Potting Media Composition for Pot Mum Chrysanthemum Production (*Dendranthema grandiflora* L.)

i,V ee Økbl Fkhee ¼*MMkUFkek xfM¶yk jk* ,y-½ mRiknu d fy, i,fVx ehfM;k jpuk

DISHA KALA

Thesis

Master of Science in Agriculture

(Horticulture)

2017

DEPARTMENT OF HORTICULTURE

Rajasthan College of Agriculture

Maharana Pratap University of Agriculture and Technology

Udaipur, Rajasthan – 313001

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Submitted to the

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In partial fulfillment of the requirements for the Degree of

Master of Science in Agriculture

(HORTICULTURE)

By

DISHA KALA

2017

RAJASTHAN COLLEGE OF AGRICULTURE

MAHARANA PRATAP UNIVERSITY OFAGRICULTURE & TECHNOLOGY, UDAIPUR

CERTIFICATE-I

Dated 1/7/2017

This is to certify that **Ms. Disha Kala** student of M.Sc. (Ag.), Department of Horticulturehas successfully completed the Comprehensive Examination held on 24/4/2017 as required under the regulation for Post – Graduate studies.

(Dr. L.N. Mahawer)
Head
Department of Horticulture
Rajasthan college of Agriculture,
Udaipur (Raj.)

RAJASTHAN COLLEGE OF AGRICULTURE

MAHARANA PRATAP UNIVERSITY OFAGRICULTURE & TECHNOLOGY, UDAIPUR

CERTIFICATE-II

Dated 1/7/2017

This is to certify that the thesis entitled, **"Potting Media Composition for Pot Mum Chrysanthemum Production *(Dendranthema grandiflora*)."**, submitted for the degree of **Master of Science in Agriculture** in the subject of **Horticulture** embodies bonafied research work carried out by **Ms. Disha Kala** under my guidance and supervision and that no part of the thesis has been submitted for any other degree. The assistance of help received during the course of investigation have been fully acknowledged. The draft of thesis was also approved by advisory committee on 16 / 5 /2017.

(Dr. L.N. Mahawer)
Head
Department of Horticulture

(Dr. L.N. Mahawer)
Major Advisor

(Dr. R. Swaminathan)
Dean
Rajasthan College of Agriculture,
Udaipur

RAJASTHAN COLLEGE OF AGRICULTURE

MAHARANA PRATAP UNIVERSITY OFAGRICULTURE & TECHNOLOGY, UDAIPUR

CERTIFICATE-III

Dated24/7/2017

This is to certify that this thesis entitled, **"Potting Media Composition for Pot Mum Chrysanthemum Production (*Dendranthema grandiflora*) .",** submitted by **Ms. Disha Kala** to the Maharana Pratap University of Agriculture and Technology, Udaipurin partial fulfillment of the requirements for the degree of **Master of Science in Agriculture in the subject of Horticulture** after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in the oral examination on his thesis has been found satisfactory, we therefore recommended that the thesis be approved

(Dr. L.N. Mahawer)
Major Advisor

(Dr. H.L. Bairwa)
Advisor

(Dr. B. Upadhyay)
Advisor

(Dr. D.P. Singh)
DRI Nominee

(Dr. R. Swaminathan)
Dean
Rajasthan College of Agriculture
Udaipur

(Dr. L.N. Mahawer)
Head
Department of Horticulture

Approved

(Dr. R. A. Kaushik)
Director
Resident Instructions
Maharana Pratap University of Agriculture and Technology, Udaipur

RAJASTHAN COLLEGE OF AGRICULTURE

MAHARANA PRATAP UNIVERSITY OFAGRICULTURE & TECHNOLOGY, UDAIPUR

CERTIFICATE-IV

Dated 24/7/2017

This is to be certify that Ms. Disha Kala Student M.Sc. (Ag.) of the Department of Horticulture, Rajasthan college of Agriculture, Udaipur has made, all correction / modification in the thesis entitled, **"Potting Media Composition for Pot Mum Chrysanthemum Production (*Dendranthema grandiflora*) ."** which were suggested by the external examiner and the advisory committee in the oral examination held on 24/7/2017. The final copies of the thesis duly bound and corrected were submitted on 24/7/2017 are enclosed here with for approval.

(Dr. L.N. Mahawer)

Major Advisor

Enclose: One original and three copies of bound thesis forwarded to the Director, Resident Instructions, Maharana Pratap University of Agriculture and Technology, Udaipur through the Dean, Rajasthan College of Agriculture, Udaipur.

(Dr. R. Swaminathan)
Dean
Rajasthan College of Agriculture
MPUAT, Udaipur

(Dr. L.N. Mahawer)
Head
Department of Horticulture
Rajasthan College of Agriculture

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PLACE : **(Disha Kala)**

DATED :

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Chapter-1

INTRODUCTION

Chrysanthemums are sometimes called mum or chrysanths.The genus Chrysanthemum belongs to family Asteraceae. It is native from Asia and Northern Europe. Most of the species originated from East Asia and center of diversity which is exist in China. The name 'chrysanthemum' is derived from the Greek words chryos (gold) and anthemon (flower). Its erract and tall growing cultivar is suitable for back ground planting in border as cut flower. The dwarf and compact growing ones are suitable for pot culture.The decorative and fully bloomed small flowered cultivar are suitable for making garland and hair decoration. Certain species like *Chrysanthemum cinerarifolium* and *Chrysanthemum coccineum* are also exploited as source of Pyrethrum which is an important insecticides(Chittenden and Carter, 1989). The genus once included more sp. but was split several decades ago into several genera, putting economically important florist chrysanthemum in the genus Dendranthema. Wild chrysanthemum Texas are herbaceous perennial plants or subshrubs. The compound inflorescence is an array of several flower heads, or sometimes a solitary head. The simple row of ray floret is white, yellow or red .The fruit is a ribbed achene. Chrysanthemum also known as mums are one of the prettiest varieties of perennial that start blooming early in the fall. This is also known as favourite flower for the month of November.

Chrysanthemums were first cultivated in China as a flowering herb as far back as the 15th century B.C. Over 500 cultivars had been recorded by the year 1630. The flower may have been brought to Japan in the 8th century A.D. The festival of Happiness in Japan celebrates the flower. The modern cultivated chrysanthemums are showier than their wild relatives. The flower head occur in various form and can be daisy like pompon or buttons.

Udaipur comes under agroclimatic zone IV A sub humid southern plains and Arawali hills (Mewar region) of Rajasthan and condition are suitable for chrysanthemum cultivation and its products. There is a great scope for its production and to buil up a commercial cut flower market for chrysanthemum in this region. Total estimated area under Indian floriculture is 317.2('000 hac.) with total production is 1804.52 MT of loose and 502(000' tones) cut flower during 2014-

15.Total area under chrysanthemum is 16.63 ha along with production is 179.37 MT of loose flower and 5.72 MT of cut flower (Indian horticulture data base, NHB 2014 - 2015) . Chrysanthemum is commercially cultivated in Maharashtra, Rajasthan, MP, Tamilnadu, Karnataka,Bihar, Delhi, Kolkata, Lucknow, Kanpur and Allahbad (Chadha, 2002).

Media is a substrate that provides physical support, moisture and aeration to the growing plant, which also play a vital role in growth and development of plants. The important potting media are- soil, sand, vermiculite, peat, cocopeat, perlite, compost and FYM, etc. Soil texture is an important physical property of the soil that plays a vital role in seed germination and rooting of cutting. The main textural classes of soil are sand, sandy loam, silt loam, clay loam and clay etc. A soil have 40% sand, 40% silt and 20% clay is considered to be the best for seed germination of many plant species. Sandy loam soils are excellent for preparation of soil mixtures for pot growing plants. Sand is the heaviest pot growing media, therefore it should be used in combination with other organic material. Sand contains silica with almost no mineral. Quartzsand, which consists chiefly of silica compounds and mainly used for propagation by the nurseryman. Vermiculite is a micaceous mineral and widely used as propagating media, contain sufficient quantity of Mg and K. Chemically, it is a hydrated magnesium – aluminium iron silicate. On the basis of their particle size vermiculite can be classified into various grade i.e., Number-1 grade (5-8mm), Number -2 (2-3mm.),Number -3 grade (1-2mm.) and Number – 4 grade (0.75-1.00 mm). Generally number- 4 grade is used as seed germinating media. It contain high water holding capacity and high cation exchange capacity. Peat contains the partially decomposed parts of acquatic vegetation,which have high water holding capacity and mainly used as propagating media.The light brown or yellowish brown in colour, fibrous type consists of remain of moss, sedges and are usually quite acidic in nature. It contain small nitrogen a little over 1% but low in phosphorus and potassium. Perlite is a grey white material of volcanic origin. It is widely used in combination with peat. Perlite is available in different grades with particle size ranging from 3-8 mm but usually a particle size ranges from 1.6 to 3.00 mm in diameter is mostly used. It improve aeration and drainage property in rooting media. Compost is a rich source of mineral nutrient with good water holding capacity. It can be used as media for propagation but by mixing with soil. Cocopeat is also called coco dust, is a byproduct

of cutting and shifting of coconut for fibre production. It has an excellent pore space (25 – 30%) and fine structure required for proper growth and development of the roots for seedling . It is also rich source of nutrients and can easily be mixed with other growing media as reported by Bhattacharjee (2006).

Keeping in view the present investigations entitled, **"Potting Media Composition for Pot Mum Chrysanthemum production (*Dendranthema grandiflora* L.)"**under taken during2016-2017with following objectives:

1. To find out suitable pot media.
2. To assess influence of pot media on growth and floral parameter.
3. To work out economic feasibility of pot media.

Chapter-2

REVIEW OF LITERATURE

In this chapter an attempt has been made to review the work done on the use of growing substrates on growth and flowering of *Dendranthema grandiflora*. Besides optimum environmental conditions, growing medium also plays a crucial role in quality of any potted plant.Similarly, the importance of pot size in improving presentability of anycontainer grown plant cannot be just overlooked. Therefore, efforts have been made to summarise the relevant literature available for various indoor plants.

Strojny (1989) reported thatcomposted ground bark and peat (1: 1, v/v) was found to be best potting media combination for the growth and flowering followed by mixture of bark, peat, soil and perlite in a ratio of 1 : 1: 1: 1, v/v and 1: 1 : 2 : 2, v/v, respectively in both the cultivars in chrysanthemum cvs. 'Mountain Snow' and 'Gold Star'at Seria.

Bowman *et al.* (1994) concluded that growing media comprising sand :sawdust (1:2,v/v) was found to be best media for flower weight and no. of open flower compared to media of rubber particle substituted for 33,67,100% of saw dust in chrysanthemum cultivar ‘ Bright Golden Anne’.

Malorgio *et al.* (1994)concluded that growing substrates, perlite and pumice with or without mixing with peat (1:1, v/v) was found to be best for producing good quality of cut flower in chrysanthemum cvs. ‘Talk Town’ and ‘Stafour’.

Bala and Singh (2013) observed that treatment comprising soil+ sand+ FYM+ vermicompost (2:1:0.5:0.5) which improve vegetative and flowering characters for specimen display of pot mum chrysanthemum both under open as well as polyhouse condition at Ludhiana.

Nair and Bharthi (2015) reported that cocopeat + FYM +sand +vermicompost (2:1:0.5:0.5v/v) was found to be best potting media combination resulting in the production of highest flower (192.02) and prolonged flowering duration (101.83 days) as compared to other cocopeat based flowering media in pot mum chrysanthemum at IIHR, Bangaluru.

Singh *et al.* (2015) recommended that cocopeat amended media mixture improve the root zone environment for satisfactory growth and flowering of chrysanthemum. The plant raised in media mixture with increasing proportion of compost were observed to be well anchored and exhibited excellent quality of flower at PAU Ludhiana.

Sekar and Sujata (2001) concluded that coir pith medium comprising coirpith, garden soil and FYM (1:1:1,v/v) was found to be best for growth and flowering of (*Gerbera jamesonii* Bolus.) cv. 'Mammut'grown in pots under naturally ventilated green house.

Barreto and Jagtap (2002) reported that the growing medium containing coco peat combined with compost (1:1, v/v) 16 produced flowers with highest net returns followed by the growing medium containing cocopeat, perlite and rice husk (3:1 :1 v/v) in gerbera under protected condition at Bangalore.

Thangam *et al.* (2009) pointed out the performance of different media comprising soil with sand, vermicompost and cocopeat. Treatment vermicompost+ soil found to produce maximum plant height in gerbera under coastal humid condition at Goa.

Chauhan *et al.* (2014) concluded that media amended with normal soil , rice husk, cocopeat ,caster cake, vermicompost (1:1:1:1:1) perform better for maximum plant height (22.93 cm.), plant spread (34.49 cm), flower diameter(12.03 cm), flower stalk length (54.59 cm) and vase life (10.31 days) at Junagadh (Gujarat) in gerbera under protected condition.

Artetxe *et al.* (1997) reported the best results in a growing substrate comprised of peat and pine bark (3:1, v/v) for growth and flowering of *Hydrangea macrophylla* plants in C 17 size container.

Latpate (2011) concluded that hydrangea*Hydrangea macrophylla* Thunb. plants grown in growing media consisiting of forest soil (Rai) : FYM : vermicompost (2:1:1,v/v) and sprayed with 5000 ppm dose of diaminozide resulted in most desirable and presentable potted hydrangea with a benefit - cost ratio of 1.92 : 1.

Dilta *et al.*(2015) observed that medium consisting soil+FYM+ vermicompost (2:1:1,v/v) sprayed with 5000 ppm dose of daminozide resulted in desirable potted hydrangea at Dr.Y.S Parmar University of Horticulture and Forestry Nauni,Solan.

Newman *et al*. (1997) reported that growing substrate comprising vermiculite: peat (1:1,v/v) exhibited the best growth and highest flower count ingeranium(*Pelargonium* × *hortorum*) cv. 'Danielle' and 'Kim' in comparison to other substrates tested.

