**Standardization of potting media composition for potmums**

**(*Chrysanthemum morifolium* Ramat.)**

**ABSTRACT**

This experiment was carried out to evaluate the effect of different potting media compositions on growth and flowering of pot mum (*Chrysanthemum morifolium* Ramat. Syn. *Dendranthema grandiflora*) cv. Sadhbhavana. Potting media compositions were comprised of five media *viz*. soil, vermicompost, cocopeat, perlite and vermiculite in different proportions (v/v). The experiment was laid out in Completely Randomized Design (CRD) and replicated thrice with five pots per treatment. The results revealed that media comprising cocopeat + vermicompost (2:1 v/v) recorded maximum plant height, number of primary and secondary branches per plant and plant spread. Significantly earliest bud appearance (85.95 days), colour break stage (96.13 days) and 50% flowering (105.00 days) with longest blooming period (60.13 days) and highest number of flowers per plant (146.13) were also recorded in the same media composition. Maximum flower diameter was recorded in media composition cocopeat + vermicompost (2:1v/v) which was statistically at par with vermiculite + vermicompost (2:1 v/v). Results of this study indicate that certain chemical and physical properties of potting media changed with the change in composition and using cocopeat + vermicompost 2:1 v/v as media is best for production of pot mum cv. Sadhbhavana with good growth and flowering attributes.

1. **INTRODUCTION**

Floriculture industry has been intensively influenced due to urbanization and life style changes. From environmental, social and economic point of view potted plants are becoming more productive technology, and among the pot plants flowering pot plants have a special demand. In recent years, demand of pot mums for decoration in ceremonies, exhibitions, flower shows and various other occasions has been increased tremendously. Chrysanthemum (*Chrysanthemum morifolium* Ramat. Syn. *Dendranthema grandiflora* Tzvelev) is herbaceous perennial flowering plant exhibiting wide range of flower colour and belongs to Asteraceae family. It is commonly known as “Queen of the East” or “Autumn Queen” [1] and in India it is also popular by the names *Sevanti* and *Guldaudi*.

Pot mum production has become the most profitable form of commercial chrysanthemum growing. Pot mums are getting popularity due to their fascinating appearance, long lasting nature, vibrant flowers as well as their overall presentability and easy portability to use at any place. Pot mums having well proportionate shape with branches producing flowers of desirable colour, shape and size are preferred by consumers but due to finite volume of the pots, there is a greater tendency for increased competition among the roots in the rhizosphere for water, air and space [2] for achieving potential plant growth, and here comes the role of a good potting media. A good growing medium would provide sufficient anchorage or support to the plant, serves as reservoir for nutrients and water, allow oxygen diffusion to the roots and permit gaseous exchange between the roots and atmosphere outside the root substrate.

Along with universal media which is soil, few soilless media *viz*. cocopeat, perlite, vermiculite are some substrates having different physical and chemical properties and used for pot plants. Cocopeat has an ability to store 8-9 times more water than its weight and able to hold water about 73%. Cocopeat can be effectively recycled and has acceptable pH 5.2-6.8 [3,4] but it has been recognized to have high water holding capacity which causes poor air-water relationship, leading to low aeration within the medium, thus affecting the oxygen diffusion to the roots. Perlite is another light weight media with almost neutral pH and used as substrate for growing plants. Vermiculite is a spongy material that is dark brown to golden brown in colour and it has slightly better effective cation change capacity, water retention capacity and positive charged nutrients such as potassium, calcium and magnesium. Vermicompost, an organic manure produced by the use of earthworms, possesses characters like good pH, fertility, aeration, water use efficiency, micronutrient availability and presence of plant growth regulators which leads to increase the growth and ﬂowering of plants. Earlier studies show that incorporation of different media in different proportions to make suitable composition could improve physical and chemical properties of substrate and results in good plant growth [5,6,7,8]. Thus, keeping in view the importance of formulation of a light weight good growing media composition in limited volume of containers, this study was carried out to standardize media composition for pot mums.

