International Journal of Environment and Climate Change

Volume 13, Issue 9, Page 2938-2945, 2023; Article no.IJECC.104028
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Influence of Different Potting Media on Growth, Yield, Quality and Value Added Products of Chrysanthemum (*Dendranthema grandiflora*) cv. Yellow Liliput

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i92529

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/104028

Original Research Article

Received: 28/05/2023
Accepted: 31/07/2023
Published: 04/08/2023

ABSTRACT

The present investigation was laid out in Completely Randomized design (CRD) with nine treatments and each replicated thrice. The treatment T_2 i.e., Soil + Sand + Perlite + Farm yard manure 1:1:1:1) reported significantly better Performance in terms of Growth parameters like plant height (60.50 cm), Number of leaves per plant (64.00), plant spread (27.80 cm), leaf length (7.60 cm); Flowering parameters like days to first flower bud appearance (84.00 days), days to 50% flowering (120.00 days), flowering duration (74.00 days), flower diameter (5.70 cm), stalk length (11.50 cm) and Yield parameters like number of flowers per plant (72.00), Individual flower weight (3.80 g), flower yield per plant (152.00 g), flower yield per 100 pots (15.20 kg).

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Keywords: Chrysanthemum; cv. yellow liliput; Soil + Sand + Perlite + FYM (1:1:1); media; yield; value-added products.

1. INTRODUCTION

"Chrysanthemum (*Dendranthema grandiflora*) occupies a prominent place in ornamental horticulture, and it is one of the commercially exploited flower crop. In many countries, including the United States and Japan, it is considered as the number one crop. While in other countries, it ranks next to rose (*Rosa* sp.) in value of the crop produced. Chrysanthemum belongs to the family *Asteraceae* and is known as "Queen of the East' and 'Glory of the East' having diploid chromosome number 2n-18. It is commonly known as 'Gaul e Dhaudi' and 'Sevanti' in Hindi and Gujrati, respectively. Chrysanthemum word derived from Greek word chrysos- golden and anthemon- flower. It is popular commercial flower grown for cut as well as a pot plant in different parts of the world. Chrysanthemum ranked third as a cut flower after rose and carnation and fifth as a pot plant during 2014" [1].

The limited flowering period of Chrysanthemum is the main bottleneck for the commercialization of this crop [2]. The current trend in the Chrysanthemum industry is focused on improving the quality of flowers and creating an environmentally friendly production system. In order to achieve these goals and accelerate the production of Chrysanthemums, further innovations are needed in improving the fertilization system and other production technologies [3]. Potting media is one of the most important factors required for the production of good quality pot mum [4]. Growth medium is known to have effect of value of potted ornamental plants and plays an important role in germination rate and many other physiological parameters including plant height, number of leaves, spike length, number of florets per spike, spike diameter and yield etc., [5].

With increased demand of potted ornamentals, the need for a light weight soilless growing medium has become more desirable due to their easy mobility and display during exhibitions and flower shows [4]. The various soilless media i.e. Cocopeat, farmyard manure, Vermicompost etc. altered the physico-chemical characteristics of the growing mixtures and affect the plant growth, nutritional status [6] and value of potted ornamental [7]. Synthetic aggregates (SA) were also developed as alternative potting media for ornamental plant production [8]. The aeration and water retention status of growing media were essential to maintain equilibrium between moisture content and gaseous exchange as well as for maintaining keeping quality of chrysanthemum in a limited volume of a pot [9]. Therefore, it becomes pertinent to formulate a soilless growing mixture amended with optimum proportions of media for growing plants in limited volume of containers. Cocopeat had been used as a light weight media constituent to raise ornamental potted plants of acceptable quality [10,11]. Thus, this experiment was conducted to study the effect of different potting media on growth, flowering, yield and value added products of chrysanthemum as well as to work out the economics of different treatments.