Iniguez and Crohn (2004) conducted a greenhouse pot experiment to evaluate the use of a slaughter house waste compost (SWC) as fertilizer for potted geranium plants. This SWC was mixed with agave bagasse compost(ABC) in the ratio of 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100% by volume basis. Samples of SWC and ABC were used to prepare 6 different mixtures. Potted geraniums grew well in the mixtures of SWC and ABC without additional fertilizer applications.

Singh *et al.* (2010) reported that growing substrate consisting of Rai Forest soil : FYM : Vermicompost (2:1:1, v/v) was found to be best for growth flowering and pot presentability of geranium at Solan, H.P.

Jawaharlal *et al.* (2001) concluded that media, cocopeat in single or in combination with leaf mould or FYM produced maximum number of suckers per plant in Anthurium (Anthurium andreanum) cv. 'Temptation' under shade net house.

Basheer and Thekkayam (2012) found that treatment sand+ coir pith compost (3:1) was found to produce the highest plant height(41.66cm), leaf area(574.48 cm^2) and petiole length at the fourth week after emergence (16.29cm.) in Anthurium at Kerela.

Eleni *et al*. (2001) concluded that growing substrate comprising perlite : cocopeat (3:1,v/v/) or perlite : zeolite (3:1,v/v) found to be best for yield and flower quality of rose cultivars 'Biance' 'First Red'.

Pooja *et al* (2017) reported that Soil : FYM : Saw dust (2:1:1 v/v) : WSF was found to be best growing media combination resulting maximum height (75.80 cm.), earlier flower bud initiation (124.70days),leaf area (35.45 cm^2, flower size (9.09cm), no. of flower (15.9) as compared to other treatments in cut rose at RVCKV, M.P.

Raviv *et al*. (2001) reported that coconut coir (made up of shredded, partially composted husk fibres) grown rose plants found to best for growth, flowering and yield of cut rose cv.'cardinal' than the university of California (UC) mix (i.e. 42% composted fir bark, 33% peat and25% sand)under glass house.

Mehmood *et al.* (2013) observed that highest plant height (13.5cm),fresh weight (63.41gm), flower diameter (0.98 cm) and flowers per plant (22.83) were obtained in potting media T1 Leaf mould + silt+ top soil (1:1:1 ratio) on *Antirrhinum majus* L. at Faisalabad(Pakistan).

Nazari *et al*. (2011) reported that soil, cocopeat, sand (2:1:1) media was found to be the best for highest water use efficiency of hyacinth growth and flowering at Shiraz University, Iran.

Tatleri *et al.* (2013) found that treatment cocopeat+ vermicompost (3:1) was found to produce the maximum plant height in *Dracaena marginata* at Islamic Azad university,Iran.

Gupta *et al.*(2014) concluded that growing media combination (20% vermicompost : soil) was found to be best media for highest, plant height, no. of flower,diameter of flower (cm.) in marigold crop at Faridabad, India.

Pathak and Sharma (1998) reported better growth, flowering and presentability score in the potting mixture comprising leaf mould, FYM and soil (1:1:1, v/v) in *Primula obconica*.

Noguera *et al*. (2000) analysed the physico-chemical properties ofcoconut coir waste (cocopeat) obtained from various sources and found thatcoconut coir (cocopeat) waste is a new, viable and ecologically friendly peat substitute. They reported that cocopeat is a low weight material with high totalporosity (over 94%), slightly acidic pH, CEC ranging between 32-95 meq./100gand a C/N ratio of 117.

Al-Menaie *et al*. (2008) reported that a mixture of potting soil : perlite in 1:1 ratio for indoor plants and potting soil: peat moss in 1:1 ratio for outdoor plants had a positive effect on healthy canopy development, growth and maximum flower production in *Gardenia jasminoides* under arid condition.

Atta-Alla (2003) recorded the highest values for plant height, number of shoots, leaves and flowers per plant, and inflorescence diameter in the potting mixture consisting of loam sand, chicken manures and sewage sludge in the ratio of 2:1:1, v/v in cineraria (Senecio cruentus).

Wazir *et al*. (2009) reported the best results ingrowing medium comprising soil + cocopeat + vermicompost + sand (1:1:1:1,v/v) forvarious vegetative, flowering

and pot presentability attributes in all alstroemeria Cultivars under wet temperate conditions.

Kiran *et al.* (2007) reported that Sand: Silt : Leaf mould found to be best for plant height (42.08 cm.), stem thickness(1.93cm.), No. of branches plant^{-1} (3.6), days to flowering(91.66days), no. of flower/plant (10.6), flower petals (13), vase life(5 days) than other treatments in dahlia (Dahlia pinnata) at Pakistan.

Awang *et al*. (2010) found that media comprising of 40 % cocopeat and 60 % Kenaf Cora Fiber gave best result for higher growth, development and flowering of *Celosia cristata*.

Younis *et al.* (2010) concluded thatmedia combination of sand+ silt+ leaf compost+ spent compost (button) in ratio of(1:1:1:1, v/v) proved to be the best media for growth and development of croton *Codiaeum variegatum* cv. 'Gold Sun'.

Chapter-3

MATERIAL AND METHODS

The present investigations entitled, **"Potting Media Composition for Pot MumChrysanthemum production (*Dendranthema grandiflora* L.)"** were carried out at Horticulture Farm, Rajasthan College of Agriculture, Udaipur in August, 2016 – February, 2017.

3.1 EXPERIMETAL SITE

The experiment was laid out at Department of Horticulture, Rajasthan College of Agriculture, Udaipur which is situated at 24.58 ^{0} N and 73.70 ^{0} E at an elevation of 602 m. above mean sea level.

3.2 AGROCLIMATIC CONDITION

This region has a typical sub tropical climate, characterised by mild winter and summer. The average annual rainfall of the tract is 637mm of which 60% is received during the period of July to September. The mean daily temperature of Udaipur during the experimental period from August 2016–February 2017 i.e., maximum and minimum temperature ranges between 20.9^{o}Cto 35.3°C and5.6°C to 23.8°C respectively while the maximum and minimum relative humidity ranged between 69.1% to 95 % and 23.1% to 89.0% respectively.

The mean weekly meteorological observation recorded during the crop period at the meteorological observatory of Agronomy instruction farm, RCA are presented in Table 3.1 and fig 3.1

Table 3.1 Mean weekly meteorological data

Standard week number	Duration	Temperature (°C)		Rainfall (mm)	Relative humidity(%)		Sunshinehours(Hours/min)
		Maximum	Minimum		Maximum	Minimum	
31	30Jul-5Aug.	27.9	23.3	124.2	92.00	83.0	0.5
32	6-12 Aug.	26.8	23.5	104.5	95.00	89.0	0.5
33	13-19 Aug.	30.0	23.0	0.6	83.6	65.6	6.3
34	20-26 Aug.	27.6	23.2	61.2	91.1	78.9	1.2
35	27Aug.-2Sept.	30.4	23.5	14.4	89.4	71.1	3.9
36	3-9Sept.	29.9	21.2	0.0	78.7	57.7	7.4
37	10-16Sept.	31.7	23.8	0.0	78.1	49.3	8.1
38	17-23Sept.	34.6	23.3	3.4	81.6	47.6	5.7
39	24-30Sept.	35.3	22.1	0.0	74.0	42.7	8.1
40	1-7Oct.	31.7	23.2	62.4	88.4	65.1	3.3
41	8-14Oct.	32.0	19.5	0.0	81.1	41.9	8.1
42	15-21Oct.	32.4	17.9	0.0	72.00	30.4	7.5
43	22-28Oct.	30.8	15.7	0.0	76.00	32.0	8.8
44	29Oct.-4Nov.	30.6	12.5	0.0	75.7	30.4	7.2
45	5-11Nov.	30.9	11.7	0.0	71.6	24.1	8.4
46	12-18Nov.	29.3	10.3	0.0	84.6	34.6	8.6
47	19-25Nov.	30.5	10.7	0.0	82.4	23.1	9.0
48	26Nov.-2 Dec.	30.3	10.6	0.0	80.4	24.7	9.0
49	3-9Dec.	27.7	8.9	0.0	88.7	27.6	8.6
50	10-16Dec.	28.3	10.4	0.0	90.1	32.4	8.7
51	17-23Dec.	27.5	9.8	0.0	89.4	29.1	8.6
52	24-31Dec.	28.0	9.3	0.0	85.8	24.6	8.6
1	1-7Jan.	26.2	8.3	0.0	92.1	37.9	2.8

2	8-14Jan.	20.9	5.6	0.0	89.6	38.9	2.3
3	15-21Jan.	21.8	7.1	0.0	80.7	43.1	2.4
4	22-28Jan.	26.1	10.5	0.0	91.6	47.0	2.6
5	29Jan-4Feb.	27.0	8.6	0.0	91.6	36	2.8
6	5-11Feb.	25.2	7.2	0.0	84.1	28.7	3.9
7	12-18Feb.	27.4	11.0	0.0	88.0	34.1	3.5
8	19-25Feb.	30.0	11.1	0.0	69.1	26.0	5.2

Source: Meteorological Observatory, Instruction Farm, Deptt. Of Agronomy, RCA, Udaipur

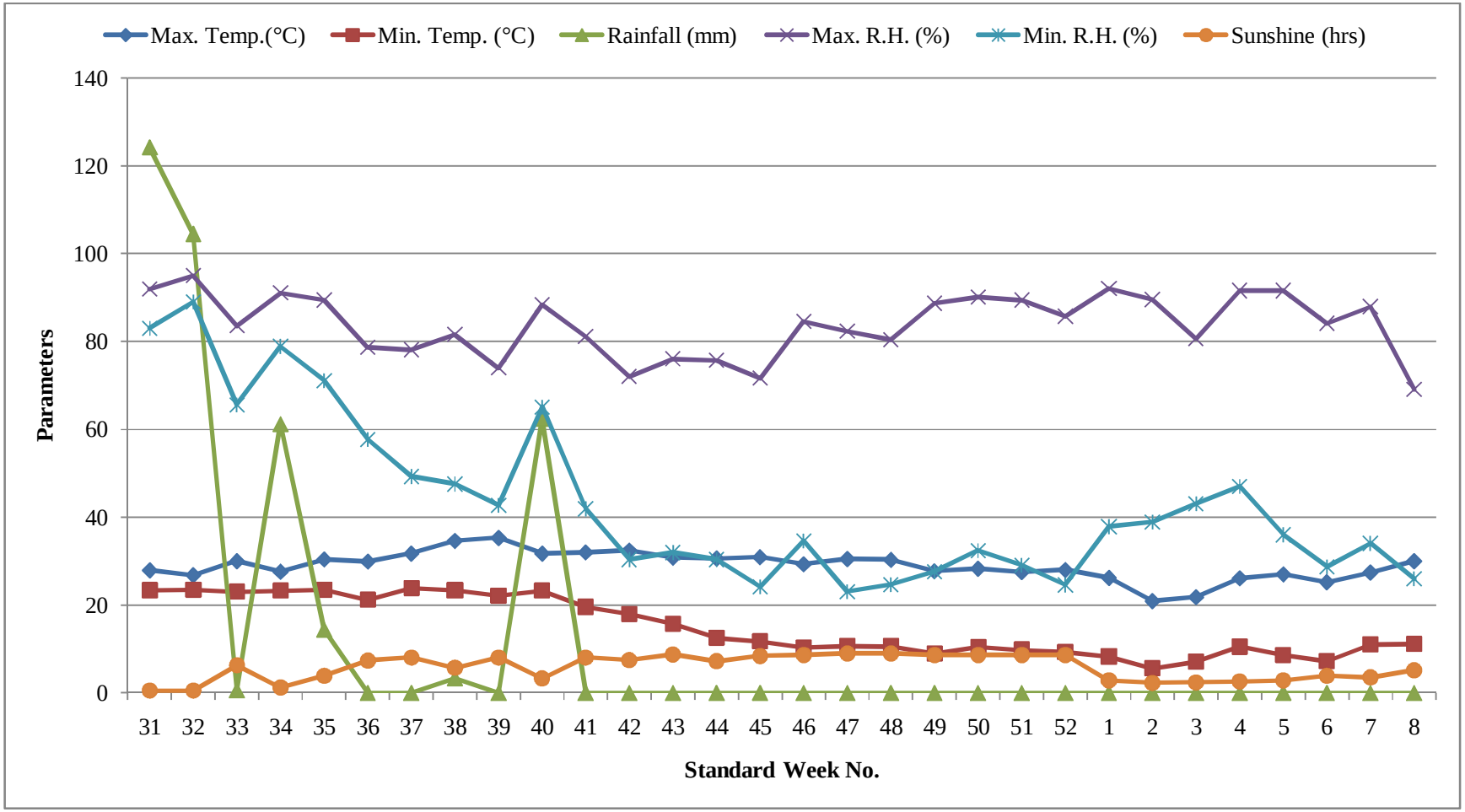

Fig 3.1 : Mean weekly meteorological data

3.3 PHYSICAL PROPERTIES OF GROWING MEDIA

In order to assess the physical properties of potting media, a representative sample was prepared and subjected to physical analysis.The results of analysis along with methods used for determination are presented in Table 3.2.

