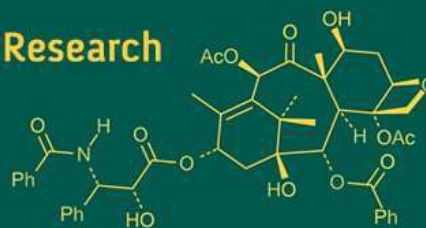


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Influence of different growing media on flower attributes and economics of chrysanthemum (*Dendranthema grandiflora*) cultivars for potmums

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Abstract

The study was conducted at the Floricultural Research Station, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad, during the period from September 2018 to February 2019. The experiment was laid out in a factorial completely randomized design with nine growing media treatments and two cultivars, namely Akitha and Redstone, replicated three times. The growing media treatments comprised: G₁-soil + sand + farmyard manure (2:1:1), G₂-soil + sand + vermicompost (2:1:1), G₃-cocopeat + sand + farmyard manure (2:1:1), G₄-cocopeat + sand + vermicompost (2:1:1), G₅-soil + cocopeat + sand + farmyard manure (2:1:0.5:0.5), G₆-soil + cocopeat + sand + vermicompost (2:1:0.5:0.5), G₇-cocopeat + soil + sand + farmyard manure (2:1:0.5:0.5), G₈-cocopeat + soil + sand + vermicompost (2:1:0.5:0.5), and G₉-red soil as control. Among the eighteen treatment combinations, the treatment C₂G₇ (cv. Redstone grown in cocopeat + soil + sand + farmyard manure at 2:1:0.5:0.5) resulted in the earliest flowering, recording the minimum number of days to flower bud initiation (49.13 days), 50 percent flowering (90.67 days), and 100 percent flowering (108.48 days). However, the treatment C₂G₈ (cv. Redstone grown in cocopeat + soil + sand + vermicompost at 2:1:0.5:0.5) produced the highest number of fully opened flowers per pot (32.17) and total flowers per pot (50.72), along with the maximum benefit-cost ratio (4.63:1).

Keywords: Soil, sand, FYM, cocopeat and vermicompost

Introduction

Chrysanthemum (*Dendranthema grandiflora* Tzvelev) is one of the most important ornamental crops cultivated worldwide due to its aesthetic appeal and versatility in use as a cut flower, loose flower, exhibition flower, and potted ornamental plant. In recent times, the demand for potted chrysanthemums (pot mums) has increased considerably, following trends observed in several Western countries where container gardening is widely practiced.

Conventional soil-based cultivation is becoming difficult by the limited availability of suitable soils possessing optimum physical properties, balanced nutrient status, and desirable pH range. Under such circumstances, soilless and substrate-based cultivation systems have emerged as viable alternatives, as they are capable of enhancing crop productivity and quality even in regions with non-arable land (Gruda, 2009) [11]. Although substrate culture in chrysanthemum is known to minimize root-borne diseases and improve root health, its adoption has been limited due to higher production costs associated with frequent substrate replacement (Buwalda *et al.*, 1994) [6]. Comparative studies conducted by Blok and Vermeulen (2012) [5] on different substrate systems such as sand, peat, and cassette-based media revealed that these systems were economically less feasible when compared to soil-based cultivation. However, the selection of an appropriate and cost-effective growing medium may contribute to improved economic returns in chrysanthemum production. Yahya (1996) [24] reported that excessive nutrient availability in the growing medium adversely affected flowering performance and reduced the longevity of flowers.

Among various substrate components, cocopeat has gained prominence due to its eco-friendly nature, low bulk density, high porosity, and ability to promote effective root aeration, thereby supporting healthy plant growth (Evans *et al.*, 1996) [10]. Sand is frequently used as a component of potting media to improve drainage, increase air-filled porosity, and provide physical stability to containers.

Vermicompost is recognized as a valuable organic amendment, supplying readily available nutrients and improving the biological and physical properties of the growing medium.

The growing medium plays a pivotal role in container-grown ornamental crops, as it functions as a reservoir of nutrients, provides anchorage to plants, retains adequate moisture for uptake, and facilitates gaseous exchange within the root zone. Considering the importance of an ideal potting medium in achieving optimum growth and superior flowering quality, the present investigation was undertaken to study the effect of different potting media on growth and flowering attributes of chrysanthemum.

