EFFECT OF DIFFERENT GROWING MEDIA ON ORCHID (*Dendrobium nobile* L.) UNDER SHADE NET HOUSE

M. Sc. (Ag.) Thesis

By

Twinkle Ratre

DEPARTMENT OF PLANT PHYSIOLOGY, AGRICULTURAL BIOCHEMISTRY, MEDICINAL AND AROMATIC PLANTS
COLLEGE OF AGRICULTURE
FACULTY OF AGRICULTURE
INDIRA GANDHI KRISHI VISHWAVIDYALAYA, RAIPUR (Chhattisgarh)

2021

EFFECT OF DIFFERENT GROWING MEDIA ON ORCHID (*Dendrobium nobile* L.) UNDER SHADE NET HOUSE

Thesis

Submitted to the

Indira Gandhi Krishi Vishwavidyalaya, Raipur

by

Twinkle Ratre

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Master of Science
in
Agriculture
(PLANT PHYSIOLOGY)

Roll No. 20192491 ID No. 20192491

OCTOBER, 2021

CERTIFICATE – I

This is to certify that the thesis entitled **"Effect of Different Growing Media on Orchid (*Dendrobium nobile* L.) under Shade Net House"** submitted in partial fulfilment of the requirements for the degree of **Master of Science in Agriculture** of the Indira Gandhi Krishi Vishwavidyalaya, Raipur, is a record of the bonafide research work carried out by **Twinkle Ratre** under my/our guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instructions.

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

Chairman

Date: 13-10-21

THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE

Chairman (Dr. S. P. Tiwari)

Member (Dr. Arti Guhey)

Member (Dr. L. S. Verma)

Member (Dr. Ravi Saxena)

CERTIFICATE – II

This is to certify that the thesis entitled **"Effect of Different Growing Media on Orchid (*Dendrobium nobile* L.) under Shade Net House"** submitted by **Twinkle Ratre** to the Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.) in partial fulfilment of the requirements for the degree of **Master of Science in Agriculture** in the Department of Plant Physiology, Agricultural Biochemistry, Medicinal and Aromatic Plants has been approved by the External Evaluator and Student's Advisory Committee after oral examination, under the Chairmanship of Head of Department.

Signature of Head of the Department

(Name Dr. Arti Guhey)

Date: 23-11-21

Major Advisor

Faculty Dean

6/12/21

Approved/Not approved

Director of Instructions

ACKNOWLEDGEMENT

I would thank God for being able to complete my research work. I would like to take this opportunity to express my heartfelt, humble and sincere appreciation to those who assisted me in completing my research work. These terms are a token of gratitude, but they never completely compensate them for their invaluable assistance and cooperation.

I would like to express my heartfelt gratitude to respected teachers and members of advisory committee, particularly ***my major advisor Dr. S.P. Tiwari*** *for the continuous support of my M. Sc. study and research, for his patience, inspiration, enthusiasm, and vast knowledge. I would like to thank the rest of my thesis advisory committee* ***Dr. Arti Guhey*** *(Professor and Head of Plant Physiology),* ***Dr. L.S. Verma*** *(Department of Floriculture and Landscaping Architecture),* ***Dr. R.R. Saxena*** *(Associate Professor, Department of Agriculture Statistics and Social Science), College of Agriculture, Raipur for their assistance and suggestions during the thesis work.*

I wish to record my special thanks to ***Dr. S.S. Senger, Hon'ble Vice Chancellor, Shri. G.K. Nirmam****, Registrar,* ***Dr. R.K. Bajpai****, Director Research Services,* ***Dr. S.S. Senger****, Director of Instructions and* ***Dr. M.P. Thakur****, Dean, College of Agriculture, IGKV, Raipur for providing necessary facilities technological and administrative supports for conductance of this research work. My sincere thanks are due to* ***Dr. Arti Guhey****, Professor and Head, Department of Plant Physiology.*

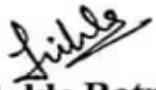
I am extremely grateful to ***Dr. Pratibha Katiyar*** *(Professor, Department of Plant Physiology),* ***Dr. V.B. Kuruwanshi*** *(Senior Scientist, Department of Plant Physiology),* ***Dr. D. Khokhar*** *(Scientist, Department of Plant Physiology, Agricultural Biochemistry and Herbal Science) for their co-operation and support throughout my work time, and for their continues encouragement and assistance during my studies. I would like to express my gratitude to other non-teaching staff of Department of Plant Physiology for their prompt assistance.*

I would like to express my sincere gratitude to ***Dr. Madhav Pandey*** *(Librarian, Nehru Library, IGKV, Raipur) and all other members of the Nehru Library for giving me their kind help during my research. I heartily wish to express my thanks to* ***Dinesh bhaiya, Ravi bhaiya, Amar bhaiya, Poornima aunty*** *for their great help during the entire research work.*

I specially want to thank my seniors, ***Bhumika, Sakina, Deepika*** *for their valuable guidance and encouragement during my research work. I am also thankful to my friends* ***Arti, Pallawee, Renuka, Daminee, Malvika, Gopika*** *and* ***Suman*** *for playing a par excellent role by showering friendly attitude, love, generous, right guidance and encouragement to complete my thesis work.*

*My inexpressible feelings and heartfelt appreciation to my greatest riches in life, my parents, **Mr. Laxman Singh** and **Smt. Premlata**, my younger siblings **Rishi** and **Shreyash** for their filial piety, unwavering sacrifice, lavish encouragement, sincere prayer and blessings which served as a vital source of inspiration.*

I would like to convey my cordial thanks to all those who helped me directly or indirectly to fulfil my dream.



Twinkle Ratre

Department of Plant Physiology,
College of agriculture,
IGKV, Raipur (C.G.)
Date: 13-10-21

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF NOTATIONS

%	Per cent
ANOVA	Analysis of Variance
CD	Critical Difference
SE(m)	Standard of mean
Etc	Etcetera
^{0}C	Degree Celsius
G	Gram
cm	Centimeters
cm^{-2}	per centimeters square
PPM	Parts per million
et al.	And co-worker/ and others
@	At the rate
i.e.,	That is

LIST OF ABBEREVATIONS

GA_3	Gibberellic acid
$AgNO_3$	Silver Nitrate
CRD	Completely randomized design
NS	Non significant
SPAD	Soil plant analytical development
N	Nitrogen
P	Phosphorus
K	Potassium

THESIS ABSTRACT

a)	Title of the Thesis	:	Effect of different growing media on orchid (*Dendrobium nobile* L.) under shade net house
b)	Full Name of the Student	:	Twinkle Ratre
c)	Major Subject	:	Plant Physiology
d)	Name and Address of the Major Advisor	:	Dr. S.P. Tiwari, Assistant Professor, Department of Plant Physiology, College of Agriculture IGKV, Raipur (C.G.)
e)	Degree to be Awarded	:	Master of Science in Agriculture (Plant Physiology)

Signature of the Student

Signature of Major Advisor

Date: 13-10-21

Signature of Head of the Department

ABSTRACT

The present investigation was carried out during *rabi* season in 2020-2021 at Department of Plant Physiology, AB & MAP, COA, IGKV, Raipur (C.G). The investigation entitled "Effect of different growing media on orchid (*Dendrobium nobile* L.) under shade net house" was carried out with treatments, T_1 -Cow dung and Vermicompost, T_2 -Charcoal, T_3 -Tree barks and T_4 -Pieces of bricks in completely randomized design (CRD) with four treatments and three replications. Four holding solution of GA_3 (25ppm), Kinetin (25 ppm), $AgNO_3$ (25 ppm) and control, to increase vase life of flower spike.

Among different growth media, tree barks media was found superior to improve in height of pseudobulb (19.20 cm), Number of internodes per plant

(3.80), Internode length (4.60 cm), Number of leaves (5.26), Shoot girth (4.16 cm), Wax content (44.66 µg/cm^2). The treatment T_4 (Pieces of bricks) recorded best for Root length (17.16 cm). The treatment T_1 (Cow dung + Vermicompost) recorded best for Leaf area (44.68), Light intensity (153.90), chlorophyll value (46.70), early flower bud initiation (38.33 days), flower bud development (9.66 days), first floret opening (47.53 days), Spike length (18.40 cm), Number oof spikes (2.06), Spike girth (3.03 cm), Number of florets per spike (1.73), Size of flower (18.20 cm^2), Longevity of flower (8.13 days). $AgNO_3$ was shown to be the most effective holding solution for extending the vase life of cut flowers (11.66 days).

