

**“EFFECT OF DIFFERENT POT MIXTURE ON GROWTH
AND FLOWER YIELD OF TUBEROSE (*Polianthes tuberosa*
Linn.)”**

M.Sc. (Hort.) THESIS

by

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**DEPARTMENT OF FLORICULTURE AND LANDSCAPE
ARCHITECTURE
COLLEGE OF AGRICULTURE
INDIRA GANDHI KRISHI VISHWA VIDYALAYA
RAIPUR (C.G.)**

2021

**“EFFECT OF DIFFERENT POT MIXTURE ON GROWTH
AND FLOWER YIELD OF TUBEROSE (*Polianthes tuberosa*
Linn.)”**

Thesis

Submitted to the

Indira Gandhi Krishi Vishwavidyalaya, Raipur

by

AMAR PRAKASH

IN PARTIAL FULFILMENT OF THE REQUIREMENT

FOR THE DEGREE OF

Master of Science

In

Horticulture

(Floriculture and Landscape Architecture)

U.E. ID No. 20192581

ID No. 20192581

October, 2021

CERTIFICATE – I

This is to certify that the thesis entitled “**Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)**” submitted in partial fulfilment of the requirements for the degree of “**Master of Science in Horticulture**” of the Indira Gandhi Krishi Vishwavidyalaya, Raipur, is a record of the bonafide research work carried out by **Amar Prakash** under my guidance and supervision. The subject of the thesis has been approved by Student’s Advisory Committee and Director of Instructions.

No part of the thesis has been submitted for any other degree or diploma or has been published/published part has been fully acknowledged. All the assistance and help received during the course of the investigations have been duly acknowledged by him.

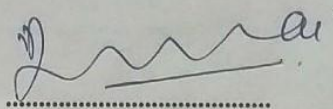
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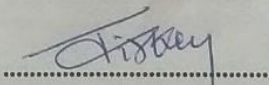
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THESIS APPROVED BY THE STUDENT’S ADVISORY COMMITTEE

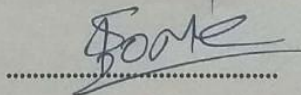
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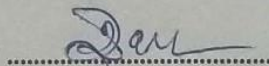
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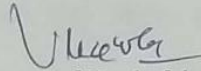


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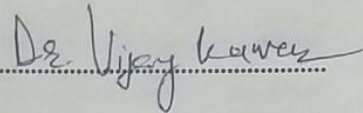
CERTIFICATE – II

This is to certify that the thesis entitled “**Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)**” submitted by **AMAR PRAKASH** to the Indira Gandhi Krishi Vishwavidyalaya, Raipur, in partial fulfilment of the requirement for the degree of **Master of science** in the **Department of Floriculture and Landscape Architecture** has been approved by the external evaluator and Student’s Advisory committee after oral examination, under the chairmanship of the Head of department



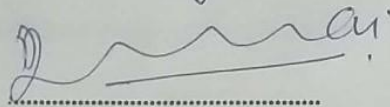
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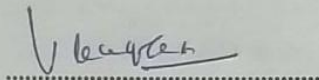


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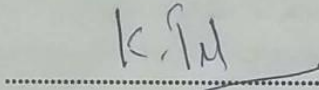
Major Advisor



Head of the Department



Faculty Dean



Approved/Not approved

.....

Director of Instructions

.....

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Date: 02-02-22*



(AMAR PRAKASH)

TABLE OF CONTENT

Chapter	Title	Page No.
	ACKNOWLEDGEMENT	
	TABLE OF CONTENTS	
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF PLATES	
	LIST OF APPENDICES	
	LIST OF NOTATIONS/SYMBOLS/ABBREVIATION	
	ABSTRACT	
I	INTRODUCTION	1-3
II	REVIEW OF LITERATURE	4-8
	2.1 Effect of pot mixture on vegetative growth	4
	2.2 Effect of Pot mixture on flowering characters	6
	2.3 Effect of pot mixture on bulb and bulblet parameters	7
	2.4 Benefit cost ratio of treatment	8
III	MATERIALS AND METHODS	9-26
	3.1 Experimental site	9
	3.2 Location and climate	9
	3.3 Experimental details	11
	3.4 Methodology	14
	3.4.1 Materials used	14
	3.4.2 Soil	14
	3.4.3 Sand	15
	3.4.4 Farm yard manure	15
	3.4.5 Vermicompost	15
	3.4.6 Goat manure	15
	3.4.7 Leaf manure	16
	3.4.8 Paddy straw compost	16
	3.5 Cultural operations	19
	3.5.1 Plant material	19
	3.5.2 Pot filling	19
	3.5.3 Planting and irrigation	20
	3.5.4 Weeding	20
	3.5.5 Plant protection	20
	3.5.6 Uprooting of bulb	20
	3.5.7 Separation, curing, grading and storage of bulb	20

Chapter	Title	Page No.
3.6	Observations recorded	21
3.6.1	Growth parameters	21
3.6.1.1	Plant height (cm)	21
3.6.1.2	Plant spread (cm)	21
3.6.1.3	Number of tillers plant ⁻¹	21
3.6.1.4	Number of leaves plant ⁻¹	22
3.6.1.5	Leaf length (cm)	22
3.6.2	Flower Parameters	22
3.6.2.1	Days to spike emergence	22
3.6.2.2	Days to opening of first floret	22
3.6.2.3	Flowering duration (days)	22
3.6.2.4	Spike length (cm)	22
3.6.2.5	Rachis length	22
3.6.2.6	Number of florets spike ⁻¹	23
3.6.2.7	Length of floret (cm)	23
3.6.2.8	Diameter of florets (cm)	23
3.6.2.9	Weight of 100 florets (g)	23
3.6.2.10	Number of spikes per pot / Number of spikes per clump	23
3.6.2.11	Loose flower yield per pot	23
3.6.3.	Bulb and bulblet Parameters	24
3.6.3.1	Number of bulbs per clump	24
3.6.3.2	Number of bulblets per clump	24
3.6.3.3	Diameter of bulb (cm)	24
3.6.3.4	Diameter of bulblet (cm)	24
3.6.3.5	Length of bulb (cm)	24
3.6.3.6	Length of bulblet (cm)	25
3.6.3.7	Weight of individual bulbs (g)	25
3.6.3.8	Weight of individual bulblet (g)	25
3.7	Economics of the treatment	25
3.8	Statistical analysis	26
IV RESULT AND DISCUSSION		27-60
4.1	Growth parameters	27
4.1.1	Plant height (cm)	27
4.1.2	Plant spread (N-S) (cm)	28
4.1.3	Plant spread (E-W) (cm)	28
4.1.4	Number of tillers plant ⁻¹	29
4.1.5	Number of leaves plant ⁻¹	30
4.1.6	Leaf length (cm)	30
4.2	Flower parameters	37
4.2.1	Days to spike emergence	37

Chapter	Title	Page No.
4.2.2	Days to opening of first floret	37
4.2.3	Flowering duration (days)	38
4.2.4	Spike length (cm)	38
4.2.5	Rachis length (cm)	38
4.2.6	Number of florets spike ⁻¹	39
4.2.7	Length of floret (cm)	40
4.2.8	Diameter of florets (cm)	45
4.2.9	Weight of 100 florets (g)	46
4.2.10	Number of spikes per pot / Number of spikes per clump	46
4.2.11	Loose flower yield per pot	47
4.3	Bulb parameters	52
4.3.1	Number of bulbs per clump	52
4.3.2	Number of bulblets per clump	52
4.3.3	Diameter of bulb (cm)	53
4.3.4	Diameter of bulblet (cm)	53
4.3.5	Length of bulb (cm)	54
4.3.6	Length of bulblet (cm)	54
4.3.7	Weight of individual bulbs (g)	54
4.3.8	Weight of individual bulblet (g)	55
4.4	Benefit cost ratio of treatment	59
V	SUMMARY AND CONCLUSION	61-68
VI	REFERENCES	69-75
VII	APPENDICES	76-81
VIII	RESUME	82

LIST OF TABLES

Table	Title	Page
3.1	Details of the experiment	12
3.2	Average nutrient content of potting mixture used for the experiment	19
4.1.1. (a)	Effect of different pot mixture on vegetative growth parameters of tuberose	32
4.1.1. (b)	Effect of different pot mixture on vegetative growth parameters of tuberose	32
4.2.1. (a)	Effect of different pot mixture on flower and flower yield parameters of tuberose	41
4.2.1. (b)	Effect of different pot mixture on flower and flower yield parameters of tuberose	42
4.2.1. (c)	Effect of different pot mixture on flower and flower yield parameters of tuberose	49
4.3.1 (a)	Effect of different pot mixture on bulb and bulblets parameters	56
4.3.1 (b)	Effect of different pot mixture on bulb and bulblets parameters	57
4.4.1.	The cost economics of different treatments used in tuberose cultivation in pot.	60

LIST OF FIGURES

Table	Title	Page
3.1	Details of the experiment	10
3.2	Average nutrient content of potting mixture used for the experiment	13
4.1	Effect of different pot mixture on plant height of tuberose	34
4.2	Effect of different pot mixture on plant spread (N-S) (cm) of tuberose	34
4.3	Effect of different pot mixture on plant spread (E-W) (cm) of tuberose	35
4.4	Effect of different pot mixture on number of tillers plant of tuberose	35
4.5	Effect of different pot mixture on number of leaves plant ⁻¹ of tuberose	36
4.6	Effect of different pot mixture on leaf length (cm) of tuberose	36
4.2.1	Effect of different pot mixture on day to spike emergence of tuberose, days to opening of first florets and flowering duration	43
4.2.2	Effect of different pot mixture on spike length (cm) of tuberose	43
4.2.3	Effect of different pot mixture on rachis length (cm) of tuberose	44
4.3.4	Effect of different pot mixture on number of floret spike ⁻¹ of tuberose	44
4.3.5	Effect of different pot mixture on length of florets (cm) of tuberose	45
4.3.6	Effect of different pot mixture on diameter of florets (cm) of tuberose	50
4.3.7	Effect of different pot mixture on weight of 100 florets (g) of tuberose	51
4.3.8	Effect of different pot mixture on number of spike per pot / number of spikes per clump of tuberose	51
4.3.9	Effect of different pot mixture on loose flower yield per pot of tuberose	52
4.3.1 (A)	Effect of different pot mixture on bulb and bulblets parameters	58
4. 4.3.1 (b)	Effect of different pot mixture on bulb and bulblets parameters	58

LIST OF PLATES

Plates	Titles	Page No.
3.1	A view of filled pot with media combination	14
3.2	A view of different pot mixture	18
3.3	A view of effect of different pot mixture on vegetative growth in tuberose	21
3.4	A view of effect of different pot mixture on flower growth in tuberose	24
3.5	A view of observation of Plant height (cm), spike length (cm) and rachis length (cm) in tuberose	48

LIST OF APPENDICES

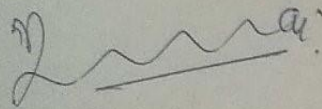
Appendix	Title	Page No.
I.	Weekly meteorological data prevailing during crop growth period (24 December 2020 to July 2021)	76
II.	Economics of various treatments used in tuberose cultivation in pot	79

LIST OF NOTATIONS/SYMBOLS AND ABBREVIATIONS

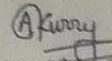
Symbols/ Notations/Abbreviations	Description
%	Percent
@	At the rate of
°C	Degree Celsius
DA P	Days after Planting
<i>et al</i>	And others
Fig.	Figure
gm	Gram
B:C ratio	Benefit cost ratio
lt	Liter
kg	Kilogram
m	Meter
ha	Hectare
i.e.	That is
t	Tones
No.	Number
m ²	Square meter
NPK	Nitrogen, Phosphorus, Potassium
FYM	Farm Yard Manure
N	North
S	South
E	East
W	West
E.C.	Electrical Conductivity
Cm	Centimetre
VC	Vermicompost
GM	Goat manure
LM	Leaf manure
PSC	Paddy straw compost

THESIS ABSTRACT

- a) Title of the Thesis : "Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)"
- b) Full Name of the Student : Amar Prakash
- c) Major Subject : Floriculture and Landscape Architecture
- d) Name and Address of the : Dr. Deo Shankar
Major Advisor
Senior Scientist, Dept. of Floriculture and
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College of Agriculture, IGKV, Raipur
(Chhattisgarh)
- e) Degree to be Awarded : Master of Science in Horticulture
(Floriculture and Landscape
Architecture)

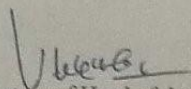


Signature of Major Advisor



Signature of the Student

Date: 02-02-2022


Signature of Head of the Department

ABSTRACT

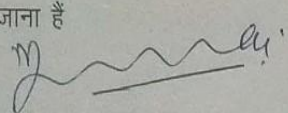
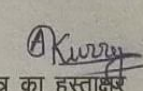
The present research entitled "Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)" was carried out

During 2020-21 at the Horticultural Research cum Instructional Farm, College of Agriculture, IGKV, Raipur, and the experiment used a Completely Randomized Design (CRD) with 12 treatments and three replications comprising of pot mixture.

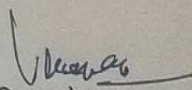
All the pot mixture treatments studied recorded superior vegetative and flower yield attributes over control. The observations showed that maximum plant height (74.82 cm), plant spread (N-S) 46.00 cm, plant spread (E-W) 47.75 cm, number of tillers plant⁻¹ (6.23) and number of leaves plant⁻¹ (56.50) was recorded in T₆ Soil + Sand + FYM + VC (1:1:1:1).

The minimum day to opening of first florets (147.67 days) was recorded T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1). The maximum spike length (67.40 cm), number of florets spike⁻¹ (29.33), weight of 100 florets (88.67 g), loose flower yield per pot (43.63 g), number of spike per pot (1.76), diameter of bulb (3.67 cm) and diameter of bulblets (1.87 cm)) was recorded in T₆ Soil + Sand + FYM + VC (1:1:1:1). The highest B : C ratio (1 : 1.26) was obtained in treatment T₄ Soil + Sand + LM (1:1:1).

शोध सारांश

- अ) शोध का शीर्षक : "रजनीगंधा की वृद्धि और फूलों की उपज पर विभिन्न गमलों के मिश्रण का प्रभाव (पोलिंएन्थेस ट्यूबेरोजा लीन.)"
- ब) छात्र का पूरा नाम : अमर प्रकाश
- स) प्रमुख विषय : पुष्प विज्ञान एवं भू-दृश्य वास्तुकला
- द) प्रमुख सलाहकार का नाम और पता : डॉ. देव शंकर
वरिष्ठ वैज्ञानिक, पुष्प विज्ञान एवं भू-दृश्य वास्तुकला, कृषि महाविद्यालय, इ.गां.कृ.वि., रायपुर छ.ग.
- इ) उपाधि से सम्मनित किया जाना है : एम.एस.सी. (उद्यानिकी)
पुष्प विज्ञान एवं भू-दृश्य वास्तुकला
- प्रमुख सलाहकार का हस्ताक्षर 
- छात्र का हस्ताक्षर 

दिनांक 02-02-22


विभाग के प्रमुख का हस्ताक्षर

शोध सारांश

वर्तमान प्रयोग जिसका शीर्षक "रजनीगंधा की वृद्धि और फूलों की उपज पर विभिन्न गमलों के मिश्रण का प्रभाव (पोलिंएन्थेस ट्यूबेरोजा लीन.) है, बागवानी अनुसंधान सह निर्देश फार्म, कृषि महाविद्यालय, आई.जी.के.वि, रायपुर, छत्तीसगढ़ में 2020-21 के दौरान पूर्ण यादृच्छिक डिज़ाइन (सीआरडी) में 12 उपचार और 3 प्रतिकृतियाँ के साथ उपयोग की गई थी, जिसमें गमलों के मिश्रण शामिल हैं।

सभी गमलों के मिश्रण की उपचारों में दर्ज किये गए बेहतर वनस्पति और फूलों की उपज विशेषताएँ नियन्त्रण से बेहतर हैं। अवलोकनों से पता चला कि अधिकतम पौधे की

ऊंचाई (74.82 सेमी), पौधा प्रसार (उत्तर-दक्षिण) (46.00 सेमी), पौधे का प्रसार (पूर्व-पश्चिम) (47.75 सेमी), प्रति पौधे टिलर की संख्या (6.23) और प्रति पौधों के पत्तियों की संख्या (56.50) जो कि टी₆ मिट्टी + रेत + गोबर खाद + केचुआ की खाद (1:1:1:1)^v दर्ज की गई है।

पुष्पक के जल्दी खुलने का दिन (147.67 दिन) जो कि टी₁₀ मिट्टी + रेत + गोबर खाद + केचुआ की खाद + बकरी की खाद (1:1:1:1:1) में दर्ज किया गया है। अधिकतम फूल डन्डी का लंबाई (67.4 सेमी), प्रति फूल डन्डी पुष्पक की संख्या (29.93), 100 पुष्पक का वजन (88.67), खुला फूलों की उपज प्रति गमला (43.63 ग्राम), प्रति गमला फूल डन्डी की संख्या (1.67), बल्ब का व्यास (3.67 सेमी) और बल्बलेट्स का व्यास (1.87 सेमी) जो कि टी₆ मिट्टी + रेत + गोबर खाद + केचुआ की खाद (1:1:1:1) में दर्ज किया गया है। उच्चतम लाभ : लागत अनुपात (1: 1.26) टी₄ मिट्टी + रेत + पत्ती खाद (1: 1: 1) में प्राप्त किया गया है।

CHAPTER –I

INTRODUCTION

Flowers are an important element of human life because of their diversity in terms of beauty, structure, texture, colour, and scent. Tuberose (*Polianthes tuberosa* Linn.) is a popular Asperagaceae bulbous ornamental plant. This flower is known as Rajanigandha and is used as a cut flower, loose flower, and in perfumery and aromatherapy. Tuberose is a popular bedding and container plant. Arka Sugandhi, a dwarf tuberose variety developed by the ICAR-Indian Institute of Horticultural Research in Hesaraghatta, Bengaluru, is ideal for landscaping and pot mixing. The flower tube is straight, the peduncle is heavily pigmented, and the leaf length is medium (40-50 cm).

The florets are densely arranged on the stalk, with a protruding stigma and an upward aspect with green tinge buds. Demand for flowering and foliage pots has increased opens the door for new fragrant floral pot plants to be introduced. Tuberose is grown for decorative purposes in the garden, such as in pots and borders, as well as for the extraction of essential oil. Tuberose flower spikes stay fresh for a long time and have a particular place in flower marketplaces. Tuberose farming is gaining popularity in our country as a result of its enormous export potential. Tuberose bulbs contain lycorine, an alkaloid that produces vomiting.

