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PLANT GROWTH ENHANCERS AND LEAF NUMBER MANAGEMENT IMPROVE POST-TRANSPLANT PERFORMANCE OF ROOTED CHRYSANTHEMUM (*Dendranthema grandiflora* Tzvelev) CUTTINGS CV. POORNIMA YELLOW

S. Sunaja^{1*}, Natarajan Seenivasan², D. Laxminarayana³ and S. Praneeth Kumar⁴

¹Department of Floriculture and Landscaping, Post Graduate Institute for Horticultural Sciences, Sri Konda Laxman Telangana Horticultural University (SKLTGHU), Mulugu, Siddipet-502 279, Telangana, India.

²Controller of Examinations & Director of Industrial & International Programmes, Sri Konda Laxman Telangana Horticultural University (SKLTGHU), Mulugu, Siddipet-502 279, Telangana, India.

³Director of Research, Sri Konda Laxman Telangana Horticultural University (SKLTGHU), Mulugu, Siddipet-502 279, Telangana, India.

⁴Department of Crop Physiology, Horticulture Polytechnic College, Ramagirikhilla, Ramagiri, Peddapalli-505 212, Telangana, India.

*Corresponding author E-mail : sunaja2002@gmail.com

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ABSTRACT

The successful establishment of rooted chrysanthemum (*Dendranthema grandiflora* Tzvelev) cuttings after transplanting is essential for producing high quality pot mums with desirable vegetative growth, uniform flowering and superior ornamental value. However, studies on the combined influence of plant growth enhancers and leaf retention levels on the post-transplant performance of rooted cuttings are limited. Therefore, the present study was undertaken to evaluate the effects of different plant growth enhancers and leaf numbers on the growth, flowering, flower quality and pot presentability of chrysanthemum cuttings cv. Poornima Yellow under shade net conditions. The experiment was conducted in a factorial completely randomized design comprising eight plant growth enhancer treatments [seaweed extract (500 and 1000 ppm), coconut water (5 and 10%), mono ammonium phosphate (MAP; 12:61:00) at 1000 and 2000 ppm, indole-3-butyric acid (IBA) at 100 ppm and distilled water as the control] and three leaf retention levels (two, four and six leaves per cutting). Plant growth enhancers and leaf retention significantly influenced vegetative growth, flowering behaviour, flower quality and pot presentability. Seaweed extract at 500 ppm recorded the maximum plant spread east- west, highest number of primary branches, earliest flower bud initiation, 50% flowering and bud to full bloom duration. MAP (12:61:00) at 1000 ppm recorded the lowest plant height, maximum secondary branches, highest number of fully opened flowers, largest flower diameter, longest flower longevity and superior pot presentability. Retaining two leaves per cutting enhanced vegetative growth and pot presentability while retaining four leaves accelerated flowering, flower size and flower longevity. Overall, the study demonstrated that integrating suitable plant growth enhancers with optimum leaf retention markedly improved the post-transplant performance and ornamental quality of chrysanthemum. Therefore, MAP at 1000 ppm with four leaves per cutting may be recommended for commercial nursery propagation, while MAP at 1000 ppm with two leaves per cutting may be recommended for compact pot plant production or as bedding plants in landscape.

Key words : *Dendranthema grandiflora*, Pot mum, Rooted cuttings, Plant growth enhancers, Leaf retention, Coconut water, Mono ammonium phosphate, Indole-3-butyric acid, Flower quality, Protected cultivation.

Introduction

Chrysanthemum (*Dendranthema grandiflora* Tzvelev) is one of the world's most important ornamental

crops, valued for its remarkable diversity in flower colour, shape and flowering habit. In addition to its widespread use as a cut flower and landscape ornamental,

chrysanthemum has gained considerable commercial importance as a potted flowering plant because of its compact growth habit, prolonged flowering period and high aesthetic appeal. The expanding market for ornamental pot plants has increased the demand for production technologies that ensure rapid establishment, uniform plant architecture, synchronized flowering and superior post production quality (Eisa *et al.*, 2022 and Leoni *et al.*, 2019).