Table 3.2 Physical properties of the potting media at experimental site (2016 – 2017)

Physical properties									
S.No.		**Soil**	**Sand**	**FYM**	**Vermicompost**	**Cocopeat**	**Perlite**	**Vermiculite**	**References**
1.	pH	7.7	7.0	8.4	7.6	6.7	6.0-8.0	7-7.5	Using glass electrode pHmeter(Jackson,1979)
2.	Ec(ds m^{-1})	0.75	0.9	1.9	0.45	0.22	0.005	0.18	Using solubridge conductivity meter (Jackson,1979)
3.	WHC(%)	27.59 %	33% %	48.43 %	49%	44.19 %	68%	78-80%	Using quincunx box (Richard,1954)

3.4 EXPERIMENTAL DESIGN

In all, there were 10 treatment replicated20thtimes in a completely randomized design (factorial). The details of treatments ofgrowing media and pot sizes as experimented are given below:

1. Growing media : 10
2. Pot sizes : 6 inch plastic pot
3. Replications : 20
4. Total no. of pot : 200
5. Design : CRD

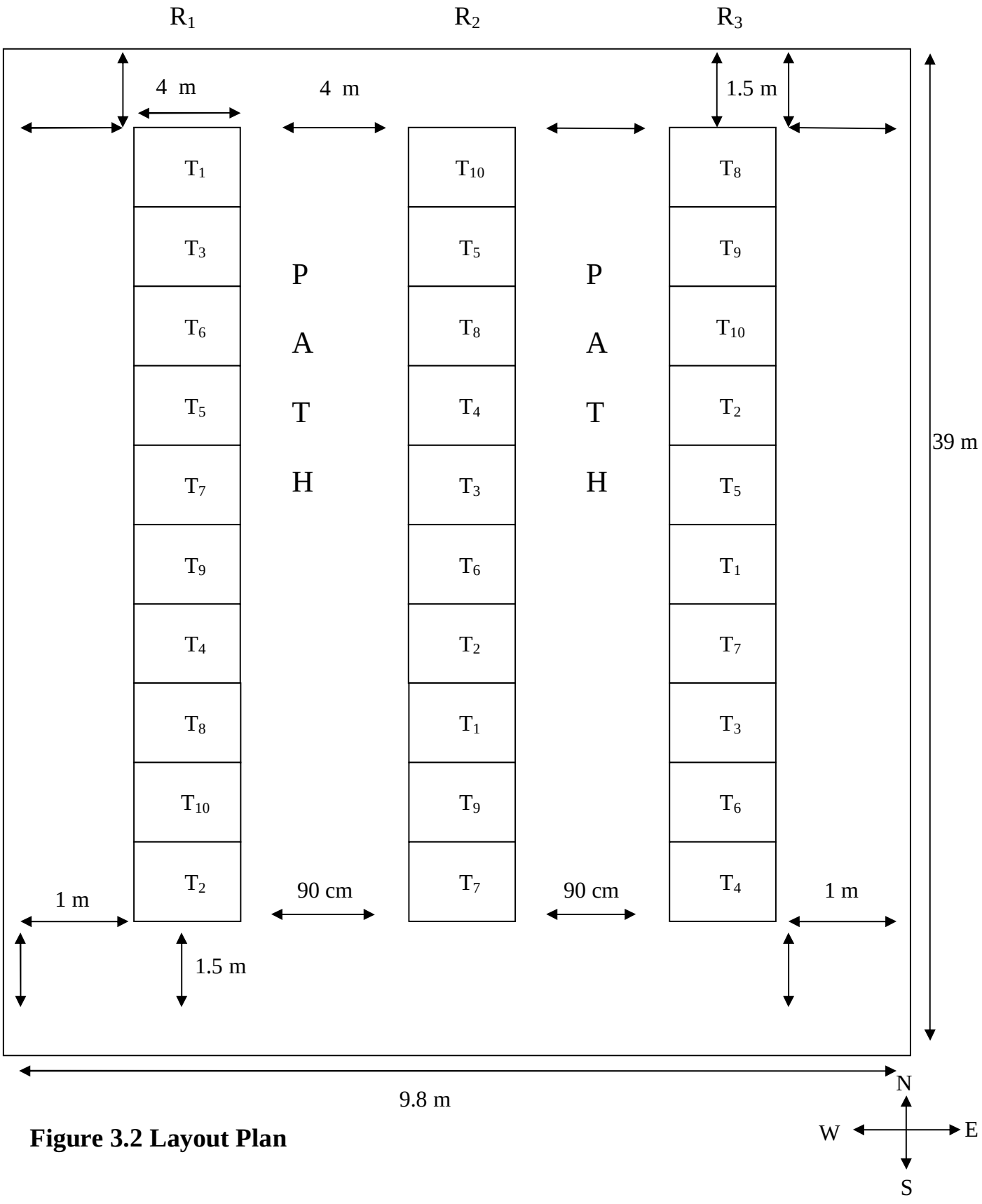

Figure 3.2 Layout Plan

TREATMENTS OF POTTING MEDIA:

The experiment comprised with ten pot media combination treatments -

T_1 = Soil (control)

T_2 = Soil + Sand + FYM (2:1:1v/v/v)

T_3 = Soil + Sand + Vermicompost (2:1:1v/v/v)

T_4 = Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5v/v)

T_5 = Cocopeat only

T_6 = Cocopeat + Sand + FYM (2:1:1v/v/v)

T_7 = Cocopeat + Sand + Vermicompost (2:1:1v/v/v)

T_8 = Cocopeat + Sand + FYM + Vermicompost (2:0.5:0.5:0.5v/v/v)

T_9 = Cocopeat + Perlite + Vermiculite (3:1:1v/v)

T_{10} = Cocopeat + Soil + Sand (2:1:1 v/v/v)

3.6 EXPERIMENTAL METHODLOGY

3.6.1 Source of planting material

The cuttings of *Dendranthema grandiflora* cv. 'Pusa Sona' were procured from Division of Floriculture and Landscaping, IARI, New Delhi.

3.6.2 Source of potting Media

Seven potting media and 200 pots of 6 inch sized were obtained from AICRP – Floriculture Department of Horticulture, RCA, Udaipur (Raj.).

3.6.3 Preparationofpottingmedia

Tenpottingmedia combinations were prepared as as per treatment details after thoroughly mixing of various ingredients on volume by volume basis *viz*.,Soil(control),Soil+Sand+FYM(2:1:1v/v/v),Soil+Sand+Vermicompost(2:1:1v/),Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5v/v),Cocopeat onlyCocopeat+ Sand + FYM(2:1:1v/v/v), Cocopeat + Sand + Vermicompost (2:1:1v/v/v),Cocopeat + Sand + FYM +Vermicompost(2:0.5:0.5:0.5v/v/v), Cocopeat+Perlite +Vermiculite(3:1:1v/v),Cocopeat + Soil + Sand (2:1:1 v/v/v). Prepared media

combination were filled in 6 inch pot by leaving 3 inch place for, irrigation & intercultural operations while transplanting.

3.7 CULTURAL PRACTICES

3.7.1 Transplanting

The procured rooted cuttings of *Dendranthema grandiflora*cv.Pusa sona were planted inplastic pots of 6 inch size containing a mixtures of different growing media in the shade nethouseon 2nd August, 2016.

3.7.2 Pinching

First pinching operation was given by removing the terminalbud at 30 daysafter transplanting planting. The second pinching operation was done after 25 days of first pinching to encourage more side shoots.

3.7.3 Nutrition and irrigation

To facilitate vegetative growth, foliar spray of water soluble fertilizer N,P,K mixed (19:19:19) was given @ 20g/20litre of water on 9thSeptember, 25th September and 10thOctober 2016.

Four irrigations per week were applied during September to October 2016 except rainy days and two irrigations per week were applied during November 2016 – January 2017 depending upon the weather conditions.

3.7.4 Plant protection measures

In order to protect the chrysanthemum crop from insect pest and disease the plants were sprayed twice with phosphomidon (0.25%) and Bavistin (0.2%) at fortnightly.

3.7.5 Weeding

Manual weeding was done at weekly intervals.

3.7.6 Stacking

To support the weak stem stacking was done with 45 to 60 cm size of bamboo sticks.

3.8 OBSERVATIONS RECORDED

The observations on plant height, plant spread, internodel length, stem diameter at flowering stage, branches plant^{-1}, days to first bud appearance, days to bud show color stage, days to floral bud break stage, flower diameter, spray plant^{-1}, days to flower withering, flower plant^{-1}, weight of flower, flower duration, pH, electrical conductivity, water holding capacity analysis of growing media before planting and after flowering completion were recorded.

3.8.1 Plant height (cm)

Plant height were measured in cm from ground level to the extreme tip of main stem in each tagged plant on the first bud appearance with the help of meter scale.

3.8.2 Plant spread(cm)

The plant spread was measured in cm for both North to South and East to West direction at first bud appearance with the help of meter scale.

3.8.3 Internodel length(cm)

The internodel length was measured as the average length between two nodes situated on the branches with the help of meter scale.

3.8.4 Stem diameter(mm)

Thestem diameter was measuredby taking average peripheraldiameter of the base of the stem with the help of vernier caliper.

3.8.5 Branches plant^{-1}

The total numbers of branches or shoots produced per plant werecounted.

3.8.6 Days to first budappearancestage

Days to first flower bud appearance were recorded by counting the date oftransplanting to the stage at which the first flower bud initiated and average was worked out.

3.8.7 Daystobudshow colorstage

Days tobud show color stage were recorded as the time taken from transplanting till the bud show colour stage.

3.8.8 Days to floralbudbreak stage

Numbers of days taken to first flower bud opening were recorded as the time taken in days from transplanting of rooted cutting to the opening of first flower.

3.8.9 Flower diameter (cm)

Diameter of the twenty flowers was measured on twenty tagged plants at the point of maximum breadth at full bloom stage. This was measured by digital vernier caliper.

3.8.10 Spray plant^{-1}

Sprays produced per plant were counted at full bloom stage.

3.8.11 Days to flower withering

Days to flowerwithering were recorded as the time taken from transplanting to till the first flower withering.

3.8.12 Flower plant^{-1}

Number of flower were counted manually to get individual spray of selected plant.

3.8.13 Weight of flower (g)

Weight of ten fully opened flowers from each selected plant was recorded on electric weighing balance and average was worked out to get average flower weight, Further average weight of these flowers was worked out to get flower weight of selected plant and expressed in gram.

3.8.14 Flower duration (days)

Total duration of flowering in days was counted from first flower bud appearance to last flower bud in each treatment.

3.8.15 Potting media analysis

Before laying out of experiment and after the flowering was over, mediasamples were collected to determine the initial and final fertility status and other physic -chemical properties (Appendix-II). The samples were air dried, groundwith wooden pastel and mortar, mixed thoroughly, sieved and used for determination of pH, EC and water holding capacity(WHC) by using standard methods as follows:

pH:pH was determined in 1:2.5 soil water suspension using glass electrode pH meter as per description of Jackson (1979).

Electrical conductivity: Electrical conductivity of 1:2.5 soil water suspension was determined by using solubridge conductivity meter as described by Jackson (1979).

Water holdingcapacity: Water holding capacity of media sample was determined by using quincunx box (Richards,1954).

FORMULA

Water holding capacity (%) =

$$\frac{\text{Total water in the weight soil}}{\text{Oven dry weight of totalsoil}} \times 100$$

3.8.16 Plant survival (%):

The plant survival (%) was determined by using following formula:-

$$\text{Plant survival (\%)} = \frac{\text{Total no.of plants - No. of dead plants}}{\text{Total no. of plants}} \times 100$$

3.9 ECONOMICS OF THE TREATMENTS

First the cost of cultivation was calculated, the gross income was estimated on the basis of the sell price of the pots.

1. Net income = Gross income – cost of cultivation

The cost of cultivation includes money spent on growing media, planting plants, fertilizer, fertilizer application, irrigation, weeding, hoeing and plant protection.

Net return per rupee investment was calculated as follows:

2. Net return / rupee investment = $\frac{\textbf{Net income}}{\textbf{Total cost of cultivation}}$

3.10 STATISTICAL ANALYSIS:

The experimental data were subjected for statistical analysis for analysis of variance and test of significance through the procedure appropriate to the completely randomized design (CRD) as suggested by Fisher (1950). The standard error deviation

and critical difference for treatment comparison were worked out where the “F” test was found significant at 5 per cent level of significance under field conditions. Summary tables along with S.Em± and C.D. were prepared and presented in the chapter entitled “Experimental Results” and analysis of variance tables for different parameters are also presented in “Appendices”.

Chapter-4
EXPERIMENTAL RESULTS

The experimental results obtained on different aspects of the studyentitled, **"Potting Media composition for pot mum Chrysanthemum production(*Dendranthema grandiflora)"*** arepresented in this chapter.The analysisofvariances for different characters studied are presented in the Appendix-II.

4.1 VEGETATIVE PARAMETERS

4.1.1 Plant height (cm)

The data pertaining to the plant height are presented in Table 4.1 and Fig. 4.1 It is clear from the table that highest significant influence onplant height was recorded in potting media combinationT_4(20.45cm) i.e. potting media composed of Soil:Sand:FYM: Vermicompost(2:1:0.5:0.5v/v) followed by T_2Soil : Sand : FYM (2:1:1v/v).While, lowest plant heightwas recorded in T_1Soil as control(8.15cm.). Which was better over the control and other treatment combination of potting media on chrysanthemum cv. Pusa Sona.

4.1.2 Plant spread (cm^2)

The data pertaining to the plant spread are presented in Table 4.1.It is clear from the table that maximum plant spread was recorded in potting media T_4 (15.69 cm^2) i.e. Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v) followed by T_2 (13.70 cm) i.e. potting media consisting from Soil : Sand : FYM (2:1:1v/v) Whereas, minimum plant spread was observed in potting mediaT_1 (9.03cm.) i.e. Soil as control on chrysanthemum cv. Pusa Sona.

4.1.3 Internodal length(cm)

The data pertaining to the internodal length are presented inTable 4.1.It is clear from the table thathighestinternodal length was recorded in T_4(3.27cm) potting media comprising with Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v), followed by T_2 (2.97cm) potting media comprising Soil: Sand: FYM (2:1:1v/v) while, lowest was observed in potting media T_1 i.e. comprising with as Soil control at 30 DAT(1.13cm), on chrysanthemum cv. Pusa Sona.

Plate 1 : Chrysanthemum cv. Pusa Sona
T_4 - Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5 v/v)
T_2 - Soil + Sand + FYM (2:1:1 v/v)

Plate 2 : Chrysanthemum cv. Pusa Sona
T_5 - Cocopeat only
T_8 - Cocopeat + Sand + FYM + Vermicompost (2:0.5:0.5:0.5 v/v)

Whereas,maximum internodal length was recorded in potting media combination T_4 i.e. 4.54cmcomprising Soil: Sand: FYM: Vermicompost(2:1:0.5:0.5v/v) followed by T_2 (3.78cm). Potting media comprising Soil: Sand: FYM(2:1:1v/v)while, minimumlength (1.59cm) was observed in potting T_1comprising with soil as control on chrysanthemum cv. Pusa Sona.