Tuberose florets are used to make creative garlands, ornaments, and button holes, while the long spikes are utilized for vase decoration and bouquet preparation. Tuberose oil is extracted from the blooms, which have a pleasant scent. Tuberose flower oil is one of the most expensive raw materials used in the perfume business. Tuberose has a unique place among flowers because of its lovely, elegant, and fragrant white blossoms. Flowers keep for a long time, can with stand long distance transit, and have a useful place in the flower market (Patil *et al.*, 1999).

Tuberose pot plants with attractive leaves and fragrant blossoms can be used as a natural room freshener, indoor air purifier, and green gift (Nair and Bharathi, 2019). Tuberose is a plant that originated in Mexico and spread around the world

during the 16th century. Single, semi-double, and double tuberose cultivars are the most common. When compared to double flowered cultivars, single flowered cultivars are more aromatic and widely utilized for essential oil extraction since the actual percent has been observed to be higher (0.08 to 0.11 percent). These can be used as cut or loose flowers. Its floral buds are a greenish white colour that turns pure white as the flower opens.

Growth standard is known to have effect on value of pot mixture ornamental plants (Vendrame *et al.*, 2005) and the stage an important role in germination rate, and a lot of additional physiological parameters include plant height, number of leafs, leaf length, spike length, number of florets per spike, diameter of spike and yield etc (Vendrame *et al.*, 2005). For cut flower production, the best bulb diameter and planting depth are 2.5-3.5 cm and 6.0 cm, respectively (Hussain, 1999). Different manures provide superior nutrition to plants when applied in combination with soilless substrates; a best growing mixture should have proper aeration, water holding capacity, and adequate nutrition (Khobragade *et al.*, 1997).

Tuberose flower quality is harmed by a variety of pre- and post-harvest conditions including as temperature, relative humidity, irrigation frequency, and nutrition (Benschop, 1993). Tuberose is a simple plant to cultivate and reproduce, with bulbs and clump division being the most common methods of commercial production. The stem is hidden within scales and the bulbs are constructed of leaf bases. The roots are haphazard and shallow.

The present area under floriculture in the Chhattisgarh state is 13,493 ha with the production of 76,219 MT approximately in the year, 2019-20. In Chhattisgarh, Tuberose growing districts are Surguja, Kondagaon, Raipur, Surajpur & Balrampur (Anon., 2019-20).

India's total export of floriculture was Rs. 541.61 Crores in 2019-20. Tuberose was grown commercially in Karnataka, Tamil Nadu, West Bengal, Andhra Pradesh, Assam, Gujarat, Maharashtra, Uttar Pradesh, Punjab, Haryana, and a few areas of Rajasthan. Tuberose is grown on about 7.95 lakh hectares of land in India. Every year, India produces 1560.70 lakh cut flowers and 27.71 million metric tonnes of loose flowers (National Horticultural Board, 2013). Tuberose had an average flower yield of 2-3 lakh cut flower spikes and loose

flowers of 14-15 t.ha.⁻¹ in India. Tuberose bulb and bulblet yields averaged 20-23 t.ha⁻¹ (harvested at the end of the third year). For multiplication, commercial bulbs and common planting material in tuberose bulblets were used. Only the remaining bulbs were available to meet the increasing demand of growers because 30% of the harvested bulbs were used for planting in the same field. (Prasanna *et al.*, 2021).

Limited research work on tuberose pot culture has been carried out in Chhattisgarh, with a focus on the effect of different pot mixtures on growth and the production of high-quality tuberose flowers in pots.

The substrate is important in the development of ornamental plants because it regulates the plant canopy and thus gives the desired visual appearance. According to Vendrame *et al.* (2005), the growing material used in pot plant production has a significant impact on pot plant quality. The ideal plant substrate should have adequate aeration, ample nutrition, and a high water holding capacity. To provide nutrients to the plants, organic manure should be added to the inert substrate (Khan *et al.*, 2006). According to Sardoei *et al.*, (2014), choosing the right media for flowering potted plants is critical for improving their aesthetic value and marketing potential. Tuberose, in addition to being in high demand as a cut flower, offers a lot of potential in the essential oil market (Alan *et al.*, 2009).

Keeping above point in view, the present investigation **“Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)”** was carried out during Rabi season of 2020-21 at the Horticulture Research cum Instructional Farm, Department of Floriculture and Landscape Architecture, Indira Gandhi Krishi Vishwavidyalaya, Raipur with the following objectives:

1. To study the effect of Pot mixture on growth parameters of Tuberose.
2. To study the effect on flower yield and yield attributing parameters of Tuberose.
3. To assess the effect on bulb and bulblet yield of Tuberose.
4. To estimate the cost of economics of different treatments.

CHAPTER –II

REVIEW OF LITERATURE

Nutrition is a crucial part of crop management in order to get a high yield and a high-value produce. The use of inorganic manure has resulted in a nutrient imbalance in the soil, which have harmed soil health and lowered yield and product quality. Green manures and other organic matter, on the other hand, was recover soil texture and increasing of soil fertility Although there has been very little research into the influence of potting mixture under tuberose, the literature scheduled the effect of different pot mixtures under tuberose is extensive. An experiment, “Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)” was conducted to study the information variable on potting media of tuberose and is reviewed under following heads in this chapter.

2.1. Effect of pot mixture on vegetative growth

Vendrame *et al.* (2005) conducted a research on six growing substrates and different bedding plants were compared with different compost percentages. Plant quality differed between the substrates and species studied, with no discernible effect of the compost proportion in the substrate. All of the plants in Fafard #2 had the lowest quality rates, indicating poor salability. Growers may find compost useful as a component of substrates for cultivating ornamental bedding plants, according to the findings.

Kiran *et al.* (2007) revealed that the potting media combination of sand + silt + leaf mould was found most suitable for parameters like plant height (42.08 cm), number of branches plant⁻¹ (3.6). The media leaf mould alone has given significant effect on maximum number of leaves plant⁻¹ (42.55).

Younis *et al.* (2008) conducted an experiment on growing media. The higher values for length of shoot, number of leaves and number of branches were recorded in T₂, where leaf manure was utilized, according to the results. Leaf manure outperformed other media as a growth medium for *Dahlia coccinia*.

Sandeep *et al.* (2011) studied different potting mixture in cosmos, where vermicopost + coarse sand + soil (2:2:1) was found efficient in increasing plant

height, plant spread, number of leaves plant⁻¹, number of branches plant⁻¹, stem diameter, length of leaf and leaf breadth.

Ikram *et al.* (2012) studied several growing media to see how they affected the tuberose's morphological attributes and vase life. In sand + FYM, the most no of leaves were recorded. To the most extreme estimate of plant height, coconut coir + FYM were added.

Mehmood *et al.* (2013) conducted a study on *Antirrhinum majus* L. in Faisalabad, researchers discovered that potting medium with top soil + leaf mould + silt (1:1:1) produced better plant height (13.5 cm), fresh weight (63.41 gm), flower diameter (0.98 cm) and blossoms plant⁻¹ (22.83). (Pakistan).

Anjana *et al.* (2017) conducted a study in which four cultivars were tested in a shade net environment with four different growing conditions. Growing material included coco-peat, vermi-compost and FYM within different amounts. Media containing coco-peat + vermin-compost + FYM in 1:2:1, (v/v) grouping highest leaf area (85.93 cm²) and root length (21.1 cm) were recorded in *Rustifolia*' and maximum leaf area (85.93 cm²) and root length (21.1 cm) in *Petra* were recorded with the media containing coco-peat + vermi-compost + FYM in 1:1:2, (v/v) combination.

Nair and Bharathi (2019) conducted a study on eight different tuberose varieties, comparing them to traditional soil base mixture. The substrate combination of coco-peat + soil + sand + FYM (1:1:1:1 v/v) was determined selected as the best suited media used for tuberose var. *Arka Sugandhi* pot plant production, with the highest number of spikes plant⁻¹ (4.87) and spike longevity (35.42 days).

Singh *et al.* (2020) examined six different potting media in an experiment. The results showed that Sand + Coco-peat + Perlite (1:1:1) had significantly superior rooting than the control, as well as all extra parameters related to rooting cutting, such as days to opening of first sprout (8.66 days), no. of vegetative buds plant⁻¹ (4.0), cutting survival percentage (100 percent), longest length of shoot (44.75 cm), fresh wt. of shoots plant⁻¹ (22.23 g) and dry wt. of shoots plant⁻¹ (7.41 g).

2.2. Effect of pot mixture on flowering characters

Mehwish *et al.* (2007) carried out an experiment on seven different growing media. Plant height (42.08 cm), stem thickness (1.93 cm), number of branches plant⁻¹ (3.6), minimum days to flowering (91.66), number of flowers plant⁻¹ (10.6), number of petals flower⁻¹ (13), diameter of flower (8.8 cm) and vase life of flower were all recorded as having the best overall performance in the media sand + silt + leaf mould (5 days).

Shankar *et al.* (2010) carried out an experiment, where tuberose generated the longest spike length (77.70 cm) and the most spikes plant⁻¹ when treated with vermicompost and PSB at 1 kg/m² with 2 g/bulb, correspondingly (1.49 and 1.49, respectively).

Chauhan *et al.* (2014) reported that gerbera under protected conditions' grown in media containing normal soil, rice husk, coco-peat, caster cake, and vermin-compost were used (1:1:1:1:1) higher plant height (22.93 cm), plant spread (34.49 cm), flower diameter (12.03 cm), flower stalk length (54.59 cm), and vase life are all better (10.31 days).

Kameshwari *et al.* (2014) indicated that alternative potting material would be suitable for cultivating chrysanthemum var. Punjab Anuradha. Higher branches plant⁻¹ (9.38), gross plant spread (23.53 cm), plant height (39.69 cm), spray length (26.58 cm), floral period (41.7 days) and highest number of flower plant⁻¹ (72.22). Were observed in the potting media cocopeat + sand + farm yard manure + vermicompost (2: 1: 0.5: 05 v / v). In terms of nutritional content, however, soil + sand + FYM + vermicompost outperformed soil + sand + FYM + vermicompost.

Rao *et al.* (2015) conducted a research on tuberose' which were treated with 75 percent RDF in combination with farm yard manure, vermicompost, Azospirillum, and phosphate solubilizing bacteria, produced the highest number of spikes plant⁻¹ (2.33), as well as enhanced spike length, rachis length, and spike florets.

Chauhan *et al.* (2005) laid out an experiment in which the application of vermicompost @ 1000 g per m² in marigold showed the highest number of flower buds plant⁻¹, wt. of individual flower and yield of flower per m².

Padaganur *et al.* (2005) discovered that using 3 kg vermin-compost per m² in combination with 50 percentage RDF within tuberose resulted in a greater flower spike yield.

Srivastava *et al.* (2014) revealed that using 2 kg vermicompost per m² produced the highest output of spikes per m² in tuberose cv. Shrinagar.

2.3 Effect of pot mixture on bulb and bulblet Parameters

Kabir *et al.* (2011) conducted an experiment on integrated nutrient management the found that length of bulb and diameter within tuberose cv. Single was superior when organic fertilizers were used in conjunction with half chemical fertilizers than when only chemical fertilizers were used.

Tripathi *et al.* (2012) carried out an experiment on tuberose cv. Single, which was treated with 75 percent RDF + 500q FYM + 250q vermicompost ha⁻¹ had produced the highest weight of bulbs (131.87 and 132.63 g), more number of bulbs per clump (7.70 and 7.767) and high bulb yield (52.60 and 53.10 t. ha⁻¹)

Jamail *et al.* (2016) studied different potting media in hippeastrum. Potting media combination of rice husk and cow-dung by a 1:1 ratio supplemented through 10 g per pot (30 cm) of TSP and MP was create to be the greatest for larger flower (14.20 x 13.70 cm) and flower scape (44.40 x 27.30 cm), highest number (7.4 cm) and weight (252.5 g) of bulblets, maximum diameter (76.0 mm) and weight (218.4 g) of mother bulb. The potting media with a 1:1:1:1 ratio of soil, rice husk, cowdung, and coirdust supplemented with 10 g each of TSP and MP had the highest number of flowers per scape (3.8) and the longest flowering time (11.60 days).

Rajera *et al.* (2017) carried out an experiment on seven emergent LA hybrids bulbs when grown in M1 - sand + soil + FYM, (1:1:1, v/v), the number of bulbs, diameter of bulb, weight of bulb, number of bulblets, diameter of bulblet, and weight of bulblet were best reported. Sand + Soil + FYM (1:1:1, v/v) is ideal for bulb/bulblet development in LA hybrid lilies. Growth

Chaudhary *et al.* (2018) conducted a research on lilium and found that the highest number of bulblets, weight of the bulb and bulblets, and diameter of the bulb and bulblets were seen in cocopeat and vermiculite, either with perlite or soil.

2.4. Benefit cost ratio of treatment

Gawali *et al.* (2016) carried out an economic analysis of Chrysanthemum production, it was discovered that the per hectare cultivation cost was rupees 86741.25, the gross return and net profit per hectare was rupees 294986.16 and rupees 108244.91, the B:C ratio was 1.57, and the per quintal cultivation cost was rupees 3224.38.

Kulkarni *et al.* (2017) showed that the treatment (T₈) containing media 10 Cocopeat 40 percent + Red soil 30 percent + FYM. 20 percent + Sand 10 percent combination had the highest benefit cost ratio (B:C ratio) (3.17 and 3.37 in two years), while the treatment containing media red soil 80 percent + sand 20 percent combination had the lowest (1.80 and 1.94). For two years, the treatment (T₈) generated highest net returns of Rs. 7, 01, 236 and Rs. 7, 11,124 in 560 m² areas.

CHAPTER –III

MATERIALS AND METHODS

The present research entitled, “**Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)**” executed in Horticultural nursery, College of Agriculture, IGKV, Raipur (C.G.), inception during 2020-21.

3.1 EXPERIMENTAL SITE:

The field experiment was performed during the year 2020-2021 at the Horticultural nursery, College of Agriculture, IGKV, Raipur (C.G). The material and methods of the investigation are enlightened in this chapter momentarily.

3.2 LOCATION AND CLIMATE:

The place of investigation is located in Raipur which is situated at 21° 23° N latitude and 81° 71° E longitude in the Central region of Chhattisgarh with an elevation of 291 m above the mean sea level (MSL). Raipur has a wet and dry tropical climate. The annual rainfall of around 1300 mm, mostly from late June to early October in the monsoon season. During the period of study the mean temperature ranged from 28.3°C to 40.57°C while the minimum temperature ranged from 10.3°C to 27.28°C. The highest and minimum relative humidity varied from 51.83 % to 89% and 38% to 27%. The total value of sunshine ranged from 3.2 days to 9.9 days-1. Throughout the experiment, weekly meteorological data measurements from 24 December 2020 to July 2021 were illustrated in Fig 3.2.AppendixI.

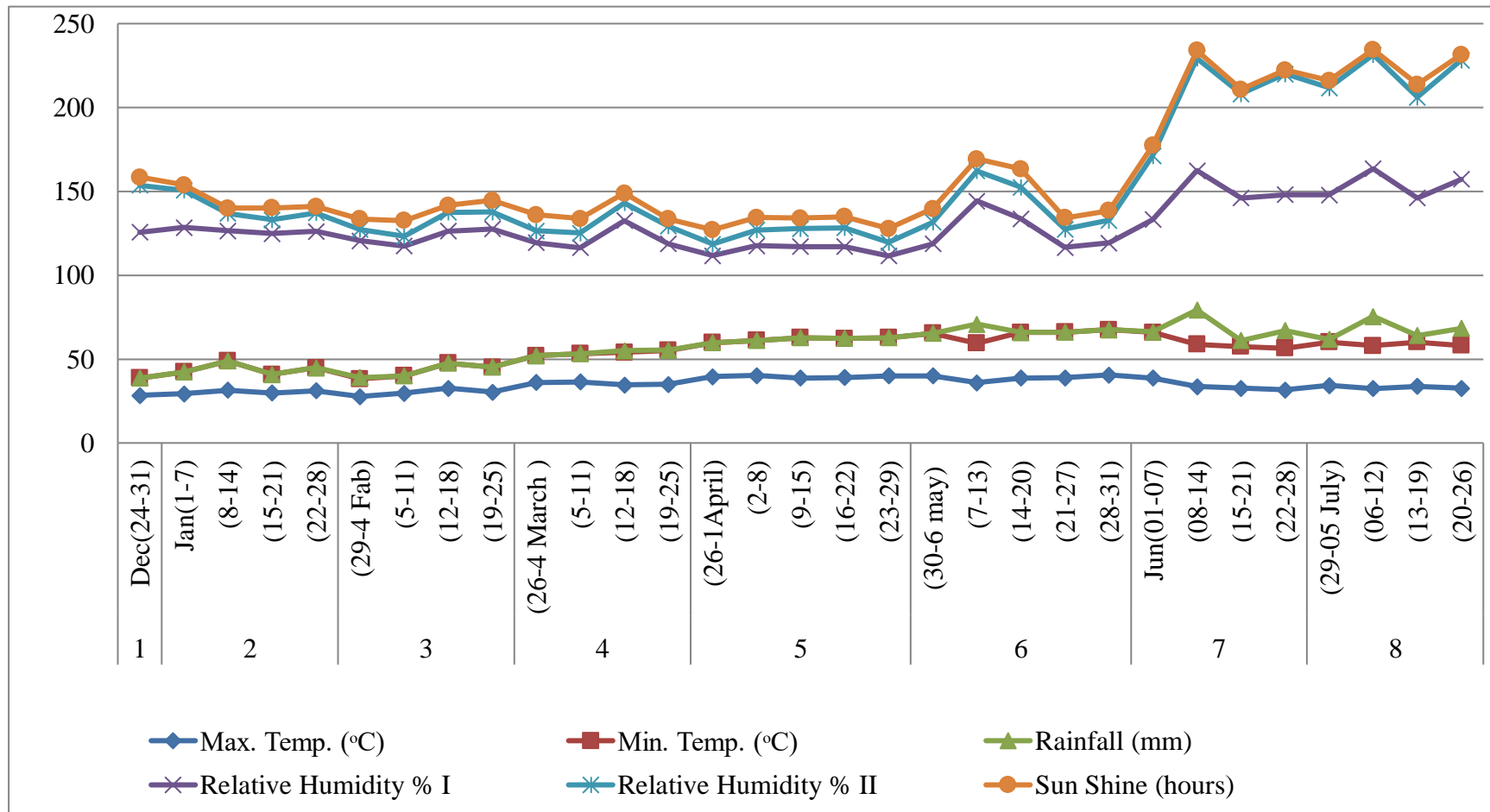


Fig.3.1. Weekly meteorological observation during the crop growth period 24 December 2020 - July 2021.