Materials and Methods

The experiment was undertaken at the Floricultural Research Station, College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad. The study was laid out using a factorial completely randomized design (FCRD), consisting of eighteen treatment combinations with three replications. The experimental treatments included nine different growing media: G₁ (soil + sand + farmyard manure in the ratio of 2:1:1), G₂ (soil + sand + vermicompost, 2:1:1), G₃ (cocopeat + sand + farmyard manure, 2:1:1), G₄ (cocopeat + sand + vermicompost, 2:1:1), G₅ (soil + cocopeat + sand + farmyard manure, 2:1:0.5:0.5), G₆ (soil + cocopeat + sand + vermicompost, 2:1:0.5:0.5), G₇ (cocopeat + soil + sand + farmyard manure, 2:1:0.5:0.5), G₈ (cocopeat + soil + sand + vermicompost, 2:1:0.5:0.5), and G₉ consisting of red soil alone as control. These media were evaluated using two chrysanthemum cultivars, namely 'Akitha' and 'Redstone'. Stem cuttings of the selected cultivars were collected from healthy, disease-free mother plants. Prior to planting, the cuttings were disinfected by immersing them for ten minutes in a fungicidal solution containing carbendazim (12%) and mancozeb (63%). A slanting cut was made at the basal end of each cutting, after which the cut ends were treated with indole-3-butyric acid (IBA) at 500 ppm to promote rooting. The treated cuttings were then planted in nursery beds for root initiation. Uniform, well-rooted, and disease-free cuttings were selected for transplanting. Three rooted cuttings were planted per pot, maintaining equal spacing in a triangular arrangement. Cultural practices included pinching at 20 days after planting (DAP) and disbudding at 40 DAP. Nutrient management involved the application of a water-soluble fertilizer containing 19:19:19 (N: P: K) at the rate of 3 g L⁻¹ of water from pinching up to 45 DAP. During the reproductive stage, a fertilizer formulation of 13:0:45 (N: P: K) was applied at 2 g L⁻¹ of water at weekly intervals.

Results and Discussion

1) Flowering attributes

a) Number of days taken for flower bud initiation

Data pertaining to the duration taken for flower bud initiation were recorded, subjected to statistical analysis under a factorial completely randomized design, and summarized in Table 1. A marked difference was observed between the cultivars, with 'Redstone' initiating flower buds at an earlier stage, with a mean of 51.78 days, while 'Akitha' required a comparatively longer period of 74.60 days for bud emergence.

With respect to the growing media, the treatment G₇, comprising cocopeat, soil, sand, and farmyard manure in the

ratio of 2:1:0.5:0.5, resulted in the earliest initiation of flower buds with a mean of 59.37 days. In contrast, the control treatment G₉ (red soil alone) recorded the longest duration for bud initiation, requiring 68.80 days. Analysis of the interaction effects revealed that the treatment combination C₂G₇ (cv. Redstone grown in cocopeat + soil + sand + FYM at 2:1:0.5:0.5) produced the minimum number of days to flower bud initiation (49.13 days). Conversely, the maximum delay in bud initiation (81.07 days) was observed in the treatment C₁G₉, where cv. Akitha was grown in red soil.

The advancement in flowering observed under G₇ may be attributed to the favorable nutrient composition of the medium, particularly its potassium content, which plays a key role in regulating stomatal activity, enhancing carbon dioxide assimilation, and improving photosynthetic efficiency. This, in turn, leads to greater accumulation of assimilates, thereby promoting early floral initiation. Similar findings were reported by Gupta *et al.* (2004), who observed earlier bud formation in media containing cocopeat, sawdust, and soil. The gradual and sustained release of nutrients from farmyard manure throughout the crop growth period may also have contributed to early flowering, as reported by Pooja *et al.* (2017) in cut rose grown in soil-based media amended with FYM and sawdust.

Additionally, improved nutrient availability coupled with balanced moisture retention in the growing medium may have created a conducive environment for early bud development. Enhanced aeration and effective drainage likely prevented moisture stress and root-zone stagnation, thereby facilitating better root growth and timely floral initiation. The present findings are in close agreement with the results reported by Singh *et al.* (2015) [21] and Meenakshi and Urfi (2023) in oriental lilly.

b) Number of days taken for 50 percent flowering

The number of days required to attain 50 percent flowering was recorded, statistically analyzed using a factorial completely randomized design, and the findings are presented in Table 1. A significant variation was observed between the cultivars, wherein 'Redstone' reached 50 percent flowering earlier, with a mean duration of 96.48 days, compared to 'Akitha', which required 117.96 days.

