight of single flower bud (5 g) was obtained with treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval)). The reason for flower weight is due to the fact that the amount of applied nitrogen significantly increased the growth parameter like number of branches, plant height which have synthesized more plant metabolites and ultimately led to increased weight of single flower bud **(Chan, 1995).** Similar results were found by **Chawala *et al*., (2007)** in Chrysanthemum.

The Chlorophyll content was found to be maximum (31.9) in the treatment T_9 (T5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture). The flower yield per ha was found to be minimum (20.1) in the treatment T_2 (19:19:19 NPK/m^2(1.2g @ alternate days interval)). To synthesized more plant metabolites and ultimately led to Chlorophyll content **(Chan, 1995).**

Table 1 : Treatment Details

Treatment symbol	Treatment Combination
T_1	**CONTROL**
T_2	19:19:19 NPK/m^2(1.2g @ alternate days interval)
T_3	19:19:19 NPK/m^2(2.33g @ 4 days interval)
T_4	19:19:19 NPK/m^2(3.5g @ 6 days interval)
T_5	19:19:19 NPK/m^2(4.6g @ 8 days interval)
T_6	T_2+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture
T_7	T_3+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture
T_8	T_4+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture
T_9	T_5+ Foliage spray of 0.2% EDTA Chelated micronutrient mixture

Table 2: Effect of fertigation on growth traits of chrysanthemum

TREATMENTS	No. of Leaves / Plant	Plant Height (cm)	No. of Branches	Plant Spread (cm)	Days to First Flowering	Day to 50% Flowering	Flowering Duration (Days)
T1	286.66	18	47	25	136	148	197
T2	214.66	16	42	22	140	152	210
T3	232.66	16	44	23	140	152	205
T4	239.22	16	45	23	139	151	199
T5	247	17	47	24	138	149	196
T6	340.33	18	48	26	135	147	194
T7	351.11	19	50	26	134	147	192
T8	387.66	19	51	26	132	145	189
T9	403.33	21	53	27	130	143	185
F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**
SE.d	**8.65**	**0.75**	**1.36**	**1.52**	**1.89**	**2.58**	**3.89**
CD (5%)	**18.33**	**1.58**	**4.20**	**3.22**	**4.01**	**5.46**	**8.25**
CV%	**3.53**	**5.14**	**5.11**	**7.53**	**1.70**	**2.13**	**2.43**

Table 3 : Effect of fertigation on yield traits of chrysanthemum

TREATMENTS	Flower Diameter (cm)	No. of Flower/ Plant	Flower Yield (q/ha.)	Flower Yield (g/plant.)	Chloropyll SPAD- 502
T1	3.5	0.28	179.0	0.54	24.1
T2	3.2	4.70	63.1	0.19	20.1
T3	3.2	0.28	87.2	0.26	23.3
T4	3.4	4.70	105.9	0.32	24.9
T5	3.5	0.28	138.2	0.41	26.7
T6	3.6	4.70	190.5	0.57	28.3
T7	3.5	0.28	216.8	0.65	29.4
T8	3.7	4.70	229.9	0.69	30.3
T9	4.0	0.28	259.5	0.78	31.9
F-Test	**S**	**S**	**S**	**S**	**S**
SE.d	**0.13**	**2.03**	**12.40**	**0.04**	**0.37**
CD (5%)	**0.28**	**4.30**	**26.29**	**0.08**	**0.78**
CV%	**4.70**	**4.21**	**9.30**	**9.30**	**1.70**

CONCLUSION

From this study it is concluded that treatment **T9** performed best in terms of Plant height, Number of Branches, Plant spread, Number of leaves, chlorophyll content, Days to first flowering, Days to 50% flowering, Flower duration, Flower diameter, in which fertigation was done at **8 days interval** (4.6g of 19:19:19 + 0.2% EDTA Chelated micronutrient mixture per 4 plants).