3.3 EXPERIMENTAL DETAILS:

Name of crop	: Tuberose (<i>Polianthes tuberosa</i> Linn.)
Name of variety	: Arka Sugandhi
Season/year	: Rabi Season (2020-21)
Design of experiment	: Completely Randomized Design
No. of treatments	: 12
No. of replication	: 03
Total number of pots	: 72
Size of pots	: 20 cm

Table 3.1. Treatment Details:

S.No	Treatment	Treatment details
1.	T ₁	Soil + Sand + FYM (1:1:1) Control
2.	T ₂	Soil + Sand + VC (1:1:1)
3.	T ₃	Soil + Sand + GM (1:1:1)
4.	T ₄	Soil + Sand + LM (1:1:1)
5.	T ₅	Soil + Sand + PSC (1:1:1)
6.	T ₆	Soil + Sand + FYM+VC (1:1:1:1)
7.	T ₇	Soil + Sand + FYM + GM (1:1:1:1)
8.	T ₈	Soil + Sand + FYM + LM (1:1:1:1)
9.	T ₉	Soil + Sand + FYM + PSC (1:1:1:1)
10.	T ₁₀	Soil + Sand + FYM + VC + GM (1:1:1:1:1)
11.	T ₁₁	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)
12.	T ₁₂	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)

FYM = Farm Yard Manure, VC = Vermicompost, GM = Goat Manure, LM = Leaf Manure, PSC = Paddy Straw Compost.

R_1	R_2	R_3
T ₁	T ₇	T ₁₂
T ₂	T ₈	T ₁₁
T ₃	T ₉	T ₁₀
T ₄	T ₁₀	T ₉
T ₅	T ₁₁	T ₈
T ₆	T ₁₂	T ₇
T ₇	T ₁	T ₆
T ₈	T ₂	T ₅
T ₉	T ₃	T ₄
T ₁₀	T ₄	T ₃
T ₁₁	T ₅	T ₂
T ₁₂	T ₆	T ₁

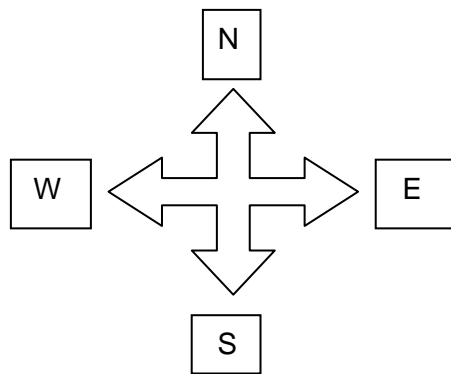


Fig.3.2. Layout and randomization of the experiment



Plate.3.1. A view of filled Pots with pot mixture combination

3.4. METHODOLOGY:

3.4.1. Materials used

As source of nutrients only organic manure were used to meet the nutritional needs of the crop. Cleaning of the pot constituents was done by removing the stones, pebbles and unwanted materials present in it. Seven potting mixture combinations were prepared as per treatment details after thoroughly mixing of various ingredients on used in same quantities and required ratios basis viz., Soil + Sand + FYM (1:1:1) Control, Soil + Sand + VC (1:1:1), Soil + Sand + GM (1:1:1), Soil + Sand + LM (1:1:1), Soil + Sand + PSC (1:1:1), Soil + Sand + FYM+VC (1:1:1:1), Soil + Sand + FYM + GM (1:1:1:1), Soil + Sand + FYM + LM (1:1:1:1), Soil + Sand + FYM + PSC (1:1:1:1), Soil + Sand + FYM + VC + GM (1:1:1:1:1), Soil + Sand + FYM + LM + PSC (1:1:1:1:1) and Soil + Sand + FYM + GM + PSC (1:1:1:1:1). Slow release fertilizer (19:19:19 of NPK) at the rate of 5 g per pot was applied to the substrate at quarterly intervals. Prepared media combinations were filled in 8 inch pot by leaving 2 inch place for, irrigation & intercultural operations while transplanting.

3.4.2 Soil

It is the most popular, readily available, and inexpensive growing medium. The loam soil was mixed in 1:1 ratio with additional potting materials such as lightly drained clay and fine parts, with fine small broken clay being favored for growth. Because of their sheet structure and enormous surface area, loam soils can absorb

and hold large amounts of water. Growing seeds in such conditions makes it easier to uproot seedlings when necessary.

3.4.3. Sand

Sand is made up of tiny grains that form as rocks wither. Sand is used fine and dry in a one-to-one ratio in potting to provide optimum moisture absorption by the plant. It's devoid of any organic stuff or nutrition. As a result, sand culture is commonly utilized in nutritional investigations to avoid bias in the results caused by the growing medium's nutritional quality. Sand has a water retention capacity of zero. When utilizing it as a seed and cutting growing medium, it's best to combine it with organic materials like compost, leaf litter, and so on.

3.4.4. Farm yard manure

It is made up of farm animal faeces and urine, as well as litter and scraps from roughages or other greens provided to the animals. Normally, animal manure and urine, as well as their litter and waste feed, are collected daily and placed in a trench, which is then filled up and covered with soil. When it is regarded usable in the field, it decomposes in two to three months. Well decomposed black and brown colour cow dung is utilized in a 1:1 ratio and is accessible in big quantities with nutritious content and absorbs water well. All of the potting combinations included soil, sand, and farm yard manure. They boost the amount of nutrients available.

3.4.5. Vermicompost

It is made up of farm animal faeces and urine, as well as litter and scraps from roughages or other greens provided to the animals. Normally, animal manure and urine, as well as their litter and waste feed, are collected daily and placed in a trench, which is then filled up and covered with soil. When it is regarded usable in the field, it decomposes in two to three months. Well decomposed black and brown colour cow dung is utilized in a 1:1 ratio and is accessible in big quantities with nutritious content and absorbs water well. All of the potting combinations included soil, sand, and farm yard manure. They boost the amount of nutrients available.

3.4.6. Goat manure

Goat droppings have a higher nutritional content than farmyard manure and compost. Brown tint that has decomposed well and a 1 ratio that was employed in

the pot. It has two applications in the field. Sweepings from goat stalls are placed in trenches to decompose and then applied to the field afterwards. This procedure wastes the nutrients found in the urine. The second approach is sheep penning, which involves keeping sheep and goats overnight in the field and incorporating urine and faeces into the soil using a working blade harrow or cultivator to a shallow depth.

3.4.7. Leaf Manure

Leaf manure is one of the more nutrient-dense types of manure that adds beneficial elements to the soil. Dry tree leaves, which are a good source of nitrogen, are the principal constituent in Leaf Manure. These leaves are combined with freshly cut grass and other green wastes to create a nourishing manure mix. It is well decomposed and utilized in a one-to-one ratio in the pot.

3.4.8. Paddy straw compost

After organic resources such as crop residues and animal manure degrade, compost is the relatively stable substance that follows. Compost usually has a low concentration of key nutrients. During composting, carbon (C) is reduced and other nutrients are concentrated. Crop leftovers are composted to make a superior organic fertilizer. Organic fertilizers, such as rice compost, are frequently low in main nutrients like nitrogen (N) and phosphorus (P), but they can be extremely beneficial since they contain micronutrients, enzymes, and microorganisms that inorganic fertilizers often lack. Potassium is abundant in rice straw (K). Paddy straw compost has the potential to improve soil quality.



Soil



Sand



Farm yard manure



Vermicompost



Leaf manure



Goat manure



Paddy straw compost

Plate.3.2 A view of different pot mixture

Table3.2. Average Nutrient Content of potting mixture used for the experiment

S. no.	Name of potting mixture	Nutrient content (%)		
		N	P ₂ O ₅	K ₂ O
1.	Soil	112.89	5:00	204:00
2.	Sand	25.08	3:00	5.82
3.	Farm yard manure	0.52	0.60	0.55
4.	Vermicompost	1.82	0.61	0.83
5.	Goat manure	1.91	0.56	1.06
6.	Leaf compost	0.98	0.07	0.04
7.	Paddy straw compost	0.80	0.17	0.48

3.5. CULTURAL OPERATIONS:

3.5.1. Plant material

Tuberose cv. Arka Sugandhi was chosen for this experiment. This cultivar was developed at ICAR-Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru released a dwarf tuberose variety Arka Sugandhi that's perfect for landscaping and pot culture. The flower tube shape is straight, pigmentation on peduncle is strong and leaf length is medium 40-50 cm. The flowers are very attractive with protruding stigma, upward looking with green tinged buds and the florets are compactly arranged on the stalk.

3.5.2. Pot filling:

In the pot with pre-punched bottom holes for drainage, various treatments containing different media were filled.

3.5.3. Planting and irrigation:

The bulb of tuberose was planted in pot on 24 December 2020 after filling the pot with various growing media. After planting plants were further watered and subsequently irrigated on alternate days during the entire crop period.

3.5.4. Weeding

During the entire crop growth period weeding has been carried out and when it required.

3.5.5. Plant protection

Plant protection chemicals were applied as and when any disease/pest is observed. No prophylactic plant protection measures were adopted by applying chemicals.

3.5.6. Uprooting of bulb

Bulbs reach maturity at the cessation of flowering when the leaves become yellow. Irrigation was withheld when crop reached this stage and soil was allowed to dry. Harvesting of bulb was done by uprooting individual clumps manually by hand. Then the bulbs were cleaned by removing the leaf portions and adhering soil.

3.5.7. Separation, curing, grading and storage of bulb

After lifting and cleaning, individual bulbs/offsets from each clump were separated out by hand. The bulbs were then graded into mother bulb, large (19 g), medium (16 -17 g) and small (16 g) bulbs based on their size/weight cleaned and graded bulbs were spread on the floor and exposed to sun to dry or cure. The bulbs were stirred everyday to prevent fungal attack and rotting. After curing bulbs were stored in protected shady place with good aeration.



Plate 3.3 A view of effect of different pot mixture on vegetative growth in tuberose

3.6. OBSERVATIONS RECORDED:

The data were recorded on various parameters of growth, development, flowering and flower quality. Plants were selected at random and tagged in each treatment and replication. The mean values of the observed data are presented.

3.6.1. Growth parameters

3.6.1.1. Plant height (cm)

Plant height was measured in each treatment from two randomly selected plants from ground to tip of the plant and their average was measured by using a measuring scale at 30 days interval upto 3 months i.e. 60, 90 and 120 days of planting.

3.6.1. 2. Plant spread (cm)

The plant spread was measured in each treatment from two randomly selected plants from distance between outer most side shoot in east to west direction and multiplied by the distance between outer most side shoot in south to north direction at 60 day of planting.

3.6.1.3. Number of tillers plant⁻¹

Number of tillers was measured two different plants, in a treatment were counted and the mean was calculated at 60 day of planting.

3.6.1.4. Number of leaves plant⁻¹

Matured leaves from tagged plants were counted and recorded at monthly intervals. Immature leaves were excluded from the count. Number of leaves in two different plants in a treatment was counted and the mean was calculated at 60 day of planting.

3.6.1.5. Leaf length (cm)

Length of two randomly selected matured leaves from each tagged plant was measured by meter scale and recorded in centimeter at monthly intervals. Length was measured from the base of the leaf to tip. Care has been taken not to select the leaves which are too long or too short from the average height of the plant. Length of three leaves each, from two different plants, in a treatment, were measured and the mean was calculated at 60 day of planting.

3.6.2. Flower Parameters

3.6.2.1. Days to spike emergence

This observation was recorded by counting the number of days from the date of planting of bulbs to the emergence of spike from flag leaf in each treatment, in the tagged plants.

3.6.2.2. Days to opening of first floret

This observation was recorded by counting the number of days from the date of planting to the first flower opening, in each treatment, in the tagged plants.

3.6.2.3 Flowering duration (days)

It was counted from the days to opening of first floret from two randomly selected plants till 75% flower senescence occurred and their average were calculated

3.6.2.4. Spike length (cm)

Length of the spike was measured, when the spike was at exact stage to harvest, with the help of meter scale and unit used was centimeter. Length was taken from the point of spike emergence to the top most floret on spike. Two spikes from each pot were taken and their average length was recorded at 15 days interval.

3.6.2.5. Rachis length (cm)

This is the flowering zone of the spike which was measured as the distance between lowermost floret to the uppermost floret and recorded in centimeter.

Length of rachis was taken when the spike is at its harvesting stage. Two spikes from each pot were taken and their average length was recorded at 15 days interval.

3.6.2.6. Number of florets spike⁻¹

The total number of florets present in a spike were counted and recorded. Number of florets present in two spikes, in each treatment and replication, were counted and the mean was calculated at 15 days interval.

3.6.2.7. Length of floret (cm)

The length of the individual floret including the petal spread was measured in centimeter using a slide calipers. Length of two florets from each spike was measured and the mean was calculated at 15 days interval.

3.6.2.8. Diameter of florets (cm)

Diameter of the basal florets in each tagged plant was measured by vernier caliper stretching the end of petals and expressed in centimeters.

3.6.2.9. Weight of 100 florets (g)

Randomly selected 100 florets were weighed by using electrical balance and the observations were recorded in grams.

3.6.2.10. Number of spikes per pot / Number of spikes per clump

Number of spike of two randomly selected plants was counted at the time of harvesting in each treatment and their average was calculated.

3.6.2.11. Loose flower yield per pot (g)

Total florets weight of three samples from each pot was measured in grams. Then the mean is multiplied to the number of plants per pot to get flower yield per pot.



Plate 3.4 A view of effect of different pot mixture on flower growth in Tuberose

3.6.3. Bulb and bulblet Parameters

3.6.3.1. Number of bulbs per clump

Number of bulbs of two randomly selected plant were counted at the time of harvesting in each treatment .The average was calculated.

3.6.3.2. Number of bulblets per clump

Number of bulblets of two randomly selected plants was counted at the time of harvesting in each treatment and their average was calculated.

3.6.3.3. Diameter of bulb (cm)

Diameter of the basal bulb in each tagged plant was measured by vernier caliper stretching the end of petals and expressed in centimeters.

3.6.3.4. Diameter of bulblet (cm)

Diameter of bulblet was calculated from two randomly selected plants with the help of vernier callipers and their mean were calculated.

3.6.3.5. Length of bulb (cm)

Length of bulb was measured in centimeter by slide caliper and it was taken along the longitudinal axis of the bulb from basal disc to tip. Observations were

recorded for the mother bulb and selected individual bulbs from each grade. Length of two bulbs in each grade, were measured and the mean was calculated.

3.6.3.6. Length of bulblet (cm)

The length of bulblet was calculated from two randomly selected plants with the help of slide caliper and their average were calculated.

3.6.3.7. Weight of individual bulbs (g)

Number of bulb from one plant was counted. It was done from two randomly selected plants and their average was calculated.

3.6.3.8. Weight of individual bulblet (g)

Number of bulblet from one plant was counted. It was done from two randomly selected plants and their average was calculated.

3.7 ECONOMICS OF THE TREATMENT

For calculating the economics only spikes and bulbs yield was considered as the economic value and market price prevailing at the time of harvest were taken into account. First the cost of cultivation was calculated, and then gross income was estimated on the basis of the average spike yield and bulb yield (both in numbers)

$$1. \text{ Number of spikes per hectare} = \frac{\text{Number of spikes}}{\text{Net experimental area}} \times 10,000$$

$$2. \text{ Number of bulbs per hectare} = \frac{\text{Number of bulbs}}{\text{Net experimental area}} \times 10,000$$

The net income was obtained by adopting the following procedure:

$$3. \text{ Net income} = \text{Gross income} - \text{Cost of cultivation}$$

The cost of cultivation included money spent on preparatory tillage, planting of bulbs, organic manure, fertilizers, fertilizers application, irrigation, weeding, earthing, staking, plant protection and harvesting.

Net return per rupee investment was calculated as follows:

$$4. \text{ Net return / rupee investment} = \frac{\text{Net income (Rs.)}}{\text{Cost of cultivation (Rs.)}}$$

(B: C ratio)

3.8. STATISTICAL ANALYSIS:

The collected present observational data entitled “Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)” have been statistically analysed using the method of analysis of variance as described by Fischer, (1954) in his book “Design of Experiments”. The structure of analysis of variance table is given below:

Source of variation	Degree of freedom	Sum of square	Mean sum of square	Calc. F
Treatments	t-1	TrSS	TrMS = TrSS/t-1	Trms/EMS
Error	rt-t	ESS	EMS = ESS/rt-t	
Total	rt-1	TSS		

Where,

t = Number of treatments

r = Number of replications

TrSS = Treatment sum of square

ESS = Error sum of square

TSS = Total sum of square

TrMS = Treatment mean sum of square

EMS = Error mean sum of square

Calculate S.E (d) SE (d), CD and CV:

$$SE (m) = \sqrt{EMS / r}$$

$$SE (d) = \sqrt{2EMS / r}$$

$$CD = t_{at \text{ error d.f.}} \times SE (d)$$

$$CV = \sqrt{EMS / GM} \times 100$$

(Gm = General mean)

CHAPTER – IV

RESULT AND DISCUSSION

This chapter discusses the conclusions of the current investigation “**Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)**” along with the related literature. The results obtained with respect to different parameters are present below the follow heading:

4.1 Growth Parameters

4.2 Flower Parameters

4.3 Bulb Parameters

4.4 Benefit cost ratio of the treatment

4.1 VGETATIVE GROWTH PARAMETERS

4.1.1 Plant height (cm)

A perusal of data in (table 4.1.1(a) and figure 4.1.1) showed that plant height was found to be significantly affected by application of different pot mixture.

At 60, and 90 DAP, the maximum plant height (50.67 and 63.33 cm) was noted with Treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) respectively which was significantly superior than all other treatment except treatment T₇ and T₁₀. Whereas it was exhibited at par with treatment T₇ and T₁₀.

Whereas at 120 DAP, the maximum plant height (74.82) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed significantly different with all other treatment, except treatment T₇, T₁₀ and T₁₂. Whereas the treatment T₇, T₁₀ and T₁₂ was found at par with treatment T₆. The minimum plant height (33.08, 41.33 and 60.08) at 60, 90 and 120 DAP, was noted with treatment T₈ Soil + Sand + FYM + LM (1:1:1:1).

The increase in plant height may be due to supply of organic sources nutrients as they are rich in micronutrients beside having plant growth promoting substances viz., hormones, enzymes and humus forming beneficial microbes. Organic sources, on application to the soil, improve the physical properties of the soil such as aggregation, aeration, permeability and water holding capacity and proper drainage of media containing which may promote growth and development of plants.

Similar findings were also reported by Treder (2008) in oriental lily, Kumar (2015) and Singh *et al.* (2015) in Tuberose and Chaudhary *et al.* (2018) in Liliun.

4.1.2. Plant spread (North–South) (cm)

It can be seen from the Table 4.1.1 (a) and Figure 4.1.2 that significantly influenced to plant spread by application of different pot mixtures.

At 60 DAP, the higher plant spread (N-S) (42.67cm) was recorded with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). Which was significantly greater to all other treatment, except treatment T₇ and T₁₀. However the treatment T₇ and T₁₀ showed equally response to plant spread with the treatment T₆.

At 90 DAP, the maximum plant spread (N-S) (43.17 cm) was noted with T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₃, T₇, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly greater than rest of the other treatment.