2. MATERIALS AND METHODS

The experiment was conducted in Horticultural research field, Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 25°39' 42''N latitude, 81°67'56" E longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the Yamuna River by the side of Prayagraj - Rewa road about 12 km from the city. The potting media used during this experiment was soil, sand, Vermicompost, Farm yard manure, Cocopeat, perlite. The experiment was laid out in Completely Randomized Design with nine treatments i.e., T_0-Soil (control), T_1-Control (Soil + Sand + Cocopeat + FYM (1:1:1:1)), T_2-(Soil + Sand + Perlite + FYM (1:1:1:1)), T_3- (Soil + FYM (1:1)), T_4-(Soil + Vermicompost (1:1)), T_5-(Soil + Sand + FYM (1:1:1)), T_6-(Soil + Sand + Vermicompost (1:1:1)), T_7-(Soil + Sand + Cocopeat + Vermicompost (1:1:1:1)), T_8-(Soil + Sand + Perlite + Vermicompost (1:1:1:1)), each replicated thrice. The treatment means were compared using Duncan Multiple Range Test (DMRT) at 5% level of Significance [12].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Plant height

The maximum plant height at 90 days after transplanting was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (60.50 cm), followed by T_1- Soil + Sand + Cocopeat + FYM

(1:1:1:1) (59.60 cm) While, minimum plant height was observed in T_0 – soil (48.70 cm).

"The increase in plant height in T_2 - Soil + Sand + Perlite + FYM (1:1:1:1) provide more nutritive media resulted in increment to plant height. which might be due that potting media combination T_2 alone had lower down clay content, pH, compactness, which improve drainage, aeration, water holding capacity and highest nutrients uptake by root system respectively". Sujatha and Usha [13] and Bala and Singh [14].

3.1.2 Number of leaves per plant

The maximum number of leaves per plant at 90 days after transplanting was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (64.00), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (63.00) While, minimum number of leaves per plant was observed in T_0 – soil (48.00).
"Major food manufacturing units in plants are leaves that are influenced by environmental conditions and soil is one of the factors which have prime importance in this regard. More number of leaves in plants reflects its good vigour and suitability of environment" Mehmood et al. [15].

3.1.3 Plant spread

The maximum plant spread at 90 days after transplanting was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (27.80 cm), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (27.00 cm) While, minimum plant spread was observed in T_0 – soil (18.60 cm).

"The plant spread was increased was mainly due to production of increased number of branches and wider angles from point of origin. Greater plant spread shows better vegetative growth of plants" Kala et al. [16].

3.1.4 Leaf length

The maximum leaf length at 90 days after transplanting was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (7.60 cm), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (7.20 cm) While, minimum leaf length was observed in T_0 – soil (3.60 cm).

"The increasing leaf length might be due to the fact that growth substrate having good favourable physicochemical properties and high nutrient content that supported proper plant growth. If any nutrient in the selected growing medium is absent or in less amount then it reduced the plant growth and development" Chavada et al. [17].

3.2 Flowering Parameters

3.2.1 Days to first flower appearance

The minimum days to first flower appearance was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (84.00 days), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (85.00 days) While, maximum days to first flower appearance was observed in T_0 – soil (97.00 days).

This might be due to vigorous growth of the plant growing in the media and the rapid uptake of nutrients and water has a pronounce effect on early production. Similar results were observed by [18] in Gerbera and [19] in Anthurium.

3.2.2 Days taken for 50% flowering

The minimum days taken for 50% flowering was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (120.00 days), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (126.50 days) While, maximum days taken for 50% flowering was observed in T_0 – soil (142.00 days).

This might be due to vigorous growth of the plant growing in the media and the rapid uptake of nutrients and water has a pronounce effect on early production. Similar results were observed by [18] in Gerbera and [19] in Anthurium.

3.2.3 Flower duration

The maximum flower duration was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (74.00 days), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (73.00 days) While, minimum flower duration was observed in T_0 – soil (59.00 days). "Soil based media is rich in minerals and micronutrients as compared to most soil-less media which provides limited or no nutrients. This might be the reason for the maximum flowering duration in the soil based potting media combination". [13].