1. **MATERIAL AND METHODS**

The present investigation was conducted during 2020-2021 at College Farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Mehsana, Gujarat (India). The climate of the area is typically subtropical characterized by semi-arid conditions having cool and dry winters, quite hot and dry summers and warm and humid monsoon. The five growing media *viz.,* soil, cocopeat, vermicompost, vermiculite, and perlite has been used for the experiment. Chrysanthemum variety Sadhbhawna was selected and used in this experiment exclusively on the bases of its dwarf, bushy and compact round shape ideal for pot cultivation without need for staking. The experiment was laid out in Completely Randomized Design (CRD) and replicated thrice with five pots per treatments. The observations recorded on different vegetative and flowering parameters of each plant in different media compositions and statistically analysed.

**2.1 Media compositions and pot filling**

The five growing media *viz.,* soil, cocopeat, vermicompost, vermiculite, and perlite were used in different proportion to make fourteen media compositions as per experiment treatments. There were total fourteen media composition treatments *viz*., T1 soil + vermicompost (2:1 v/v), T2 cocopeat + vermicompost (2:1 v/v), T3 perlite + vermicompost (2:1 v/v), T4 vermiculite + vermicompost (2:1 v/v), T5 soil +cocopeat+ vermicompost (1:1:1 v/v), T6 soil + perlite + vermicompost (1:1:1 v/v), T7 soil + vermiculite + vermicompost (1:1:1 v/v), ), T8 cocopeat + perlite + vermicompost (1:1:1 v/v), T9 cocopeat + vermiculite + vermicompost (1:1:1 v/v), T10 perlite + vermiculite + vermicompost (1:1:1 v/v), T11 soil + cocopeat + perlite + vermicompost (1:1:1:1 v/v), T12 soil + cocopeat + vermiculite + vermicompost (1:1:1 v/v), T13 soil + perlite + vermiculite + vermicompost (1:1:1:1 v/v), T14 cocopeat + perlite + vermiculite + vermicompost (1:1:1:1 v/v). Plastic pots (8”diameter) were taken and filled with growing media compositions according to different experimental treatments. One month old rooted cuttings of pot mum chrysanthemum cv. Sadhbhavana having uniform size and vigour were selected and one plant was transplanted in each pot in the first fortnight of August. At the top of the pot 3-4 cm space was maintained by uniformly tapping the media to maintain equal compaction as well as space for irrigation. Immediately after planting, a light irrigation was given for better establishment of the plants.

**2.2 Physical and chemical analysis of media compositions**

Randomly drawn representative samples were taken from different media compositions to analyse different physico-chemical properties viz. pH (Photometric method), EC (conductometry method), Water holding capacity (Gravimetric method), bulk density (core method), particle density (Pycnometer method) before filling of media in to the pots. Observations on physico-chemical parameters were recorded and presented in Fig 1 to Fig 5.

**2.3 Cultural Practices**

Water soluble fertilizer 19:19:19 (N:P:K) @ 2g/l was applied at weekly interval to all the pot plants. After one month of transplanting of cuttings in the pot, pinching was done. Regular irrigation was provided through micro-irrigation.

1. **RESULTS AND DISCUSSION**

**3.1 Vegetative Parameters**

Data pertaining to the effect of different potting media compositions on vegetative parameters of potmum chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. Sadhbhavana are presented in Table 1.. Data clearly reveal that vegetative characters were significantly influenced by different media compositions. Maximum plant height (22.81cm) was observed in treatment T2 *i.e.* soil + vermicompost (2:1 v/v) which was at par with T4 *i.e.* vermiculite+ vermicompost (2:1 v/v), which might be due to the suitable physio-chemical properties of the media compositions and nutrient status. This media composition has low bulk density and higher water holding capacity resulting in better drainage of water and aeration which might have sustained good root and shoot growth leading to increase in plant height. Further, vermicompost supplied micronutrients, growth hormones and retain nutrients for longer period of time which might also lead to the increase in plant height. These results corroborate the earlier findings of Kameshwari *et al*. [9] and Padiyar *et al.* [10] in chrysanthemum. In gerbera, earlier studies also show maximum plant height in cocopeat followed by vermicompost which was at par with media composition 75% cocopeat + 25% vermicompost [11].