शोध सारांश

अ)	शोध शीर्षक	–	"छायांकित नेट हाउस के तहत आर्किड (डेन्ड्रोबियम नोबेल एल.) पर विभिन्न मीडिया का प्रभाव"
ब)	विद्यार्थी का नाम	–	त्रिवंकल रात्रे
स)	प्रमुख विषय	–	पादप कार्यिकी
द)	प्रमुख सलाहकार का नाम व पता	–	डॉ. शशि प्रकाश तिवारी (सहायक प्राध्यापक) पादप कार्यिकी, कृषि जैव रसायन, औषधि एवं सुगंधित पौध विभाग इं.गा.कृ.वि. रायपुर (छ.ग)
इ)	प्रदान की जाने वाली उपाधि	–	एम.एस.सी. (कृषि) पादप कार्यिकी

मुख्य सलाहकार के हस्ताक्षर

विद्यार्थी का हस्ताक्षर

दिनांक – 13-10-21

विभाग प्रमुख के हस्ताक्षर

शोध सारांश

वर्तमान प्रयोग 2020–21 में पादप कार्यिकी कृषि जैव रसायन, औषधीय एवं सुगंधित पौध विभाग में किया गया, जिसका शीर्षक "छायांकित नेट हाउस के तहत आर्किड (डेन्ड्रोबियम नोबेल एल.) पर विभिन्न मीडिया का प्रभाव" है । इस प्रयोग में चार उपचार और तीन प्रतिकृति लिया गया जो कमशः गोबरखाद और वर्मीकम्पोस्ट, चारकोल, पेड़ की छाल और ईंट के टुकड़े है । कट फ्लावर के गुण्वत्ता तथा उनके जीवन को बढ़ाने के लिए चार उपचार जी.ए. 3 (25 पीपीएम), काइनेटिन (25 पीपीएम), सिल्वर नाइट्रेट (25 पीपीएम), कन्ट्रोल (डिस्टिल्ड जल) का उपयोग किया गया था।

परीक्षण किए गए वृद्धि मीडिया में, पेड़ की छाल मीडिया को पौधें की ऊँचाई (19.20 से.मी), पत्तियों की संख्या (5.26), प्रति पौधें इंटरनोड की संख्या (3.80), इंटरनोड की लंबाई (4.60 से.मी.), शूट परिधि (4.16 से.मी.) और मोम सामग्री (44.66) के लिये सबसे अच्छा पाया गया। उपचार ईंट के टुकड़े को जड़ की लंबाई (17.16 से.मी.) के लिये सबसे अच्छा पाया गया।

उपचार गोबरखाद और वर्मीकम्पोस्ट को पत्ती की क्षेत्रफल (44.68), प्रकाश की तीव्रता (153.90) और क्लोरोफिल मूल्य (46.70), शुरूआती पुष्पकली का न्यूनतम दिन (38.33 दिन) पुष्पकली के विकास का न्यूनतम दिन (9.66 दिन) पहले पुष्प का खिलना (47.53 दिन) स्पाईक की लंबाई (18.40 से.मी.), स्पाईक की संख्या (2.6) स्पाईक गर्थ (3.03 से.मी.), प्रति स्पाईक फ्लोरेट की संख्या (7.73) फूलों का आकार (18.20 से. मी.) और फूलों की दीर्घायु (8.13 दिन) के लिये सबसे अच्छा पाया गया। फूलों के कटाई के बाद के

अध्ययन में सिल्वर नाइट्रेट को फूलों के फूलदान जीवन को बढ़ाने के लिए अच्छा पाया गया। इसमें फूल 12.33 दिन तक अधिकतम रहा।

CHAPTER -I

INTRODUCTION

Orchids are the most beautiful flowers in God's creation, and they are one of the most distinctive plants in nature, as well as one of the most expensive flowers in the international flower trade, owing to their remarkable range of size, colour, shape, form, look and long-lasting characteristics. Orchids are members of the Orchidaceae family, which is the biggest flowering plant family, with 25,000 species divided into 600-800 genera (Chowdhery, 2001). There are many different types of orchids such as *Dendrobium, Phalaenopsis*, *Vanda*, *Onicidium*, *Epidendordium*, *Cattleya* and so on. Orchids are commonly produced as decorative plants and are used as cut flowers and potted plants (Chugh *et al*., 2009).

The *Dendrobium* plant has a unique look, since it is sympodial, epiphytic, and lacks a bulb, yet it has stalks that produce the papery-green leaves (Hew and Yong, 2004). Each year, throughout the months of December and January, vegetative growth begins. The pseudobulb or thickened stem are useful for the storage of food and water. Flower buds develop in the leaf axis. Pseudobulb is ready to harvest in November and December of the following year. Following proper cooling, flowers begin to bloom in February and March of the following year. Up to three blooms can be produced from each node.

Orchids are simple to grow, quite popular and in high demand on the worldwide market. In the worldwide flower market, the *Dendrobium* orchid is the most popular (Puchooa, 2004) *Dendrobium* orchids are grown in Thailand, China, Taiwan, Germany, the Philippines, Japan, the United States and India. Because of their beauty, long shelf life, great output, correct season of bloom, and ease of packing and shipping, orchids have gained a prominent place in the cut flower market. Orchids make for a significant portion of world trade in both cut flowers and potted plants, accounting for around 10% of global fresh cut flower sales *Dendrobium* species account for 85 percent of the global orchid cut flower

commerce, while *Phalaenopsis* and *Cymbidium* species account for 15 percent. (Cheamuangphan *et al.*, 2013).

India is home to a wide range of orchid species. Arunachal Pradesh has the most orchid species (612), followed by Sikkim (560), West Bengal (479), and the Darjeeling Himalayas (479), with north east India ranking first in terms of species concentration. Northeast India, which is made up of eight states: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, is home to around 750-876 orchid species belonging to 151 genera that may be found in various areas of the region. (Hynneiwta, 2000).

In the state of Chhattisgarh, a limited population of *Dendrobium* species may be found growing on a variety of host trees. *Shorea robusta*, *Ochna gamblei*, *Terminalia alata* and *Madhuca longifolia* were some of the most significant host trees for this orchid in the area. *Vanda tessellate*, a monopodial orchid with large showy flowers, is abundant in Ambikapur, Jagdalpur, Bilaspur, and Kanker districts, growing naturally on trees such as *Mangifera indica*, *Madhuca indica*, *Syzygium cumini*, *Butea monosperma*, *Shorea robusta* and others in the forests or along the roadside (Kumar, 2008).

Plant location, humidity conditions, and fertilizer influence the growth of *Dendrobium* orchids (Teixeira da Silva *et al*., 2017, Trimanto & Rahadiantoro, 2017, Hariyanto *et al*., 2019). Rapid vegetative development occurs in most *Dendrobium* orchids at temperatures between 24°C and 30°C (Leonhardt, 2000). *Dendrobium* orchids are professionally cultivated in greenhouses, where they demand shade, a cool environment and a high level of humidity. Plants that are exposed to direct sunlight have charred leaves and wilt (Lavanya *et al*., 2009).

Dendrobium orchids growth is primarily governed by the right planting media combination and media has a protective effect against diseases (Naik *et al*., 2014). A good planting media provides proper aeration, drainage and water holding capacity. Planting media can be in form of wood charcoal, fern roots,

broken tile or brick, tree barks, cow dung, vermicompost, cocopeat, rice husk, coconut husk, leaf mould, sphagnum moss, sawdust, manure, bone meal etc.

In cut flowers business, post-harvest damage and mishandling methods account for 10 to 30% of losses. For flower industry, there is a need for extended handling and proper transportation. The longevity of cut flower can be increased by adding various preservatives to the vase water, resulting in delay of senescence in cut flowers (Reid, 2012). The preservatives can be used are Sucrose, Silver thiosulphate, Aluminium sulphate, Kinetin, GA_3, Silver nitrate etc. $AgNO_3$ increases the sugar content of the flower spike plays important role in post-harvest decay of orchids. Sugars used in preservatives often extend the vase life of cut flowers.

The aim of present study was to evaluate the effects different growing media on orchid (*Dendrobium nobile)*. Keeping in view the above-mentioned information from previous studies, present research was designed to assess the **'Effect of different growing media on orchid (*Dendrobium nobile* L.) under shade net house'** under following objectives**.**

Objectives of the present study are:

1. To study the effect of different growing media on morpho-physiological traits of orchid under shade net house.
2. Impact of different growing media on biochemical and phenological traits of orchid under shade net house.
3. To assess the yield and its attributes of orchid as affected by different growing media.
4. To correlate the temperature and photoperiod with the flower yield

CHAPTER-II

REVIEW OF LITERATURE

The brief review of experimental findings pertaining to studies on the "Effect of different growing media on orchid (*Dendrobium nobile* L.) under shade net house" has been reviewed under following heads:

1. Effect of different growing media on morpho-physiological traits of orchid.
2 Effect of different growing media on biochemical and phenological traits of orchid.
3 Effect of different growing media on yield and its attributes of orchid.
4 Correlation of various traits (temperature and photoperiod) on flower yield of orchid.