The commercial success of pot chrysanthemums largely depends on the quality and post-transplant performance of rooted cuttings. Successful establishment immediately after transplanting determines subsequent vegetative growth, canopy development, flowering behaviour and overall ornamental value. Among the factors influencing early establishment, the number of leaves retained on rooted cuttings is particularly important because retained leaves serve as the primary source of photosynthates required for root growth, shoot development and maintenance of endogenous hormonal balance. Appropriate leaf retention therefore promotes rapid establishment and improves plant vigour, whereas excessive leaf removal may restrict carbohydrate availability and delay subsequent growth and flowering (Eisa *et al.*, 2022; Leoni *et al.*, 2019 and Loconsole *et al.*, 2024).

Plant growth enhancers have emerged as effective approaches for improving the growth and quality of ornamental crops. Natural biostimulants such as seaweed extract and coconut water contain phytohormones, amino acids, vitamins, minerals and other bioactive compounds that stimulate cell division, nutrient uptake, photosynthesis and stress tolerance, thereby enhancing vegetative growth and flowering (Loconsole *et al.*, 2022; Carillo *et al.*, 2022; Suchitha *et al.*, 2023). Likewise, mono ammonium phosphate (MAP; 12:61:00) provides readily available nitrogen and phosphorus that support vigorous vegetative growth, flower initiation and reproductive development under intensive cultivation systems (Eisa *et al.*, 2022). Indole-3-butyric acid (IBA), one of the most widely used auxins in ornamental horticulture, promotes adventitious root formation, improves root architecture and enhances transplant establishment by stimulating early root growth (Abdel-Rahman *et al.*, 2020 and Kim *et al.*, 2019).

Although, the individual effects of biostimulants, nutrient supplements and auxins on chrysanthemum growth have been widely documented, limited information is available regarding their combined influence with leaf retention during the post-transplant stage of rooted cuttings. Previous investigations have largely examined these factors independently, leaving an important

knowledge gap concerning their interactive effects on vegetative growth, flowering performance, flower quality and the overall marketability of pot chrysanthemums (Loconsole *et al.*, 2024; Carillo *et al.*, 2022; Abdel-Rahman *et al.*, 2020; Suchitha *et al.*, 2023). Understanding these interactions is essential for developing efficient nursery plants production protocols that improve plant quality while reducing production time and input costs.

Therefore, the present study was undertaken to investigate the combined effects of different plant growth enhancers and leaf retention levels for nursery plant production on the post-transplant performance of these rooted chrysanthemum cuttings (*Dendranthema grandiflora* Tzvelev) cv. Poornima Yellow under shade net conditions. Specifically, the study aimed to identify treatment combinations for rooting of cuttings and its influence on enhancing post-transplant vegetative growth, flowering behaviour, flower quality and pot presentability to develop practical, sustainable and commercially viable production strategies for high quality chrysanthemum pot mums.

Materials and Methods

Experimental site and plant material

The experiment entitled “Plant growth enhancers and leaf number management improve post-transplant performance of rooted Chrysanthemum (*Dendranthema grandiflora* Tzvelev) Cuttings cv. Poornima Yellow” was conducted under shade net conditions to evaluate the influence of plant growth enhancers and leaf retention levels on the post-transplant performance of chrysanthemum cv. Poornima Yellow. Healthy, uniform and well rooted cuttings (50 days old), obtained from the rooting experiment were used as planting material.

Experimental design and treatments

The rooting experiment was laid out in a Factorial Completely Randomized Design (FCRD) consisting of two experimental factors. The first factor comprised eight plant growth enhancer treatments: seaweed extract at 500 ppm (P_1) and 1000 ppm (P_2), coconut water at 5% (P_3) and 10% (P_4), mono ammonium phosphate [MAP (12:61:00)] at 1000 ppm (P_5) and 2000 ppm (P_6), indole-3-butyric acid (IBA) at 100 ppm (P_7) and distilled water as the control (P_8). The second factor consisted of three leaf retention levels: two leaves (L_1), four leaves (L_2) and six leaves (L_3) retained per cutting. The two factors generated a total of 24 treatment combinations.

Potting medium and transplanting

Rooted cuttings from the experiment were

transplanted into six (6) inch plastic pots (11 cm bottom diameter) containing approximately 2 kg of a potting mixture comprising soil, cocopeat and vermicompost in a 1:1:1 (v/v/v) ratio. Two rooted chrysanthemum cuttings were transplanted into each pot.

Crop management

All experimental units were maintained under uniform cultural practices throughout the experimental period. Light irrigation was applied immediately after transplanting and subsequently on alternate days, depending on soil moisture conditions. Hand weeding was carried out at weekly intervals to maintain weed free pots. To support vegetative growth, a foliar spray of water-soluble fertilizer (19:19:19 NPK) at 2 g L⁻¹ was applied 25 days after transplanting (DAT).