Similarly, for other vegetative characters also T2 was found best, and maximum number of primary branches (12.03), secondary branches (27.00) plant spread (35.04 cm in N-S direction and 34.58 cm in E-W direction) as well as maximum leaf area (151.60 cm2) was recorded in media composition cocopeat + vermicompost (2:1 v/v) which might be the result of availability of nutrients and their easy uptake due to favourable physico-chemical properties of the media particularly during early crop growth phase which put fourth early vigour and helped to increase number of branches. The plant spread increase was mainly due to production of a greater number of branches and more plant spread also shows more vegetative growth of plant which might be due to proper aeration, good water holding capacity, supply of substantial amount of nutrient through media compositions of cocopeat and vermicompost (2:1 v/v) which converted in photosynthates and further enhanced cell division and cell elongation. Similar results were obtained by Kameshwari *et al.* [9], Nair and Bharati [12], Deogade *et al*. [13] in chrysanthemum.

**3.2 Flowering Parameters**

A perusal of data indicates that different media compositions had significant influence of flowering parameters of pot mum variety ‘Sadhbhawna’ (Table 2). The result revealed that earliest flower bud initiation (85.95 days), colour break stage (96.13 days), and 50 % flowering (105 days) were recorded in treatment T2 *i.e* media composition Cocopeat + Vermicompost (2:1v/v) which were statistically remained at par with T4 *i.e.* media composition Vermiculite + Vermicompost (2:1 v/v).

This might be due to high porosity which improve the aeration into root system, availability of nutrients whose rapid uptake by plants leads to higher accumulation of carbohydrate which is further responsible for earliness in colour break. It is a well proven fact that there is a linear relationship between vegetative growth and flowering of plants. Earliest flowering may be ascribed easy uptake of macro and micro nutrients which ultimately resulted in better sink for faster mobilization of photosynthates and carries transformation of plant from vegetative to reproductive stage. Better performance in this media composition can be ascribed mainly to characteristics of cocopeat and vermicompost. Cocopeat has the ability to store and release nutrients to plants for an extended period of time. Further, vermicompost has considerable amount of humic substrates and improves plant nutrition. Similar finding of early bud break has been reported by Karthikeyan and Jawaharlal [14] and Nair and Bharati [12] in pot mum chrysanthemum when cocopeat and vermicompost composition was used as growing substrate.

The longest blooming period (60.13 days) and maximum flower diameter (3.48 cm) was found in T2 Cocopeat + Vermicompost (2:1 v/v), and these results were at par with the results obtained in T4 i.e. Vermiculite + Vermicompost (2:1 v/v) days. Longest duration of blooming period in this potting media might be due to the reason that this potting media composition has provided better growing condition, rapid uptake of nutrients as well as better physico-chemical properties which leads to better growth and flowering of plants. Similar findings have been reported by Kameshwari *et al* [9] and Padhiyar *et al* [10] in pot chrysanthemum. The possible reason for larger flower diameter in cocopeat + vermicompost (2:1 v/v) may be that this media composition possesses better physico-chemical properties for growth and a good number of leaves coupled with conducive environment in root area which has led to proper nutrient uptake and may resulted in continuously availability of photosynthates from leaves to flowers. These results are in accordance with the findings of Padhiyar *et al.* [10] and Kala *et al* [15]. Arunesh *et al.* [16] and Lalmuanpuii *et al*. [11] also recorded similar results in gerbera.