REFERENCES

1. **Ahmed R, Hussain MJ, Ahmed S, Karim MR, Siddiky MA**. Effect of N, P and K fertilizer on the flower yield of Chrysanthemum. The Agriculturalists. 2017; 15(1):58- 67.
2. **Antonio Eduardo FN, Karina Volpi, Neil SM**. Nutrition and Quality in Ornamental Plants, Ornamental Horticulture. 2015; 21 (2):139-150.
3. **Archana, D., Prasanth, P., Seenivasan, N. and Joshi, V. (2019)**. Pot presentability of different chrysanthemum cultivars for pot mums based on vegetative attributes. International Journal of Current Microbiology and Applied Sciences, 8(12): 3020-3023.
4. **Balaji, S.K. and Reddy, B.S. (2004)**. Vegetative growth, flower yield and quality of different chrysanthemum cultivars. Journal of Ornamental Horticulture, 7(3):32-36
5. **Beniwal BS, Ahlawat VP, Sukhbir Singh**. Effect of nitrogen and phosphorus levels on flowering and yield of chrysanthemum (*Chrysanthemum morifolium*) cv. Flirt. Crop Research. 2005; 30(2):177-180.
6. **Barman, D. and Pal, P. (1990).** Effect of micronutrients on growth and flowering of *Chrysanthemum morifolium* cv. CHANDRAMA. *Haryana J. Hort. Sci.*, 28 (1) : 78-7.
7. **Cantor, M., Hitter, T., Varga, Z.S. and Buta, E. (2020).** Studies Regarding a Varietal Assortment of Potted Chrysanthemum. *Romanian Journal of Horticulture*, **1**:159- 166.
8. **Chawla, S.L., Patel, R.B., Dhaduk, B.K., Sudha, P. and Dipal, B. (2021).** Varietal assessment of Chrysanthemum (*Dendranthema grandiflora*) under South Gujarat agro-climatic conditions. *Current Horticulture*, **9**(2): 64-67.

9. **Guddaraddi, A. and Mishra, A. (2021).** Varietal evaluation and genetic variability of chrysanthemum (Dendranthema grandiflora Tzvelev). *The Pharma Innovation Journal*, **10**(12): 563-566.
10. **Henny, T., Palai, S.K., Beura, S., Chongloi, L., Devi, O.B. and Mishra, S. (2021).** Evaluation and selection of spray chrysanthemum (*Chrysanthemum morifolium* Ramat) genotypes suitable for commercial cultivation under coastal plain zone of Odisha. *The Pharma Innovation Journal*, **10**(4): 124-126.
11. **Joshi, M., Varma, L.R. and Mau, M.M. (2009).** Performance of Different varieties of chrysanthemum in respect of growth, flowering and yield under North Gujarat Conditions. *The Asian Journal of Horticulture*, **4**(2):292-294.
12. **Ganesh S, Kannan M, Jawaharlal M, Arulmozhiyan R, Jeyakumar P.** Improvement of Growth and Plant Physiology of Spray Chrysanthemum through Fertigation. Advances in Life Sciences. 2016; 5(11):4418-4423.
13. **Ganga, M., Jegadeeswari, V., Padmadevi, K. and Jawaharlal, M. (2008).** Response of chrysanthemum cv. Co.1 to the application of micronutrients. *J. Orna. Hort.*, 11(3) : 220-223.
14. **Kumar, A.S. and Polara, N. D. (2017).** Evaluation of Chrysanthemum Varieties on Growth and Quality under South Saurashtra Region. *International Journal of Pure Applied Biosciences*, **5** (4): 1989-1997.
15. **Kumar, S., Kumar, M., Malik, S., Singh, M.K. and Kumar, S. (2014).** Evaluation of Chrysanthemum (*Dendranthema grandiflora* Tzvelev) Genotypes using Morphological Characters Under Climatic Conditions of Western UP. *Annals of Horticulture* **7** (2): 162-165.
16. **Madhumathi, C., Bhargav, V., Reddy, D.S., Kameshwari, P.L., Sreedhar, D. and Lakshmi, T.N. (2018)**. Assessment of chrysanthemum (*Chrysanthemum morifolium* Ramat.) germplasm for commercial cultivation under Rayalaseema region of Andhra Pradesh. *Journal of Applied Horticulture*, **20**(3): 213-218.
17. **Negi, R., Dhiman, S.R. and Gupta, Y.C. (2019).** Studies on Growth and Flowering Behavior of Newly Evolved Genotypes of Chrysanthemum (*Dendranthema grandiflora*

Tzvelev) for Loose Flower Production. *International Journal of Current Microbiology and Applied Sciences*, **8**(11): 341-346.