Similarly at 120 DAP, the longest plant spread (N-S) (46.00) was recorded with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was found at par with treatment T₉, T₁₀, T₁₁ and T₁₂ whereas it was found significantly different with rest of the other treatment. The shortest plant spread (24.67, 31.68 and 33.17 cm) was recorded in treatment T₈ Soil + Sand + FYM + LM (1:1:1:1), at 60, 90 and 120 DAP.

The maximum plant spread (N-S) in tuberose might be due to the reason that during the initial stage, treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) supplemented with inorganic fertilizers provided with the slow release nutrient for long time that may have supported the luxuriant growth of foliage for the better growth of plant spread. Likely, same observations were also reported by Sarodoei *et al.* (2011) in Zinnia and Nair and Bharathi (2019) in Tuberose.

4.1.3 Plant spread (E-W) (cm)

It was observed from the Table 4.1.1 (a) and Figure 4.1.3 show that plant spread was significantly affected by application of different pot mixture.

At 60 DAP, the longest plant spread (E-W) (37.57 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was initiate at par with treatment T₇, T₉, T₁₀, T₁₁ and T₁₂. However it was showed superior than rest of the other treatment, except treatment T₇, T₉, T₁₀, T₁₁ and T₁₂.

At 90 DAP, the longer plant spread (E-W) (43.67 cm) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was found at par with treatment T₁, T₂, T₃, T₄, T₅, T₇, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly superior than treatment T₈.

Similarly at 120 DAP, the highest plant spread (E-W) (47.75 cm) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₇, T₁₀ and T₁₁ whereas it was found significantly different with the rest of other treatment. The shorted plant spread (E-W) (26.00, 29.98 and 31.87 cm) were recorded in treatment T₈ Soil + Sand + FYM + LM (1:1:1:1).

The maximum plant spread (E-W) might be due to the reason that potting mixture is slow releasing manure, which continuously supplies nutrient to the plant for long time so that plant shows luxuriant growth of foliage, which in turn showed maximum plant spread of the plant. Similar result was obtained by Sandeep *et al.* (2011) in Cosmos, Sarodoei *et al.* (2011) in Zinnia and Nair and Bharathi (2019) in Tuberose.

4.1.4. Number of tillers plant⁻¹

Observations recorded on the impact of different pot mixture on number of tillers plant⁻¹ of tuberose are given in Table 4.1.1 (b) and Fig 4.1.4 that non significantly affected by application of pot mixture.

At 60 DAP, the longest number of tillers plant⁻¹ (3.83) was recorded in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was significantly greater to rest of the all treatment, except treatment T₁₀, treatment T₁₀ was exhibited at par with treatment T₆.

Whereas at 90 DAP, the higher number of tillers plant⁻¹(4.70) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1), treatment T₁₀ and T₁₁ was exhibited at par with treatment T₆. Whereas it was significantly superior to rest of the all treatment, except treatment T₁₀ and T₁₁.

Similarly at 120 DAP, the highest number tillers plant⁻¹ (6.23) was observed with T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was significantly greater to rest of the all treatment, except treatment T₇ and T₁₀, treatment T₇ and T₁₀ was exhibited at par with treatment T₆. At 60, 90 and 120 DAP, the shortest number of tillers plant⁻¹ (1.33, 1.50 and 3.03) was noted in T₅ Soil + Sand + PSC (1:1:1).

The highest number of tillers plant⁻¹ was observed in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) that may be due to the potting mixture is a slow releasing manure, with tends to provide nutrient continuously for longer time that, may be favorable for growth of foliage. Similarly, vermicompost contains water soluble nutrients, whereas sand has optimum porosity and aeration, which provide favorable condition for increasing number of tillers plant⁻¹. These results in accordance with the finding reported by previous investigator Younis *et al.* (2008) in Dahlia, Kiran *et al.* (2017) in Dahlia, and Nair and Bharathi (2019) in Tuberose.

4.1.5. Number of leaves plant⁻¹

It was found significantly influenced by application of different pot mixture on number of leaves plant⁻¹ of tuberose are presented in Table 4.1. (b) and Fig 4.1.5.

At 60 DAP, the longest number of leaves plant⁻¹ (23.67) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was significantly greater to other treatment, except treatment T₂, T₇, T₉, T₁₀, T₁₁ and T₁₂ However it was showed at par with treatment T₆.

As for as at 90 and 120 DAP, the higher number of leaves plant⁻¹ (36.83 and 56.50) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was significantly superior than all other treatment, except treatment T₁₀. Which was exhibited at par with treatment T₆ during 90 DAP. The lowest number of leaves plant⁻¹ for 60, 90 and 120 DAP (9.50, 15.50 and 28.17 cm) was seen in T₅ Soil + Sand + PSC (1:1:1).

The increasing number of leaves plant⁻¹ may be due to the reason that vermicompost is known to have more water holding capacity, good vigour and their suitability to environment which enhances nutrient uptake that may be favorable for growth of plant (Atiyes *et al.* 2002 and Bechman and Matzger 2008). Addition of vermicompost as a source of organic nutrients augmented the vegetative growth. Increased number of leaves of plants can also be due to adequate availability of nitrogen contain in media amended with vermicompost has also been reported by benito *et al.* (2005), Moghadam *et al.* (2012) in Liliun and Arunesh *et al.* (2020) in Gerbera

4.1.6. Leaf length (cm)

The data observed and presented in table 4.1.1 (b) and figure 4.1.6 showed

that the leaf length (cm) was found to be significant affected by application of pot mixture.

Among the potting mixture, at 60 DAP, the highest leaf length (43.48 cm) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). Which was significantly greater to treatment T₁, T₂, T₄, and T₅. Whereas it was found at par with treatment T₃, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂.

At 90 DAP, the longest leaf length (48.23 cm) was recorded with T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was found at par with treatment T₇, T₁₀ and T₁₂. However it was showed significantly greater than rest of the other treatment.

Similarly at 120 DAP, the higher leaf length (49.50 cm) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₃, T₇, T₉, T₁₀, T₁₁ and T₁₂. Whereas it was found significantly different with rest of the other treatment. The shortest leaf length (31.60, 38.90 and 41.52 cm) was noted with treatment T₅ Soil + Sand + PSC (1:1:1) at 60, 90 and 120 DAP.

The maximum leaf length may be due to the fact that Concerning the interaction, using composted leaves medium or its mixture with sand and applying the potting mixture is slow-release manure that provides continuous nutrients to the plant for a long period, allowing for plant growth and luxuriant foliage growth, which may result in the increasing the leaf length. The current result is consistent with the findings of Naggar and Nasharty (2009) in *Hippeastrum*, Sardoei *et al.* (2014) and Nair and Bharathi (2019) in *Tuberose*.

Table.4.1.1. (a) Effect of different pot mixture on vegetative growth parameters of tuberose

Tr. No.	Treatment	Plant height (cm)			Plant spread (North-South) (cm)			Plant spread (East-West) (cm)		
		60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
T1	Soil + Sand + FYM (1:1:1) Control	41.25	51.03	67.37	28.33	32.83	36.40	27.83	30.83	39.50
T2	Soil + Sand + VC (1:1:1)	33.55	51.33	63.83	26.83	32.23	35.08	28.33	36.88	38.65
T3	Soil + Sand + GM (1:1:1)	41.33	43.73	65.83	30.00	37.43	36.60	29.97	31.58	34.92
T4	Soil + Sand + LM (1:1:1)	41.68	50.55	65.73	27.67	32.58	35.12	29.00	30.40	37.28
T5	Soil + Sand + PSC (1:1:1)	38.93	49.47	66.87	31.50	32.37	37.43	30.00	31.75	36.63
T6	Soil + Sand + FYM + VC (1:1:1:1)	50.67	63.33	74.82	42.67	43.17	46.00	37.57	43.67	47.75
T7	Soil + Sand + FYM + GM (1:1:1:1)	41.33	52.85	68.18	35.33	36.77	38.23	36.50	42.50	40.60
T8	Soil + Sand + FYM + LM (1:1:1:1)	33.08	41.33	60.83	24.67	31.68	33.17	26.00	29.98	31.87
T9	Soil + Sand + FYM + PSC (1:1:1:1)	37.85	46.25	62.87	30.67	39.67	40.17	32.17	41.07	38.50
T10	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	40.62	55.83	71.00	40.00	40.87	44.42	34.67	42.83	43.77
T11	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	35.47	51.43	67.10	28.83	36.47	39.95	35.83	39.25	41.98
T12	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	35.67	47.25	68.85	30.33	40.17	40.93	34.40	38.43	38.57
	SEm ±	2.87	3.8	2.4	2.82	2.38	2.42	2.34	4.58	2.74
	C.D @ 5%	8.39	11.09	7.03	8.23	6.97	7.07	6.84	13.36	8.00
	C.V.	12.68	13.07	6.23	15.55	11.37	10.93	12.75	21.67	12.13

Table.4.1.1. (b) Effect of different pot mixture on vegetative growth parameters of tuberose

Tr. No.	Treatment	Number of tillers plant ⁻¹			Number of leaves plant ⁻¹			Leaf length (cm)		
		60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
T1	Soil + Sand + FYM (1:1:1) Control	2.00	2.83	3.27	13.17	23.17	35.83	34.65	40.75	43.98
T2	Soil + Sand + VC (1:1:1)	1.67	2.17	4.00	16.17	22.50	32.67	33.75	41.60	42.22
T3	Soil + Sand + GM (1:1:1)	1.67	2.83	3.37	14.83	26.83	34.50	36.37	42.43	45.90
T4	Soil + Sand + LM (1:1:1)	2.17	2.83	4.30	12.33	22.33	31.00	32.48	40.58	43.70
T5	Soil + Sand + PSC (1:1:1)	1.33	1.50	3.03	9.50	15.50	28.17	31.60	38.90	41.52
T6	Soil + Sand + FYM + VC (1:1:1:1)	3.83	4.70	6.23	23.67	36.83	56.50	43.48	48.23	49.50
T7	Soil + Sand + FYM + GM (1:1:1:1)	2.50	2.83	5.10	16.00	22.33	38.50	39.60	42.83	46.12
T8	Soil + Sand + FYM + LM (1:1:1:1)	1.50	2.00	3.50	14.67	27.50	38.17	37.42	41.17	43.30
T9	Soil + Sand + FYM + PSC (1:1:1:1)	2.00	2.33	4.03	16.00	26.17	38.33	39.23	40.92	45.30
T10	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	2.83	3.70	6.00	21.50	29.67	38.50	41.90	47.78	47.73
T11	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	1.67	3.17	3.50	17.67	21.17	40.00	39.70	42.62	45.92
T12	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	1.50	2.17	4.10	16.33	24.17	36.00	39.28	43.95	46.42
	SEm ±	0.45	0.56	0.55	2.87	2.74	4.97	2.49	1.88	1.53
	C.D @ 5%	1.31	1.65	1.63	8.38	8.02	14.52	7.29	5.5	4.48
	C.V.	38.03	35.61	23.05	28.00	19.16	21.23	11.55	7.66	5.90

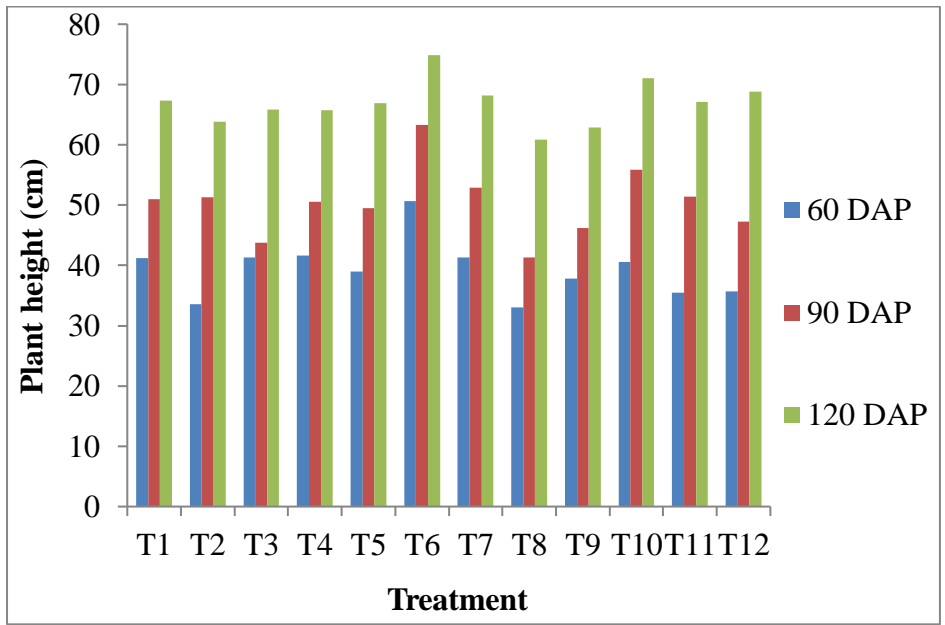


Fig 4.1.1 Effect of different pot mixture on plant height (cm) of tuberose

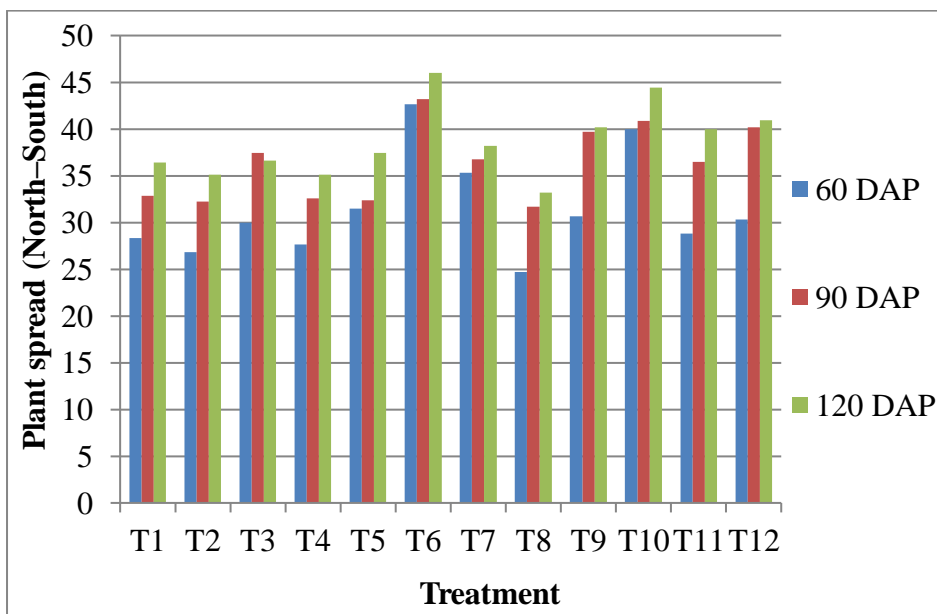


Fig 4.1.2 Effect of different pot mixture on plant spread (N-S) (cm) of tuberose

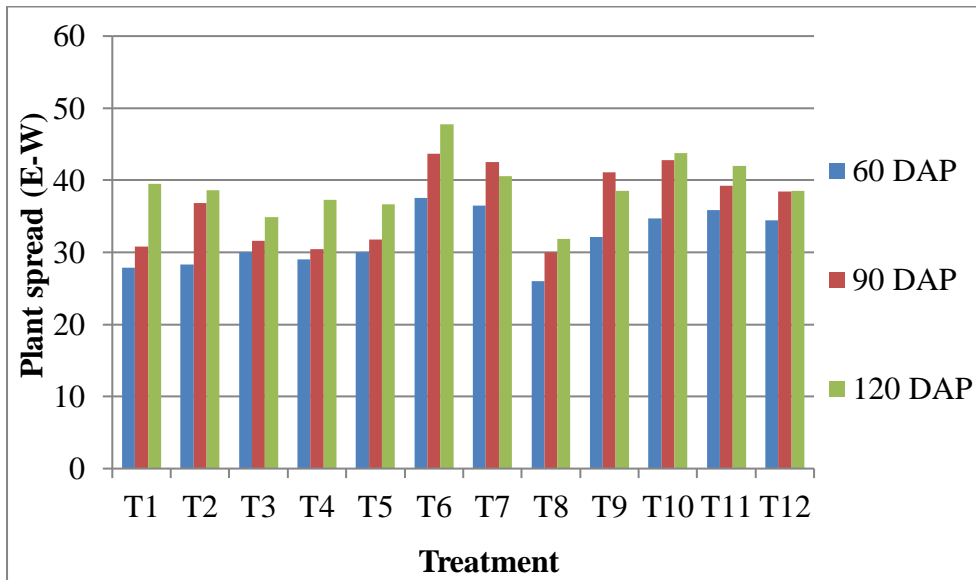


Fig 4.1.3 Effect of different pot mixture on plant spread (E-W) (cm) of tuberose

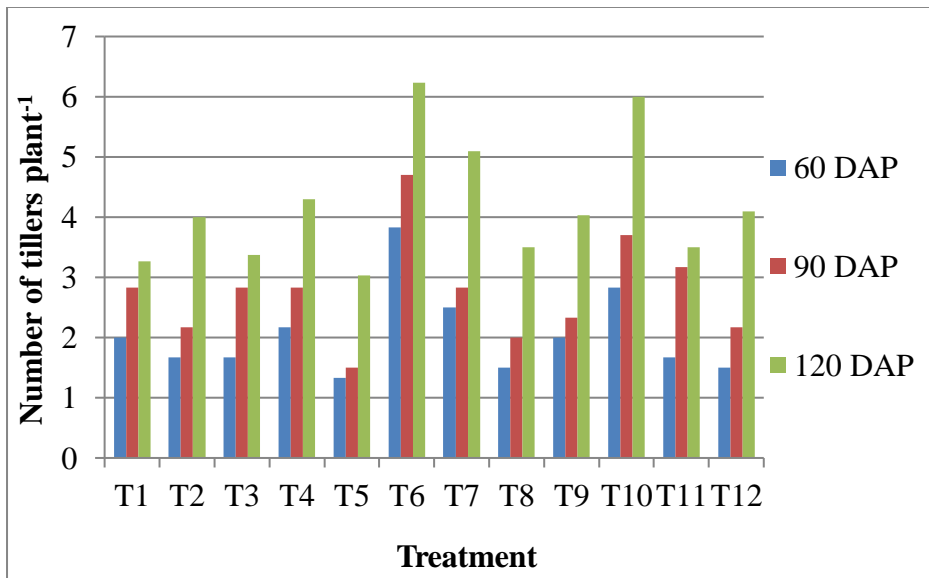


Fig 4.1.4 Effect of different pot mixture on number of tillers plant⁻¹ of tuberose