Observations recorded

Five plants were randomly selected and tagged from each treatment for recording observations.

Vegetative growth parameters, including plant height, plant spread (East-West and North-South directions), number of primary branches and number of secondary branches were recorded at 30 and 60 DAT.

Flowering parameters comprised days to flower bud initiation, days to 50% flowering, days from flower bud initiation to full bloom and the number of fully opened flowers per plant.

Flower quality was evaluated by recording flower diameter, flower longevity. The overall ornamental value of each treatment was assessed using the pot presentability scoring system proposed by Conover (1986).

Statistical analysis

The experimental data were subjected to analysis of variance (ANOVA) appropriate for a Factorial Completely Randomized Design (FCRD). Treatment means were compared using the critical difference (CD) test at the 5% level of significance. The standard error of mean [SE(m) ±] and coefficient of variation (CV%) were also calculated to assess experimental precision and the significance of treatment effects.

Results and Discussion

Vegetative growth

a) Plant height

Plant height at 30 and 60 DAT varied significantly among the plant growth enhancer treatments, leaf-retention levels and their interactions (observations are listed in Table 1). Among the plant growth enhancers, rooted cuttings treated with MAP (12:61:00) at 1000 ppm

recorded the lowest plant height at both 30 and 60 DAT, whereas coconut water at 10% produced the tallest plants. Among the leaf retention treatments, cuttings retaining two leaves consistently recorded the lowest plant height, while those retaining six leaves produced the tallest plants. Among the interaction combinations, MAP at 1000 ppm + 2 leaves per cutting recorded the lowest plant height at both observation stages, whereas Coconut water at 10% + 6 leaves per cutting produced the highest plant height.

The reduced plant height observed under MAP at 1000 ppm may be attributed to the role of phosphorus in regulating cell division and limiting excessive internode elongation, resulting in compact plant growth. In contrast, coconut water at 10% promoted greater plant height due to the presence of naturally occurring cytokinins and auxins, which enhance cell division, elongation and vegetative growth. Likewise, retaining two leaves appeared to provide a balanced assimilate supply that favoured compact growth, whereas six retained leaves increased the photosynthetic area and carbohydrate availability, thereby promoting greater shoot elongation. Similar observations have been reported by Kavanova *et al.* (2006), Lazim *et al.* (2015) and Caspersen and Bergstrand (2020).

b) Plant spread

Plant growth enhancers significantly influenced plant spread in both the East-West and North-South directions throughout the experimental period (observations are listed in Table 1). Seaweed extract at 500 ppm (P₁) promoted greater plant spread in the East-West direction, while MAP (12:61:00) at 1000 ppm (P₅), followed by IBA at 100 ppm (P₇), produced comparatively greater plant spread in the North-South direction. Leaf retention levels also affected canopy development, with cuttings retaining four to six leaves generally exhibiting wider plant spread than those retaining two leaves. The interaction effects were also significant, with combinations of seaweed extract or MAP with 6 leaves per cutting and IBA with 2 leaves per cutting producing the maximum plant spread, whereas the control treatments recorded the minimum values.

The improved plant spread may be attributed to enhanced vegetative growth and canopy development promoted by the applied plant growth enhancers. Seaweed extract contains naturally occurring growth regulators, betaines and micronutrients that stimulate lateral shoot development, while phosphorus supplied through MAP enhances energy transfer and cell division, resulting in vigorous canopy expansion. Likewise, improved rooting

under IBA enhanced water and nutrient uptake, supporting better vegetative growth after transplanting. Greater leaf retention increased the photosynthetic area and assimilate production, thereby favouring continuous canopy expansion. Similar observations have been reported by Stirk and Van Staden (1997), Craigie (2011), Taiz *et al.* (2015), Carillo *et al.* (2022), Loconsole *et al.* (2022) and Lykokanellos *et al.* (2025).

c) Primary and secondary branches

The number of primary and secondary branches varied significantly among the plant growth enhancer treatments, leaf retention levels and their interaction effects (observations are listed in Table 1). Among the plant growth enhancers, MAP (12:61:00) at 1000 ppm consistently recorded the highest number of branches and was statistically on par with seaweed extract at 500 ppm for primary branches at 60 DAT. Among the leaf retention treatments, cuttings retaining two leaves generally produced the highest number of primary and secondary branches. Among the interaction combinations Seaweed extract at 500 ppm + 2 leaves recorded the maximum number of primary branches, while MAP at 1000 ppm + 2 leaves produced the highest number of secondary branches.