Among the growing media, G₇ comprising cocopeat, soil, sand, and farmyard manure in the proportion of 2:1:0.5:0.5 resulted in the earliest attainment of 50 percent flowering (103.14 days). In contrast, the control treatment G₉ (red soil) exhibited the longest duration to reach this stage, recording 112.57 days. Examination of interaction effects indicated that the combination C₂G₇ (cv. Redstone grown in cocopeat + soil + sand + FYM at 2:1:0.5:0.5) produced the minimum number of days to 50 percent flowering (90.67 days), whereas the maximum delay (121.73 days) was observed in C₁G₉, where cv. Akitha was grown under control conditions (red soil). The effects of cultivar, growing medium, and their interaction on 50 percent flowering were found to be statistically significant. The present findings are in agreement with earlier reports by Lairingdi *et al.* (2024) [14].

c) Number of days taken for 100 percent flowering (full bloom)

Observations pertaining to the number of days required to attain 100 percent flowering were recorded, statistically analyzed using a factorial completely randomized design,

and are presented in Table 1. Among the cultivars studied, cv. Redstone (C₂) attained full bloom earlier, requiring an average of 112.51 days, whereas cv. Akitha (C₁) reached this stage after a longer duration of 132.37 days.

With respect to growing media, the treatment G₇ consisting of cocopeat, soil, sand, and farmyard manure in the ratio of 2:1:0.5:0.5 resulted in the earliest full flowering, recording a mean of 118.71 days. In contrast, the control treatment G₉ (red soil) required the maximum time to reach full bloom, with an average of 127.38 days. Statistical analysis revealed

that the main effects of cultivar and growing medium significantly influenced the duration to full flowering; however, their interaction did not show a significant effect on this parameter.

Similar observations were reported by Mehwish *et al.* (2007), who recorded earlier flowering in dahlia grown in a medium composed of sand, silt, and leaf mould. The present findings are also in agreement with earlier reports by Lairingdi *et al.* (2024) ^[14] in rose.

Table 1: Effect of different growing media on flowering attributes of chrysanthemum (*Dendranthema grandiflora*) cultivars for potmums.

Treatments		Number of days taken for flower bud initiation			Number of days taken for 50 percent flowering			Number of days taken for 100 percent flowering		
		Akitha (C ₁)	Redstone (C ₂)	Mean	Akitha (C ₁)	Redstone (C ₂)	Mean	Akitha (C ₁)	Redstone (C ₂)	Mean
G ₁	Soil + Sand + FYM (2:1:1)	73.08	51.42	62.25	116.07	102.20	109.13	135.00	114.23	124.61
G ₂	Soil + Sand + Vermicompost (2:1:1)	74.33	52.03	63.18	117.75	98.63	108.19	133.37	113.53	123.45
G ₃	Cocopeat + Sand + FYM (2:1:1)	72.16	50.33	61.25	118.50	96.73	107.62	132.53	112.20	122.37
G ₄	Cocopeat + Sand + Vermicompost (2:1:1)	73.26	52.47	62.86	118.73	96.25	107.49	131.55	111.02	121.28
G ₅	Soil + Cocopeat + Sand + FYM (2:1:0.5:0.5)	77.80	51.63	64.72	117.02	93.79	105.41	132.42	115.68	124.05
G ₆	Soil + Cocopeat + Sand + Vermicompost (2:1:0.5:0.5)	76.45	50.49	63.47	117.29	91.73	104.51	130.47	110.13	120.30
G ₇	Cocopeat + Soil + Sand + FYM (2:1:0.5:0.5)	69.60	49.13	59.37	115.61	90.67	103.14	128.93	108.48	118.71
G ₈	Cocopeat + Soil + Sand + Vermicompost (2:1:0.5:0.5)	73.67	52.00	62.84	118.98	94.93	106.96	129.33	110.35	119.84
G ₉	Control (Red Soil)	81.07	56.53	68.80	121.73	103.40	112.57	137.77	117.00	127.38
Mean		74.60	51.78		117.96	96.48		132.37	112.51	

For comparing the means of	SEm ±	CD @ 5%	SEm ±	CD @ 5%	SEm ±	CD @ 5%
Cultivars (C)	0.224	0.642	0.258	0.704	0.266	0.765
Growing media (G)	0.475	1.363	0.547	1.570	0.566	1.624
CXG	0.677	1.928	0.774	2.221	0.800	N.S.

Table 2: Effect of different growing media on number of flowers of chrysanthemum (*Dendranthema grandiflora*) cultivars for potmums.