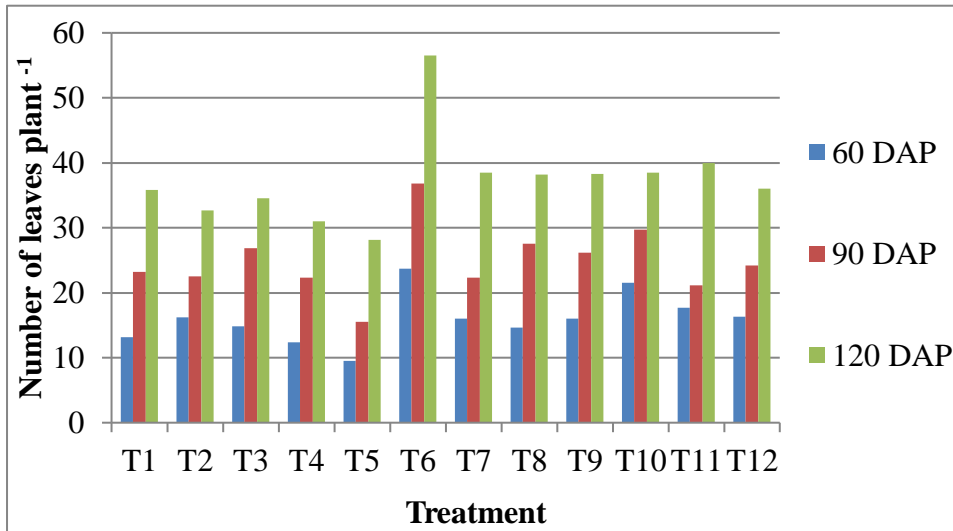


Fig 4.1.5 Effect of different pot mixture on number of leaves plant⁻¹ of tuberoses

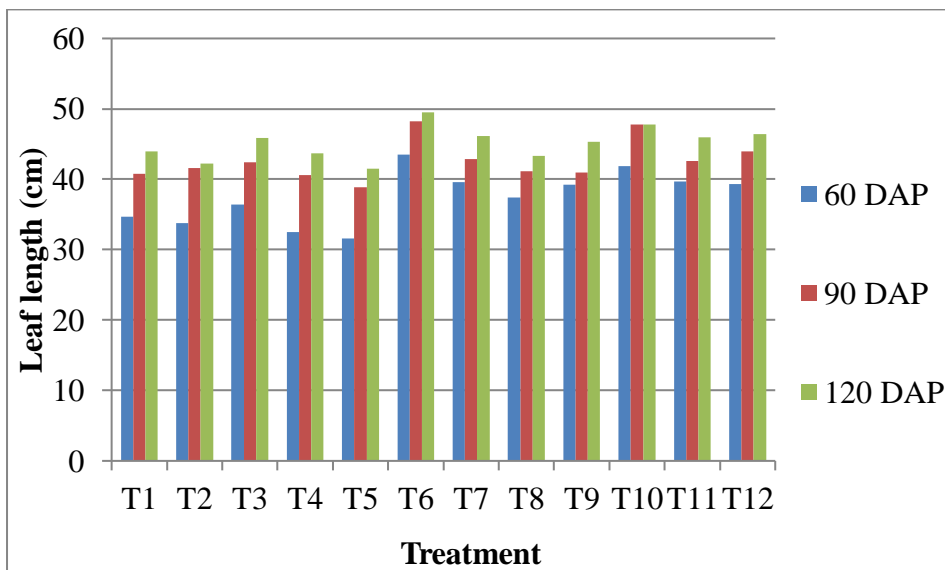


Fig 4.1.6 Effect of different pot mixture on leaf length (cm) of tuberoses

4.2. Flower Parameters

4.2.1. Day to spike emergence

The data recorded and depicted in (Table 4.2.1 (a) and Fig 4.2.1) that the days to spike emergence was significantly affected with application of potting mixture.

Among the potting mixture application of treatment T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1) showed earliest (132.66 days) to spike emergence which was at par with T₄, T₅, T₇, T₈, T₉, T₁₁ and T₁₂. However it was found significantly earliest than rest of the other treatment. While the treatment T₅ Soil + Sand + PSC (1:1:1) showed higher (162.33 days) to spike emergence.

The early emergence of spike in tuberose might be due to the application of organic substance, which slowly releases nutrient continuously for long time, that improved the physico- chemical properties of the soil, and ultimately plant get favourable condition for better growth that may have enhance the early emergence of spike. These finding can be confirmightly with the finding of Grassotti *et al.* (2003) in Liliium, Parmar (2006), Chauhan *et al.* (2014) in Gerbera and Bharathi (2019) in Tuberose.

4.2.2. Day to opening of first florets

It is observed from the Table 4. 4.2.1 (a) and Fig 4.2.1 that the days to opening of first florets was significantly affected by application of pot mixture.

Among the different potting mixture, treatment T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1) showed earliest (147.67 days) to opening of first florets which was found significantly earlier with treatment T₆, T₇ and T₁₀. However it was showed at par with remaining of the other treatment. The treatment T₅ Soil + Sand + PSC (1:1:1) and the treatment T₅ Soil + Sand + PSC (1:1:1) showed maximum (171.33 days) to opening of first florets.

The earlier days to opening of first florets might be due to the organic potting mixture, which show vigorous growth of the plant also improved the water holding capacity that has a pronouce effect on early production. This is also due to an increase in photosynthates in the growing medium, which may have induced early flowering. These results were in accordance with the finding of Khayyat *et al.* (2007), Chauhan *et al.* (2014) in Gerbera and Karthikeyan and Jawaharlal (2015) in Carnation.

4.2.3. Flowering duration (days)

It can be seen from the (Table 4.2.1 (a) and Fig 4.2.1) that the flowering duration (days) was significantly influenced with application of different pot mixture.

Among the different of potting mixture, the treatment T₅ Soil + Sand + PSC (1:1:1) showed higher (24.33 days) to flowering duration, which was significantly superior than treatment T₁₀ and T₁₁. However it was found at par with T₁, T₂, T₃, T₄, T₅, T₆, T₇, T₈, T₉ and T₁₂. The treatment T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1) showed shorted (14.33 days) for flowering duration.

The maximum flower retention in plants could be due to better growing conditions and good physico-chemical properties of media containing vermicompost, as well as abundant oxygen supply to the plants. These results collaborated with the previous finding of Padhiyar *et al.* (2017) in chrysanthemum, Chaudhary *et al.* (2018) in Liliun and Arunesh *et al.* (2020) in Gerbera.

4.2.4. Spike length (cm)

It was significantly affected in spike length was recorded with application of pot mixture from the data given in (Table 4.2.1 (b) and Fig 4.2.2).

Among the potting mixture at 150 and 165 DAP, the highest Spike length (60.16 and 67.4 cm) was observed in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). Which was significantly superior than all other treatment, except treatment T₁₀ and T₁₂, which was showed at par with treatment T₆. The lowest spike length (45.166 and 51.60 cm) was recorded in T₅ Soil + Sand + PSC (1:1:1) at 150 and 165 DAP.

The increase in spike length might be due to the application of organic sources to soil, which supplies micronutrients growth promoting substances hormones, enzymes and humus) but also improves physico-chemical properties of soil such as aggregation, aeration, permeability and water holding capacity which promotes spike length of plants. Similar findings were also reported by Awang *et al.* (2009) in *Celosia cristata*, Kumar (2015) and Singh *et al.* (2015) in *Tuberose*, Chaudhary *et al.* (2018) in *Lilium*.

4.2.5. Rachis length (cm)

Observation recorded on the impact of pot mixture on rachis length (cm) of

tuberosa is illustrated in (Table 4.2.1 (b) and Fig 4.2.3) that significantly affected by application of different potting mixture.

Among the potting mixture, at 150 DAP, the longest rachis length (39.30 cm) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed significantly greater to all other treatment, except treatment T₇, T₁₀, T₁₁ and T₁₂. Which was showed at par with treatment T₆.

Similarly at 165 DAP, the higher rachis length (41.50) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₇, T₁₀ and T₁₂, whereas it was found significantly different with rest of the all other treatment. The shortest rachis length (25.73 and 29.56 cm) was noted in treatment T₅ Soil + Sand + PSC (1:1:1) at 150 and 165 DAP.

The rachis must have increase in length due to potting mixture as it is a slow - release manure which ensures the supply of hormones like auxins & gibberellins, enzymes and humus for a longer time to the plant. This in turn, improved the physical properties of soil. Similar findings were also previous investigator Kale *et al.* (2009) in gerbera, Naggar and Nasharty (2009) in *Hippeastrum vittatum* Kumar (2015), Singh *et al.* (2015) and Preetham *et al.* (2019) in Tuberosa.

4.2.6. Number of florets spike⁻¹

The data in Table 4.2.1 (b) and Fig 4.2.4 showed that the number of florets spike⁻¹ varied significantly among the different potting mixture of treatments. At 150 DAP, the longest number of florets spike⁻¹ (24.66) was observed in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₂, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was exhibited significant difference with rest of the other treatment.

Similarly at 165 DAP, the highest number of florets spike⁻¹(29.33) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was showed at par with treatment T₄, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly greater than rest of the other treatment. At 150 and 165 DAP, the lowest number of florets spike⁻¹ (12.33 and 21.00) was noted in T₅ Soil + Sand + PSC (1:1:1).

The better results may be due to slow – release manure played an important role in plant growth as well as in conversion of vegetative phase in reproductive phase of plant. The differences in cut flower quality parameters, applying of

vermicompost which is high amount of humus and plant growth substances hormones might be due to presence of more organic matter percentage in media that facilitated availability of essential nutrients, which resulted in cell division, elongation and cell size that may have increased number of florets spike⁻¹. These results were collaborated with the previous findings of Parmar (2006), Naggar and Nasharty (2009) in *Hippeastrum vittatum* and Chauhan *et al.* (2014) in *Gerbera*, Nair and Bharathi (2019) in *Tuberose*.

4.2.7. Length of florets (cm)

The data presented on the impact of various potting mixture on length of florets (cm) of tuberose is provided in Table 4.2.1 (b) and Fig. 4.2.5 and the result show that there are significantly affected by application of pot mixture.

There was a substantial effect on the length of florets (cm) at 150 and 160 DAP on the various nutrient combinations. At 150 DAP, the highest length of florets (6.03 cm) was recorded with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was showed at par with treatment T₁₀ and T₁₂. However it was showed significantly greater than all other treatment.

Similarly at 165 DAP, the longest length of florets (6.10 cm) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was found at par with treatment T₇, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly superior than all other treatment. At 150 and 165 DAP, The shorter length of florets (5.70 and 5.80 cm) was noted in treatment T₅ Soil + Sand + PSC (1:1:1).

The increase in florets length could be attributed to the application of organic sources to soil, which provides micronutrients and growth stimulating compound but also enhances the soil physical properties, aggregation, aeration and water holding capacity of the soil that may be promoted length of florets in tuberose. Similar results were also reported by Kumar (2015), Singh *et al.* (2015) and Preetham *et al.* (2019) in *Tuberose*.

Table4.2.1. (a) Effect of different pot mixture on flower and flower yield parameters of tuberose

Tr. No.	Treatment	Day to spike emergence	Days to opening of first florets	Flowering duration
T1	Soil + Sand + FYM (1:1:1) Control	144.66	171.34	20.67
T2	Soil + Sand + VC (1:1:1)	144.33	166.00	21.00
T3	Soil + Sand + GM (1:1:1)	144.00	168.67	19.67
T4	Soil + Sand + LM (1:1:1)	151.33	166.00	22.33
T5	Soil + Sand + PSC (1:1:1)	162.33	171.33	24.33
T6	Soil + Sand + FYM + VC (1:1:1:1)	143.33	149.33	19.33
T7	Soil + Sand + FYM + GM (1:1:1:1)	148.00	162.33	21.67
T8	Soil + Sand + FYM + LM (1:1:1:1)	148.66	165.67	19.67
T9	Soil + Sand + FYM + PSC (1:1:1:1)	145.66	169.00	23.67
T10	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	132.66	147.67	14.33
T11	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	145.33	164.00	16.33
T12	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	145.00	162.67	24.00
	SEm ±	4.24	5.06	1.88
	C.D @ 5%	12.40	14.78	5.48
	C. V.	5.03	5.36	15.82

Table4.2.1. (b) Effect of different pot mixture on flower and flower yield parameters of tuberose

Tr. No.	Treatment	Spike length (cm)		Rachis length (cm)		Number of florets spike ⁻¹		Length of florets (cm)	
		150 DAP	165 DAP	150 DAP	165 DAP	150 DAP	165 DAP	150 DAP	165 DAP
T1	Soil + Sand + FYM (1:1:1) Control	48.50	52.33	31.00	34.46	15.33	21.33	5.80	5.90
T2	Soil + Sand + VC (1:1:1)	48.00	51.66	28.83	31.66	19.00	23.66	5.73	5.83
T3	Soil + Sand + GM (1:1:1)	48.00	53.06	27.50	32.00	13.00	22.66	5.80	5.83
T4	Soil + Sand + LM (1:1:1)	51.53	58.00	29.36	32.00	17.66	24.66	5.80	5.90
T5	Soil + Sand + PSC (1:1:1)	45.16	51.60	25.73	29.56	12.33	21.00	5.70	5.80
T6	Soil + Sand + FYM + VC (1:1:1:1)	60.16	67.40	39.30	41.50	24.66	29.33	6.03	6.10
T7	Soil + Sand + FYM + GM (1:1:1:1)	50.33	54.00	35.83	37.73	18.66	25.33	5.83	5.97
T8	Soil + Sand + FYM + LM (1:1:1:1)	47.60	52.33	31.16	34.33	20.66	25.66	5.83	5.87
T9	Soil + Sand + FYM + PSC (1:1:1:1)	51.13	54.66	30.83	32.80	22.66	25.66	5.83	5.97
T10	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	55.50	59.03	37.40	38.26	23.00	28.33	5.97	6.07
T11	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	51.26	55.43	33.66	34.20	20.00	27.00	5.80	6.00
T12	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	53.66	58.66	37.40	39.86	21.33	28.00	5.97	6.03
	SEm ±	2.65	3.00	2.60	2.10	2.27	1.74	0.08	0.08
	C.D @ 5%	7.75	8.78	7.60	6.15	6.62	5.07	0.18	0.18
	C. V.	9.03	9.36	13.94	10.47	20.67	11.94	1.87	184

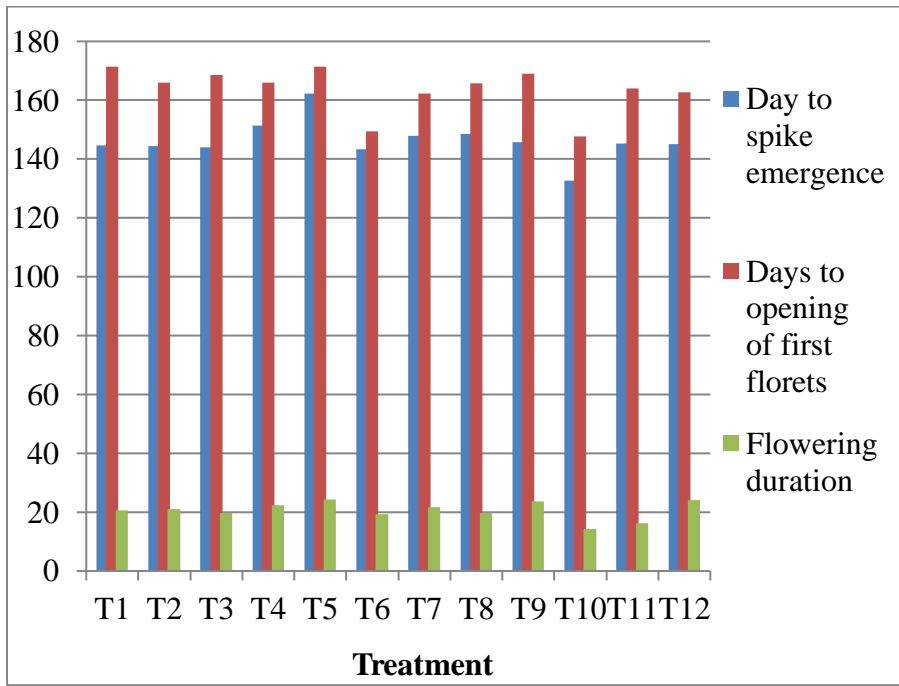


Fig.4.2.1. Effect of different pot mixture on day to spike emergence of tuberose, days to opening of first florets and flowering duration