2.1 Effect of different growing media on morpho-physiological traits of orchid

Wang (2000) observed that *Phalaenopsis* orchid when grown in a mix containing *Douglas* Fir bark and sphagnum peat, 50 mg/L P was found adequate for vegetative growth and reproductive development.

Wang and Konow (2002) observed that *Phalaenopsis* resulted enhanced growth and flower number when grown in a mix of bark with media components of high water-holding capacity such as peat and vermiculite as compared to plants grown alone of bark.

Indhumathi *et al*. (2003) suggested that the media containing charcoal, brick and cocopeat (1:1:1) gave the highest plant height, leaf size and root length in *Dendrobium* Hybrid Sonia-17.

Arumugan and Jawaharlal (2004) recorded that when NPK is used in the ratio 10:30:30 with brick pieces+ gravel+ poultry manure resulted in maximum shoot girth (3.25) in *Dendrobium* orchid cv. Emma White.

Puchooa (2004) observed that when *Dendrobium* plantlets were transported to the green house into baskets containing wood charcoal, the survival rate was 84 percent. Wood charcoal provides improved drainage to the roots, which is important in orchid growth.

Verdonck and Demeyer (2004) found that physical characteristics of various growing media improved root zone growth, resulting in increased water and nutrient absorption by plants.

Gowda *et al*. (2005) suggested that a mixture containing coconut husk and broken pot pieces resulted in superior performance of plant height, number of leaves, leaf length, leaf width and shoot girth in *Anthurium* cv. Lady Jane.

Mani and Nagaraju (2005) observed the effect of different substrates on *Cymbidium* hybrids and resulted that plantlet grown in cocopeat had the greatest increase in length of shoot (15.02%) and broad leaves, while plantlets grown in cocopeat with sand had the greatest increase in number of leaves (42.31%) and length of leaf (32.24 percent).

Mahopatra and Saravanan (2006) recorded that the media containing gravel + groundnut shell + cow dung shows highest shoot girth, followed by charcoal + coconut coir + cow dung media in *Dendrobium* var. Emma White.

Arancon *et al*. (2008) reported that vermicompost gives better response as plant growth media because they are finely divided materials with high porosity, good aeration in roots, proper drainage, better water holding capacity and very high microbial activity, which make them excellent as soil amendments or conditioners.

Suntibala and Kishore (2009) observed that acclimatization of *Dendrobium tranparens* plantlets in a potting media containing mixture of brick and charcoal (2:1) gave best results with above 90% of transplanted plants survived in greenhouse condition.

Deb and Imchen (2010) recommended that coconut husk was found beneficial for survival and growth of plantlets of *Dendrobium.* He stated that the

media provides support to plantlets and also provide nutrients and water to roots of plantlets.

Hatamzadeh *et al.* (2011) reported that *Cymbidium* was cultivated in a media container to see how vermicompost affected the flower plant's growth and productivity. *Cymbidium* were grown in a shade net house with a basic growth media of 50 percent pumice, 10 percent vermiculite, 30 percent charcoal, and 10% peat moss, which was replaced with 10 percent, 20 percent, 30 percent, and 40 percent (by volume) vermicompost. The growth media without vermicompost is used as a control. Mineral nutrition and irrigation were delivered on a regular basis. The most vegetative growth was observed in medium containing 30% and 40% vermicompost, whereas the lowest growth was observed in 0% vermicompost. In 30% and 40% of the cases, there was increased inflorescence and flower growth, as well as a higher number of flowers. In 30% of the media, inflorescence length was longer.

Basheer and Thekkayam (2012) was conducted an experiment to standardize different growing media and organic nutrient dosage for *Anthurium* orchid. The result shows that when plants are treated with 4g/l and 6g/l fresh cow dung extract at varying stages of orchid, it enhances the vegetative growth of the plant. The maximum plant height and leaf area was recorded for plants receiving 4g/l cow dung extract.

Pant and Thapa (2012) observed that the highest survival rate of *Dendrobium* Sonia was 66.67% in hardening mixture charcoal and brick pieces at 1:1 proportion when transferred in greenhouse condition.

Sahoo (2012) reported that the combination of brick pieces, charcoal, cocopeat, sphagnum moss and decay wood was observed to be most appropriate for acclimatization of *Dendrobium* cv. Sonia 17.

Suradinata *et al*. (2012) reported that treatment containing a combination of coconut husk and charcoal with 1:1 ratio and application of 2g/ L Gaviota fertilizer results best effect on plant height and leaf width on *Dendrobium* sps.

Ahmad and Saravanan (2014) reported that NPK ratio 10:30:30 with 0.3% brick pieces, gravel, poultry manure recorded highest leaf area (cm^2) under shade net house.

Muraleedharan and Karuppaiah (2015) suggested that highly organic, well aerated media with good water holding capacity and drainage is needed in *Anthurium* because of its epiphytic nature.

Kreij and Berg (2017) observed that good vegetative growth is required to obtain a large number of generative buds, but too much vegetative growth can reduce generative bud formation, thus a combination of a high nitrogen level during vegetative growth and omitting fertilizer during generative bud emergence should give the highest yield and earlier flowering.

Sabreeswaran *et al*. (2018) conducted an experiment taking four different growing media as charcoal, broken pot pieces, coconut husk and their combinations. They reached the conclusion that combination of coconut husk and broken pot pieces in 1:1 are best media for *Dendrobium* var. Thongchai Gold.

Lakshanthi and Seran (2019) observed that the potting media containing brick pieces, coconut husk, chip stones charcoal at ratio 1:1:1:1 recorded the highest survival percentage, shoot length, number of leaves per plant, leaf width and length of root in *Dendrobium* orchid.

2.2 Effect of different growing media on biochemical and phenological traits of orchid

Anand and Jawaharlal (2003) observed that when plants are sprayed NPK @ 20:20:20 at 0.25% along with BA (benzyl adenine) 500ppm resulted in greater leaf number and high leaf area.

Marschner *et al*. (2003) recommended that nitrogen is required for chloroplast development, deficiencies in nitrogen and phosphorus can impair photosynthesis. The chloroplast of green leaf cells contains 75 percent of total organic nitrogen.

Wang *et al*. (2007) reported that when coarse materials are combined with a water-absorptive material for growing *Phalaenopsis* provides excellent movement of air through the medium such as charcoal and peat.

Schmilewski (2008) observed that wood fibers are fibrous in structure, loose, porous and elastic. They have low bulk density, very high air capacity, very low water holding capacity and pH 4.0-6.0. Furthermore, they have good rewet ability, free from weeds and pathogens.

Saravanan and Amit (2009) observed different growing media and plant growth regulators on *Dendrobium* hybrid "Sonia-17". The result shows earlier initiation of flower bud and maximum number of spikes per plant in the media containing application of BA @ 500 ppm+ Groundnut shell+ Gravel+ Cow dung.

Singh *et al*. (2010) observed that the treatment containing combination involving wooden charcoal, saw dust, sand, soil, FYM in the ratio of 1:2:1:1:1 shows the maximum number of leaves/ plant and longest inflorescence longevity.

Barman *et al*. (2012) observed that the growing media *Castanopsis hysterix* bark, maize cob and leaf mould recorded maximum number of shoots, shoot girth, leaf length, spike length and number of spikes.

Monda *et al*. (2014) reported that when spray formulation 1 (N: P: K=2:2:1), spray formulation 2 (N: P: K=3:2:2), spray formulation 3 (N: P: K=4:3:2) and control (tap water) and two cultivars (*Dendrobium* Red Bull and *Dendrobium* Sacula Pink) were used as treatment variables. The spray composition had a big impact on the growth of the two cultivars that were evaluated. *Dendrobium* Red Bull was determined to have the greatest plant height (18.61), stem diameter (1.01), leaf number (11.17), leaf length (13.42), leaf width (3.05), leaf area (39.89), and root length (3.12 cm). *Dendrobium* Sacula Pink generated more roots and had a larger root diameter. In spray formulation 3, the maximum plant height (19.03 cm), leaf number (11.83), leaf length (13.83 cm), and leaf area (41.78 cm2) were measured (S3). The results revealed that *Dendrobium* Red Bull with spray

formulation 3 outperformed *Dendrobium* cultivars in most vegetative and reproductive phases.

Adhikari (2015) recommended that a proper combination of peat moss, bark, compost and wood pieces including litters for potting media makes the media porous and drainable, which helps in better growth of orchids.