Treatments		Number of fully opened flowers per pot			Total number of flowers per pot		
		Akitha (C ₁)	Redstone (C ₂)	Mean	Akitha (C ₁)	Redstone (C ₂)	Mean
G ₁	Soil + Sand + FYM (2:1:1)	20.33	24.80	22.57	38.60	44.80	41.70
G ₂	Soil + Sand + Vermicompost (2:1:1)	21.07	25.13	23.10	42.73	45.00	43.87
G ₃	Cocopeat + Sand + FYM (2:1:1)	21.60	25.81	23.71	42.60	46.47	44.53
G ₄	Cocopeat + Sand + Vermicompost (2:1:1)	22.67	26.30	24.48	40.07	47.73	43.90
G ₅	Soil + Cocopeat + Sand + FYM (2:1:0.5:0.5)	23.93	27.87	25.90	45.40	47.47	46.43
G ₆	Soil + Cocopeat + Sand + Vermicompost (2:1:0.5:0.5)	25.00	29.07	27.03	46.07	47.80	46.93
G ₇	Cocopeat + Soil + Sand + FYM (2:1:0.5:0.5)	26.07	30.25	28.16	46.80	47.87	47.33
G ₈	Cocopeat + Soil + Sand + Vermicompost (2:1:0.5:0.5)	28.33	32.17	30.25	48.07	50.72	49.40
G ₉	Control (Red Soil)	17.00	17.53	17.27	30.80	32.93	31.87
Mean		22.89	26.55		42.35	45.64	42.35

For comparing the means of	SEm ±	CD @ 5%	SEm ±	CD @ 5%
Cultivars (C)	0.181	0.521	0.331	0.952
Growing media (G)	0.385	1.106	0.704	2.019
CXG	0.545	1.564	0.995	2.857

d) Number of fully opened flowers per pot

Data on the number of fully opened flowers per pot were recorded, analyzed statistically using a factorial completely randomized design, and are presented in Table 2. Among the cultivars, cv. Redstone produced a significantly higher mean number of fully opened flowers per pot (26.55) compared to cv. Akitha (22.89).

Evaluation of the growing media indicated that G₈, comprising cocopeat, soil, sand, and vermicompost in the proportion of 2:1:0.5:0.5, was most effective in enhancing flower production, recording the highest mean number of fully opened flowers (30.25). In contrast, the lowest flower

count (17.27) was observed in the control treatment G₉, consisting of red soil alone. The interaction effect revealed that the treatment combination C₂G₈ (cv. Redstone grown in cocopeat + soil + sand + vermicompost at 2:1:0.5:0.5) resulted in the maximum number of fully opened flowers per pot (32.17). Conversely, the minimum number of flowers (17.00) was recorded in C₁G₉, where cv. Akitha was grown under control conditions.

The enhanced flower production observed under vermicompost-amended media may be attributed to improved nutrient availability and the presence of growth-promoting substances. Similar findings were reported by

Weena (2014), who observed increased flower production with the combined application of inorganic fertilizers and vermicompost. Shadanpour *et al.* (2011) [23] reported that vermicompost, being rich in humic substances and plant growth regulators such as auxins and gibberellins, positively influences plant growth, development, and flowering in potted plants. Chamani *et al.* (2008) also reported that vermicompost at 20 percent concentration significantly increased flower number, while higher levels resulted in a decline in flower production in petunia. The present results are in agreement with earlier studies by Barreto *et al.* (2006) and Awang *et al.* (2010) [1].

e) Total number of flowers per pot

The total number of flowers produced per pot was recorded and analyzed using a factorial completely randomized design. The results are presented in Table 2. Among the cultivars, cv. Redstone (C₂) produced a higher average number of flowers per pot (45.64) compared to cv. Akitha (C₁), which recorded 42.35 flowers per pot.

Regarding the growing media, the mixture G₈ (cocopeat + soil + sand + vermicompost in the ratio of 2:1:0.5:0.5) resulted in the highest flower count, with a mean of 49.40 flowers per pot. The lowest flower production was observed in the control treatment G₉ (red soil), which recorded a mean of 31.87 flowers per pot. The interaction effect showed that the combination C₂G₈ (cv. Redstone grown in cocopeat + soil + sand + vermicompost at 2:1:0.5:0.5) produced the maximum number of flowers per pot (50.72). In contrast, the minimum number of flowers (30.80) was recorded in C₁G₉, where cv. Akitha was grown in red soil.