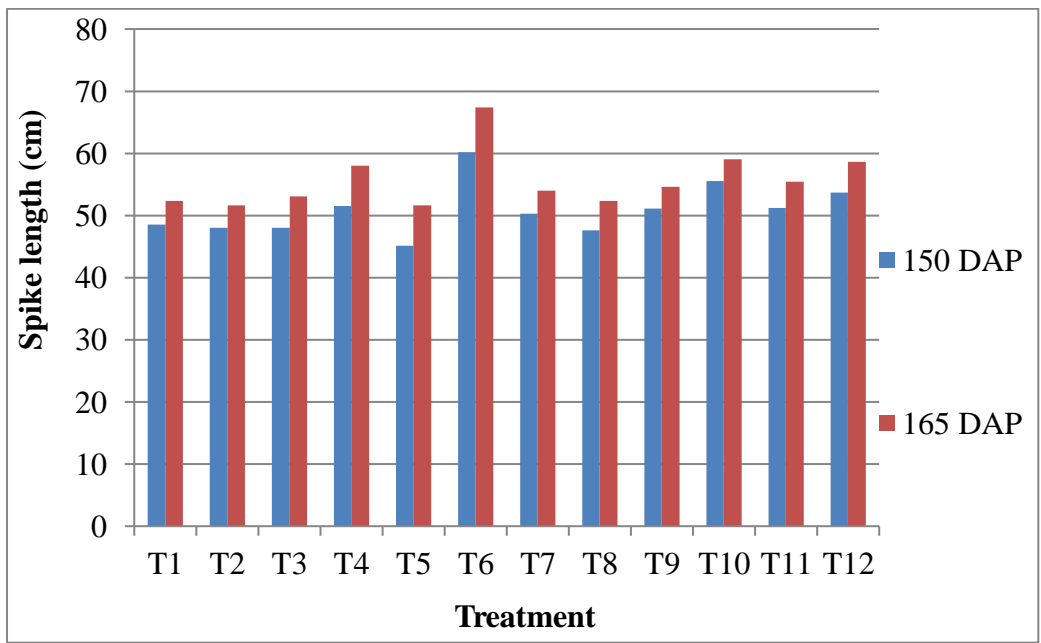


Fig.4.2.2. Effect of different pot mixture on spike length (cm) of tuberose

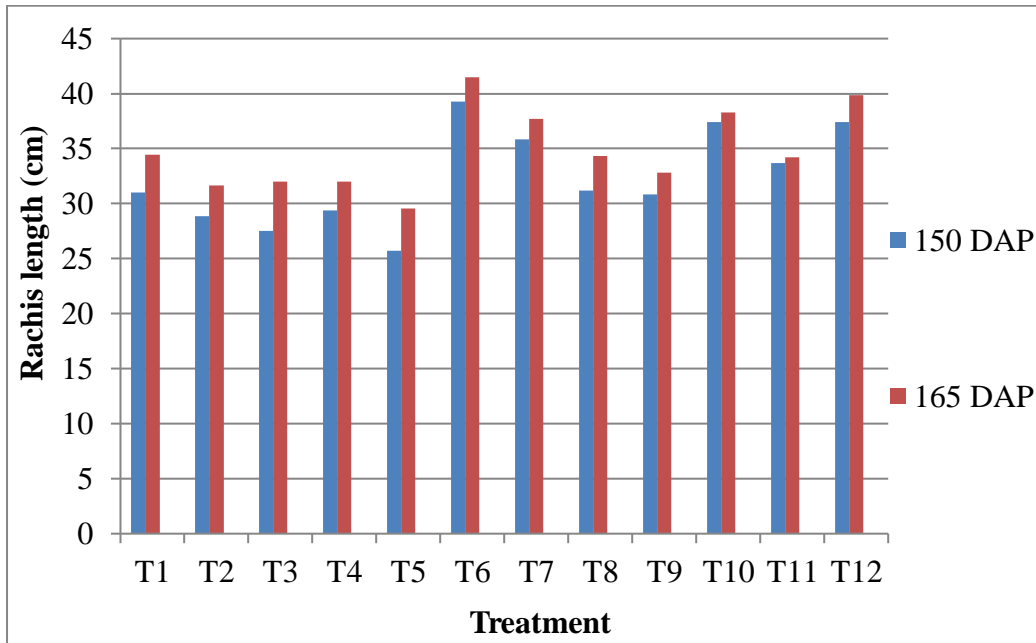


Fig.4.2.3. Effect of different pot mixture on rachis length (cm) of tuberose

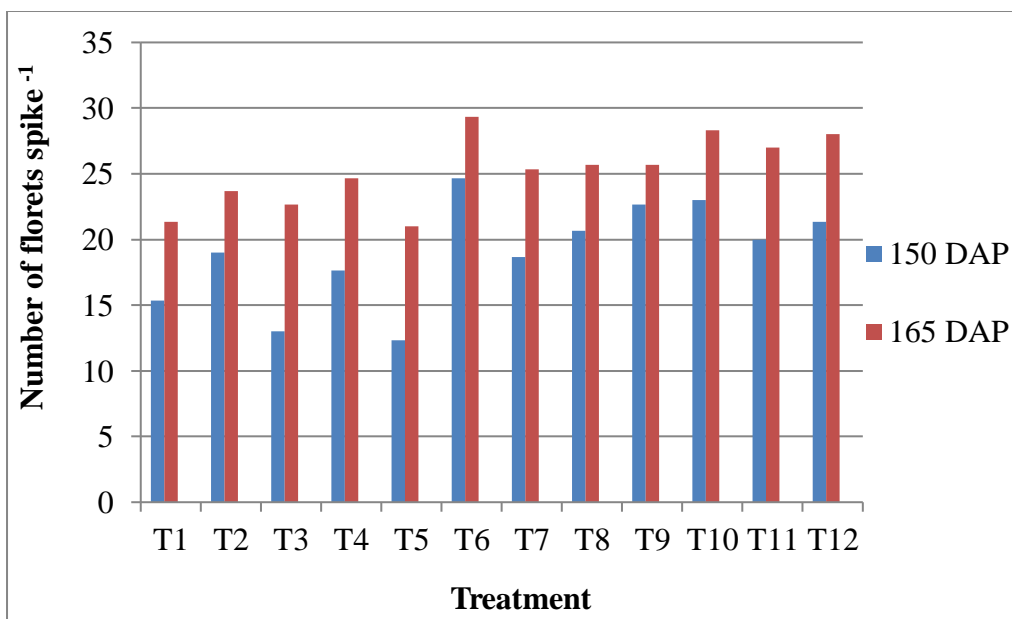


Fig.4.2.4. Effect of different pot mixture on number of florets spike⁻¹ of tuberose

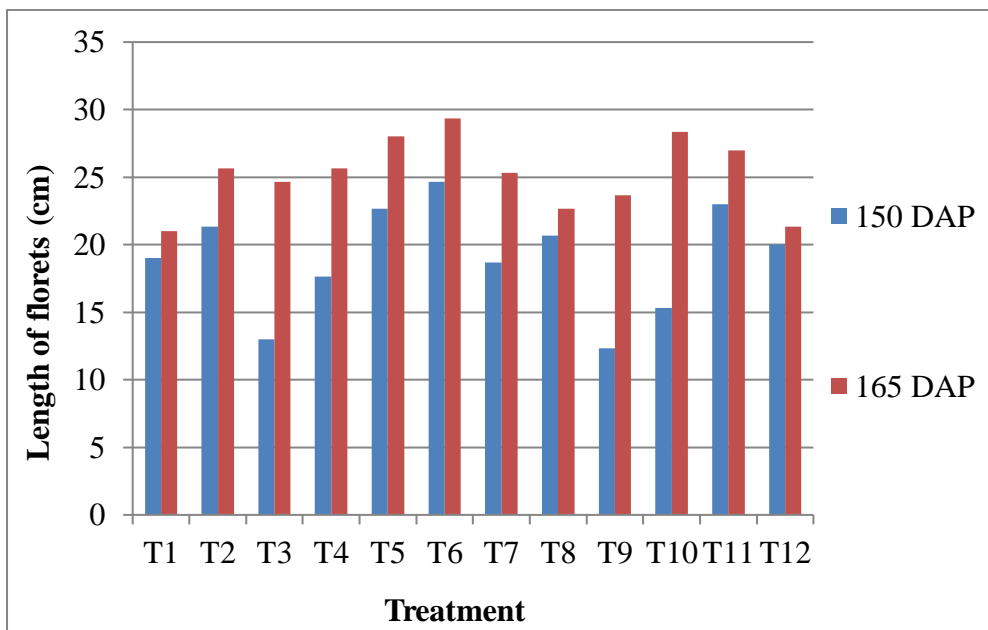


Fig.4.2.5. Effect of different pot mixture on length of florets (cm) of tuberose

4.2.8. Diameter of florets (cm)

It is observed from Table 4.2.1. (c) and Fig 4.2.6 that significantly affected by application of pot mixture.

The maximum diameter of florets (4.05 cm) was recorded in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1), which was showed at par with treatment T₂, T₃, T₄, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly greater to treatment T₁ and T₅. While the lowest diameter of florets (3.24 cm) was recorded with treatment T₅ Soil + Sand + PSC (1:1:1)).

The increasing in diameter of florets might be due to the application of vermicompost & goat manure to the soil. As they are slow release manure tends to provide nutrients for longer times. The differences in cut flower quality parameters might be due to more organic matter percentage in media which facilitates availability of essential nutrients resulted increase in cell division, elongation and cell size. Luxuriant growth with more green biomass of plant have more availability of primary and secondary metabolites, higher the source to sink response, more is diameter of flower. The increased flower head diameter may be

related to the optimum growing conditions of the medium i.e. lower bulk density, high porosity, high water holding capacity as well better nutrient uptake. This result was also in collaboration with findings of Parmar (2006), Chauhan *et al.* (2014) in Gerbera & Nair and bharathi (2019) in tuberose.

4.2.9. Weight of 100 florets (g)

It is evident from data presented in the Table 4.2.1. (c) and graphically Fig 4.2.8 and it was showed significantly affected by application of different potting mixture.

Among the different potting mixture, the highest weight of 100 florets (88.67 g) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was at par with treatment T₉, T₁₀, T₁₁ and T₁₂ and it was showed significantly superior than all other treatment. The lowest weight of 100 florets (75.66 g) was noted in treatment T₅ Soil + Sand + PSC (1:1:1).

The maximum weight of 100 florets (g) might be due to the vermicompost and goat manure, which are rich source of nutrients, and it with provided continuously slow release nutrient for long times and also rich in humus plant growth promoting hormones like (auxins & gibberellins) and growing media posses high physico-chemical properties for increase in flower size and more accumulation of starch from leaves of flowers as well as the improved growth and development of plant and hence increased the weight of florets. Similar result was obtained by Koley and Pal (2011) and Kumar *et al.* (2012) in Tuberose, Chauhan *et al.* (2014), Vamanrao (2015) and Arunesh *et al.* (2020) in Gerbera.

4.2.10. Number of spike per pot / Number of spike per clump

The number of spike per pot and number of spike per clump was found significantly differ with application of potting mixture, according to the data show and depicted in Table 4.2.1. (c) and fig 4.2.9.

Among the potting mixture, the higher number of spike per pot and number of spike per clump (1.76) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was significantly greater than rest of the other treatment, except treatment T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. It was showed at par with treatment T₆. The minimum number of spike per pot and number of spike per clump (1.33) was recorded with treatment T₅ Soil + Sand + PSC (1:1:1).

The increased in number of spike per pot and number of spike per clump may be goat manure available of high amount of nitrogen and potassium of the soil. As they are slow release manure tends to provide nutrients for longer times. As measured by either by improved nutrient uptake or reduced nutrient losses to the environment, or both or its acts as a soil amendment to help improve soil structure or function and Optimum growing conditions provided by the medium amended with vermicompost and paddy straw compost helped to optimize the plant health resulting in the production of more number of flowers/spike. As well as the vermicompost is a sustainable source of macro and micro nutrients and has a considerable potential for improving plant growth thus enhance yield. Similar observations were reported by Patil (1999), Sahni *et al*, (2008), Moghadam *et al*. (2012) in Asiatic hybrid lily ‘Navona, Rajera and Sharma (2017) in hybrid Lily and Karim *et al*. (2017) in Tuberose.

4.2.11. Loose flower yield per pot (g)

Data observed and depicted in Table 4.2.1. (c) and graphically figure 4.2.10 indicated that loose flower yield per pot varied significantly among different application of potting mixture.

Among the potting mixture, the highest loose flower yield per pot (43.63 g) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at pat with treatment T₇, T₁₀, T₁₁ and T₁₂. However it was observed significant difference with rest of the other treatments. The lowest loose flower yield per pot (25.91 g) was noted in treatment T₅ Soil + Sand + PSC (1:1:1).

The maximum loose flower yield per pot may be due to the application of vermicompost, which is rich in humus-promoting hormones like auxins and gibberellins, to the improved growth of plant and the better physical properties of the substrate media which influences the absorption of nutrients by the plants. As the vegetative growth was better, reduced nutrient losses to the environment, or both or it acts as a soil amendment to help improve soil structure or functions and thus may be influenced positively on flower production. These findings are in agreement with those of Singh (2000), Dutt *et al*. (2002), Marban *et al*. (2008), Dogra *et al*. (2009), Naggar and Nasharty (2009) in Hippeastrum, Chauhan *et al*. (2014) in Gerbera, Sankari *et al*. (2015) and Karim *et al*. (2017) in Tuberose.



Plate 3.6: A view of observation of plant height, spike length (cm), rachis length (cm) and length of florets of tuberose

Table4.2.1. (c) Effect of different pot mixture on flower and flower yield parameters of tuberose

Tr. No.	Treatment	Diameter of florets (cm)	Weight of 100 florets (g)	No. of spike per pot / Number of spike per clump	Loose flower yield per pot (g)
T1	Soil + Sand + FYM (1:1:1) Control	3.31	80.00	1.33	29.51
T2	Soil + Sand + VC (1:1:1)	3.83	81.00	1.40	30.68
T3	Soil + Sand + GM (1:1:1)	3.57	79.00	1.40	28.47
T4	Soil + Sand + LM (1:1:1)	3.69	78.66	1.40	27.43
T5	Soil + Sand + PSC (1:1:1)	3.24	75.66	1.33	25.91
T6	Soil + Sand + FYM + VC (1:1:1:1)	4.05	88.67	1.76	43.63
T7	Soil + Sand + FYM + GM (1:1:1:1)	3.67	81.00	1.46	34.66
T8	Soil + Sand + FYM + LM (1:1:1:1)	3.88	80.00	1.46	31.48
T9	Soil + Sand + FYM + PSC (1:1:1:1)	3.95	81.66	1.46	31.54
T10	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	4.00	86.66	1.75	41.96
T11	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	4.03	82.00	1.70	35.12
T12	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	4.04	85.66	1.70	39.54
	SEm ±	0.26	2.46	0.11	3.86
	C.D @ 5%	0.54	7.19	0.32	11.28
	C. V.	8.56	5.23	12.81	20.08

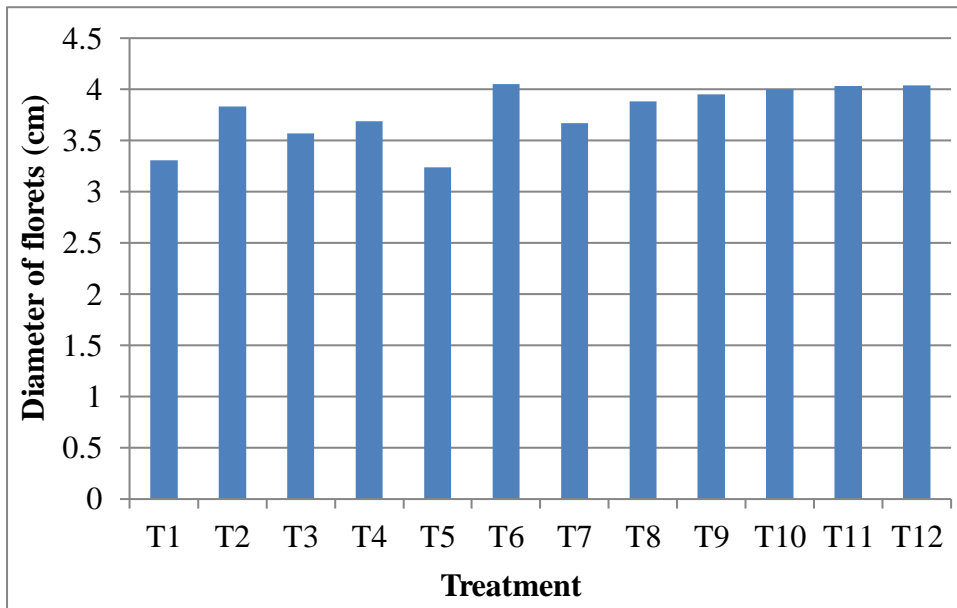


Fig.4.2.6. Effect of different pot mixture on diameter of florets (cm) of tuberose

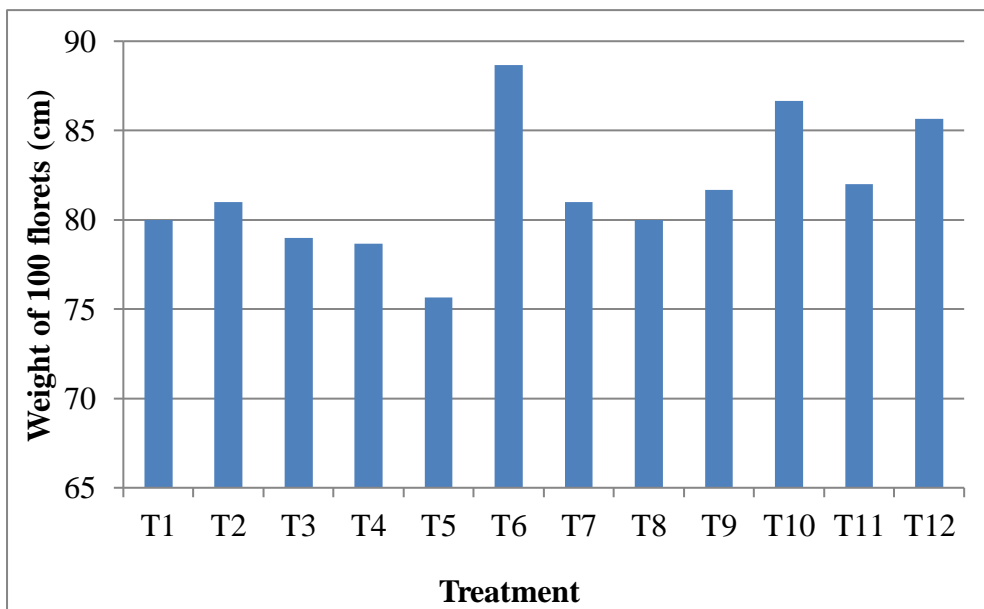


Fig.4.2.7. Effect of different pot mixture on weight of 100 florets (g) of tuberose

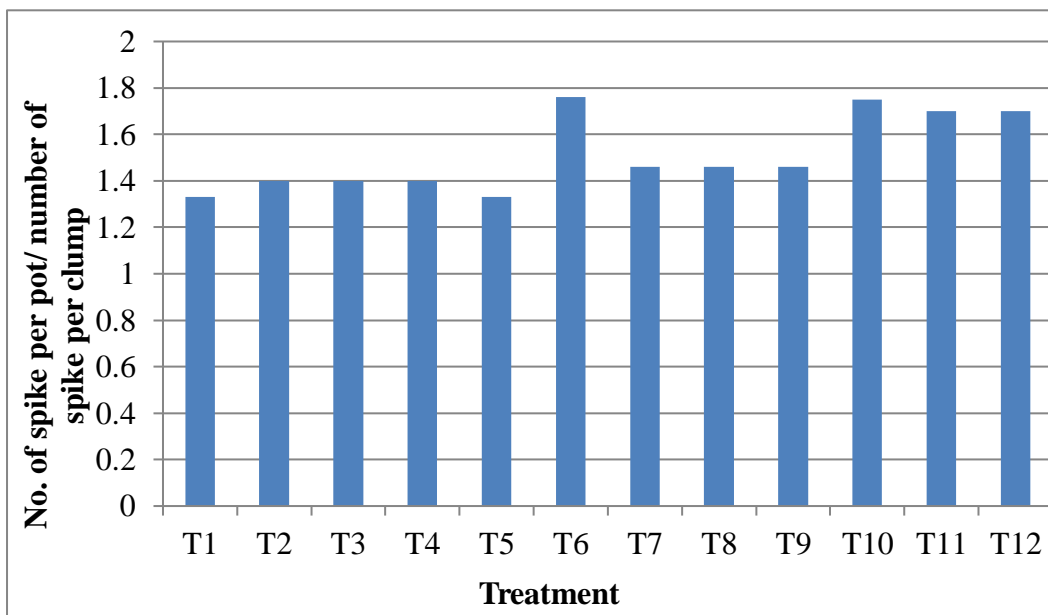


Fig.4.2.8. Effect of different pot mixture on no. of spike per pot and number of spike per clump of tuberose

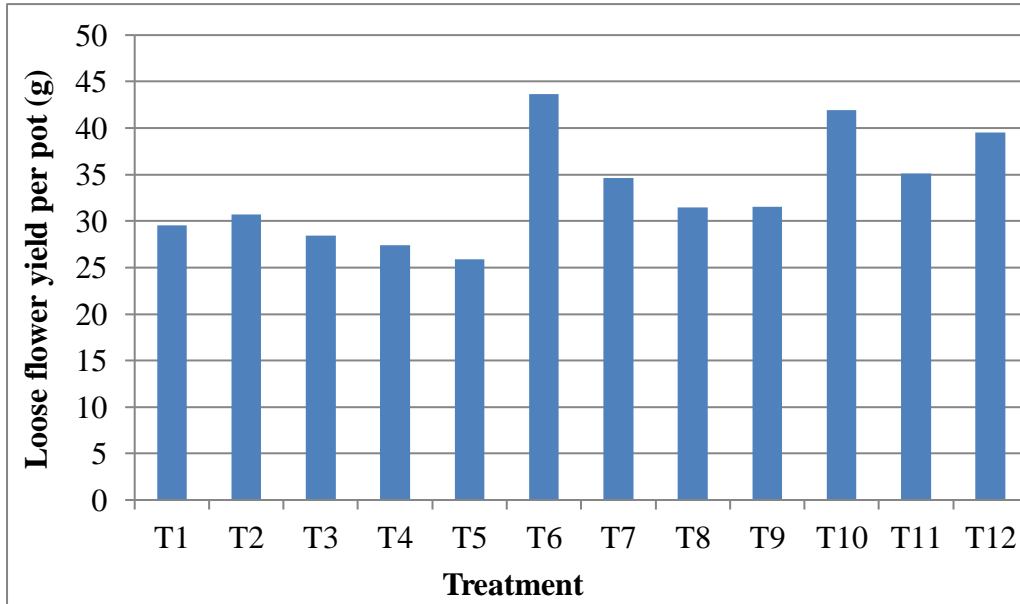


Fig.4.2.9. Effect of different pot mixture on loose flower yield per pot of tuberose

4.3. Bulb and bulblet parameters

4.3.1. Number of bulb per clump

The data Observations on the effects of different pot mixtures on the number of bulbs per clump of tuberose are provided in Table 4.3.1 (a) and Fig. 4.3.1 (a) that shows was non significantly effect on the number of bulbs per clump of tuberose.