Bahadur (2018) studied the effects of growing media and results that media having bark only gave the highest number of flowering plants.

Barad *et al*. (2018) suggested that saw dust: brick pieces: wooden charcoal: sand: FYM in ratio 2:1:1: 1:1 results maximum no. of leaves/ plant, leaf area (cm^2), no. of flowers/ plant and it required minimum to flowering (days).

De *et al*. (2018) observed the effects of different potting mixtures and resulted that the media contains coco chips + cocopeat + bricks pieces + green moss in the ratio of 3:1:1:1 enhances maximum pseudobulb diameter (4.0 cm).

2.3 Effect of different growing media on yield and its attributes of orchid

Makhanya (2002) suggested that when orchid cut flowers treated with a combination of vinegar, apple and JIK had the highest rate of petal drop, apple which is a sign of senescence. Senescence may induce petal drop in cut flowers and rapid opening of flowers.

Anand and Jawaharlal (2003) observed that when NPK 20:20:40 is used at 0.25% along with BA 500 ppm results in maximum number of leaves/plant and high leaf area.

Hatibarua *et al*. (2003) suggested that sand and coconut husk media show best results with respect to flowering in *Anthurium* orchid.

Horio and Ichihashi (2004) reported that N concentration at 280 mg/L caused a short delay in spiking on *Phalaenopsis* orchids.

Vaz *et al*. (2004) stated that on high carbohydrate levels accumulated in the plants helps in increasing the number of florets per spikes.

Arancon *et al*. (2006) observed that plant growth hormone and humic acid are produced as a result of the interaction between microorganisms and earthworms, and they act as plant growth regulators. Metro mix 360 (MM60) was given to pepper, marigold, and strawberry plants at a dosage of 0, 250, and 500 mg humates/kg dry wt. of MM360.When humates were used to replace 250-1000 mg kg-1 of MM360, marigold and pepper roots grew faster and produced more fruits.

Ramachandradu (2006) observed different varieties of *Dendrobium* and resulted that maximum spike yield per m^2 was recorded in variety Big White (61.83), followed by var. Mono Red (56.00) while minimum was recorded in var. Burana Jade (40.83).

Ruamrungsri *et al*. (2007) reported that 200 mg/L N resulted in longer inflorescence length and higher flower count than 100 mg/L in orchids.

Bichsel *et al*. (2008) observed that the bimonthly application of NPK 19:19:19 gave the increased number of flower spikes in the plants.

Amberger-Ochsenbauer (2010) reported that plants grown in mixtures containing coarse wood fibers developed an equally high number of flower spikes and number of flowers as plants cultivated in the standard mix of 70 percent pine bark and 30 percent coarse peat.

Kumar *et al*. (2013) observed the influence of various treatments and holding solutions on the vase life of cut flower spikes on *Dendrobium* cv. Sonia-17. In an experiment, employed several holding solutions, among all, $AgNO_3$ (25 ppm) + sugar (5 percent) provided the longest vase life of 35 days, the most days for withering of the first bloom (17.3 days), and the most days for wilting of all flowers (15 days) (53.7 days). The best treatments for extending the vase life of cut spikes of the orchid *Dendrobium* cv. SONIA-17 were a pre-cooling treatment at 150-degree Celsius for 12 hours and in holding solutions, $AgNO_3$ (25 ppm) + sugar (5 percent).

Thwala *et al*. (2013) conducted an experiment to standardize the effect of different floral preservative on vase life of orchids. Four floral preservative solutions, chrysal (commercial floral preservative) and different homemade floral preservatives: apple juice, vine garand laundry bleach JIK; Rite brand bleach, lemon juice and Sprite; and sugar, lime juice, Listerine mouth wash (homemade floral preservatives) were used. Tap water was used as the control. He resulted that homemade floral preservative combinations of Rite brand bleach, Lemon and Sprite and sugar, lime and Listerine could, shows best results for pre-treatment of *Epidendrum* orchid cut flowers.

Ruamrungsri *et al*. (2014) showed that number of florets/spikes, the length of spike and flowering percent increased when ratio of NH_4 increased on *Dendrobium* Sonia

Sardoei (2014) concluded that when plants are treated with 60% vermicompost resulted in highest number of bud and open floret, root dry weight, number of root and shoot fresh weight as compare to control.

Miano *et al*. (2015) reported that when *Dendrobium* Sonia is treated with 30 Mm $AgNO_3$ + 225 mM HQC +400 mM resulted in maximum opened flower buds (100.00 % at 10 days), minimum flower drops percentage (0.00%), maximum days to flower color retention (23.15 days), flower diameter (30.32 cm), vase life of flower (23.15 days).

Chaturvedi *et al.* (2016) observed the potential effects of cycocel, Malic hydride, Gibberellic acid, Potassium permanganate and IAA, $AgNO_3$, Al_2SO_4 in combination with sucrose and glucose on *Dendrobium* hybrid Sonia 17. The result shows that the combined spray of IAA, Al_2SO_4 and Sucrose (100ppm + 100ppm + 4%) gave the best result regarding vase life and longevity of flower.

Ozer *et al*. (2016) conducted an experiment to determine the vase life of *Orchis palustris* under different conditions using chemical preservatives as sodium benzoate, 8-HQ, $AlSO_4$, $AgNO_3$, sugar and kinetin and resulted that $AgNO_3$ solution shows prolonged life of the orchids by 23 days, which is 8.4 days longer than control.

Srinivasulu *et al.* (2017) reported that media containing charcoal + peanut shell + maize rind pieces resulted maximum plant height (38.57 cm), number of leaves (10.33), number of pseudo bulbs (5.33), stalk length (39.69 cm) and number of florets per spike (8.20) in *Dendrobium* var. Sonia 17.

Gohil *et al*. (2018) suggested that *Castanopsis hysterix* bark with leaf mould gave maximum number of flowers per spike, spike length (cm) and spike per m^2, and rotten log + sand + coconut husk + brick pieces gave highest result in flower diameter(cm).

Mehraj *et al*. (2018) observed the effects of different varieties of *Dendrobium* and resulted that among all, variety 'Bubble Gum' recorded maximum number of florets per spike (7.55) while minimum florets per spike were obtained in var. 'Nopporn Pink'.

Sudeep *et al*. (2018) observed different varieties of *Dendrobium* and resulted that under polyhouse condition plants took early days to flower bud initiation (291.55 days) and first floret opening (33.17 days) as compare to shade net house condition.

Sumathi *et al*. (2018) suggested that coconut husk + charcoal (3:1) as a growing media significantly improved all the vegetative and flowering parameters. Weekly once foliar application of 12:61:40 (NPK) @ 2.0% recorded significantly early flower bud emergence, maximum stalk length, stalk diameter and flower yield.

Kumar *et al*. (2019) conducted an experiment on *Anthurium andreanum* taking ten treatment combinations, comprising five levels of water-soluble fertilizer (1 g/L, 2 g/L, 3 g/L, 4 g/L and 5 g/L) and two frequencies of spray (once a week and twice a week). Plants were maintained in net house conditions (75% shade). The result showed that among all treatment combinations, NPK 19:19:19 @ 5 g/L twice a week found to be best in terms of vegetative growth, flowering and productivity recorded maximum values for all characters.

Sanghamitra *et al*. (2019) concluded that when plants grown in potting media combination of Coconut husk chips + Brick pieces + Charcoal + Gravel (2:1:1:1) gave maximum vase life of 15.86 days, while, plants grown in potting media mixture of Paddy husk + Brick pieces + Gravel (2:1:1) recorded significantly the minimum vase life 12.90 days.

2.4 Correlation of various traits (temperature and photoperiod) on flower yield of orchid

Leonhardt (2000) suggested that for most *Dendrobium* orchids, rapid vegetative growth occurs at temperature between 24^{o}C and 30^{o}C.

Sayed (2001) recorded that on the onset of spring in March, a rise in temperature breaks vegetative dormancy set in the winter and induces flowering in many *Dendrobiums.* He resulted that a correlation between light intensity and flowering shows that light intensity during floral initiation affected the quality of plant or flower.

Robinson (2002) conducted an experiment in *Phalaenopsis* to determine the effects of temperature (from 14 to 29^{o}C) on time from spike emergence to flowering and on plant quality and resulted that as the temperature increased from 20 to 23^{o}C, days from visible flower bud to first flower opening decreased from 50 to 35 days.

Robinson (2002) suggested that when the day temperature decreased from 25.5 ^{o}C to 14.3 ^{o}C, resulted in increased number of flower buds on the main axis in *Phalaenopsis* ‘Alba’.