The enhanced branching under MAP at 1000 ppm may be attributed to improved phosphorus availability, which promotes energy transfer, meristem activity and axillary bud development. Likewise, seaweed extract enhanced primary branching through naturally occurring cytokinins and other bioactive compounds that stimulate lateral bud growth. Retention of two leaves appeared to provide an optimum source-sink balance, ensuring sufficient assimilate supply while reducing competition for developing axillary buds, thereby favouring branch initiation and development. Similar observations have been reported by Craigie (2011), Hartmann *et al.* (2011), Marschner (2012) and Havlin *et al.* (2014).

Overall, the vegetative growth responses indicated that MAP (12:61:00) at 1000 ppm produced compact, well branched plants with improved plant architecture, making it more suitable for pot presentability. In contrast, coconut water promoted greater plant elongation, while seaweed extract enhanced canopy expansion. Leaf retention also influenced vegetative growth, with six retained leaves favouring plant height and plant spread, whereas two retained leaves promoted branching and compact growth through efficient assimilate partitioning. These findings are in agreement with Kavanova *et al.* (2006), Craigie (2011), Taiz *et al.* (2015) and Caspersen and Bergstrand (2020).

d) Flowering

Flowering behaviour was significantly influenced by both plant growth enhancers and leaf retention levels, indicating that physiological responses established during the early post-transplant stage strongly affected reproductive development.

Days to flower bud initiation: Plant growth enhancers, leaf retention levels and their interactions significantly influenced the number of days taken for flower bud initiation (observations are listed in Table 2). Seaweed extract at 500 ppm recorded the earliest flower bud initiation, whereas the control treatment required the longest duration. Among the leaf retention treatments, cuttings retaining four leaves exhibited earlier bud initiation than those retaining two or six leaves. The interaction of seaweed extract at 500 ppm with four leaves per cutting further accelerated flower bud initiation.

The earlier flower bud initiation under seaweed extract may be attributed to the presence of naturally occurring cytokinins and other bioactive compounds that enhance physiological activity and promote early floral transition. Likewise, retaining four leaves appeared to provide an optimum balance between photosynthetic activity and vegetative growth, favouring early floral induction, whereas excessive or insufficient leaf retention delayed flower bud initiation. Similar observations have been reported by Craigie (2011), Kim *et al.* (2019), Abdel-Rahman *et al.* (2020) and Eisa *et al.* (2022).

Days to 50% flowering: Plant growth enhancers, leaf-retention levels and their interactions significantly influenced the number of days taken for 50% flowering (observations are listed in Table 2). Seaweed extract at 500 ppm recorded the earliest 50% flowering, whereas the control treatment required the longest duration. Among the leaf-retention treatments, cuttings retaining four leaves reached 50% flowering earlier than those retaining two or six leaves. The interaction of seaweed extract at 500 ppm with four leaves per cutting further hastened 50% flowering.

The earlier attainment of 50% flowering under seaweed extract may be attributed to the presence of naturally occurring bioactive compounds, including cytokinins, which enhance physiological activity and accelerate floral development. Likewise, retaining four leaves appeared to provide an optimum balance between photosynthetic activity and reproductive growth, thereby promoting earlier flowering, whereas lower or higher leaf retention delayed the flowering process. Similar observations have been reported by Craigie (2011), Kim *et al.* (2019), Abdel-Rahman *et al.* (2020) and Eisa *et al.*

Table 1 : Plant growth enhancers and leaf number management improve post-transplant performance of rooted Chrysanthemum (*Dendranthema grandiflora* Tzvelev) cuttings cv. Poornima Yellow on vegetative growth.