4.1.4 Stem diameter (mm)

The data pertaining to the stem diameter (mm) are presented in Table 4.1. It is clear from the table that highest stem diameter was recorded in potting media T_4(4.43mm) comprising with Soil : Sand : FYM: Vermicompost (2:1:0.5:0.5v/v), followed by T_2 (3.55 mm) comprising Soil : Sand : FYM : Vermi compost (2:1:1 v/v).While, lowest stem diameter was recorded inpotting media T_1(1.48mm) comprising with soil as control control on chrysanthemum cv. Pusa Sona.

4.1.5 Branches plant^{-1}

Further, it is indicated that data pertaining to branches plant^{-1}are presented in Table 4.1 and Fig. 4.2.It is clear from the table data that potting media had significant influence on highest branches plant^{-1} was recorded in T_4(7.15) comprising with Soil: Sand : FYM : Vermicompost (2:1:0.5:0.5v/v) followed by T_2(4.55) comprising with Soil : Sand : FYM (2:1:1v/v) while, minimum branches plant^{-1} was recorded in T_1 media comprising with soil as control (2.45) on chrysanthemum cv. Pusa Sona.

Table-4.1 Effect of potting media on vegetative parameter of chrysanthemum cv. Pusa Sona

Treatments (v/v)	Plant height (cm)	Plant spread (cm^2)	Inter nodal length(cm)		Stem diameter (mm)	Branches $plant^{-1}$
			30 DAT	60 DAT		
T_1-Soil (control)	8.15	8.31	1.13	1.57	1.48	2.45
T_2 -Soil + Sand + FYM (2:1:1)	18.25	13.70	2.97	3.78	3.55	4.60
T_3- Soil + Sand + Vermicompost (2:1:1)	15.05	11.26	2.17	3.45	2.02	3.95
T_4-Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5)	20.45	15.69	3.29	4.54	4.43	7.15
T_5-Cocopeat only	15.25	10.83	2.66	2.77	3.31	3.40
T_6-Cocopeat + Sand + FYM (2:1:1)	13.45	9.03	2.04	2.40	3.26	4.50
T_7 -Cocopeat + Sand + Vermicompost (2:1:1)	12.35	10.83	1.91	2.47	1.57	3.55
T_8 -Cocopeat + Sand + FYM+ Vermiompost(2:0.5:0.5:0.5)	12.65	10.18	1.91	2.51	1.71	4.25
T_9- Cocopeat + Perlite + Vermiculite (3:1:1)	11.30	9.98	1.82	2.46	1.96	2.50
T_{10}- Cocopeat + Soil + Sand (2:1:1)	10.15	9.59	2.22	2.50	1.99	3.55
SEm±	**0.47**	**0.56**	**0.06**	**0.12**	**0.08**	**0.24**
CD (P= 0.05)	**1.35**	**1.64**	**0.19**	**0.32**	**0.24**	**0.67**

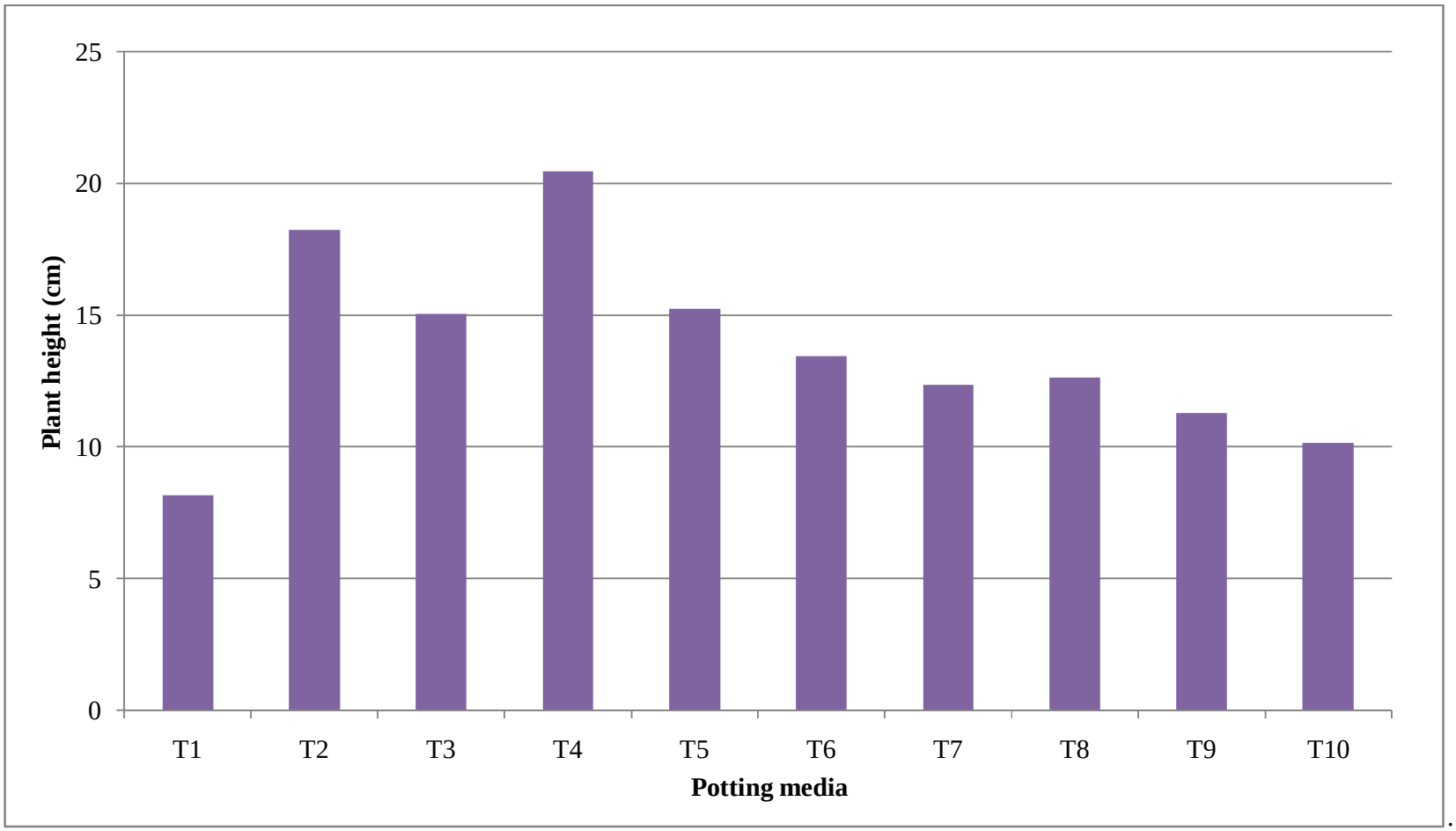

Fig. 4.1: Effect of potting media on plant height (cm) of chrysanthemum cv. Pusa Sona

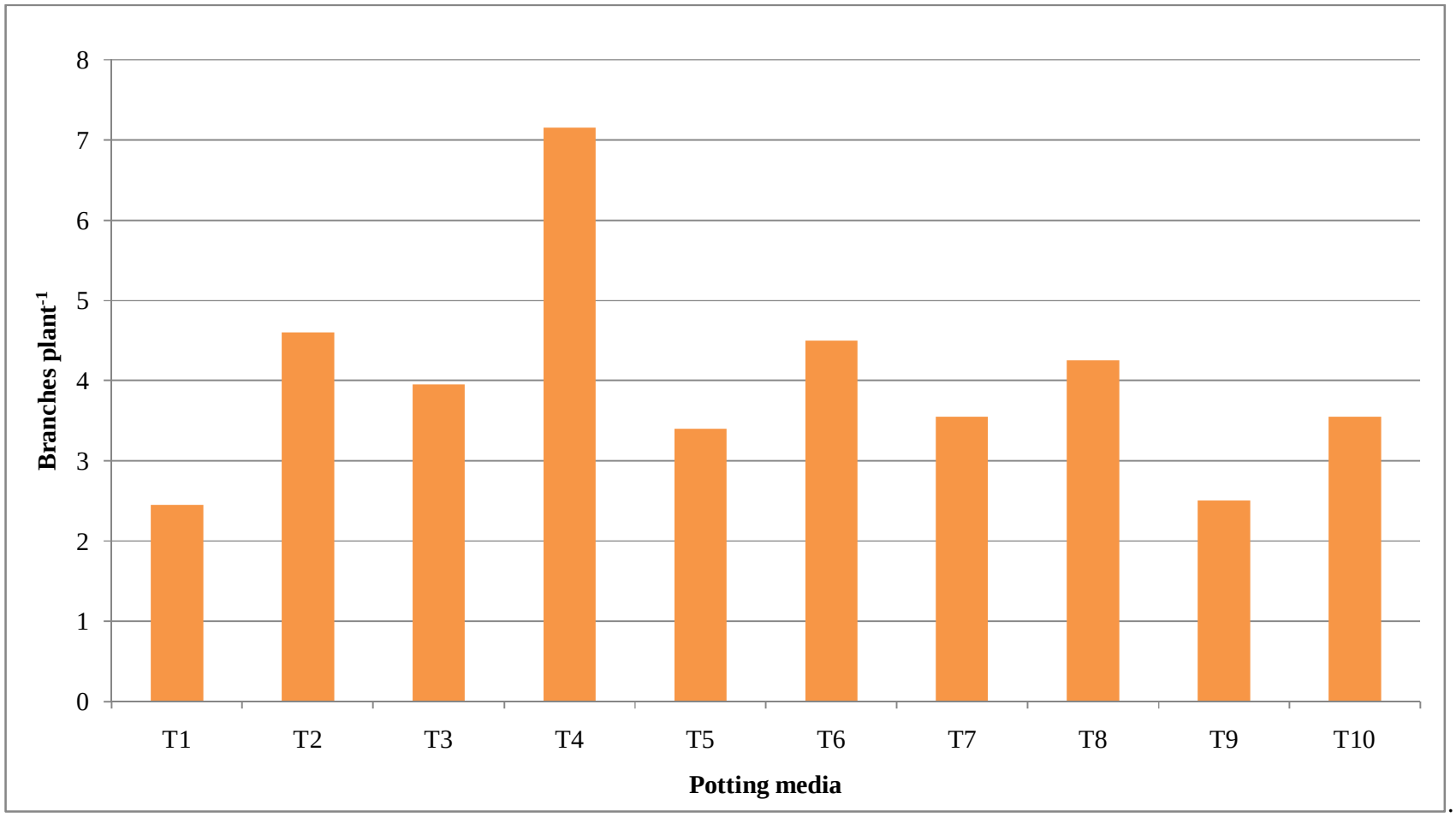

Fig.4.2: Effect of potting media on no. of branches of chrysanthemum cv. Pusa Sona

Plate 4 : Effect of potting media on Vegetative growth of Chrysanthemum cv. Pusa Sona

4.2 FLORAL PARAMETER

4.2.1 Days to first bud appearance stage

The data pertaining to first flower bud appearance are presented in Table 4.2 and Fig. 4.3 It is clear from the table data that potting media showed significant influence on earliest time to first flower bud appearance was recorded in potting media T_4 (75.3 days) comprising from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v) followed by potting media T_2 (76.55days) comprising from Soil : Sand : FYM (2:1:1,v/v).While potting media T_1– comprising from Soil as control delayed first bud appearance (83.5 days) the other treatments on chrysanthemum cv. Pusa Sona.

4.2.2 Days to bud show colour

The data pertaining to thedays to bud show color are presented in Table 4.2 and Fig. 4.3.It is clear from the data that potting media showed significant influence on earliest bud show color was recorded in T_4 (83.0 days) consisting from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5, v/v) followed by potting media T_2 (83.35days) comprising with Soil : Sand : FYM (2:1:1v/v) and T_5 (84.25 days) comprising with cocopeat only were statistically at par with T_4potting media .Whereas, latest bud show color was recorded in potting media T_1 – Soil as control on chrysanthemum cv. Pusa Sona.

4.2.3 Days to floral bud break stage

Thedata pertaining to days to floral bud break stage are presented in Table 4.2 and Fig. 4.3. It is clear from the table data that potting media showed significant influence on earliest floral bud break recorded in T_4(101.5 days) media comprising from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v) followed by potting media T_2(102.40 days) comprising with Soil : Sand : FYM (2:1:1v/v),whereas delayed flower bud break stage was recorded in T_1 – Soil as control & T_8 – Cocopeat : Sand :FYM : Vermicompost (2:0.5:0.5:0.5 v/v) on chrysanthemum cv. Pusa Sona.

4.2.4 Flower diameter (cm)

The data indicated for the flower diameter are presented in Table 4.2 and Fig. 4.4. The potting media having highest significant influence on flower diameter was recorded in potting mediaT_4 (1.91cm) consisting from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v) and found to be significantly higher than other potting media. However, lowest flower diameter was recorded in potting media T_1 (1.17 cm) on soil as control on chrysanthemum cv. Pusa Sona.

4.2.5 Spray plant^{-1}

The data pertaining to spray plant^{-1}are presented in Table 4.2 and Fig. 4.5 . It is clear from the table data that potting media shows significant influence on highest spray plant^{-1} was recorded in T_4(7.6)composed from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5,v/v), followed by T_2(6.40) comprising Soil : Sand : FYM (2:1:1,v/v).However, lowest spray plant^{-1} was recorded in potting media T_1(3.25) consisting from soil as controlon chrysanthemum cv. Pusa Sona.

4.2.6 Days to flower withering

Further, data pertaining to days to flower withering are presented in Table 4.2 and Fig. 4.6.Maximum days taken to flower withering was recorded in potting media T_4(149.45days)composed from Soil: Sand : FYM : Vermicompost (2:1:0.5:0.5,v/v) and found to be significantly superior over all other potting media combination treatments. While minimum days to flower withering was observed in potting media T_1containing soil as control (133.30 days) on chrysanthemum cv. Pusa Sona.