Lopez *et al*. (2003) conducted an experiment on the influence of temperature and photoperiod on leaf development and flower induction of *Zygopetalum* Redvale ‘Fire Kiss’. In the first experiment, plants were placed under photoperiods ranging from 10 to 24 hour of continuous light or 9 hours with a 4-hour night interruption (NI). 60% to 80% plants flowered and flowering was slightly hastened under photoperiods ≤14 hour. In a separate experiment, plants were placed into environmental chambers with constant temperatures of 14, 17, 20, 23, 26 and 29°C

and 9-hour photoperiods with or without a 4-hour NI. The results showed that plants developed nodes faster as temperature increased from 14 to 26 ^{o}C after 15 weeks.

Lopez and Runkle (2004) observed the effects of temperature and flower development and flower longevity of *Zygopetalum* orchid and resulted that as temperature increases from 14 to 29^{0}C, flower and inflorescence longevity decreased from 37 and 38 days to 13 and 15 days.

Wang (2004) reported that when hybrid orchid *Doritaenopsis* grown for 29–36 weeks at 25/20, 20/25, 25/15, or 15/25 ^{o}C (12 h day/12 h night) had flowering percentages of 33, 93, 0, and 100%. Therefore, he concluded that a day temperature >26 ^{o}C inhibits inflorescence initiation. However, the night temperature may influence flower initiation when the day temperature is <26 ^{o}C.

Fausey (2005) reported that after vernalization at -2.5^{o}C and 0^{o}C for >4weeks, 2.5^{o}C and 5.0^{o}C for >6 weeks, and at 7.5^{o}C for 8weeks resulted in complete flowering in orchid *Veronica spicata* L. 'Red Fox'.

Roberto and Runkle (2005) suggested that for *Dendrobium* orchid, the combination of short photoperiod and low temperature induces flowering in the most complete, rapid and uniform manner. Once the flower buds have initiated, flower development time is dependent upon genotype and temperature.

Blanchard and Runkle (2006) observed that the number of inflorescences per plant and the number of flower buds on the first inflorescence were greatest when the average daily temperature was 14 degree C or 17-degree C. They suggested that a day or night fluctuation in temperature is not required for inflorescence initiation in these two *Phalaenopsis* clones.

Wang *et al*. (2006) suggested that when day temperature was maintained at 28 or 30^{0}C, *Phalaenopsis* hybrids remained at vegetative stage.

Bichsel *et al*. (2008) reported that 100 mg/L N, 25 mg/L P and 100 mg/L K gave optimal results of vegetative growth and reproductive development in *Dendrobium* cv Red Emperor 'Prince'.

Yen *et al*. (2008) observed the effects of cooling temperature and duration on growth and flowering of *Dendrobium* Sea Mary 'Snow King' and resulted that 3 week at 13^0C is recommended cooling requirement for *Dendrobium* orchid.

Gupta *et al.* (2013) observed the effect of different media on plant growth and spike yield of *Dendrobium* orchid and reported that tile bits pieces found to be the best medium for growing *Dendrobium* orchids and produced the best vegetative growth and spike yield.

Barman (2014) reported that *Cymbidium* hybrid on application of an N:P:K dose of 300:200:300 mg/L with benzyl adenine (BA) and gibberellic acid (GA_3) at 500 mg/L was found to be best for enhancing flowering frequency.

Allen and Kannan (2015) reported that the nutrient mixture 30:10:10 (Plantafol) (0.4%) resulted in highest plant height (33.60cm), internodal length (4.56 cm), leaf length (13.98 cm), leaf width (4.11cm), leaf area (42.32 cm^2), total chlorophyll content (0.74 mg/g) and leaf nitrogen content (2.37%) while shoot diameter (11.43 mm) was found highest in the plants treated with combination of 0.4% 12:61:0 and 13:0:45 on Dendrobium orchid cv. Emma white

Anitha and Kannan (2015) observed that the application of 30:10:10 (0.4%) increased the plant height (37.63 cm), pseudobulb circumference (4.93 cm), number of pseudobulbs per plant (6.89), number of leaves per plant (29.85), leaf length (14.77 cm), leaf width (5.33 cm), leaf area (56.94 cm^2), yield (4.56 spikes/plant/year) and spike quality parameters such as, spike length (38.10 cm), number of florets per spike (7.89), floret length (8.27 cm), floret width (8.40 cm) and vase life (22.33 days). Flower bud initiation was earlier (117.67 days) and flower quality was also enhanced in plants treated with 20:20:20 (0.2%) +13:27:27 (0.4%).

Zheng *et al*. (2018) observed the process of flower bud differentiation and development under the temperature conditions of 26/21°C, 22/17°C and 18/13°C and the results showed that flower bud differentiation of *Dendrobium* could not happen under the high temperature of 26/21°C, it could complete the flower bud differentiation under 22/17°C in 56 days, and under 18/13°C in 35 days.

Saikia *et al*. (2019) observed the highest negative correlation coefficient of most of the flower characters in pheno phases viz. PP_1 (planting to bud visibility) and PP_4 (bud visibility to full bloom) phase in respect of maximum temperature and minimum temperature.

Nair *et al*. (2020) observed that Foliar spray of 30:20:20 NPK 0.1% at weekly intervals results in maximum plant height of 53.21cm, number of spikes/plant/year (10.01) with spike length of 44.43 cm and16-20 flower spike on *Dendrobium* Orchid cv. Singapore White.

CHAPTER-III

MATERIALS AND METHODS

This chapter deals with description of materials used and methods adopted during investigation. The present experiment entitled **"Effect of different growing media on orchid (*Dendrobium nobile* L.) under shade net house"** was conducted at shade net house of the Department of Plant Physiology, Agricultural Biochemistry, Medicinal and Aromatic Plant, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh during the year 2020-2021. The materials used and methods adopted are described in this chapter.

3.1 Experimental Site

The experiment was carried out during the Rabi season year 2020-21 at the Department of Plant Physiology, Agricultural Biochemistry, Medicinal and Aromatic Plant, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh to examine the performance of different growing media on *Dendrobium* orchid under shade net house.

3.2 Climate

Raipur the state capital of Chhattisgarh, is located in the country's seventh agroclimatic zone, the eastern plateau and hills, which is classified as subhumid and has hot summers and chilly winters. Raipur is located at an elevation of 298.56 meters above sea level (MSL). With the exception of the summer, Raipur's climate will be mild throughout the year. The maximum temperature recorded in the summer is 47.8^{o}C, while the minimum temperature in the winter is 5-6^{o}C (December to July). Chhattisgarh receives an average annual rainfall of 1326 mm.

3.3 Materials

3.3.1 Experimental material

A one-year-old *Dendrobium* orchid was utilized in the experiment.

3.3.2 Details of the experiment

The experimental area was set up in a CRD (Completely Randomized Design) with three replications, each with four treatments. The details are as follows:

Table 3.1 Experimental Details

Crop	**Orchid**
Variety	*Dendrobium nobile* L.
Design of the experiment	Completely Randomized Design (CRD)
Number of treatments	4
Number of replications	3
Year of experiment	2020-21

Table 3.2 Treatment details

Treatment no.	**Treatment's name**
T_1	Cow dung and Vermicompost (1:1)
T_2	Charcoal
T_3	Tree barks
T_4	Pieces of bricks

3.3.3 Growing system and containers

The orchids were grown in a shade net house that offered a partially controlled climate and environment by limiting the intensity of light and effective heat during the day. Hygienic planting methods are used because they produce roots from the base and are more prone to contamination by microbes.

For the experiment, plastic pots with drainage holes on the bottom and sides were utilized. Each of the four treatments receives 15 pots, which are then replicated three times. A total of 60 pots are utilized in the experiment, with 15 pots for each treatment.

3.3.4 Properties of potting media

The growing media used for the experiment consisted of cow dung and vermicompost, charcoal, tree barks and pieces of bricks for vegetative growth and flowering. These growing media are collected from different places before experiment.

The properties of media are as follows:

1. **Cow dung and Vermicompost:** The combination maintains humidity while allowing air to circulate through the roots.
2. **Charcoal:** Charcoal removes odors, breaks down bacteria growth, absorbs salt residue and does not decompose.
3. **Barks of tree:** Bark is a well-draining growth media that allows for air circulation around the roots of the orchid while still retaining some water.
4. **Bricks pieces:** The aeration and rapid draining environment provided by the brick pieces is essential for optimal development.

3.3.5 Fertilizers

The optimum nutrition media for epiphytic orchids has been found to be water soluble fertilizers. It aids fertigation by releasing important plant nutrients at the root zone, where they may be quickly absorbed and used elsewhere in the plant system. NPK 19:19:19, 12:61:00, 00:00:50 was tested at a concentration of 0.1 percent and fertigated three times weekly. It boosts the plant's vegetative and reproductive activities.