18. **Negi, R., Dhiman, S.R., Gupta, Y.C., Dogra, R.K., Gupta, R.K. and Dhiman, M.R. (2020).** Evaluation of Chrysanthemum on Growth and Flowering Yield of Newly Evolved Genotypes of Chrysanthemum (*Dendranthema grandiflora* Tzvelev) for Loose Flower Production. *International Journal of Current Microbiology and Applied Sciences*, **9**(7): 2660-2664.
19. **Ona, A.F., Roni, M.Z.K., Ahmad, H., Jui, N.J. and Jamal Uddin, A.F.M. (2015).** Study on Growth and Flower Yield of Five Snowball Varieties. *Bangladesh Research Publications Journal*, **11**(3): 182-186.
20. Srilatha, V., Kumar, K.S. and Kiran, Y.D. (2015). Evaluation of chrysanthemum (Dendranthema grandiflora Tzvelev) varieties in Southern zone of Andhra Pradesh. Agricultural Research Communication Centre, 35(2): 155-157.
21. Shohe, M., Fatmi, U., Singh, D. and Deepanshu. (2017). Evaluation of Chrysanthemum (Dendranthema grandiflora Tzvelev) Cultivars under Allahabad agro-climatic conditions. Trends in Biosciences, 10(24):5115-5119.
22. **Suvija, N.V., Kannan, M., Suresh, J. and Subesh, R.K., 2016,** Evaluation of chrysanthemum (Chrysanthemum morifolium Ramat) genotypes for loose flower, cut flower and pot mums. Inter. J. Innov. Res. And Adv. Studies, 3(4): 100-10.
23. **Swaroop, K.; Prasad, K.V. and Raju, D.V.S. (2008).** Evaluation of chrysanthemum (Dendrathema grandiflora Tzvelev) germplasm in winter season under Delhi condition. J. Orna. Hort., 11(1): 58-61.
24. **Singh, A.K., Singh, D. K. and Kumar, R. (2017).** Evaluation of different chrysanthemum (*Chrysanthemum morifolium) g*enotypes under shade net in North West Himalaya. *International Journal of Pure and Applied Bioscience, **5**(1):*980-985
25. **Singh, D.D., Tyagi, S., Singh, S. and Kumar, P. (2017).** Studies on the Performances and Flower Characterization of Chrysanthemum (*Dendranthema grandiflora* Tzvelev) Genotypes under Uttar Pradesh conditions. *Advances in Research*, **9**(1):1-7.

26. **Singh, L.J., Khangjarakpam, G., Shadukan, R. and Dhua, R.S. (2019).** Quality Characterization of New Chrysanthemum Genotypes. Journal of Pharmacognosy and Phytochemistry, **8**(4): 1611-1617.
27. **Singh, S. and Godara, A.K. (2021).** Evaluation of Chrysanthemum (*Dendranthema grandiflora* Tzvelev) Genotypes for Plant Growth Characters. *Biological Forum – An International Journal*, **13(**1): 169-175.
28. **Thakur, N., Sujatha, Nair, A., Kumar, R., Bharathi, T.U., Dhananjaya, M.V. and Venugopalan, R. (2018).** Evaluation of Chrysanthemum (*Dendranthema grandiflora* Tzvelev) for Desirable Horticultural Traits. *International Journal of Current Microbiology and Applied Sciences,* **7**(8): 565-574.
29. **Uddin, A.F.M.J., Taufique, T., Ona, A. F., Shahrin, S. and Mehraj, H. (2015).** Growth and flowering performance evaluation of thirty-two chrysanthemum cultivars. *Journal of Bioscience and Agriculture Research,* 04(01): 40-51.
30. **Visen, D., Kumar, A., Sonkar, P. and Gallani, R. (2021).** Performance of standard Chrysanthemum (*Dendranthema grandiflora* Tzvelev.) cultivars for growth and post-harvest life under Malwa region of M.P. *The Pharma Innovation Journal*, **10(**12): 280