There was a substantial effect on the number of bulb per clump on the various nutrient combinations. Among the potting mixture, the highest number of bulb per clump (2.66) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). The lowest number of bulb per clump (1.66) was noted in treatment T₄ Soil + Sand + LM (1:1:1).

4.3.2 Number of bulblets per clump

The data presented in Table 4.3.1 (a) and Fig. 4.3.1 (a) showed that the number of bulblets per clump was non significantly influenced by the application of potting mixture.

The higher number of bulblets per clump (32.66) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). The lower number of bulblets per clump (29.33) was noted in treatment T₄ Soil + Sand + LM (1:1:1).

4.3.3 Diameter of bulb (cm)

The data observations given on the impact of several pot mixtures on tuberose bulb diameter (cm) are provided in Table 4.3.1 (a) and Fig. 4.3.1 (a) which show that potting mixture has significantly impact.

There was a substantial effect on the diameter of bulb (cm) on the various nutrient combinations. Among the potting mixture, the highest diameter of bulb (3.93 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). Which was showed at par with T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly different among treatment in diameter of bulb. The lowest diameter of bulb (2.17 cm) was observed in treatment T₄ Soil + Sand + LM (1:1:1).

Increased bulb size might be due to the reason that in bulbous crops, bulbs development depends upon the availability of sufficient quantity of carbohydrates for translocation of photosynthates from above ground portion of the plant to the underground bulbs which favored the production of more photosynthates acts as a

sink resulting in bigger size of mother bulb. Likely results have been finding with also reported by Younis *et al.* (2008) in Dahlia, Moghadam *et al.* (2012) and Rajera and Sharma (2017) in Lilies.

4.3.4. Diameter of bulblet (cm)

The data in Table 4.3.1 (a) and 4.3.1 (a) verified that the diameter of bulblet (cm) was significantly tainted by the application of potting mixture.

Among potting mixture, the higher diameter of bulblet (1.83 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was found at par with treatment T₃, T₅, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly different among treatment in diameter of bulblets. While the lowest diameter of bulblet (1.20 cm) was recorded in treatment T₄ Soil + Sand + LM (1:1:1).

Bulblets size was also found maximum in T₆ Soil + Sand + FYM + VC (1:1:1:1) in both the cultivars. Soil amended with sand and FYM has beneficial effects on bulblet size. It could be attributed to the diversion of more carbohydrates to underground portion due to less flowering parameters resulting into production of larger sized bulblets. Similar findings were observed by Moghadam *et al.* (2012), Jamil *et al.* (2016) in Hippeastrum and Rajera and Sharma (2017) in Lilies.

4.3.5. Length of bulb (cm)

The data in Table 4.3.1 (b) and Fig 4.3.1 (b) reveal that the potting mixture has significantly affected to length of bulb.

There was a substantial effect on the length of bulb (cm) on the various nutrient combinations. The longest length of bulb (7.47 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with T₁₀ and T₁₂. However it was showed significantly differ with remaining all other treatment. The shorted length of bulb (5.27 cm) was noted in treatment T₄ Soil + Sand + LM (1:1:1).

The result showed that the longest bulb length may be due to that development of bulbs depends on the availability of high amount of carbohydrates for translocation of photosynthates from more than soil portion of the plant to the underground bulbs which acts as a sink. Similar results were also reported by

Younis *et al.* (2008) in Dahlia, Moghadam *et al.* (2012) and Rajera and Sharma (2017) in Lilies.

4.3.6. Length of bulblet (cm)

Based on the findings in Table 4.3.1 (b) and Fig. 4.3.1 (b) the length of bulblets was showed significant difference by the potting mixture.

Among the different potting mixture, the longer length of bulblet (6.7 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and which was found at par with treatment T₁₂. However it was showed significantly different that all other treatment. The shorter value length of bulblet (4.73 cm) was noted in treatment T₄ Soil + Sand + LM (1:1:1).

Bulblets length was also found maximum in T₆ Soil + Sand + FYM + VC (1:1:1:1) that might be soil amended with sand and FYM has beneficial effects on bulblet length. It could be attributed to the diversion of more carbohydrates to underground portion of the plant that resulting into production of higher length of bulblets. Similar findings were also reported by Moghadam *et al.* (2012), Jamil *et al.* (2016) in Hippeastrum and Rajera and Sharma (2017) in Lilies.

4.3.7. Weight of individual bulbs (g)

The weight of individual bulbs was found to be significantly affected by the potting mixture, according to the results given in Table 4.3.1 (b) and Fig 4.3.1 (b)

Among the potting mixture, the highest weight of individual bulbs (19.76 g) was recorded in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₇, T₉, T₁₀, T₁₁ and T₁₂. Whereas it was showed significantly greater than rest of the other treatment. The lowest weight of individual bulbs (15.46 g) was observed in treatment T₄ Soil + Sand + LM (1:1:1).

This may be due to the fact that potting mixture supply sufficient quantity of carbohydrates for translocation to photosynthates from above ground portion of the plant to the underground bulbs which acts as a sink, preventing media compaction, accumulating more fresh weight, increasing the weight of individual bulbs, and increasing bulb production Similar findings have been previous reported by Klasman *et al.* (2002), Treder (2008) in oriental Lily, Moghadam *et al.* (2012), Jamil *et al.* (2016) in Hippeastrum, Rajera and Sharma (2017) in Lilies and Nair and Bharathi (2019) in tuberose.

4.3.8. Weight of individual bulblet (g)

The data in Table 4.3.1 (b) and Fig 4.3.1 (b) indicate that the weight of individual bulblets was found to be significantly affected by the application of potting mixture.

The higher weight of individual bulblet (5.40 g) was observed in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed significantly superior than rest of the other treatment. However it was showed at par with treatment T₇ and T₁₀ and the lower weight of individual bulblet (3.46 g) was noted in treatment T₄ Soil + Sand + LM (1:1:1).

This might be due to the bulblets weight was also found maximum in T₆ Soil + Sand + FYM + VC (1:1:1:1) in both the cultivars. Soil amended with sand and FYM has beneficial effects on bulblet weight. It could be attributed to the diversion of more carbohydrates to underground portion due to less flowering parameters resulting into production of higher bulblets weight and the better physical, chemical and biological properties of media containing and vermicompost and paddy straw compost either with soil which provide congenial environment for proper growth of bulblets. Similar findings were observed by Nazari *et al.* (2011) in Hyacinth, Moghadam *et al.* (2012), Rajera and Sharma (2017) in Lilies and Chaudhary *et al.* (2018) in Lilium.

Table 4.3.1 (a) Effect of different pot mixture on bulb and bulblets parameters

Tr. No.	Treatment	Number of bulb per clump	Number of bulblets per clump	Diameter of bulb (cm)	Diameter of bulblets (cm)
T1	Soil + Sand + FYM (1:1:1) Control	2.00	29.66	2.83	1.37
T2	Soil + Sand + VC (1:1:1)	2.00	31.33	2.73	1.33
T3	Soil + Sand + GM (1:1:1)	2.00	31.00	2.60	1.47
T4	Soil + Sand + LM (1:1:1)	1.66	29.33	2.17	1.20
T5	Soil + Sand + PSC (1:1:1)	2.00	30.66	3.00	1.47
T6	Soil + Sand + FYM + VC (1:1:1:1)	2.66	32.66	3.93	1.83
T7	Soil + Sand + FYM + GM (1:1:1:1)	2.33	31.33	3.13	1.59
T8	Soil + Sand + FYM + LM (1:1:1:1)	2.33	30.00	3.10	1.50
T9	Soil + Sand + FYM + PSC (1:1:1:1)	2.33	31.00	3.33	1.56
T10	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	2.65	32.34	3.50	1.77
T11	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	2.33	32.00	3.50	1.71
T12	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	2.64	32.33	3.60	1.72
	SEm ±	0.56	2.33	0.31	0.12
	C.D @ 5%	NS (1.66)	NS (6.80)	0.92	0.37
	C.V.	43.82	12.96	17.60	14.28

Table 4.3.1 (b) Effect of different pot mixture on bulb and bulblets parameters

Tr. No.	Treatment	Length of bulb (cm)	Length of bulblets (cm)	Weight of individual bulb (g)	Weight of individual bulblets (g)
T1	Soil + Sand + FYM (1:1:1) Control	5.80	5.06	16.43	3.77
T2	Soil + Sand + VC (1:1:1)	5.80	5.26	17.07	3.89
T3	Soil + Sand + GM (1:1:1)	5.83	5.00	16.22	4.10
T4	Soil + Sand + LM (1:1:1)	5.27	4.80	16.60	3.74
T5	Soil + Sand + PSC (1:1:1)	5.70	5.06	16.44	3.78
T6	Soil + Sand + FYM + VC (1:1:1:1)	7.47	6.70	19.76	5.40
T7	Soil + Sand + FYM + GM (1:1:1:1)	5.93	5.20	17.35	4.55
T8	Soil + Sand + FYM + LM (1:1:1:1)	5.87	4.73	15.46	3.46
T9	Soil + Sand + FYM + PSC (1:1:1:1)	5.87	4.83	17.27	3.58
T10	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	6.77	5.00	19.64	4.78
T11	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	5.97	5.33	17.58	4.25
T12	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	7.33	5.76	18.59	3.86
	SEm ±	0.41	0.32	0.85	0.37
	C.D @ 5%	1.21	0.95	2.50	1.09
	C. V.	11.77	10.89	8.57	15.80

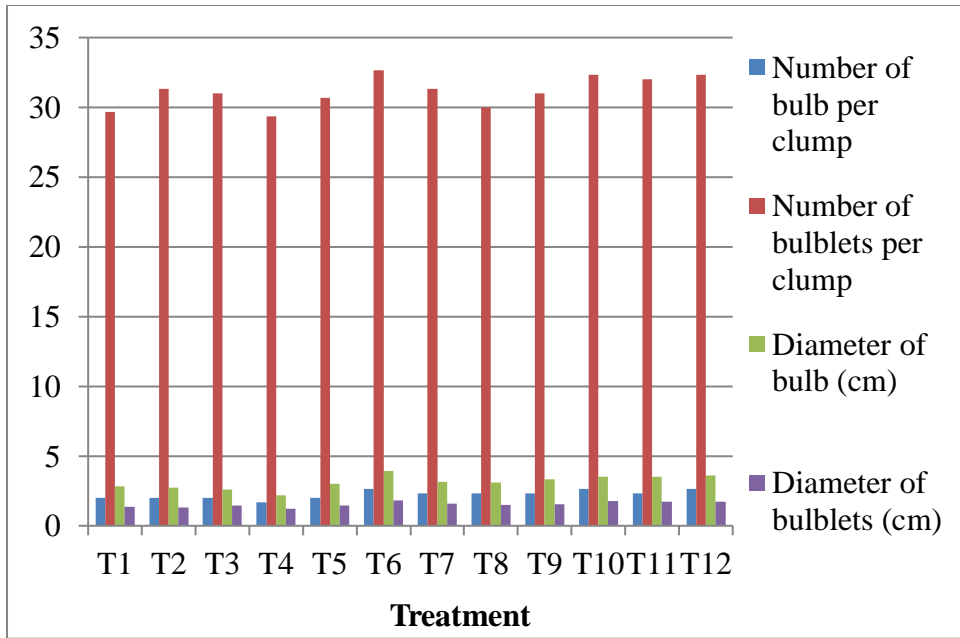


Fig 4.3.1 (a) Effect of different pot mixture on bulb and bulblets parameters

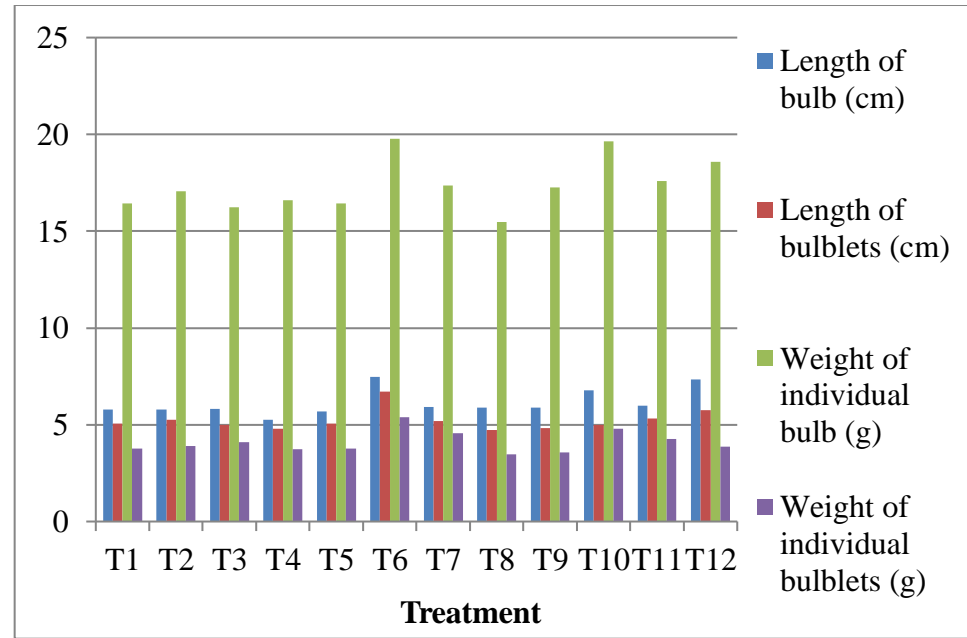


Fig 4.3.1 (b) Effect of different pot mixture on bulb and bulblets parameters

4.4. Benefit cost ratio of the treatment

The data obtainable cost of economic in different treatments per pot was observed in Table 4.4. The calculated values indicated that the higher net income (Rs. 111.57) was obtained in T₄ Soil + Sand + LM (1:1:1). The minimum net income (Rs. 92.67) was obtained by T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1). The maximum overall production cost was seen in T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1) and the least production cost in T₄ Soil + Sand + LM (1:1:1).

The maximum Benefit Cost ratio (1: 1.26) was obtained in T₄ Soil + Sand + LM (1:1:1) and lowest B : C ratio (1 : 0.86) related outcome was noted in (Gohil *et al.* 2018) and (Kulkarni *et al* 2017).

Table4.4.1. The cost economics of different treatments used in tuberose cultivation in pot.

Tr. N.	Treatment	Total cost (Rs. Per pot)	Gross Return (Rs. Per pot)	Net return (Rs. Per pot)	Benefit Cost Ratio
T ₁	Soil+ Sand + FYM (1:1:1) Control	90.83	200	109.17	1.20
T ₂	Soil + Sand + VC (1:1:1)	104.63	200	95.37	0.91
T ₃	Soil + Sand + GM (1:1:1)	92.63	200	107.37	1.15
T ₄	Soil + Sand + LM (1:1:1)	88.43	200	111.57	1.26
T ₅	Soil + Sand + PSC (1:1:1)	98.15	200	101.85	1.03
T ₆	Soil + Sand + FYM + VC (1:1:1:1)	105.53	200	94.47	0.89
T ₇	Soil + Sand + FYM + GM (1:1:1:1)	96.83	200	103.17	1.06
T ₈	Soil + Sand + FYM + LM (1:1:1:1)	94.29	200	105.71	1.12
T ₉	Soil + Sand + FYM + PSC (1:1:1:1)	100.79	200	99.21	0.98
T ₁₀	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	107.33	200	92.67	0.86
T ₁₁	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	99.17	200	100.83	1.01
T ₁₂	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	103.61	200	96.39	0.93

Average Selling price of tuberose	Rs. 200
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CHAPTER – V

SUMMARY, CONCLUSIONS AND SUGGESTIONS

Tuberose can be cultivated in pots, borders, and beds, as well as in commercial settings for a variety of purposes. Tuberose blossoms are also used to make floral garlands, bouquets, buttonholes, gajras, and essential oil. It's also a popular cut flower, not just for usage in bouquets and boutonnieres, but also for the individual florets that give fragrance to bouquets and boutonnieres. Tuberose is a sensual flower that opens the heart and calms the nerves, returning joy, peace, and harmony through aromatherapy.

The present research work entitled “**Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)**” enlightened the importance for investigating different potting mixture treatments for tuberose. The investigation was accomplished at Horticultural nursery, College of Agriculture, IGKV, Raipur, Chhattisgarh during the year 2020-21.

It was set up in a Completely Randomized Design with three replications and 12 treatments (CRD). Soil + Sand + FYM (1:1:1) Control (T₁), Soil + Sand + VC (1:1:1) (T₂), Soil + Sand + GM (1:1:1) (T₃), Soil + Sand + LM (1:1:1) (T₄), Soil + Sand + PSC (1:1:1) (T₅), Soil + Sand + FYM+VC (1:1:1:1) (T₆), Soil + Sand + FYM + GM (1:1:1:1) (T₇), Soil + Sand + FYM + LM (1:1:1:1) (T₈), Soil + Sand + FYM + PSC (1:1:1:1) (T₉), Soil + Sand + FYM + VC + GM (1:1:1:1:1) (T₁₀), Soil + Sand + FYM + LM + PSC (1:1:1:1:1) (T₁₁), Soil + Sand + FYM + GM + PSC (1:1:1:1:1) (T₁₂).