3.2.4 Flower diameter

The maximum flower diameter was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (5.70 cm), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (5.40 cm) While,

minimum flower diameter was observed in T_0 – soil (2.50 cm).Increase in flower diameter is mainly due to the genetic make-up and which might have been further modified by prevailing environmental conditions and potting media combination Soil + Sand + Perlite + FYM (1:1:1:1). It helps in more accumulation of photosynthates in the sink (flower) from source (leaves). Continuous availability of photosynthates, cell division, cell elongation & cell enlargement remain on peak resulted in higher flower diameter. Similar results were also obtained by Kala et al. [16].

3.2.5 Stalk length

The maximum stalk length was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (11.50), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (11.00) While, minimum stalk length was observed in T_0 – soil (6.30).

This might be due to growing substrate with excellent nutrient quality influences plant growth. Availability of P contents in soil has positive relationship with flowering indices. Treder [20] reported that "plants have long stem in growing media with optimum phosphorus contents. Potting media comprising FYM showed maximum amount of P content".

3.3 Yield Parameters

3.3.1 Number of flowers per plant

The maximum number of flowers per plant was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (72.00), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (69.00) While, minimum number of flowers per plant was observed in T_0 – soil (55.00).

An increase in number of flowers per plant could be attributed to overall vegetative growth of chrysanthemum plants grown in these substrates grater carbohydrate accumulation due to increased photosynthesis might have caused the production of more number of flowers per plant which turn might have been caused due to the optimum balance and supply of plant nutrients in the substrate. Similarly, increased availability of essential elements at critical growth stages could have led to increase in number of flowers. These results are in corroboration with the findings of Bisht et al. [21], Singh et al. [22], Madhu and Kushal (2013) in chrysanthemum and Jawaharlal et al. [19] in Anthurium.

3.3.2 Individual flower weight

The maximum individual flower weight was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (3.80 g), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (3.40 g) While, minimum individual flower weight was observed in T_0 – soil (1.30 g).

Reason of maximum flower weight might be due to more availability of nutrients, media and genetic make-up. Similar finding have been reported by Chauhan et al. [23] in gerbera.

3.3.3 Flower yield per plant

The maximum flower yield per plant was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (152.00 g), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (136.00 g) While, minimum flower yield per plant was observed in T_0 – soil (52.00 g).

"An increase in flower yield per plant could be attributed to overall vegetative growth of chrysanthemum plants grown in these substrates grater carbohydrate accumulation due to increased photosynthesis might have caused the production of more number of flowers per plant which turn might have been caused due to the optimum balance and supply of plant nutrients in the substrate. Similarly, increased availability of essential elements at critical growth stages could have led to increase in number of flowers" Bisht et al. [21].

3.3.4 Flower yield per 100 pots

The maximum flower yield per 100 pots was observed in the treatment T_2 – Soil + Sand + Perlite + FYM (1:1:1:1) (15.20 kg), followed by T_1- Soil + Sand + Cocopeat + FYM (1:1:1:1) (13.60 kg) While, minimum flower yield per 100 pots was observed in T_0 – soil (5.20 kg).

"An increase in flower yield per 100 pots could be attributed to overall vegetative growth of chrysanthemum plants grown in these substrates grater carbohydrate accumulation due to increased photosynthesis might have caused the production of more number of flowers per plant which turn might have been caused due to the optimum balance and supply of plant nutrients in the substrate. Similarly, increased availability of essential elements at critical growth stages could have led to increase in number of flowers" Bisht et al. [21].

Table 1. Growth parameters of different potting media on chrysanthemum (*Dendranthema grandiflora)* cv. yellow liliput

Notation	Treatments	plant height (cm)	Number of leaves per plant	Plant spread (cm)	Leaf length (cm)
T_0	Soil (control)	48.70	48.00	18.60	3.60
T_1	Soil + Sand + Cocopeat + FYM (1:1:1:1)	59.60	63.00	27.00	7.20
T_2	Soil + Sand + Perlite + FYM (1:1:1:1)	60.50	64.00	27.80	7.60
T_3	Soil + FYM (1:1)	55.00	58.00	22.70	5.00
T_4	Soil + Vermicompost (1:1)	53.80	57.50	21.00	4.70
T_5	Soil + Sand + FYM (1:1:1)	57.00	60.50	24.00	6.00
T_6	Soil + Sand + Vermicompost (1:1:1)	56.40	59.00	23.40	5.60
T_7	Soil + Sand + Cocopeat + Vermicompost (1:1:1:1)	58.50	62.00	25.50	6.40
T_8	Soil + Sand + Perlite + Vermicompost (1:1:1:1)	59.00	62.50	26.00	6.80
F-Test		**S**	**S**	**S**	**S**
S.ED		**0.73**	**0.57**	**0.66**	**0.52**
CD (5%)		**1.54**	**1.21**	**1.39**	**1.11**