Table-4.2 Effect of potting media on floral bud parameter of chrysanthemum cv. Pusa Sona

Treatments (v/v)	First bud appearance (days)	Bud show colour stage (days)	Floral bud break stage (days)	Flower diameter (cm)	Spray plant^{-1}	Flower withering (days)
T_1-Soil (control)	83.85	89.30	120.15	1.17	3.25	133.30
T_2 -Soil + Sand + FYM (2:1:1)	76.55	83.25	102.40	1.72	6.40	137.50
T_3- Soil + Sand + Vermi compost (2:1:1)	78.80	84.80	105.25	1.43	5.05	142.50
T_4-Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5)	75.30	83.00	101.50	1.91	7.60	149.45
T_5-Cocopeat only	76.95	84.25	108.90	1.34	4.50	133.85
T_6-Cocopeat + Sand + FYM (2:1:1)	79.40	85.75	108.90	1.32	4.35	138.25
T_7 -Cocopeat + Sand + Vermi compost (2:1:1)	76.95	84.50	109.20	1.19	3.90	136.55
T_8-Cocopeat + Sand+FYM+Vermiompost(2:0.5:0.5:0.5)	78.30	86.55	119.15	1.29	4.00	136.90
T_9- Cocopeat + Perlite + Vermiculite (3:1:1)	79.35	84.90	114.70	1.37	4.00	139.70
T_{10}- Cocopeat + Soil + Sand (2:1:1)	78.25	85.00	105.55	1.26	3.40	137.70
SEm±	**0.48**	**0.68**	**1.87**	**0.03**	**0.30**	**0.83**
CD (P= 0.05)	**1.35**	**1.69**	**5.18**	**0 0. 097**	**0.84**	**2.32**

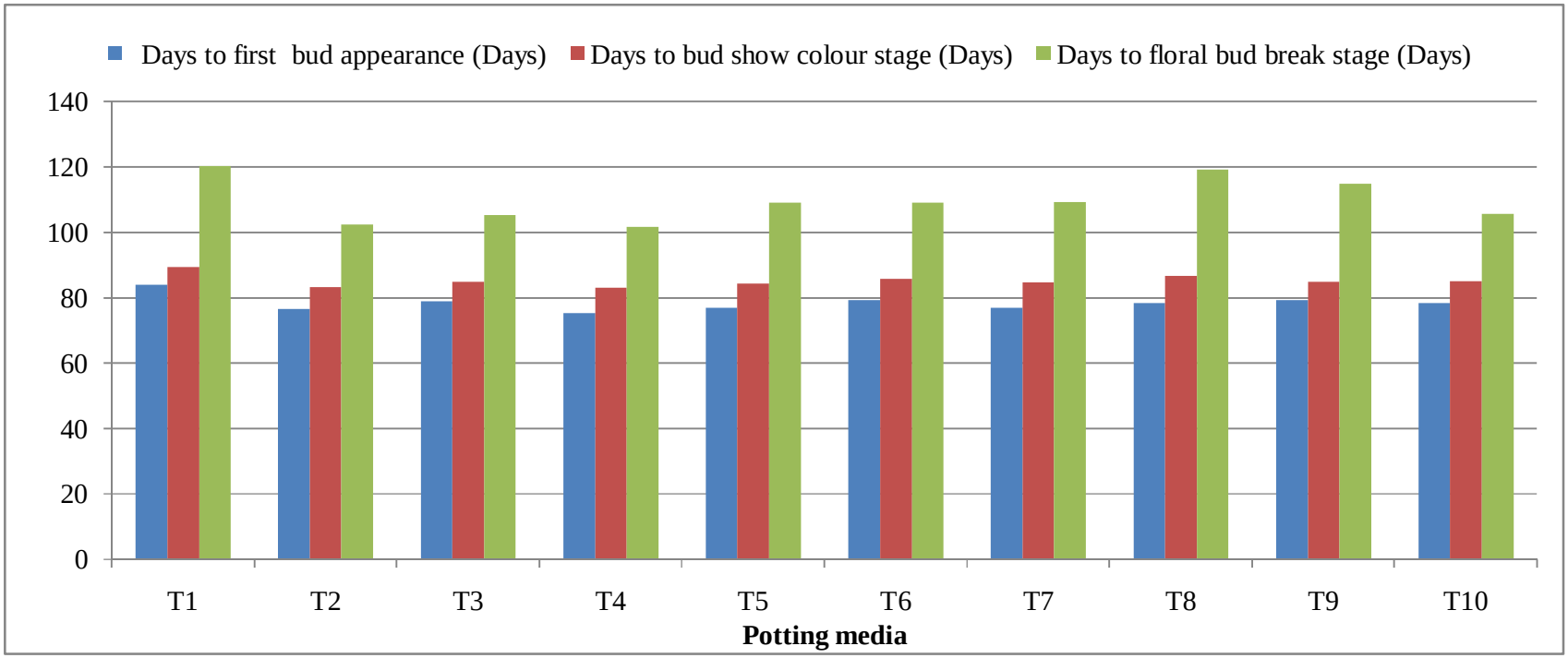

Fig.4.3: Effect of potting media on floral parameters of chrysanthemum cv. Pusa Sona

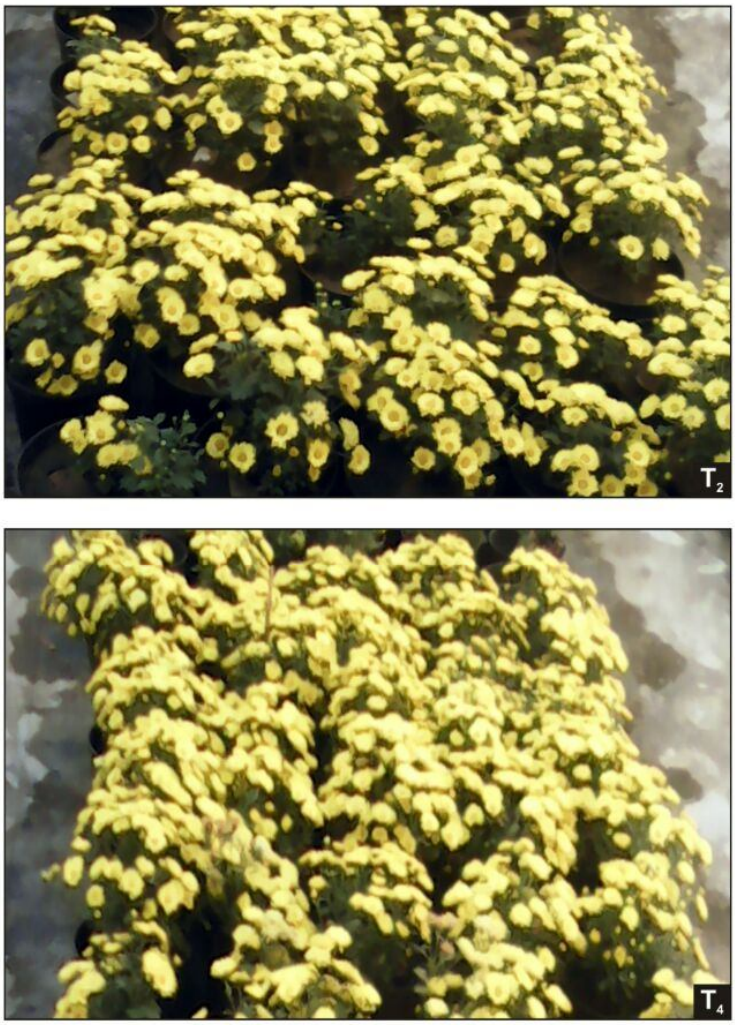

Plate 3 : Chrysanthemum cv. Pusa Sona
T_2 - Soil + Sand + FYM (2:1:1 v/v)
T_4 - Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5 v/v)

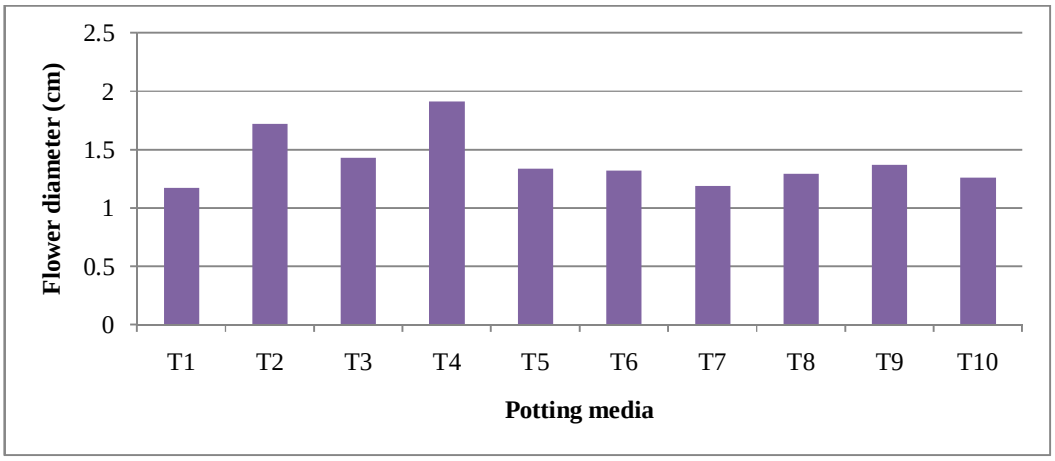

Fig.4.4: Effect of potting media on flower diameter(cm) of chrysanthemum cv.Pusa Sona

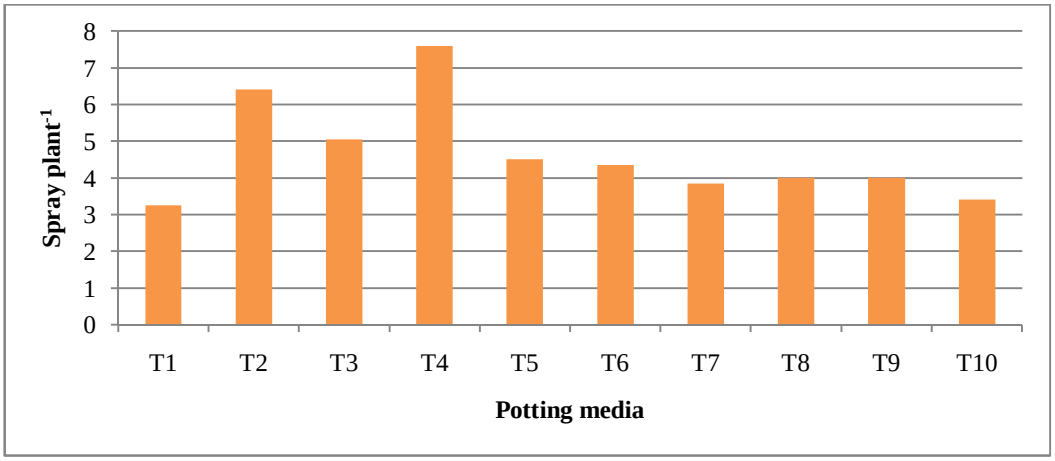

Fig 4.5:Effect of potting media on spray plant^{-1} of chrysanthemum cv. Pusa Sona

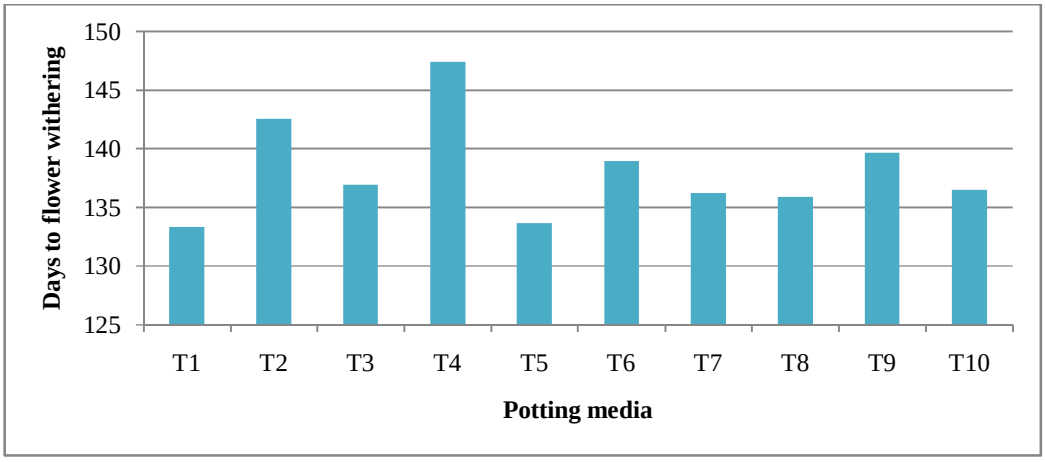

Fig 4.6: Effect of potting media on days to flower withering of chrysanthemum cv.Pusa Sona

Plate 5 : An overview of Chrysanthemum cv. Pusa Sona during floral bud break

4.2.6 Flower plant^{-1}

The data indicated for the flower plant^{-1}are presented in Table 4.3 and Fig. 4.7 The highest flowers per plant was observed in potting media T_4 (50.60) composed from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v) followed by T_2(49.80) potting media composed from Soil : Sand : FYM (2:1:1 v/v). However, lowest flowers plant^{-1} were observed in T_1(16) i.e. when plants were grown in soil. Potting media combinations T_6, T_7 and T_8 were statistically at par with each other for flower plant^{-1}on chrysanthemum cv. Pusa Sona.

4.2.7 Flower weight (g.)

The data pertaining to flower weight plant-^{1} are presented in Table 4.3 and Fig. 4.8.It is clear from the table data that potting media showed significant influence on maximum flower weight plant^{-1} was recorded in potting media T_4(46.54gm.) comprising from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v) followed by T_2 (40.96 gm.) i.e. growing media comprising of Soil : Sand : FYM (2:1:1v/v) while, minimum flower weight plant^{-1} was observed in potting media T_1(6.87gm.) consisting from soil as control in chrysanthemum cv. Pusa Sona.