Observations	Plant height						Plant spread E-W						Plant spread N-S						Primary branches						Secondary branches		
	30	30	30	30	60	60	60	60	60	60	60	60	30	30	30	30	30	30	30	30	30	30	30	30	60	60	60
Days after Transplanting																											
Plant growth enhancers (P)/Leaf number (L)	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
P ₁ Seaweed extract 500 ppm	28.11	30.21	35.58	32.89	33.69	37.23	8.33	8.00	8.33	11.99	13.75	16.78	7.78	7.22	7.05	9.33	9.22	8.72	1.78	1.33	1.20	8.11	5.89	4.66	0.78	0.11	0.01
P ₂ Seaweed extract 1000 ppm	27.35	34.02	30.63	30.44	36.78	32.00	7.33	7.89	7.92	12.22	14.56	11.86	7.22	6.78	7.33	8.22	8.89	10.11	1.11	1.14	1.17	5.78	5.16	4.19	0.33	0.11	0.12
P ₃ Coconut water 5%	25.58	33.58	36.52	28.11	35.00	39.07	7.22	7.78	7.70	11.78	10.56	11.86	6.78	6.06	6.67	9.11	8.78	10.11	1.00	1.03	1.21	6.00	5.11	3.33	0.22	0.55	0.11
P ₄ Coconut water 10%	26.03	32.79	38.79	31.71	36.00	40.89	7.00	7.56	7.56	15.56	12.89	12.70	7.00	8.72	7.55	10.00	9.32	9.37	1.33	1.11	1.31	6.00	4.84	4.10	0.33	0.44	0.21
P ₅ MAP 1000 ppm	21.41	25.61	35.79	24.22	28.00	37.90	7.71	8.17	7.95	14.28	13.50	14.21	7.33	7.61	8.92	10.52	9.64	8.78	1.74	1.22	1.67	7.89	5.78	4.67	2.11	0.67	0.89
P ₆ MAP 2000 ppm	21.69	34.58	35.57	26.22	36.89	36.44	7.45	7.67	7.11	13.45	14.10	10.94	6.89	6.89	7.67	8.55	9.22	8.39	0.89	1.11	1.55	4.90	5.54	4.33	0.33	0.33	0.78
P ₇ IBA 100 ppm	23.91	34.46	28.46	27.44	36.00	31.44	8.00	7.00	7.50	11.78	14.33	13.61	8.00	7.17	8.56	10.56	8.45	9.72	1.10	1.22	1.33	7.44	5.33	5.00	0.01	0.22	0.67
P ₈ Control	28.58	30.36	31.58	33.39	32.11	32.39	7.00	6.80	6.89	10.56	11.42	11.44	6.11	6.04	6.89	8.17	8.31	8.22	1.00	0.78	0.45	4.78	3.00	3.33	0.01	0.22	0.11
Mean	25.33	31.95	34.12	29.30	34.31	35.92	7.51	7.61	7.62	12.70	13.14	12.93	7.14	7.06	7.58	9.31	8.98	9.18	1.24	1.12	1.24	6.36	5.08	4.20	0.52	0.33	0.36
SEM ±	0.24	0.15	0.42	0.27	0.17	0.47	0.10	0.06	0.18	0.14	0.08	0.24	0.09	0.05	0.15	0.10	0.06	0.18	0.01	0.01	0.02	0.07	0.04	0.12	0.01	0.00	0.01
CD/LSD 5%	0.70	0.43	1.21	0.78	0.47	1.34	0.29	NS	0.50	0.39	0.24	0.67	0.24	0.15	0.42	0.29	0.18	0.50	0.04	0.02	0.07	0.19	0.12	0.34	0.02	0.01	0.03
CV %		2.41			2.46			4.04			3.30			3.52			3.35		3.41				3.94			4.85	

(2022).

Days from flower bud initiation to full bloom:

The interval between flower bud initiation and full bloom differed significantly among the treatments (observations are listed in Table 2). Seaweed extract at 500 and 1000 ppm recorded the shortest bud to bloom duration, whereas the control treatment required the longest duration. Across the leaf retention treatments, cuttings retaining four leaves reached full bloom earlier than those retaining two or six leaves. The interaction of seaweed extract at 500 ppm with four leaves per cutting further reduced the duration from bud initiation to full bloom.

The shorter bud to bloom period under seaweed extract may be attributed to the presence of naturally occurring bioactive compounds that enhance physiological activity and accelerate floral development. Likewise, retaining four leaves appeared to provide an optimum balance between assimilate production and utilization, ensuring a continuous supply of carbohydrates for rapid petal expansion and flower opening. Similar observations have been reported by Poincelot (1993), Taiz *et al.* (2015), Kim *et al.* (2019) and Eisa *et al.* (2022).

Number of fully opened flowers: The number of fully opened flowers per plant was significantly affected by both plant growth enhancers and leaf retention levels (observations are listed in Table 2). MAP (12:61:00) at 1000 ppm recorded the highest number of fully opened flowers, whereas the control treatment recorded the lowest. Among the leaf retention treatments, cuttings retaining six leaves produced comparatively more fully opened flowers than those retaining fewer leaves. The interaction of MAP at 1000 ppm with six leaves per cutting recorded the maximum number of fully opened flowers per plant.