1. 19:19:19
2. 12:61:00
3. 00:00:50

3.3.6 Potting of plants

Dendrobium plants of uniform size with one or two pseudobulbs were planted in plastic pots in various growth medium.

3.3.7 Water management

The overhead misting system was used to irrigate the plants in net house. In addition, water was sprayed on the floor once a day to regulate the temperature and humidity within the shade net home. Fertigation was done twice or thrice in a week, depending on the plant's needs.

3.3.8 Plant protection measures

Fusarium wilt, Phytophthora rot and Leaf spot were all controlled using the fungicide Bavistin (1.5 ml/ l) before planting the *Dendrobium*.

3.3.9 Weed management

To minimize weed competition and adequate aeration, weeding was done manually.

3.3.10 Other cultural operations

To keep the pot clean and the greenhouse clean, dried leaves, flowers and pseudobulbs were removed on a regular basis.

3.3.11 Harvesting

Early in the morning, a *Dendrobium* orchid spike was picked, and the cut bloom was sealed with damp cotton to avoid microbial contamination.

3.4 Observations recorded

During the orchid's vegetative and blooming periods, data was gathered on a regular basis.

3.4.1 Morphological Parameters

3.4.1.1 Height of pseudobulb (cm)

The height of pseudobulb was recorded by measuring scale from base to top of the main stem at vegetative and flowering stage under different media and expressed as plant height in centimeters.

3.4.1.2 Number of leaves/ pseudobulb

The number of leaves per shoot was determined by physically counting all of the leaves in each pot of various medium.

3.4.1.3 Number of pseudobulbs/ plant

The average number of shoots per plant was determined from all plants during the vegetative and blooming stages.

3.4.1.4 Girth of pseudobulb (cm)

With the aid of a vernier caliper, the girth of the shoot was measured at the vegetative and blooming stages. The average was calculated and recorded as the girth of the shoot in centimeters.

3.4.1.5 Internode length per shoot (cm)

For each growth media, the length between two nodes (internodal length) was measured at the vegetative and blooming stages and is expressed in cm.

3.4.1.6 Number of internodes per shoot

At the vegetative and blooming stages, the number of internodes was counted, and mean was calculated.

3.4.1.7 Root length (cm)

Each treatment's root length was documented and measured in centimeters.

3.4.2 Physiological parameters

3.4.2.1 Leaf Area

Leaf area was measured using a petiole mobile app. Firstly, place your smartphone on top of the measuring stand and fix it properly. Then place the calibration pad in front of smartphone's camera and calibrate a camera by pressing a square in top right corner of the screen. Place a leaf on the measuring stand, in front of the camera. Leaf area was noted and average was calculated.

3.4.2.2 Light intensity (kilolux)

Light intensity approximation was measured with a luxmeter during the day and represented in Lux or kilolux.

3.4.2.3 Chlorophyll fluorescence

Chlorophyll fluorescence was measured using JUNIOR-PAM chlorophyll fluorometer. It gives information of light re-emitted by chlorophyll molecules during return from excited to non-excited states. It is used as an indicator of photosynthetic energy conversion. It was collected from four randomly chosen plants of each treatment.

3.4.3 Biochemical parameters

3.4.3.1 Chlorophyll value (SPAD units)

The value of SPAD (Soil Plant Analytical Development) was measured using a SPAD meter. It receives information in the form of SPAD units, which reflect actual variations due to differential nitrogen response. It was collected from all plants and an average was determined.

3.4.3.2 Wax content (µg/cm^2)

Cuticular wax content was extracted by gravimetric method (Znidarcic D. *et al*.2008, Saeed M. *et al*.2018). Firstly, fresh leaf samples were taken and weight it to 4g. Leaves were immersed in pre- weighed petri plates having chloroform (30ml) for 10-15 seconds. The extract was filtered and evaporated for 24 hours at room temperature. After complete evaporation of chloroform, petri

plates were weighed again. Wax content was calculated by subtracting the initial weight from final weight of petri plates and expressed as µg/cm^2.

3.4.4 Phenological parameters

3.4.4.1 Days taken for flower bud initiation (days)

The number of days taken for initiation of flower bud from the date of planting was counted and expressed in days.

3.4.4.2 Days taken for flower bud development (days)

From the date of flower bud initiation, the number of days it took for the flower bud to mature (before the first floret opened) was recorded and indicated in days.

3.4.4.3 Days taken for first floret opening (days)

The number of days it took to harvest the first floret from the day it opened was determined and represented in days.

3.4.5 Yield and its attributes

3.4.5.1 Length of spikes (cm)

The length of the spikes was measured in centimeters from the point of emergence to the highest flower stalk of a fully open flower.

3.4.5.2 Flower diameter (cm)

The diameter of fully opened flower was measured from each plant of the treatments and expressed in centimeters.

3.4.5.3 Number of spikes

The number of spikes from each plant was counted and average was calculated.

3.4.5.4 Spike girth (cm)

The girth of the spike was measured in centimeters with a vernier caliper.

3.4.5.5 Number of floret/ spikes

The average of the number of florets per spike measured from all plants harvested at the time of harvest was computed.

3.4.5.6 Size of flower (cm^2)

The length (vertically) and breadth (across) of each individual flower were measured in cm^2 and recorded.

3.4.5.7 Longevity of flower (days)

The number of days from the initial floret opening to the full withering of the spike on the plant was used to determine the flower's longevity.

3.4.5.8 Vase life of cut flower (days)

The first day of retaining a spike in solution until the last day of withering was recorded for each treatment (GA_3, $AgNO_3$, kinetin and control). There were three holding solutions and control viz.

H_1- Control (Pure Water)

H_2- GA_3 (25 ppm)

H_3- Kinetin (25 ppm)

H_4- $AgNO_3$ (25 ppm)

3.5 Statistical Analysis

The data was gathered from numerous observations from each treatment and statistically evaluated using the CRD method. For evaluating the significance of the treatment means, the crucial difference at a 5% level of significance was calculated for each parameter. The data was tabulated and placed in the proper areas for result interpretation. The data gathered for the experiment was recorded both in the net house and in the lab, and it was statistically analyzed to determine the degree of variance across all of the treatments. Gomez and Gomez (1983) proposed the table for analysis of variance (ANOVA), which is shown below:

Source of variation	**Degree of Freedom**	**Sum of square**	**Mean sum of square**	**F calculated**	**F tabulated**
Treatment	(t-1)	TrSS	TrMSS= TrSS/ df	TrMSS/ ESS	
Error	t(r-1)	ESS	EMSS= ESS/ df		
Total	(rt-1)	TSS			

where,

TrSS = Treatment Sum of Square

TrMSS = Treatment Mean Sum of Square

ESS = Error Sum of Square

EMSS = Mean Sum of Square of Error

The calculated F value is compared to the tabulated F value; if the F test is significant, the critical difference and standard error are calculated to determine whether therapy is preferable. The following formulas were used to compute the standard error of the mean, standard difference, and critical difference:

a. Standard error of mean

SEm = $\sqrt{EMS/r}$

EMS = Error mean of square

r = No. of replication

b. Critical difference

CD (5%) = SEd x t value at 5% degree of freedom

c. Coefficient of variation

CV = $\sqrt{EMS/grandmean}$ x 100

3.6 Correlation analysis

The correlation between temperature and photoperiod was calculated. The correlation coefficient is a statistical metric that is used to determine the strength and direction of a link between two or more variables. The efficiency of the selecting process is also influenced by the degree of relationship. As a result, correlation denotes the degree of similarity between distinct attributing characters.