4.2.8 Flower duration (days)

The data pertaining to the flower duration are presented in Table 4.3 and Fig. 4.9. The potting media combination showed significant influence on highest flower duration was recorded in T_4(45.95 days) media composed from Soil: Sand: FYM: Vermicompost (2:1:0.5:0.5v/v) and found to be significantly better over all other treatment combinations. In contrast, lowest flower duration was recorded in potting media T_1(14.25 days) consisting from soil as control on chrysanthemum cv. Pusa Sona.

Table-4.3 Effect of potting media on floral parameter of chrysanthemum cv. Pusa Sona

Treatments (v/v)	Flower plant^{-1}	Flower weight (g.)	Flower duration(Days)
T_1-Soil (control)	16.00	6.87	14.25
T_2 -Soil + Sand + FYM (2:1:1)	49.80	40.96	38.60
T_3- Soil + Sand + Vermi compost (2:1:1)	45.80	28.36	31.70
T_4-Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5)	50.60	46.54	45.95
T_5-Cocopeat only	33.85	24.65	24.95
T_6-Cocopeat + Sand + FYM (2:1:1)	37.80	20.95	29.35
T_7 -Cocopeat + Sand + Vermicompost (2:1:1)	37.50	23.24	26.85
T_8 -Cocopeat + Sand + FYM+ Vermiompost(2:0.5:0.5:0.5)	36.45	25.77	17.25
T_9- Cocopeat + Perlite + Vermiculite (3:1:1)	31.30	22.84	25.25
T_{10}- Cocopeat + Soil + Sand (2:1:1)	30.15	17.59	31.00
SEm±	**0.85**	**0.21**	**1.24**
CD (P= 0.05)	**2.36**	**0.60**	**4.52**

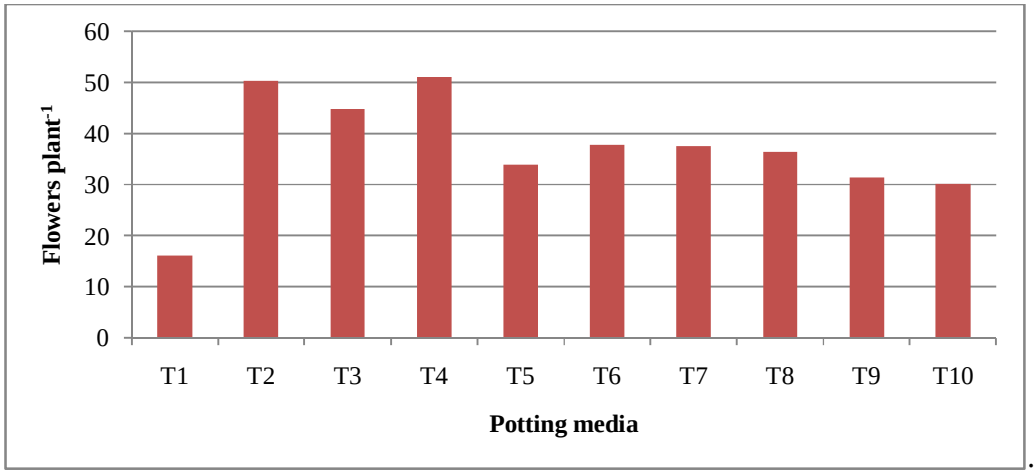

Fig.4.7:Effect of potting media on flower plant^{-1}of chrysanthemum cv. Pusa Sona

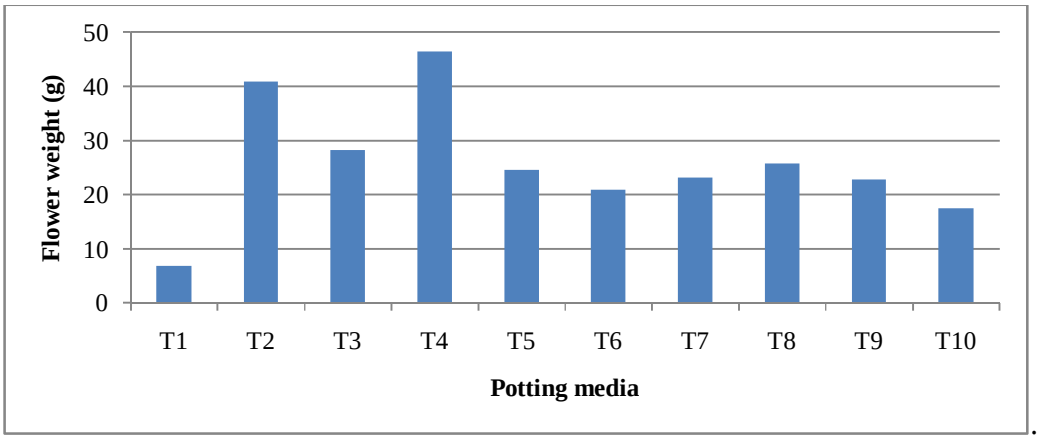

Fig.4.8: Effect of potting media on flower weight (g.) of chrysanthemum cv. Pusa Sona

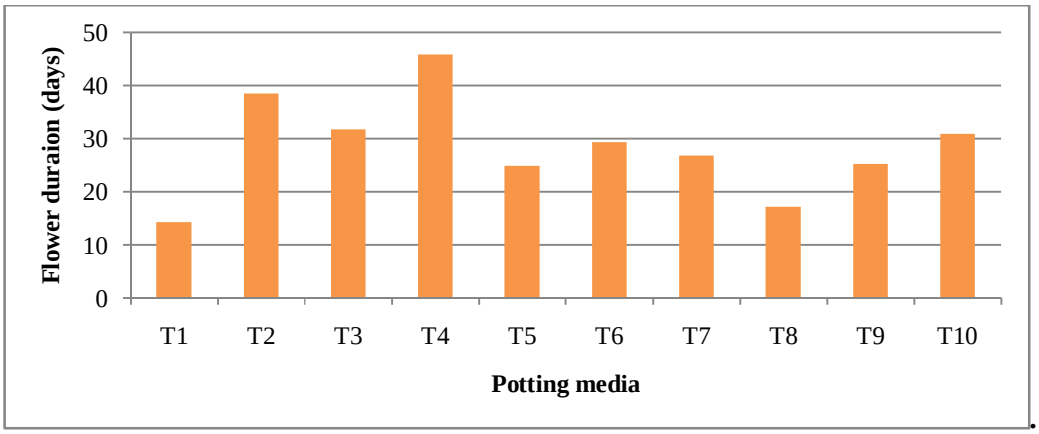

Fig.4.9:Effect of potting media on flower duration (days) of chrysanthemum cv. Pusa Sona

4.3 POTTING MEDIA ANALYSIS

The data for various potting media combination treatments indicated that ideal pH, EC, WHC (6.1, 0.64dsm^{-1},87.85%) were recorded in T_4- Soil: Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v) followed by T_2 - Soil: Sand : FYM (2:1:1 v/v) and poor performing potting media treatment T_1 – Soil as control (7.7 , 0.75 dsm^{-1},27.59%) respectively, before transplanting of chrysanthemum rooted cutting cv. Pusa Sona .

However, after completion of flowering ideal pH (7.3), EC(1.47 dsm^{-1}) and highest water holding capacity (97.36%) were recorded in potting media T_4 consisting from Soil: Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v) followed by T_2 - Soil: Sand: FYM (2:1:1 v/v) whereas T_1 – Soil as control recorded highest pH(7.7) and poor water holding capacity on chrysanthemum cv. Pusa Sona.

4.4 Plant survival (%)

Moreover data indicated percent plant survival are presented in Table-4.5 and fig.4.10. The potting media had significant influence on highest percent plant survival were recorded in T_4 consisting from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v), followed by T_2 (96.70) comprising from Soil : Sand : FYM (2:1:1, v/v) and T_7 (93.60) media consisting from (Cocopeat : Vermicompost (2:1:1 v/v), while minimum percent plant survival (67.50) was recorded in potting media T_1 - Soil as controlon chrysanthemum cv. Pusa Sona.

Table-4.4 Effect of potting media on physical properties of chrysanthemum cv. Pusa Sona

Treatments (v/v)	Before Transplanting			After Flowering Phase		
	pH	EC (ds/m)	WHC (%)	pH	EC(ds/m)	WHC(%)
T_1-Soil (control)	7.7	0.75	27.59	8.3	1.06	43.36
T_2 -Soil + Sand + FYM (2:1:1)	7.3	0.82	55.32	7.4	1.80	81.10
T_3- Soil + Sand + Vermi compost (2:1:1)	7.4	0.73	56.46	7.8	1.52	58.68
T_4-Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5)	6.1	0.64	87.85	7.3	1.47	97.36
T_5-Cocopeat only	6.7	0.22	44.19	7.3	1.46	77.86
T_6-Cocopeat + Sand + FYM (2:1:1)	6.9	1.66	52.13	7.6	3.17	77.11
T_7 -Cocopeat + Sand + Vermi compost (2:1:1)	6.6	1.08	61.07	8.7	4.15	67.71
T_8 -Cocopeat +Sand + FYM+Vermiompost(2:0.5:0.5:0.5)	7.2	1.47	65.60	7.7	4.09	77.94
T_9- Cocopeat + Perlite + Vermiculite (3:1:1)	6.4	0.27	67.15	7.6	2.21	83.28
T_{10}- Cocopeat + Soil + Sand (2:1:1)	6.8	0.85	65.21	7.8	3.45	84.47
SEm±	**0.021**	**0.007**	**0.25**	**0.01**	**0.01**	**0.26**
CD (P= 0.05)	**0.06**	**0.02**	**0.69**	**0.04**	**0.05**	**0.73**

Table-4.5 Effect of potting media on plant survival (%) of chrysanthemum cv. Pusa Sona

Treatments (v/v)	Plant Survival (%)
T_1-Soil (control)	67.50%
T_2 -Soil + Sand + FYM (2:1:1)	96.70%
T_3- Soil + Sand + Vermi compost (2:1:1)	93.50%
T_4-Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5)	96.70%
T_5-Cocopeat only	93.50%
T_6-Cocopeat + Sand + FYM (2:1:1)	93.48%
T_7 -Cocopeat + Sand + Vermicompost (2:1:1)	93.60%
T_8 -Cocopeat + Sand + FYM + Vermiompost (2:0.5:0.5:0.5)	90.40%
T_9- Cocopeat + Perlite + Vermiculite (3:1:1)	90.45%
T_{10}- Cocopeat + Soil + Sand (2:1:1)	93.30%
SEm±	**0.12**
CD (P= 0.05)	**0.34**

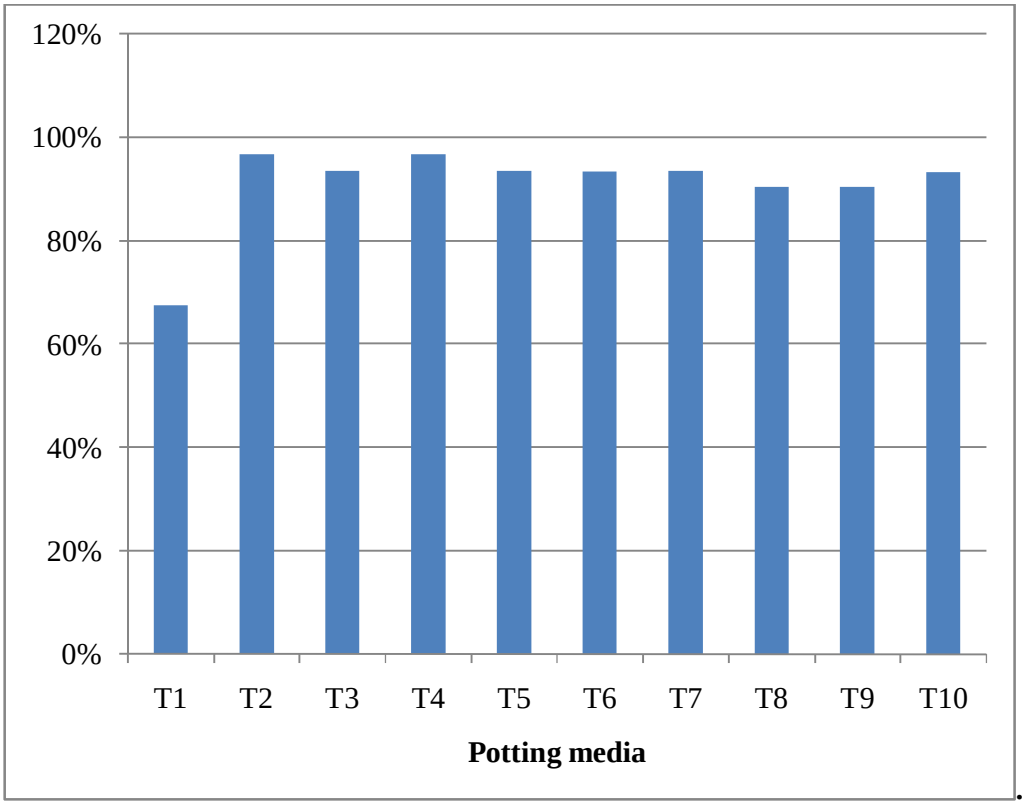

Fig.4.10:Effect of growing media on plant survival (%) of chrysanthemum cv. Pusa Sona

4.5 ECONOMICS ANALYSIS OF THE POTTING MEDIA

The relative economics of the potting media were calculated as per formula given in the material and methods. On the basis of the results obtained potting media combination T_4 - Soil: Sand : FYM: Vermicompost (2:1:0.5:0.5 v/v) was found best for highest gross return of (` 62855) and net return of (`40225) and net return per rupee investment (1.78), while it was minimum(0.56) in potting media combination T_1 - Soil as control in chrysanthemum cv. Pusa Sona tested under Udaipur condition(Table 4.6 and Appendix XXIV).