The maximum number of flowers (146.13) were obtained in T2 Cocopeat + Vermicompost (2:1v/v). More number of flowers per plant in T2 cocopeat + vermicompost (2:1 v/v) might be due to production of a greater number of branches per plant those further have a greater number of buds. Another reason might be that this media composition contains cocopeat and as it adds organic matter and contains potassium as a source of nutrition might further resulted in development of more number of flowers per plant. These results can be supported by the findings of Padhiyar *et al.* [10] in chrysanthemum who recorded greater number of flowers per plant in cocopeat and vermicompost based growing media. These results are in line with the findings of Sangwan *et al.* [17] who reported that addition of vermicompost to potting media has synergistic effects for number of buds and number of flowers in marigold.

1. **CONCLUSION**

This study indicates that media composition cocopeat + vermicompost (2:1 v/v) results in better growth and flowering in potted chrysanthemum. However, except plant spread and number of flowers per plant, rest all vegetative and flowering parameters *viz*. plant height, days to bud initiation, days to colour break stage, days to flowering, blooming period, and flower diameter were at par with media composition Vermiculite + Cocopeat (2:1 v/v). So, cocopeat + vermicompost (2:1 v/v) composition could be the best growing substrate for chrysanthemum pot culture followed by Vermiculite + Vermicompost (2:1 v/v).

**DISCLIMER (ARTIFICIAL INTELLIGENCE)**

Author (s) hereby declares that NO generative AI technologies such as Large language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

**COMPETING INTERESTS**

Authors have declared that no competing interest exist.

**COMPETING INTERESTS DISCLAIMER**:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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 Fig 4. Particle density of different potting media compositions

Fig1 Bulk density of different potting media compositions

Fig 5. Electrical conductivity of different potting media compositions

Fig 4. Particle density of different potting media compositions

Fig 2. Water holding capacity of different potting media compositions

Fig 3 .pH of different potting media compositions

**Table 1:Effect of different potting media compositions on growth characters of potmum cv.Sadhbhawna**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatment** | **Media composition** | **Plant height** **(cm)** | **Number of branches** | **Plant spread (cm)** | **Leaf area (cm2)** |
| **Primary** | **Secondary** | **N-S direction** | **E-W direction** |
| **T1** | Soil + Vermicompost (2:1 v/v) | 14.20 | 4.63 | 10.00 | 17.78 | 16.16 |  92.9 |
| **T2** | Cocopeat + Vermicompost (2:1 v/v) | 22.81 | 12.03 | 27.00 | 35.04 | 34.58 |  151.6 |
| **T3** | Perlite +Vermicompost (2:1 v/v) | 18.61 | 8.47 | 18.87 | 29.57 | 27.03 |  118.2 |
| **T4** | Vermiculite + Vermicompost (2:1 v/v) | 21.56 | 11.07 | 23.07 | 32.53 | 31.17 |  127.3 |
| **T5** | Soil + Cocopeat + Vermicompost (1:1:1v/v) | 16.95 | 5.20 | 17.27 | 24.27 | 23.09 |  114.4 |
| **T6** | Soil + Perlite + Vermicompost (1:1:1 v/v) | 16.27 | 5.00 | 17.00 | 21.70 | 20.97 |  115.2 |
| **T7** | Soil + Vermiculite + Vermicompost (1:1:1 v/v) | 16.52 | 7.00 | 15.93 | 24.62 | 24.30 |  113.0 |
| **T8** | Cocopeat + Perlite + Vermicompost (1:1:1 v/v) | 18.41 | 9.53 | 20.47 | 31.32 | 30.24 |  130.9 |
| **T9** | Cocopeat + Vermiculite + Vermicompost (1:1:1 v/v) | 16.71 | 8.13 | 18.80 | 30.46 | 29.81 |  126.6 |
| **T10** | Perlite + Vermiculite + Vermicompost (1:1:1 v/v) | 14.71 | 5.47 | 15.00 | 19.17 | 19.11 |  127.0 |
| **T11** | Soil + Cocopeat + Perlite + Vermicompost (1:1:1:1 v/v) | 16.56 | 6.87 | 16.20 | 25.85 | 22.11 |  106.8 |
| **T12** | Soil + Cocopeat + Vermiculite + Vermicompost (1:1:1:1 v/v) | 16.05 | 6.20 | 15.53 | 27.41 | 26.39 |  110.6 |
| **T13** | Soil + Perlite + Vermiculite + Vermicompost (1:1:1:1 v/v) | 16.12 | 7.47 | 16.33 | 25.55 | 23.72 |  115.9 |
| **T14** | Cocopeat + Perlite + Vermiculite + Vermicompost (1:1:1:1 v/v) | 14.62 | 6.03 | 15.13 | 25.83 | 23.63 |  129.8 |
| **S.Em. ±** | S. Em. ± | 0.54 | 0.28 | 0.65 | 0.77 | 0.69 |  4.3 |
| **CD (p = 0.05)** | CD @ 5 % | 1.54 | 0.80 | 1.84 | 2.18 | 1.95 |  12.3 |
| **CV %** | CV % | 5.48 | 6.64 | 6.35 | 5.01 | 4.72 |  6.21 |