Plate 3.1 View of experiment at Department of Plant Physiology, IGKV, Raipur

Plate 3.2 Cow dung + Vermicompost

Plate 3.3 Charcoal

Plate 3.4 Tree bricks

Plate 3.5 Pieces of bricks

Plate 3.6 Comparison of number of leaves in different media: 1(T_1 = Cow dung + Vermicompost), 2(T_2= Charcoal), 3(T_3= Tree barks), 4(T_4= Pieces of bricks)

Plate 3.7 View of flowers of different media - 1(T_1 = Cow dung + Vermicompost), 2(T_2= Charcoal), 3(T_3= Tree barks), 4(T_4= Pieces of bricks)

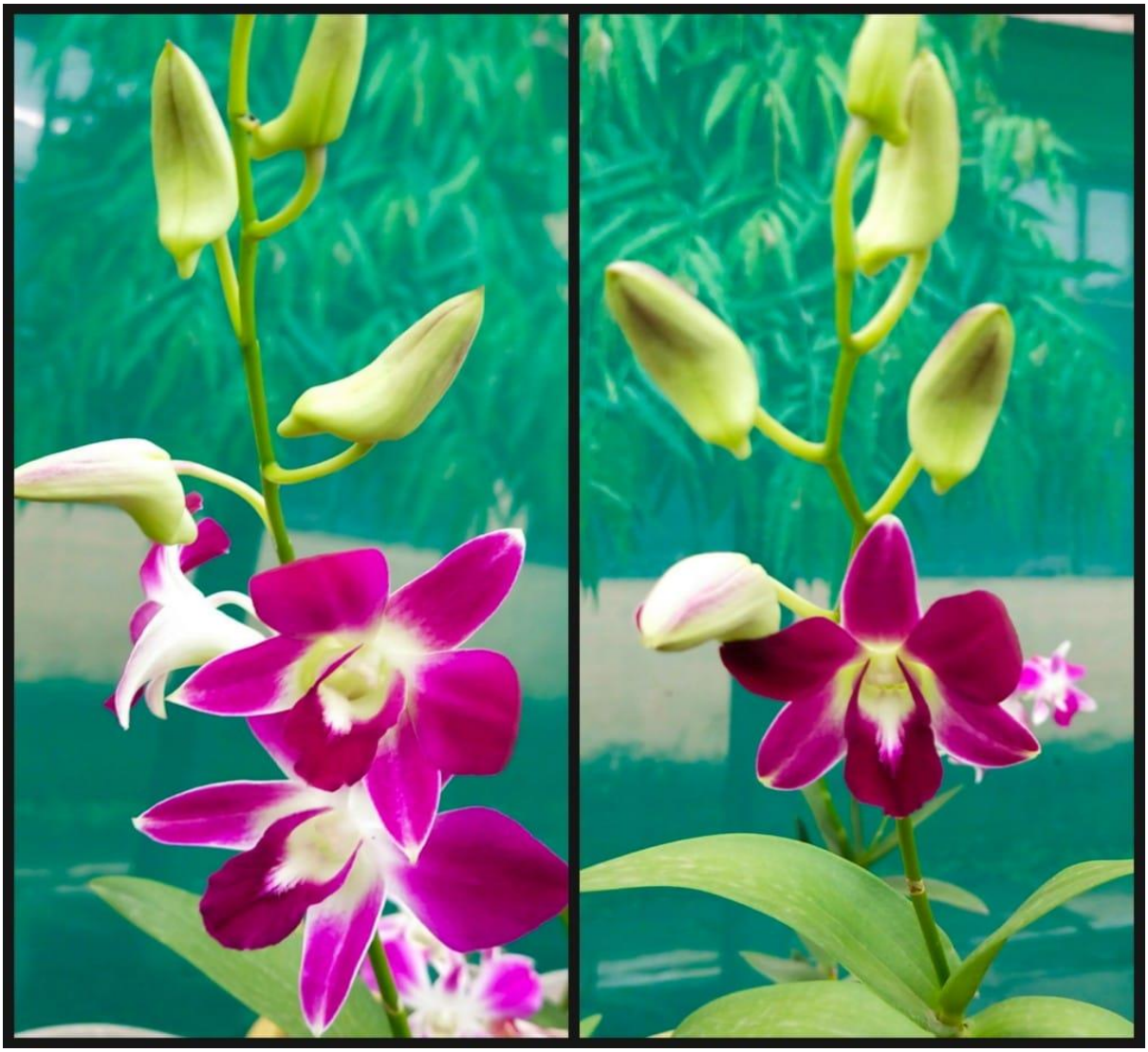


Plate 3.8 Comparison of flower quality: T_1 = Cow dung + Vermicompost) with T_3= Tree barks

CHAPTER – IV
RESULT AND DISCUSSION

The present chapter deals with experimental findings and discussion obtained for **"Effect of different growing media on orchid (*Dendrobium nobile* L.) under shade net house''**. The experimental data were statically analysed and presented in tabular form as well as supported by graphical representation. The data recorded under the following parameters.

4.1 Morphological Parameters.

4.2 Physiological Parameters.

4.3 Biochemical Parameters.

4.4 Phenological Parameters.

4.5 Yield and its Attributes.

4.6 Correlation analysis

4.1 Morphological Parameters

4.1.1 Plant Height (cm)

The result related to plant height at both stages has been presented in Table 4.1.1 and depicted in figure 4.1. The growth media was found significant in relation to plant height.

Among the treatments, T_3, tree bark resulted maximum plant height at both stages, vegetative stage (15.36 cm) and flowering stage (19.20 cm), followed by T_1, cow dung+ vermicompost at vegetative stage (14.33 cm) and flowering stage (15.26 cm) and minimum plant height was noticed under the treatment T_2, charcoal at vegetative stage (12.60 cm) and flowering stage (12.53 cm). The similar result was found by Ramya (2007) and Swapna (2000) and Patnaik *et al*. (2017). From this study, it is observed that tree bark media provides balanced nutritional supplements to the plant and nitrogen is a chief constituent of proteins for the formation of protoplasm, providing metabolic energy to cell division and cell enlargement.

Table 4.1.1 Effect of different growth media on the plant height (cm) of *Dendrobium* L.

Treatments	Plant height(cm)	
	Vegetative Stage	Flowering Stage
Cow dung+ Vermicompost (T_1)	14.33	15.26
Charcoal (T_2)	12.6	12.53
Tree barks (T_3)	15.36	19.2
Pieces of bricks (T_4)	13	14.26
SEm±	0.86	0.97
CD (P=0.05)	NS	3.22
CV (%)	10.82	11

4.1.2 Number of leaves

The results of number of leaves at both stages has been presented in Table 4.1.2 and depicted in figure 4.2. There was a significant difference among the treatments in relation to number of leaves.

Maximum number of leaves was found in T_3, tree bark media at both stages, vegetative stage (3.26) and flowering stage (5.26), followed by T_1, cow dung and vermicompost media at vegetative stage (3.60) and flowering stage (4.86) and minimum number of leaves was observed in T_2, charcoal media at vegetative stage (3.13) and flowering stage (4.40). The similar result was found by Arthagama. I. D. M. *et al*. (2019). Lower number of leaves in charcoal media is due to less porous in nature so that the aeration and drainage is not good, also the water holding capacity and nutrient absorption was low.

Table 4.1.2 Effect of different growth media on the number of leaves of *Dendrobium* L.

Treatments	Number of leaves	
	Vegetative Stage	Flowering Stage
Cow dung + Vermicompost (T_1)	3.60	4.86
Charcoal (T_2)	3.13	4.40
Tree barks (T_3)	3.26	5.26
Pieces of bricks (T_4)	3.53	4.46
SEm±	0.12	0.18
CD (P=0.05)	NS	0.60
CV (%)	6.60	6.65

4.1.3 Number of shoots per plant

The results related to number of shoots per plant at both stages has been presented in Table 4.1.3 and depicted in figure 4.3. The growth media was found non significant in relation to number of shoots per plant.

Among the treatments, T_3, tree bark was noticed maximum number of shoots at both stages, vegetative stage (1.46) and flowering stage (2.20), followed by T_1, cow dung+ vermicompost at vegetative stage (1.36) and flowering stage (2.06) and minimum number of shoots was found under the treatment T_2, charcoal at vegetative stage (1.33) and flowering stage (1.93).

Table 4.1.3 Effect of different growth media on the number of shoots per plant of *Dendrobium* L.

Treatments	Number of shoots per plant	
	Vegetative Stage	Flowering Stage
Cow dung+ Vermicompost (T_1)	1.36	2.06
Charcoal (T_2)	1.33	1.93
Tree barks (T_3)	1.46	2.20
Pieces of bricks (T_4)	1.26	2.00
SEm±	0.07	0.09
CD (P=0.05)	NS	NS
CV (%)	9.32	7.96

4.1.4 Number of internodes per shoot

The results related to number of internodes per shoot at both stages has been presented in Table 4.1.4 and depicted in figure 4.4. The growth media was significantly different in relation to number of internodes per shoot.

Among the treatments, T_3, tree bark was observed maximum number of internodes at both stages, vegetative stage (3.60) and flowering stage (3.80), followed by T_1, cow dung+ vermicompost at vegetative stage (3.20) and flowering stage (3.40) and minimum number of shoots was exhibited under the treatment T_3, pieces of bricks (3.33) and T_2, charcoal (3.26). The similar result was found by Wang and Konow (2002). From this study, it is observed that tree bark media contains higher concentrations of mineral nutrients such as N, Ca, Fe, Na, Cl, B and Al which helps in plant growth.

Table 4.1.4 Effect of different growth media on the number of internodes per shoot of *Dendrobium* L.