The superior flower production observed under under MAP at 1000 ppm may be attributed to the role of phosphorus in enhancing energy metabolism, assimilate translocation and reproductive development, thereby promoting flower bud differentiation and development. Likewise, retaining six leaves provided greater photosynthetic capacity and carbohydrate availability, supporting the production and development of a higher number of flowers. Similar observations have been reported by Marschner (2012), Havlin *et al.* (2014) and Taiz *et al.* (2015).

Overall, the flowering responses demonstrate that seaweed extract primarily accelerated reproductive development by promoting earlier flower bud initiation, 50% flowering and bud to bloom duration, whereas MAP (12:61:00) at 1000 ppm enhanced flower production by

increasing the number of fully opened flowers. Leaf retention levels also played a key role in flowering behaviour, with four retained leaves favouring earlier flowering through an optimum source-sink balance, while six retained leaves maximized flower production by providing greater photosynthetic capacity and assimilate availability during reproductive growth. These findings are in agreement with Leoni *et al.* (2019), Eisa *et al.* (2022), Carillo *et al.* (2022) and Suchitha *et al.* (2023).

e) Flower quality and Pot presentability

Flower quality and pot presentability are important commercial attributes determining the market acceptance of ornamental potted chrysanthemums. Both plant growth enhancers and leaf retention levels significantly influenced flower diameter, flower longevity and pot presentability, indicating that appropriate physiological conditioning before transplanting enhanced the ornamental and commercial value of chrysanthemum pot mums.

Flower Diameter: Flower diameter differed significantly among the treatments. MAP (12:61:00) at 1000 ppm recorded the maximum flower diameter, whereas the control treatment produced the smallest flowers (observations are listed in Table 2). Among the leaf retention treatments, cuttings retaining six leaves produced the largest flowers. The interaction of MAP (12:61:00) at 1000 ppm with six leaves per cutting recorded the maximum flower diameter.

The increased flower diameter under MAP application may be attributed to the adequate supply of phosphorus, which promotes cell division, cell enlargement and assimilate translocation during floral development. Improved phosphorus nutrition enhances metabolic activity and provides sufficient energy for the development of larger and well-formed flowers. Likewise, retaining six leaves increased photosynthetic efficiency and carbohydrate production, ensuring a continuous supply of assimilates required for flower expansion. Similar observations have been reported by Eisa *et al.* (2022), Carillo *et al.* (2022), Leoni *et al.* (2019) and Loconsole *et al.* (2024).

Flower longevity : Flower longevity was significantly influenced by both plant growth enhancers and leaf retention levels (observations are listed in Table 2). MAP (12:61:00) at 1000 ppm produced flowers with the longest longevity, whereas flowers produced under the control treatment exhibited the shortest longevity. Similarly, retaining six leaves per cutting significantly prolonged flower longevity compared with retaining two or four leaves. The interaction of MAP (12:61:00) at 1000 ppm with six leaves per cutting recorded the maximum

flower longevity

The extended flower longevity observed under MAP treatment may be associated with improved nutritional status, greater carbohydrate accumulation and delayed senescence of floral tissues. Increased assimilate availability resulting from greater leaf retention further maintained cellular integrity and reduced the rate of physiological deterioration, thereby extending the decorative life of flowers. Similar findings have been reported by Eisa *et al.* (2022), Suchitha *et al.* (2023), Carillo *et al.* (2022) and Loconsole *et al.* (2022).

Pot presentability : Pot presentability, an important criterion determining the commercial acceptability of ornamental potted plants, was significantly affected by both experimental factors. MAP (12:61:00) at 1000 ppm recorded the highest pot presentability score, indicating superior plant symmetry, flower display and overall ornamental appeal (observations are listed in Table 2). Among the leaf retention treatments, cuttings retaining two leaves achieved the highest presentability score despite producing comparatively fewer flowers. The interaction of MAP (12:61:00) at 1000 ppm with two leaves per cutting recorded the highest pot presentability score.