**Table 2: Effect of different potting media compositions on flowering parameters of potmum cv. Sadhbhavana**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Media compositions** | **Days to bud initiation** | **Days to colour break**  | **Days to 50 % flowering** | **Blooming period(days)** | **Flower diameter (cm)** | **Number of flowers/plant** |
| Soil + Vermicompost (2:1 v/v) | 104.67 | 119.20 | 127.00 | 43.27 | 2.80 | 51.27 |
| Cocopeat + Vermicompost (2:1 v/v) | 85.95 | 96.13 | 105.00 | 60.13 | 3.48 | 146.13 |
| Perlite +Vermicompost (2:1 v/v) | 93.47 | 104.27 | 112.53 | 50.60 | 3.03 | 96.87 |
| Vermiculite + Vermicompost (2:1 v/v) | 88.13 | 99.33 | 107.60 | 59.20 | 3.39 | 130.93 |
| Soil + Cocopeat + Vermicompost (1:1:1v/v) | 96.83 | 107.47 | 115.47 | 49.27 | 3.19 | 77.27 |
| Soil + Perlite + Vermicompost (1:1:1 v/v) | 91.74 | 104.00 | 113.33 | 53.27 | 3.08 | 69.27 |
| Soil + Vermiculite + Vermicompost (1:1:1 v/v) | 92.00 | 105.07 | 112.60 | 49.33 | 3.07 | 91.20 |
| Cocopeat + Perlite + Vermicompost (1:1:1 v/v) | 90.67 | 102.60 | 109.60 | 53.40 | 3.24 | 121.20 |
| Cocopeat + Vermiculite + Vermicompost (1:1:1 v/v) | 91.23 | 105.80 | 114.20 | 50.73 | 3.23 | 105.33 |
| Perlite + Vermiculite + Vermicompost (1:1:1 v/v) | 92.68 | 103.00 | 110.93 | 53.53 | 3.09 | 81.87 |
| Soil + Cocopeat + Perlite + Vermicompost (1:1:1:1 v/v) | 94.33 | 106.33 | 111.93 | 47.60 | 3.04 | 77.33 |
| Soil + Cocopeat + Vermiculite + Vermicompost (1:1:1:1 v/v) | 95.67 | 104.80 | 111.07 | 49.53 | 2.92 | 99.93 |
| Soil + Perlite + Vermiculite + Vermicompost (1:1:1:1 v/v) | 91.88 | 105.53 | 112.73 | 51.47 | 3.03 | 110.87 |
| Cocopeat + Perlite + Vermiculite + Vermicompost (1:1:1:1 v/v) | 92.54 | 103.27 | 110.67 | 54.00 | 3.20 | 98.73 |
| S.Em. ± | 1.62 | 1.46 | 1.25 | 1.85 | 0.07 | 1.62 |
| CD @ 5 % | 4.61 | 4.15 | 3.55 | 5.27 | 0.19 | 4.60 |
| CV % | 3.02 | 2.41 | 1.92 | 6.19 | 3.75 | 2.89 |