Table – 4.6 Relative economics of potting media in chrysanthemum cv. Pusa Sona

Treatments (v/v)	Total cost (`)	Survive pots for sale	Price/pot (`)	Gross return (`)	Net return (`)	B : C ratio
T_1-Soil (control)	21615	675	50	3 33750	12135	0.56
T_2 -Soil + Sand + FYM (2:1:1)	22193	967	60	58020	35827	1.62
T_3- Soil + Sand + Vermi compost (2:1:1)	23062	935	60	56100	33038	1.43
T_4-Soil + Sand + FYM + Vermicompost (2:1:0.5:0.5)	22630	967	65	62855	40225	1.78
T_5-Cocopeat only	25872	935	60	56100	30228	1.17
T_6-Cocopeat + Sand + FYM (2:1:1)	24327	935	60	56100	31773	1.30
T_7 -Cocopeat + Sand + Vermi compost (2:1:1)	25190	936	60	56160	30970	1.23
T_8 -Cocopeat + Sand + FYM +Vermicompost(2:0.5:0.5:0.5)	24484	904	60	54240	29756	1.22
T_9 - Cocopeat + Perlite + Vermiculite (3:1:1)	34403	905	60	54300	19897	0.58
T_{10}- Cocopeat + Soil + Sand (2:1:1)	24170	933	60	55980	31810	1.32

Chapter-5

DISCUSSION

Preceding chapter deals with the results obtained from the investigation entitled "Potting Media Composition for Pot Mum Chrysanthemum Production (*Dendranthema grandiflora*)", which showed significant variation for vegetative, floral & potting media analysis. This chapter, deals only with the brief discussion on the present findings in the light of similar work done by various workers at different locations.

5.1 VEGETATIVE PARAMETERS

The results from potting media composition exhibited significant difference for plant height in chrysanthemum.Potting media comprising Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v) recorded highest plant height (20.45 cm) which was found to be better over the T_1(Soil) as control and other potting media.

Present findings have indicated that potting media composition has a definite role to play in the overall growth of pot mum chrysanthemum. The increase in plant height in T_4 - Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v) provide more nutritive media resulted in increment to plant height. which might be due that potting media combination T_4 alone had lower clay content, pH, compactness, which improve drainage, aeration, water holding capacity and highest nutrients uptake by root system respectively results in highest plant height in potting media T_4 - Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v).

Present findings are in conformity with the findings of Bala and Singh (2013) in chrysanthemum var. "Yellow Charm" for plant height (20.46cm) in media combination Soil : Sand: FYM: Vermicompost (2:1:0.5:0.5 v/v). Nair and Bharti (2015) also obtained better plant height in cocopeat only in chrysanthemum cv. Sadbhavana. Dilta *et al*. (2015) also obtained highest plant height in growing media combination with Forest soil (Rhododendron) : FYM : Vermicompost (2:1:1 v/v) in *Hydrangea macrophylla,* Basheer and Thekkyam (2012) in anthurium with growing media combination Sand : Coirpith compost (3:1 v/v) .

However, highest plant spread (15.69 cm) was obtained in T_4. Whereas, it was minimum (9.03cm) in T_1 potting media composed from soil as control. The plant spread increase was mainly due to production of increased number of branches and wider angles from point of origin. Greater plant spread shows vegetative growth of plants.

Present findings are in confirmity with the finding of Bala and Singh (2013) in chrysanthemum, var. "Yellow Charm" for plant spread (21.75cm) with media consisting from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5, v/v), Nair and Bharti (2015) in chrysanthemum with media combination cocopeat recorded highest plant spread (25.49cm). Chauhan *et al.* (2014) in gerbera with potting media consisting Soil : Rice husk : Cocopeat : Castor cake : Vermicompost (1:1:1:1:1 v/v) for highest plant spread (34.49cm.) and Dilta *et al.* (2015) also obtained highest plant spread (78.21cm) in *Hydrangea macrophylla* in growing media combination with Forest soil (Rhododendron) : FYM : Vermicompost.(2:1:1)

While, higher stem diameter was recorded (4.43mm) in T_4- potting media comprising with Soil: Sand: FYM: Vermicompost (2:1:0.5:0.5v/v) whereas, minimum stem diameter (1.48mm) was recorded in T_1 potting media comprising with Soil as control. The increase in diameter of stem might be due to the reason that the growing media improveproper aeration, water holding capacity, supplying substantial amount of nutrients through root absorption which converts in photosynthates helps in cell division and cell elongation results in higher stem diameter. Similar findings have been reported by Mehwish *et al.* (2007) with growing media combinations Sand : Silt : Leaf (1:1:1 v/v) in stem diameter (1.93cm.) in dahlia **.** Wazir *et al.* (2005) also obtained highest stem diameter (0.69cm.) in alstromeria cv. Pluto with growing media combining Soil: Sand : Cocopeat : Vermicompost : FYM(1:1:1:1:1 v/v).

The maximum branches plant^{-1} (7.15) were observed in potting media combination T_4 Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v) , which may be due to the reason that the potting media in combination might have provided optimal conditions for the better growth after pinching, more no. of lateral shoots increase in gibberelline synthesis in plant system consequently resulted in more branches plant$^{-1.}$ Whereas, minimum number of branches per plant (2.45) were produced in the potting media consisting with soil as control. Similar findings have been reported by Bala and Singh (2013) in chrysanthemum with media combination Soil : Sand : FYM

: Vermicompost (2:1:0.5:0.5, v/v) var. “Yellow Charm” for branches plant^{-1} (39.97), Nair and Bharti (2015) in chrysanthemum cv. Sadabhavana with media combination cocopeat only for highest branches plant-^{1} (7.6).) and Mehwish *et al.* (2007) with growing media combinations Sand : Silt : Leaf mould (1:1:1 v/v) for maximum branches per plant (3.6)in dahlia.

5.2 FLORAL BUD PARAMETERS

Earliest first flower bud appearance (75.3days), floral bud show color (83.0 days), floral bud break (101.5 days) was recorded in potting media T_4 comprising from Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v). While, potting media T_1 – comprising from Soil as control delayed first bud appearance, bud show color & floral bud break stage.

The combined influence of soil with sand improve drainage, aeration, lower compactness along with farm yard manure and vermicompost brings down the pH to optimum level for the availability of macro and micro nutrients uptake by plant root system with the help of improve water holding capacity and higher photosynthetic activity resulted in better C :N ratio . When C : N ratio improve , simultaneously florigen plant harmone level also improve, which is responsible for earliest flower bud initiation, flower bud show color and anthesin is a plant harmone, which responsible for early flower bud break in chrysanthemum. Vermicompost in combination treatment also enrich soil micro-organism, adding plant hormone such as auxins and gibberelline, adding phosphatase and cellulose enzyme.

Similar finding have been reported by Bala and Singh earliest floral bud break (113.28days) in chrysanthemum with growing media consisting Soil : Sand :FYM : Vermicompost. (2:1:0.5:0.5v/v), Dingdrodiya *et al.*(2017) in rose with growing media consisting from Soil : FYM: Saw dust(2:1:1v/v) with fertigation WSF mix for first flower bud initiation (124.70 days), Mehwish *et al.* (2007) in dahlia with growing media comprising Sand: Silt: Leaf mould (1:1:1 v/v) for earliest floral bud break (91.66 days). Wazir *et al.* (2009) also obtained earliest flower bud initiation (147.80 days) in alstromeria cv. Sel. No. 14 with growing media combining Soil: Sand : Cocopeat : Vermicompost : FYM.(1:1:1:1 v/v).

While maximum flower diameter was recorded (1.91cm) in T_4 Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v). While minimum (1.17cm) in potting media T_1- Soil as control.

It may be concluded that increase flower diameter is mainly due to the genetic makeup and which might have been further modified by prevailing environmental condition and potting media combination Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v). It helps in more accumulation of photosynthates in the sink (flower) from source (leaves). Continueous availability of photosynthates, cell division, cell elongation & cell enlargement remain on peak resulted in higher flower diameter.

Similar trends Bala and Singh (2013) in chrysanthemum, var. Yellow Charm for highest flower diameter (3.91cm) with growing media consisting consisting Soil : Sand :FYM : Vermicompost. (2:1:0.5:0.5v/v)**,** Gupta *et al.* (2014) in marigold with media combination cowdung Vermicompost :Soil (20% : 80%) for maximum flower diameter (8cm.), Dilta *et al.* (2015) also obtained highest flower diameter (21.45cm) in *Hydrangea macrophylla* ingrowing media combination with Forest soil (Rhododendron) : FYM : Vermicompost (2:1:1v/v), Mehwish *et al.* (2007) in dahlia with growing media combinations Sand : Silt : Leaf mould for flower diameter(8.8cm.) and Dingrodiya *et al.* (2017) also obtained with growing media comprising with Soil : FYM :Saw dust (2:1:1v/v) with fertigation WSF mixresulted highest flower diameter (9.09 cm.) in polyhouse rose .

The potting media T_4 comprising with Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5, v/v) recorded maximum number of spray per plant (7.6). Higher spray were increased due to pinching operation lower down auxin level and more gibberellines synthesis in plant system might be resulted in lateral shoot induction due to combined influence Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5, v/v). Similar findings have been reported in alstroemeria by Wazir *et al.* (2009)and Dutt *et al.* (2002) in chrysanthemum.

Maximum days taken to flower withering was recorded in potting media T_4(149.45days)composed from Soil: Sand : FYM : Vermicompost (2:1:0.5:0.5,v/v) . While, minimum days to flower withering was observed in potting media T_1(133.30 days) containing soil as control. The reason of maximum days taken to flower

withering in potting media might be due to the hereditary traits, prevailing environmental and growing media combination.

Further, highest flowers plant^{-1} (51.1) were recorded in T_4 - Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v). Whereas, minimum flowers plant^{-1} (16) were observed in potting media T_1 comprising with soil as control. The production of higher number of flowers per plant in the potting media could be due to the reason that this media have produced more spray, flower bud per plant as well as more number of flowers per spray. Hence, resulted in higher flowers plant^{-1} .

Similar finding have been reported by Balaand Singh (2013) in Chrysanthemum, var. "Yellow Charm" for highest flower plant^{-1} (210.69) growing media consisting from Soil : Sand :FYM : Vermicompost. (2:1:0.5:0.5v/v), Chauhan *et al*. (2014) in gerbera with growing media combination Soil : Rice husk :Cocopeat: Castor Cake : Vermicompost (1:1:1:1:1v/v) resulted highest flower plant^{-1} (8.97), Gupta *et al.* (2014) in marigold with media combination cowdung Vermicompost : Soil (20 : 80%) for maximum flower plant^{-1} (100), Dilta *et al.* (2015) also obtained highest flower no. (17.84) in *Hydrangea macrophylla* in growing media combination with Forest soil (Rhododendron) : FYM : Vermicompost(2:1:1v/v), Mehwish *et al.* (2007) in dahlia with growing media combinations Sand : Silt : Leaf mould for maximum no. of flower (10.6.) and Dingrodiya *et al.* (2017) obtained highest flower plant^{-1} (15.9) with growing media comprising with Soil : FYM :Saw dust (2:1:1v/v)with fertigation of WSF mix under polyhouse condition.

Further, highest significance influence maximum flower weight plant^{-1} (46.54gm.) was recorded in T_4 comprised with Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5v/v). Whereas, minimum flower weight plant^{-1} (6.87 gm.) were observed in potting media comprising with soil as control. Reason of maximum flower weight might be due to more availability of nutrients,media and genetic makeup. Similar finding have been reported by Chauhan *et al.* (2014) in gerbera with potting media consisting Soil : Rice husk : Cocopeat : Castor cake : Vermicompost (1:1:1:1:1v/v) for highest flower weight (42.10gm).

However, maximum flower duration (45.95 days) was recorded in T_4 Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v). While, minimum flowering duration (14.25 days) was registered in T_1 soil (control). Maximum flower duration in potting

media may be due to that this potting media might have provided optimum growing environment particularly in the root zone besides supplying sufficient nutrients in available forms as well better physico-chemical and biological properties which led to better growth and flowering of plants. Thus exhibiting maximum flowering duration.

Similar findings have been reported by Bala and Singh (2013) in chrysanthemum, var. Yellow Charm for highest flower duration (35.24 days) with growing media consisting from Soil :Sand:FYM :Vermicompost(2:1:0.5:0.5v/v), Nair and Bharti (2015) in chrysanthemum with media combination Soil:Sand :FYM (2:1:1v/v) for flower duration (108.47 days) and Dilta *et al.* (2015) also obtained longest flower duration (99.56 days) in *Hydrangea macrophylla* in growing media combination with Forest soil (Rai) : FYM : Vermicompost (2:1:1v/v).

5.3 POTTING MEDIA ANALYSIS

The ideal pH, EC, WHC (6.1, 0.64dsm^{-1},87.85%) respectively were recorded in potting media T_4 - Soil: Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v). Whereas, poor performing potting media treatment T_1 soil as control (7.7, 0.75 dsm^{-1}, 27.59%) before transplanting of chrysanthemum rooted cutting cv. Pusa Sona .While, after completion of flowering ideal pH (7.3), EC (1.47 dsm^{-1}) and higher water holding capacity (97.37%) were recorded in potting media T_4 - Soil: Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v).

Similar findings have been reported by Ahmad *et al.* (2012) in gerbera with growing media consisting Soil : Sand : Mushroom compost (1:1:1v/v) for pH, EC (7.6, 0.73 dsm-^{1}) respectively. The soil pH in the range of 6.5-8.7 has been reported to be the best for the availability of most of the nutrient elements (Jackson, 1979).In light of the suggested EC value less than 0.8 dSm^{-1} as normal and suitable for all crops (Richard, 1954). The water holding capacity of compost amended soil increased compared to the control soil. The gain in water holding capacity occurred only with compost amended of sandy soil but appeared to decrease with compost amendment of clay soils (Krichoff *et al.*, 2003).

5.4 PLANT SURVIVAL (%)

Highest percent plant survival were recorded in T_4 consisting from Soil : Sand: FYM : Vermicompost (2:1:0.5:0.5 v/v) and T_2 (96.70) comprising from Soil : Sand :

FYM (2:1:1, v/v). While, minimum percent plant survival (67.50) was recorded in potting media T_1 - Soil as control.