The superior presentability of MAP treated plants resulted from the combined improvement in branching, flower production and flower quality, producing visually attractive and marketable pot plants. Although retaining six leaves enhanced vegetative growth and highest number of fully opened flowers, plants retaining two leaves developed a more compact and balanced canopy, which is highly desirable in ornamental pot production where plant proportion and symmetry are major quality attributes. Similar observations have been reported by Leoni *et al.* (2019), Eisa *et al.* (2022), Loconsole *et al.* (2024) and Suchitha *et al.* (2023).

Overall, the results demonstrate that flower quality and commercial value can be substantially improved through appropriate management of plant growth enhancers and leaf retention levels. MAP (12:61:00) at 1000 ppm consistently enhanced flower size, longevity and overall ornamental quality, whereas optimum leaf retention balanced vegetative growth with plant compactness. These findings corroborate previous reports emphasizing the importance of plant growth enhancers application and appropriate leaf area in producing premium quality chrysanthemum pot mums (Eisa *et al.*, 2022; Carillo *et al.*, 2022; Loconsole *et al.*, 2024; Leoni *et al.*, 2019).

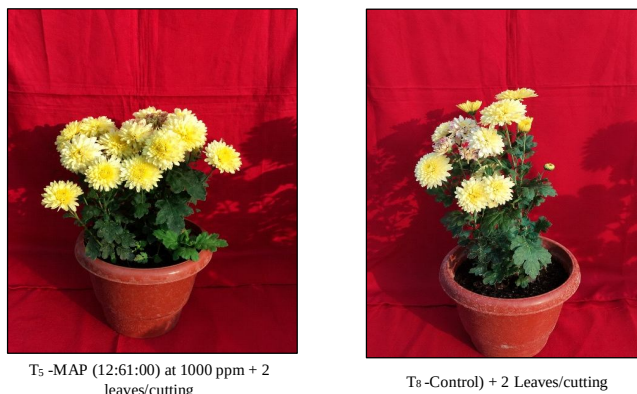


Fig. 1 : Pot presentability.

Conclusion

The present investigation demonstrated that the post-transplant performance of rooted chrysanthemum (*Dendranthema grandiflora* Tzvelev) cuttings was significantly influenced by the combined effects of plant growth enhancers and leaf retention levels. Significant variations were observed in vegetative growth, flowering behaviour, flower quality and pot presentability, highlighting the importance of physiological conditioning of rooted cuttings before transplanting. These findings corroborate earlier reports that emphasized the role of plant growth enhancers and leaf retention in improving transplant establishment and ornamental quality in chrysanthemum (Eisa *et al.*, 2022; Leoni *et al.*, 2019; Loconsole *et al.*, 2024).

Among the plant growth enhancers evaluated, Seaweed extract at 500 ppm accelerated flowering by promoting earlier flower bud initiation, 50% flowering and bud to bloom duration, MAP (12:61:00) at 1000 ppm consistently produced compact, well branched plants with superior flower production, larger flower diameter, longer flower longevity and the highest pot presentability, making it the most effective treatment for improving the ornamental quality of potted chrysanthemums. Similar observations have been reported by Craigie (2011), Carillo *et al.* (2022), Eisa *et al.* (2022), Leoni *et al.* (2019) and Loconsole *et al.* (2024).

Leaf retention levels also played a crucial role in determining plant performance. Retaining four leaves promoted earlier flowering by maintaining an optimum source-sink balance, whereas six retained leaves enhanced flower production and quality through greater photosynthetic capacity. In contrast, retaining two leaves produced compact plants with improved branching and superior pot presentability, an important characteristic for commercial pot mum production. These observations agree with the findings of Eisa *et al.* (2022), Leoni *et al.* (2019), Loconsole *et al.* (2024), Suchitha *et al.* (2023)

and Taiz *et al.* (2015).

Overall, the results demonstrate that plant growth enhancers and leaf retention levels act synergistically to regulate the growth, flowering and marketability of chrysanthemum pot mums. For commercial nursery propagation, the application of MAP (12:61:00) at 1000 ppm in combination with six retained leaves per cutting may be recommended. However, for the production of compact potted chrysanthemums and bedding plants, MAP (12:61:00) at 1000 ppm combined with two retained leaves per cutting may be recommended owing to its superior pot presentability and balanced plant architecture. These findings provide a practical and sustainable production strategy for improving the commercial quality of chrysanthemum cv. Poornima Yellow under protected cultivation and may serve as a useful guideline for commercial growers. Further studies involving different cultivars, growing environments and physiological or biochemical analyses are recommended to validate and expand the applicability of these production practices.

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