The superior flowering performance observed under G₈ may be attributed to improved plant growth resulting from better nutrient availability and favorable physical properties of the medium, such as optimal bulk density, pH, and electrical conductivity. Chavada *et al.* (2017) [18] reported similar findings in rose, where plants grown in a mixture of cocopeat, soil, and leaf mould produced more flowers. Fascella and Zizzo (2005) also reported higher flower numbers in plants grown in organic media compared to inert substrates. The increased flower production under G₈ could be linked to enhanced vegetative growth and higher carbohydrate accumulation due to efficient nutrient uptake. This, in turn, supported greater flowering. These observations are in agreement with previous reports by Padhiyar *et al.* (2017) [18], and Sharukh *et al.* (2020) [20] in chrysanthemum.

2) Economics of cultivation

Benefit cost ratio

The accessibility and expense of growing media are major factors influencing the production of container-grown flowering plants. To address this, different alternative substrate formulations for potting and bedding plants have been developed and successfully adopted in several production systems. The physical and chemical characteristics of these substrates play a crucial role in offering structural support as well as serving as reservoirs for water and nutrients required by the plants. In the present study, the highest benefit-cost ratio was observed in redstone with greater number of flowers. The highest benefit-cost ratio (4.63:1) was recorded for the treatment combination C₂G₈, where cv. Redstone was grown in a medium consisting of cocopeat, soil, sand, and vermicompost in the ratio of 2:1:0.5:0.5. The next best

economic performance was observed in C₂G₇ (cv. Redstone in cocopeat + soil + sand + FYM at 2:1:0.5:0.5), which recorded a benefit-cost ratio of 4.56. The lowest profitability was recorded in C₁G₉ (cv. Akitha grown in red soil), with a benefit-cost ratio of 1.17.

Table 3: Effect of different growing media on number of flowers of chrysanthemum (*Dendranthema grandiflora*) cultivars for potmums.

S. No	Cost of cultivation per each treatment	Price per each pot	Net profit	Benefit cost ratio
C ₁ G ₁	37.22	100	62.78	1.68
C ₁ G ₂	41.60	110	68.40	1.40
C ₁ G ₃	36.20	120	83.80	2.31
C ₁ G ₄	38.83	130	91.17	2.34
C ₁ G ₅	36.38	140	104.62	2.87
C ₁ G ₆	38.13	150	111.87	2.93
C ₁ G ₇	35.97	160	124.03	3.26
C ₁ G ₈	37.28	170	132.71	3.56
C ₁ G ₉	36.24	80	43.26	1.17
C ₂ G ₁	37.22	140	112.78	2.76
C ₂ G ₂	41.60	150	108.40	2.60
C ₂ G ₃	36.20	160	123.80	3.41
C ₂ G ₄	38.83	170	131.17	3.37
C ₂ G ₅	36.38	180	143.62	3.94
C ₂ G ₆	38.13	190	151.48	3.98
C ₂ G ₇	35.97	200	164.03	4.56
C ₂ G ₈	37.28	210	172.72	4.63
C ₂ G ₉	36.24	120	83.26	2.29

Treatment details

Factor 1: Cultivars

1. C₁ : Akitha
2. C₂ : Redstone

Factor 2: Growing media

1. G₁ : soil + sand + FYM (2:1:1),
2. G₂ : soil + sand + vermicompost (2:1:1)
3. G₃: cocopeat + sand + FYM (2:1:1)
4. G₄: cocopeat + sand + vermicompost (2:1:1),
5. G₅: soil + cocopeat + sand + FYM (2:1:0.5:0.5),
6. G₆: soil + cocopeat + sand + vermicompost (2:1:0.5:0.5),
7. G₇:cocopeat + soil + sand + FYM (2:1:0.5:0.5),
8. G₈: cocopeat + soil + sand + vermicompost (2:1:0.5:0.5),
9. G₉: control (red soil)

Comparable findings were reported by Mahadik *et al.* (2017) [15] in chrysanthemum, where the application of biofertilizers combined with 50% RDF and 10 t ha⁻¹ vermicompost resulted in a high benefit-cost ratio of 2.94:1

Conclusion

It can be concluded from present investigation that among two cultivars Cv. Redstone responded well when compared to Cv. Akitha. The growing media G₈: cocopeat + soil + sand + vermicompost (2:1:0.5:0.5) had shown significant difference in flowering attributes with highest benefit cost ratio (4.63:1) among all other growing media.

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