The experimental results based on vegetative growth findings and other characteristics of tuberose are described below:

Effect of different pot mixture on growth parameters attributes

- Results showed that at 120 DAP, the maximum plant height (74.82) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed significantly different with all other treatment, except treatment T₇,

T₁₀ and T₁₂. Whereas the treatment T₇, T₁₀ and T₁₂ was found at par with treatment T₆. The minimum plant height (33.08, 41.33 and 60.08) at 60, 90 and 120 DAP, was noted with treatment T₈ Soil + Sand + FYM + LM (1:1:1:1).

- Data reported at 120 DAP, the longest plant spread (N-S) (46.00) was recorded with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₉, T₁₀, T₁₁ and T₁₂ whereas it was found significantly different with rest of the other treatment. The shortest plant spread (24.67, 31.68 and 33.17 cm) was recorded in treatment T₈ Soil + Sand + FYM + LM (1:1:1:1), at 60, 90 and 120 DAP.
- Similarly at 120 DAP, the highest plant spread (E-W) (47.75 cm) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₇, T₁₀ and T₁₁ whereas it was found significantly different with the rest of other treatment. The shorted plant spread (E-W) (26.00, 29.98 and 31.87 cm) were recorded in treatment T₈ Soil + Sand + FYM + LM (1:1:1:1).
- Results showed that similarly at 120 DAP, the highest number tillers plant⁻¹ (6.23) was observed with T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was significantly greater to rest of the all treatment, except treatment T₇ and T₁₀, treatment T₇ and T₁₀ was exhibited at par with treatment T₆. At 60, 90 and 120 DAP, the lowest number of tillers plant⁻¹ (1.33, 1.50 and 3.03) was recorded in T₅ Soil + Sand + PSC (1:1:1).
- As for as at 90 and 120 DAP, the higher number of leaves plant⁻¹ (36.83 and 56.50) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was significantly superior than all other treatment, except treatment T₁₀. Which was exhibited at par with treatment T₆ during 90 DAP. The lowest number of leaves plant⁻¹ for 60, 90 and 120 DAP (9.50, 15.50 and 28.17 cm) was seen in T₅ Soil + Sand + PSC (1:1:1).
- Similarly at 120 DAP, the higher leaf length (49.50 cm) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₃, T₇, T₉, T₁₀, T₁₁ and T₁₂. Whereas it was found significantly different with rest of the other treatment. The shortest leaf length (31.60, 38.90

and 41.52 cm) was noted with treatment T₅ Soil + Sand + PSC (1:1:1) at 60, 90 and 120 DAP.

Effect of different pot mixture on flower yield parameters attributes

- Result showed that among the potting mixture application of treatment T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1) showed earliest (132.66 days) to spike emergence which was at par with T₄, T₅, T₇, T₈, T₉, T₁₁ and T₁₂. However it was found significantly earliest than rest of the other treatment. While the treatment T₅ Soil + Sand + PSC (1:1:1) showed higher (162.33 days) to spike emergence.
- Among the different potting mixture, treatment T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1) showed earliest (147.67 days) to opening of first florets which was found significantly earlier with treatment T₆, T₇ and T₁₀. However it was showed at par with remaining of the other treatment. The treatment T₅ Soil + Sand + PSC (1:1:1) and the treatment T₅ Soil + Sand + PSC (1:1:1) showed maximum (171.33 days) to opening of first florets.
- Among the different of potting mixture, the treatment T₅ Soil + Sand + PSC (1:1:1) showed higher (24.33 days) to flowering duration, which was significantly superior than treatment T₁₀ and T₁₁. However it was found at par with T₁, T₂, T₃, T₄, T₅, T₆, T₇, T₈, T₉ and T₁₂. The treatment T₁₀ Soil + Sand + FYM + VC + GM (1:1:1:1:1) showed shorted (14.33 days) for flowering duration.
- Among the potting mixture at 150 and 165 DAP, the highest Spike length (60.16 and 67.4 cm) was observed in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). Which was significantly superior than all other treatment, except treatment T₁₀ and T₁₂, which was showed at par with treatment T₆. The lowest spike length (45.166 and 51.60 cm) was recorded in T₅ Soil + Sand + PSC (1:1:1) at 150 and 165 DAP.
- Similarly at 165 DAP, the higher rachis length (41.50) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₇, T₁₀ and T₁₂, whereas it was found significantly different with rest of the all other treatment. The shortest rachis length (25.73 and 29.56

- cm) was noted in treatment T₅ Soil + Sand + PSC (1:1:1) at 150 and 165 DAP.
- Similarly at 165 DAP, the highest number of florets spike⁻¹(29.33) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and it was showed at par with treatment T₄, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly greater than rest of the other treatment. At 150 and 165 DAP, the lowest number of florets spike⁻¹ (12.33 and 21.00) was noted in T₅ Soil + Sand + PSC (1:1:1).
 - At 165 DAP, the longest length of florets (6.10 cm) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was found at par with treatment T₇, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly superior than all other treatment. At 150 and 165 DAP, The shorter length of florets (5.70 and 5.80 cm) was noted in treatment T₅ Soil + Sand + PSC (1:1:1).
 - The maximum diameter of florets (4.05 cm) was recorded in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1), which was showed at par with treatment T₂, T₃, T₄, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly greater to treatment T₁ and T₅. While the lowest diameter of florets (3.24 cm) was recorded with treatment T₅ Soil + Sand + PSC (1:1:1)).
 - Data reported the highest number of spike per clump (2.33) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed non significantly different among treatment in number of spike per clump. The lowest number of spike per clump (1.33) was noted in treatment T₅ Soil + Sand + PSC (1:1:1) and T₈.
 - Among the different potting mixture, the highest weight of 100 florets (88.67 g) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was at par with treatment T₉, T₁₀, T₁₁ and T₁₂ and it was showed significantly superior than all other treatment. The lowest weight of 100 florets (75.66 g) was noted in treatment T₅ Soil + Sand + PSC (1:1:1).
 - Among the potting mixture, the higher number of spike ha⁻¹ (1.76) was observed with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was significantly greater than rest of the other treatment, except treatment T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. It was showed at par with treatment T₆. The minimum number of spike ha⁻¹ (1.33) was recorded with treatment T₅ Soil + Sand + PSC

(1:1:1).

- Among the potting mixture, the highest loose flower yield t. ha⁻¹ (17.40) was noted with treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was observed significant difference with rest of the other treatments. The lowest loose flower yield t. ha⁻¹ (14.3) was noted in treatment T₅ Soil + Sand + PSC (1:1:1).

Effect of different pot mixture on bulb and bulblet parameters attributes

- The result showed among the potting mixture, the highest number of bulb per clump (2.66) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). The lowest number of bulb per clump (1.66) was noted in treatment T₄ Soil + Sand + LM (1:1:1).
- Data reported the higher number of bulblets per clump (32.66) was recorded in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). The minimum number of bulblets per clump (29.33) was noted in treatment T₄ Soil + Sand + LM (1:1:1).
- Among the potting mixture, the highest diameter of bulb (3.93 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1). Which was showed at par with T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly different among treatment in diameter of bulb. The lowest diameter of bulb (2.17 cm) was observed in treatment T₄ Soil + Sand + LM (1:1:1).
- Among potting mixture, the higher diameter of bulblet (1.83 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was found at par with treatment T₃, T₅, T₇, T₈, T₉, T₁₀, T₁₁ and T₁₂. However it was showed significantly different among treatment in diameter of bulblets. While the lowest diameter of bulblet (1.20 cm) was recorded in treatment T₄ Soil + Sand + LM (1:1:1).
- There was a substantial effect on the length of bulb (cm) on the various nutrient combinations. The longest length of bulb (7.47 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with T₁₀ and T₁₂. However it was showed significantly differ with remaining all other treatment. The shorted length of bulb (5.27 cm) was noted in treatment T₄

Soil + Sand + LM (1:1:1).

- Among the different potting mixture, the longer length of bulblet (6.7 cm) was noted in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) and which was found at par with treatment T₁₂. However it was showed significantly different that all other treatment. The shorter value length of bulblet (4.73 cm) was noted in treatment T₄ Soil + Sand + LM (1:1:1).
- Among the potting mixture, the highest weight of individual bulbs (19.76 g) was recorded in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed at par with treatment T₇, T₉, T₁₀, T₁₁ and T₁₂. Whereas it was showed significantly greater than rest of the other treatment. The lowest weight of individual bulbs (15.46 g) was observed in treatment T₈ Soil + Sand + FYM + LM (1:1:1:1).
- The higher weight of individual bulblet (5.40 g) was observed in treatment T₆ Soil + Sand + FYM + VC (1:1:1:1) which was showed significantly superior than rest of the other treatment. However it was showed at par with treatment T₇ and T₁₀ and the lower weight of individual bulblet (3.46 g) was noted in treatment T₈ Soil + Sand + FYM + LM (1:1:1:1).

Effect of different pot mixture on economics

- The result showed that the maximum B:C ratio (1 : 1.26) was obtained in treatment T₄ Soil + Sand + LM (1:1:1) and lowest B : C ratio (1 : 0.86) Similar results were noted by (Gohil *et al.* 2018) and (Kulkarni *et al.* 2017).

CONCLUSION

On the basis of present investigation it can be concluded “**Effect of Different Pot Mixture on Growth and Flower Yield of Tuberose (*Polianthes tuberosa* Linn.)**” the following conclusion me be made:

1. The analysis of different pot mixture on growth parameters that the combination of T₆ Soil + Sand + FYM + VC (1:1:1:1) was highest for the plant height (cm), plant spread (cm), number of tillers plant⁻¹, number of leaves plant⁻¹ and leaf length (cm), The increase in plant growth may be due to supply of organic sources nutrients as they are rich in micronutrients beside having plant growth promoting substances viz., hormones, enzymes and humus forming beneficial microbes. Organic sources, on application to the

soil, improve the physical properties of the soil such as aggregation, aeration, permeability and water holding capacity and proper drainage of media containing which may promote growth and development of plants.

2. The analysis of different pot mixture on flower parameters that the combination of T₆ Soil + Sand + FYM + VC (1:1:1:1) was maximum for days to spike emergence, days to opening of first floret, flowering duration (days), spike length (cm), rachis length (cm), number of florets spike⁻¹, length of floret (cm), diameter of florets (cm), weight of 100 florets (g), number of spikes per clump, number of spikes ha⁻¹ and loose flower yield ha⁻¹ (t. ha⁻¹). The maximum flower growth may be due to application of vermicompost is rich in humus promoting hormones like auxins & gibberellins to the improved growth of plant and the better physical properties of the substrate media which influences the absorption of nutrients by the plants. As the vegetative growth was better, reduced nutrient losses to the environment, or both or it acts as a soil amendment to help improve soil structure or functions and thus may be influenced positively on flower production.
3. The analysis of different pot mixture on bulb and bulblet parameters that the combination of T₆ Soil + Sand + FYM+VC (1:1:1:1) is best for number of bulbs per clump, number of bulblets per clump, diameter of bulb (cm), diameter of bulblet (cm), length of bulb (cm), length of bulblet (cm), weight of individual bulbs (g) and weight of individual bulblet (g). This might be due to the soil amended with sand and FYM has beneficial effects on bulb and bulblet growth. It could be attributed to the diversion of more carbohydrates to underground portion due to less flowering parameters resulting into production of higher growth bulb and bulblets and the better physical, chemical and biological properties of media containing and vermicompost and paddy straw compost either with soil which provide congenial environment for proper growth of bulb and bulblets. Therefore, it can be concluded that the pot mixture containing T₆ Soil + Sand + FYM + VC (1:1:1:1) showed better growth and is advantageous than all treatments.
4. The highest net income (Rs. 111.57) was obtained in T₄ Soil + Sand + LM (1:1:1)

SUGGESTIONS FOR FUTURE LINE OF WORK

Following are some proposals for future lines of work, based on the enhanced information gained during the study and the results obtained:

1. To make a definitive recommendation, the experiment must be repeated to ensure that the results are consistent..
2. This same experiment method can be adopted for other tuberose varieties and other pot mixture.
3. Research can also be carried out in Chhattisgarh's other agro-climatic zones.
4. A study can be carried out to determine the optimal potting mixture for the job combination of Soil + Sand + FYM + VC (1:1:1:1)
5. The experiment may be carried out to adopt tuberose in various farming system.
6. Study may be carried influence of potting mixture on flower yield of tuberose during different seasons.

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APPENDIX-I Table: Weekly meteorological data ((24 December 2020 – July 2021.

W.K. No	Date	Max. Temp. (°C)	Min. Temp. (°C)	Rainfall (mm)	Relative Humidity % I	Relative Humidity % II	Sun Shine (hours)
1	Dec(24-31)	28.4	10.3	0	87	28	4.8
2	Jan(1-7)	29.33	12.97	0	86.17	22.2	3.1
	(8-14)	31.52	17.48	0	77.5	10.38	3.13
	(15-21)	29.8	11.13	0	83.83	8.23	7.13
	(22-28)	31.17	13.7	0	81.33	10.95	3.87
3	(29-4 Feb.)	27.72	10.57	0.77	81.5	6.72	6.33
	(5-11)	29.67	10.4	0	77.33	5.77	9.47
	(12-18)	32.67	14.88	0	78.83	11.05	4.17
	(19-25)	30.4	14.68	0.23	82.33	10.03	6.93
4	(26-4 March)	36.1	16.03	0	67.33	6.98	9.52
	(5-11)	36.4	16.88	0	63.17	8.65	8.55
	(12-18)	34.6	19.43	1.03	77.5	10.6	5.73
	(19-25)	34.9	20.25	0.23	63.33	10.57	4.3

5	(26-1 April)	39.5	20.37	0	51.83	6.9	8.47
	(2-8)	40.28	20.78	0	56.5	9.38	7.42
	(9-15)	38.8	23.93	0.17	54.33	10.68	6.35
	(16-22)	39.12	23.08	0	54.67	11.23	6.62
	(23-29)	39.97	22.87	0	48.67	8.13	8.23
6	(30-6 may)	40.07	25.27	0	53.33	12.95	8.07
	(7-13)	35.98	23.5	11.43	73.33	17.92	7.17
	(14-20)	38.72	27.15	0.1	67.83	18.67	10.88
	(21-27)	38.83	27.28	0	50.5	10.9	6.63
	(28-31)	40.57	27.04	0	51.7	13.42	5.83
7	Jun(01-07)	38.7	27.2	0.4	67	38	6.1
	(08-14)	33.6	25.2	20.5	83	67	4.7
	(15-21)	32.6	24.9	3.6	85	62	2.7
	(22-28)	31.7	24.8	10.5	81	72	2.3
8	(29-05 July)	34.3	25.8	1.7	86	64	4.2

	(06-12)	32.4	25.6	17.5	88	68	3
	(13-19)	33.8	26.4	3.9	82	60	7.6
	(20-26)	32.6	25.5	10.2	89	71	3.2

APPENDIX-II Table: Economics of various treatments used in tuberose cultivation in pots.

A. Fixed cost of tuberose production in pots:

S. No.	Particular	Input	Rate (Rs.)	Total Cost (Rs.)
1	Planting material	72	6	432
2	Pot	72	28	2,016
3	Labour			
(a)	Pot mixture preparation, pot filling and transplanting	2 man days	290	580
(b)	Irrigation	5	290	1450
(c)	Intercultural operation and insecticide application	1 man day	290	290
(d)	Treatment application	1 man day	290	290
4	Plant protection			100
Total fixed cost				5158
Fixed cost		Total cost/Total Pots	5158/72	71.63
Cost of one pot		71.63		

B. Variable cost of tuberose production in pots:

S.no	Treatment	Particulars	Input per pot	Rate (Rs. unit-1)	Total cost (Rs. per grow pot)
1	T1	Soil + Sand + FYM (1:1:1) Control	1.6 kg	2 kg ⁻¹	3.2
			1.6 kg	10 kg ⁻¹	16
2	T2	Soil + Sand + VC (1:1:1)	1.65 kg	2 kg ⁻¹	3.3
			1.65 kg	18 kg ⁻¹	29.7
3	T3	Soil + Sand + GM (1:1:1)	1.5 kg	2 kg ⁻¹	3
			1.5 kg	12 kg ⁻¹	18
4	T4	Soil + Sand + LM (1:1:1)	1.4 kg	2 kg ⁻¹	2.8
			1.4 kg	10 kg ⁻¹	14
5	T5	Soil + Sand + PSC (1:1:1)	1.56 kg	2 kg ⁻¹	3.12
			1.56 kg	15 kg ⁻¹	23.4
6	T6	Soil + Sand + FYM + VC (1:1:1:1)	1.13 kg	2 kg ⁻¹	2.26
			1.13 kg	10 kg ⁻¹	11.3
			1.13 kg	18 kg ⁻¹	20.34
7	T7	Soil + Sand + FYM + GM (1:1:1:1)	1.05 kg	2 kg ⁻¹	2.1
			1.05 kg	10 kg ⁻¹	10.5
			1.05 kg	12 kg ⁻¹	12.6

8	T8	Soil + Sand + FYM + LM (1:1:1:1)	1.03 kg ⁻¹	2 kg ⁻¹	2.06
			1.03 kg ⁻¹	10 kg ⁻¹	10.3
			1.03 kg ⁻¹	10 kg ⁻¹	10.3
9	T9	Soil + Sand + FYM + PSC (1:1:1:1)	1.08 kg ⁻¹	2 kg ⁻¹	2.16
			1.08 kg ⁻¹	10 kg ⁻¹	10.8
			1.08 kg ⁻¹	15 kg ⁻¹	16.2
10	T10	Soil + Sand + FYM + VC + GM (1:1:1:1:1)	0.85 kg ⁻¹	2 kg ⁻¹	1.7
			0.85 kg ⁻¹	10 kg ⁻¹	8.5
			0.85 kg ⁻¹	18 kg ⁻¹	15.3
			0.85 kg ⁻¹	12 kg ⁻¹	10.2
11	T11	Soil + Sand + FYM + LM + PSC (1:1:1:1:1)	0.81 kg ⁻¹	2 kg ⁻¹	1.62
			0.81 kg ⁻¹	10 kg ⁻¹	8.1
			0.81 kg ⁻¹	10 kg ⁻¹	8.1
			0.81 kg ⁻¹	12 kg ⁻¹	9.72
12	T12	Soil + Sand + FYM + GM + PSC (1:1:1:1:1)	0.82 kg ⁻¹	2 kg ⁻¹	1.64
			0.82 kg ⁻¹	10 kg ⁻¹	8.2
			0.82 kg ⁻¹	12 kg ⁻¹	9.84
			0.82 kg ⁻¹	15 kg ⁻¹	12.3

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
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 Signature