Table 2. Flowering parameters of different potting media on chrysanthemum (*Dendranthema grandiflora)* cv. yellow liliput

Notation	Treatments	First flower appearance (days)	50% flowering (days)	Flower duration (days)	Flower diameter (cm)	Stalk length (cm)
T_0	Soil (control)	97.00	142.00	59.00	2.50	6.30
T_1	Soil + Sand + Cocopeat + FYM (1:1:1:1)	85.00	126.50	73.00	5.40	11.00
T_2	Soil + Sand + Perlite + FYM (1:1:1:1)	84.00	120.00	74.00	5.70	11.50
T_3	Soil + FYM (1:1)	90.00	135.50	65.00	3.50	8.00
T_4	Soil + Vermicompost (1:1)	92.00	137.00	64.00	3.00	7.50
T_5	Soil + Sand + FYM (1:1:1)	88.50	132.00	68.00	4.20	9.00
T_6	Soil + Sand + Vermicompost (1:1:1)	89.00	134.00	67.00	3.90	8.60
T_7	Soil + Sand + Cocopeat + Vermicompost (1:1:1:1)	87.00	130.50	70.00	4.80	9.80
T_8	Soil + Sand + Perlite + Vermicompost (1:1:1:1)	86.50	129.00	71.00	5.00	10.40
F-Test		**S**	**S**	**S**	**S**	**S**
S.ED		**1.14**	**1.11**	**1.00**	**0.27**	**0.36**
CD (5%)		**2.42**	**2.34**	**2.12**	**0.57**	**0.76**

Table 3. Yield parameters of different potting media on chrysanthemum (*Dendranthema grandiflora)* cv. yellow liliput

Notation	Treatments	Flowers per plant	Individual flower weight (g)	Flower yield per plant (g)	Flower yield per 100 pots (kg)
T_0	Soil (control)	55.00	1.30	52.00	5.20
T_1	Soil + Sand + Cocopeat + FYM (1:1:1:1)	69.00	3.40	136.00	13.60
T_2	Soil + Sand + Perlite + FYM (1:1:1:1)	72.00	3.80	152.00	15.20
T_3	Soil + FYM (1:1)	60.00	2.00	80.00	8.00
T_4	Soil + Vermicompost (1:1)	58.00	1.80	72.00	7.20
T_5	Soil + Sand + FYM (1:1:1)	64.00	2.70	108.00	10.80
T_6	Soil + Sand + Vermicompost (1:1:1)	62.00	2.40	96.00	9.60
T_7	Soil + Sand + Cocopeat + Vermicompost (1:1:1:1)	65.00	3.00	120.00	12.00
T_8	Soil + Sand + Perlite + Vermicompost (1:1:1:1)	67.00	3.20	128.00	12.80
F-Test		**S**	**S**	**S**	**S**
S.ED		**0.95**	**0.16**	**6.39**	**0.64**
CD (5%)		**2.02**	**0.34**	**13.56**	**1.36**

4. CONCLUSION

From the Present investigation, it is concluded that treatment T_2 i.e., (Soil + Sand + Perlite + FYM (1:1:1:1)) performed best in terms of plant height, number of leaves per plant, plant spread, leaf length, days to first flower appearance, days to 50% flowering, flower duration, flower diameter, stalk length, number of flowers per plant, plant, Individual flower weight, flower yield per plant (g), flower yield per 100 pots.

ACKNOWLEDGEMENT

I express my gratitude to my advisor Dr. Samir E. Topno and all the faculty members of the Department of Horticulture for the constant supply to carry out the whole experimental research study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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