The overall growth and flowering performance resulted in highest plant survival percent in given media. Similar findings were recorded by Wazir *et al.* (2009) in alstromeria cv. Sel. No. 14 for pot presentability score (72.24 %) in growing media comprising Soil : Sand : Vermicompost : FYM.(1:1:1:1 v/v).

Chapter-6

SUMMARY

An experiment entitled, **"Potting media composition for Pot Mum Chrysanthemum Production (*Dendranthema grandiflora*)"** wereconducted at the top roof of Department of Horticulture, during the year Aug. 2016 to Feb.2017. The experimental treatments comprised of ten potting media. The healthy, disease free and seedlings of *Dendranthema grandiflora* were transplanted into plastic pots of 6 inch size asper the experimental details. Standard cultural practices were followed for raisinga successful crop. The important findings of the present investigationsaresummarizedasbelow:

1. Maximum plant height (20.45cm) and plant spread (15.69 cm), intermodal length (3.27, 4.45cm) at 30,60 days after transplanting, stem diameter (4.43mm),branches plant^{-1}(7.15) were recorded in potting media combination T_4 - Soil :Sand :FYM : Vermicompost (2:1:0.5:0.5, v/v). Which were lowest in potting media T_1- Soil as control on chrysanthemum cv, Pusa Sona whereas, minimum plant height (8.15 cm) and plant spread (9.03 cm) were recorded in the potting media T_1comprising withSoil as control.

2. However, earliest first flower bud appearance (75.3days), bud show colour (83 days), flower bud break(101.5 days), flower diameter (1.91cm), spray plant^{-1}(7.6), flower withering (147.45 days), flower plant^{-1} (51.1), flower weight plant^{-1} (46.54gm),flower durations (45.95) were recorded in potting media combination T_4 - Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5, v/v), which was better than other treatment combination and media soil as control.

3. Potting media - T_4 having Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5 v/v) showed P^H(6.1), Ec (0.64 d s/m), water holding capacity (87.85%) before transplanting and (7.3), (1.47 ds/m) and (97.36%) pH, Ec, water holding capacity respectively after flowering phase in the ideal range and potting media T_1 – soil as control show poor range for pH, Ec (ds m$^{-1)}$ and water holding capacity (8.3), (1.06) and (43.36%) respectively after flowering phase in chrysanthemum cv. Pusa Sona.

4. Further, the highest percent pot survival (96.70%), gross returns (`62855), net returns(`40225), net returns per rupee investment (1.78) were obtained in potting combination T_4 - Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5, v/v). Which was better over rest of treatment combination on chrysanthemum cv. Pusa Sona.

Chapter-7

CONCLUSION

On the basis of the result obtained from the experiment entitled "Potting media Composition for Pot mum Chrysanthemum Production (*Dendranthema grandiflora*)" it may be concluded that among various potting media combination treatment T_4 - Soil:Sand:FYM:Vermicompost(2:1:0.5:0.5 v/v) was found best over all the potting media treatments with respect to plant height (20.45cm), plant spread (15.69cm.) internodal length (3.29cm.)(30DAS),4.54cm(60DAS),stem diameter (4.43mm.), branches plant^{-1} (7.15), days to first bud appearance(75.30), days to bud show color stage (83), days to floral bud break stage(101.50), flower diameter(1.91cm.),spray plant^{-1} (7.60), days to flower withering(149.45), flower plant^{-1} (50.60), flower weight (46.54gm), flower duration (45.95days), pH (6.1), Ec (0.64 d s/m), water holding capacity (87.85%) of potting media before transplanting and (7.3), (1.47 ds/m) and (97.36%) pH, EC, water holding capacity respectively after completion of flowering phase, percent plant survival (96.70%). This treatment was also found economically viable resulting in highest gross return of `62855 and net return`40225 and B C ratio 1.78than other treatmentsunder study.

It is mentioned that the present results are only indicative and based on one year of experimentation.Therefore, it is suggested to confirm the result to establish the importance of above conclusion.

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Potting Media Composition for Pot mum Chrysanthemum production (Dendranthema grandiflora) cv. Pusa Sona

Disha Kala* **Research scholar**

Dr. L.N. Mahawer** **Major Advisor**

ABSTRACT

An experiment was conducted at the Horticulture Department, Maharana Pratap University of Agriculture and Technology, Rajasthan College of Agriculture, Udaipur (Raj.) during August, 2016- February to February 2017 to work out themost suitable growing mediafor producing the best quality and most presentable potted Chrysanthemum. Theexperiment was laid out in Completely Randomized Design having 10 treatmentcombinationsofgrowingmediaandreplicated20times.

The potting media - T_4comprising Soil: Sand: FYM:Vermicompost (2:1:0.5:0.5, v/v/v) recorded highest values in terms of plant height, plant spread, internodal length, diameter, number of branches, earliest flower bud appearance(75.30 days), bud show color stage(83 days), floral bud break stage(101.50days),flower diameter,spray plant^{-1}, days to flower withering, flower per plant(51.10), weight of flower (46.54g), flower duration (45.95days), whereas, ideal potting T_4 - comprising Soil : Sand : FYM : Vermicompost (2:1:0.5:0.5, v/v/v) PH(6.1), Ec (0.64 ds m^{-1}) and water holding capacity (87.85%) before transplanting was better than T_1– Soil as control. After completion of flowering phase lowest pH (7.3), higher Ec (1.47) and higher water holding capacity (97.36%) were obtained in T_4Soil : Sand : FYM : Vermicompost(2:1:0.5:0.5, v/v/v) than the T_1 - Soil as controlplant survival (96.67%). The study indicated that most desirable and presentable potted plants of Chrysanthemum can be raised by using soil: sand: FYM : vermicompost (2:1:0.5:0.5, v/v/v) as growing media.

* P.G. Scholar, Department of Horticulture, RCA, Udaipur
** Associate Professor, Department of Horticulture, RCA, Udaipur

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APPENDIX-I

Analysis of variance for plant height (cm)

Source of variance	D.F	S.S	M.S.S	F Calculated value	F tabulated value
Replication	19	192907.62	10153.03	2231.43	
Treatment	9	2286.60	254.06	55.81**	1.98
Error	190	864.90	4.55		
Total	199	196059.42			

****Significant at 5 % level of significance**

APPENDIX-II

Analysis of variance for plant spread (cm^2)

Source of variance	D.F	S.S	M.S.S	F Calculated value	F tabulated value
Replication	19	232380.92	12230.57	1899.15	
Treatment	9	883.76	98.19	15.22**	1.98
Error	190	1225.22	6.44		
Total	199	234489.9			

****Significant at 5 % level of significance**

APPENDIX-III

Analysis of variance for internodal length (cm) at 30 days

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	9896.29	520.85	5425.52	
Treatment	9	68.18	7.56	78.70**	1.98
Error	190	18.28	0.096		
Total	199	9982.75			

****Significant at 5 % level of significance**

APPENDIX-IV

Analysis of variance for internodal length (cm) at 60 days

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	16888.07	888.84	56106.54	
Treatment	9	129.73	14.41	52.84**	1.98
Error	190	51.10	0.301		
Total	199	17068.9			

****Significant at 5 % level of significance**

APPENDIX-V

Analysis of variance for stem diameter (mm)

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	12916.01	13130.89	98728.49	
Treatment	9	186.69	20.74	156.43**	1.98
Error	190	25.19	0.133		
Total	199	129327.89			

****Significant at 5 % level of significance**

APPENDIX-VI

Analysis of variance forbranches plant $^{-1}$

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	33633	1770.15	1500.12	
Treatment	9	320.28	35.58	29.95**	1.98
Error	190	225.70	1.18		
Total	199	34178.98	-		

****Significant at 5 % level of significance**

APPENDIX-VII

Analysis of variance for Days to first bud appearance

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	123214	6484.94	1365.25	
Treatment	9	938.28	104.25	21.92**	1.98
Error	190	903.70	4.75		
Total	199	125055.98	-		

****Significant at 5 % level of significance**

APPENDIX-VIII

Analysis of variance for days to bud show colour

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	14517847	764097.21	81028.33	
Treatment	9	584.22	64.91	6.88**	1.98
Error	190	1792.40	9.43		
Total	199	14520223.6			

****Significant at 5 % level of significance**

APPENDIX-IX

Analysis of variance for floral bud break stage

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	24028663	1264666.47	18082.16	
Treatment	9	6579.14	731.016	10.45**	1.98
Error	190	13289.45	69.94		
Total	199	24048531.6	-		

****Significant at 5 % level of significance**

APPENDIX-X

Analysis of variance for flower diameter (cm)

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value	
Replication	19	40338.58	2123.08	106154		
Treatment	9	9.91	1.10	45.08**	1.98	
Error	190	4.64	0.02			
Total	199	40353.13				

****Significant at 5 % level of significance**

APPENDIX-XI

Analysis of variance for spray plant $^{-1}$

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	43569	2293.10	1246.25	
Treatment	9	399.34	37.70	20.44**	1.98
Error	190	350.45	1.84		
Total	199	44318.7			

****Significant at 5 % level of significance**

APPENDIX-XII

Analysis of variance for days to flower withering

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	36292255	1910118.68	136242.41	
Treatment	9	3906.72	434.08	30.95**	1.98
Error	190	2664.15	14.02		
Total	199	36298825.9			

****Significant at 5 % level of significance**

APPENDIX-XIII

Analysis of variance for flowers plant^{-1}

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	2589161	136271.63	9333.67	
Treatments	9	18947.78	2105.30	144.18**	1.98
Error	190	2774.30	14.60		
Total	199	2610883.08			

****Significant at 5 % level of significance**

APPENDIX-XIV

Analysis of variance for flowers weight (g)

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	1330850.02	6886.84	7249.30	
Treatment	9	22648.31	2516.47	2648.29**	1.98
Error	190	180.88	0.95		
Total	199	1353679.21	-		

****Significant at 5 % level of significance**

APPENDIX-XV

Analysis of variance for flower durations (days)

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	1549575	81556.57	2639.37	
Treatment	9	15584.70	1731.63	56.03**	1.98
Error	190	5871.25	30.90		
Total	199	1571030.95			

****Significant at 5 % level of significance**

APPENDIX-XVI

Analysis of variance for pH before planting

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	97529.49	5133.13	570347.77	
Treatment	9	44.38	4.93	562.32**	1.98
Error	190	1.66	0.009		
Total	199	97575.53			

****Significant at 5 % level of significance**

APPENDIX-XVII

Analysis of variance for pH after planting

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	124014.29	6527.06	1305412	
Treatment	9	36.16	4.019	828.11**	1.98
Error	190	0.92	0.005		
Total	199	124051.37			

****Significant at 5 % level of significance**

APPENDIX-XVIII

Analysis of variance for Ec before planting

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	1360856.16	71624.008	71624008	
Treatment	9	37.78	4.19	3855.04**	1.98
Error	190	0.20	0.001		
Total	199	-	-	-	

****Significant at 5 % level of significance**

APPENDIX-XIX

Analysis of variance for Ec after flowering phase

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	11637.63	612.50	102083.33	
Treatment	9	246.08	27.34	4406.72**	1.98
Error	190	1.17	0.006		
Total	199	11884.88			

****Significant at 5 % level of significance**

APPENDIX-XX

Analysis of variance for water holding capacity before planting

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	1650609	86874.15	68947.73	
Treatment	9	45064.67	5007.18	3973.73**	1.98
Error	190	239.41	1.26		
Total	199	1695913.08			

****Significant at 5 % level of significance**

APPENDIX-XXI

Analysis of variance for water holding capacity after flowering phase

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	10815088	569215.15	412474.74	
Treatment	9	40743.99	4527.11	3259.64**	1.98
Error	190	263.87	1.38		
Total	199	10856095.9			

****Significant at 5 % level of significance**

APPENDIX-XXII

Analysis of variance for plant survival (%)

Source of variance	D.F.	S.S.	M.S.S.	F Calculated value	F tabulated value
Replication	19	10464441.2	550760.05	1776645.16	
Treatment	9	12956.42	1439.60	4590.898**	1.98
Error	190	59.58	0.31		
Total	199	10477457.1			

****Significant at 5 % level of significance**

APPENDIX-XXIII
QUANTITY ANALYSIS OF TREATMENTS

1. Media quantity used in treatment -

Particulars	**Treatment input required (kg)**									
	T_1	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**	**T_{10}**
Soil quantity	1500	750	750	750						375
Sand quantity		400	400	400		400	400	200		400
FYM quantity		170		85		170		85		
Vermicompost quantity			160	80			160	80		
Cocopeat quantity					54	27	27	27	36.	27
Perlite quantity									60	
Vermiculite quantity									63	

APPENDIX-XXIV
TREATMENT COST ANALYSIS

Particulars (`/kg)	**Total treatment cost (`)**									
	T_1	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**	**T_8**	**T_9**	**T_{10}**
Soil cost(0.3`/kg)	450	225	225	225						113
Sand cost (1.25`/kg)		500	500	500		500	500	250		500
FYMcost (1.5`/kg)		255		128		255		128		
Vermicompost cost(6.5`/kg)			1040	520			1040	520		
Cocopeat cost(80`/kg)					4320	2160	2160	2160	2880	2160
Perlite cost (85`/kg)									5100	
Vermiculite cost (65`/kg)									4095	
Cutting (5`/cutting)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Pot cost(12`/pot)	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
Management cost (2.2`/pot)	2200	2200	2200	2200	2200	2200	2200	2200	2200	2200
Total cost	19650	20130	20965	20573	23520	22115	22900	22258	31275	21973
10% interest on total cost	1965	2013	2096	2057	2352	2211	2290	2225	3128	2197
Total cost	21615	22193	23062	22630	25872	24327	25190	24484	34403	24170
Pot survival	675	967	935.3	967	935.3	935	936	904	905	933
Pot selling price	50	60	60	65	60	60	60	60	60	60
Gross return	33750	58020	56100	62855	56100	56100	56160	54240	54300	55980
Net return	12135	35827	33038	40225	30228	31773	30970	29756	19897	31810
B : C ratio	0.56	1.62	1.43	1.78	1.17	1.30	1.23	1.22	0.58	1.32