Treatments	Number of internodes per shoot	
	Vegetative Stage	**Flowering Stage**
Cow dung+ Vermicompost (T_1)	3.20	3.40
Charcoal (T_2)	3.26	3.26
Tree barks (T_3)	3.60	3.80
Pieces of bricks (T_4)	3.33	3.53
SEm±	0.09	0.09
CD (P=0.05)	NS	0.31
CV (%)	4.87	4.66

4.1.5 Internode length (cm)

The results related to length of internode at both stages has been presented in Table 4.1.5 and depicted in figure 4.5. There was significant difference in relation to internode length per shoot.

Among the treatments, T_3, tree bark was noticed maximum internode length at flowering stage (4.60) and T_4, pieces of bricks media at flowering stage (4.33), followed by T_1, cow dung+ vermicompost media at flowering stage (4.14). Lowest internode length was exhibited under the treatment T_2, charcoal (3.43). The similar result was found by Ilek *et al*. (2017). From this study, it is observed that tree bark media is very porous and has more water storage capacity which helps in increasing internode length of plant.

Table 4.1.5 Effect of different growth media on the internode length (cm) of *Dendrobium* L.

Treatments	Internode length (cm)	
	Vegetative Stage	**Flowering Stage**
Cow dung+ Vermicompost (T_1)	4.26	4.13
Charcoal (T_2)	4.13	3.43
Tree barks (T_3)	3.90	4.60
Pieces of bricks (T_4)	4.06	4.33
SEm±	0.24	0.18
CD (P=0.05)	NS	0.59
CV (%)	10.14	7.57

4.1.6 Shoot girth (cm)

The results related to shoot girth at both stages has been presented in Table 4.1.6 and depicted in figure 4.6. The growth media were significantly different in relation to shoot girth.

Among the treatments, T_3, tree bark was found highest shoot girth, at vegetative stage (3.93 cm) and flowering stage (4.16 cm), followed by T_1, cow dung+ vermicompost media at flowering stage (4.06 cm). Lowest shoot girth was exhibited under the treatment T_2, charcoal (3.20 cm). The similar result was found by Sumathi, T. *et al*. (2018). From this study, it is observed that it might be due to tree bark media contains a good number of leaves with conducive root environment which would have led to proper nutrient uptake in the organic substrates resulted in greater accumulation of food matter leading to maximum shoot girth.

Table 4.1.6 Effect of different growth media on the shoot girth (cm) of *Dendrobium* L.

Treatments	Shoot girth (cm)	
	Vegetative Stage	Flowering Stage
Cow dung+ Vermicompost (T_1)	3.40	4.06
Charcoal (T_2)	3.20	3.36
Tree barks (T_3)	3.93	4.16
Pieces of bricks (T_4)	3.46	3.80
SEm±	0.11	0.15
CD (P=0.05)	0.36	0.50
CV (%)	5.47	6.87

4.1.7 Root length (cm)

The results related to root length (cm) has been presented in Table 4.1.7 and depicted in figure 4.7. The growth media were significantly different in relation to root length.

Among the treatments, T_4, pieces of bricks were observed highest root length (17.16 cm), followed by T_1, cow dung+ vermicompost media (16.76 cm) and T_3, tree barks (16.33 cm). Lowest root length was exhibited under the treatment T_2, charcoal (14.93 cm). The similar result was found by M. Sanghamitra *et al*. (2019). From this study it is observed that the pieces of bricks media are not compact, provided good aeration and allowed free growth of roots which resulted in increase of length of roots.

Table 4.1.7 Effect of different growth media on the root length (cm) of *Dendrobium* L.

Treatments	Root length (cm)
Cow dung+ Vermicompost (T_1)	16.76
Charcoal (T_2)	14.93
Tree barks (T_3)	16.33
Pieces of bricks (T_4)	17.16
SEm±	0.43
CD (P=0.05)	1.44
CV (%)	4.63

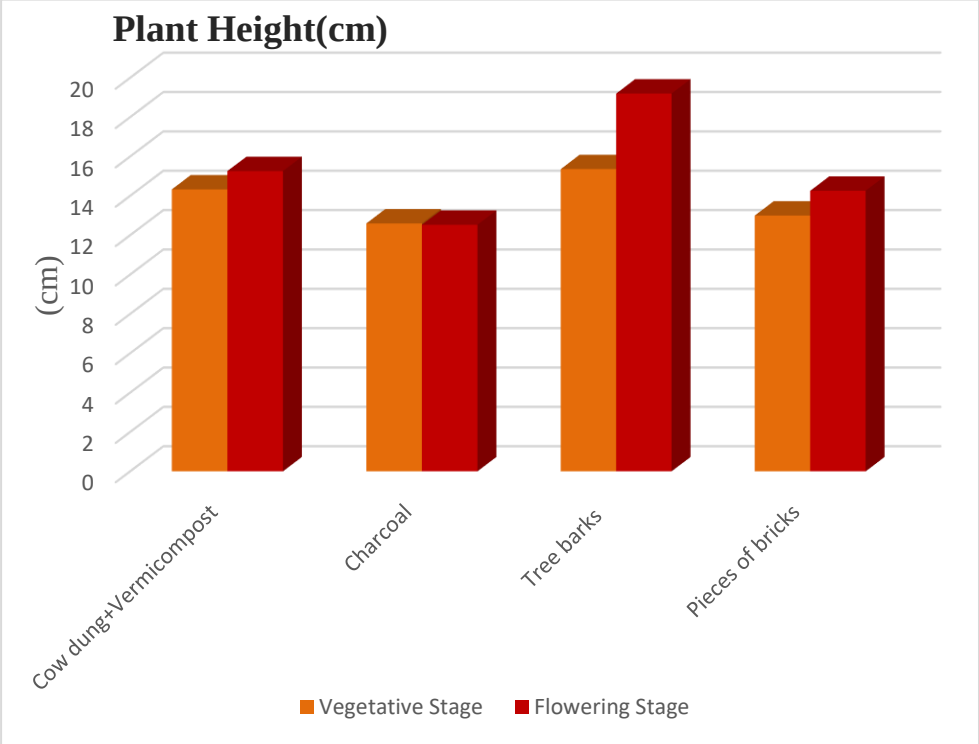


Fig 4.1. Effect of different growth media on the plant height (cm) of *Dendrobium* L.

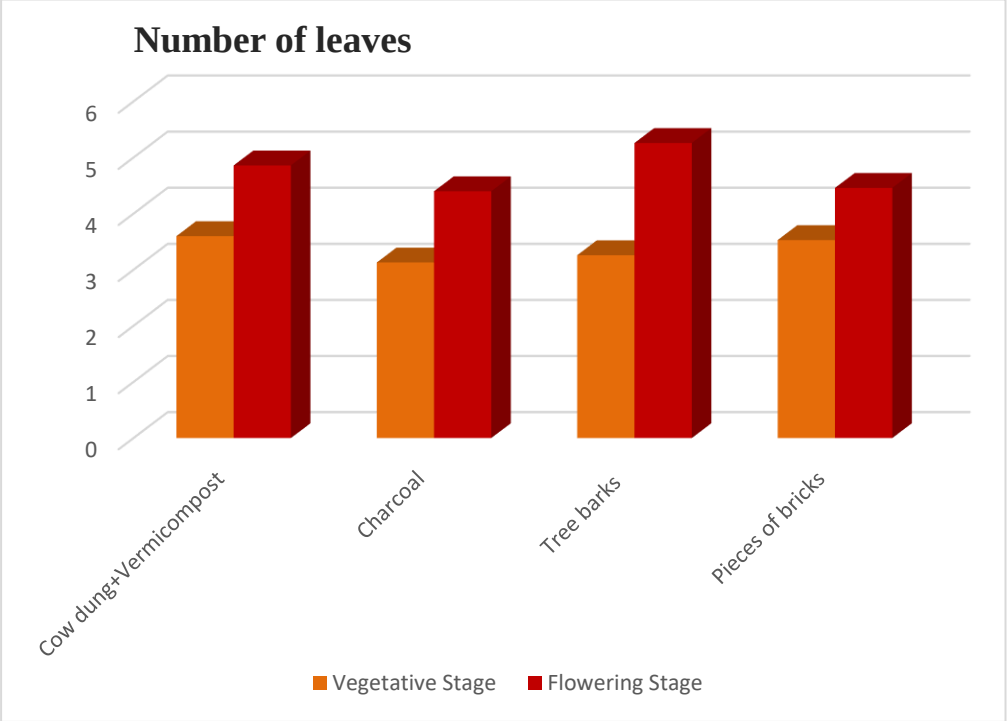


Fig 4.2. Effect of different growth media on the number of leaves of *Dendrobium* L.

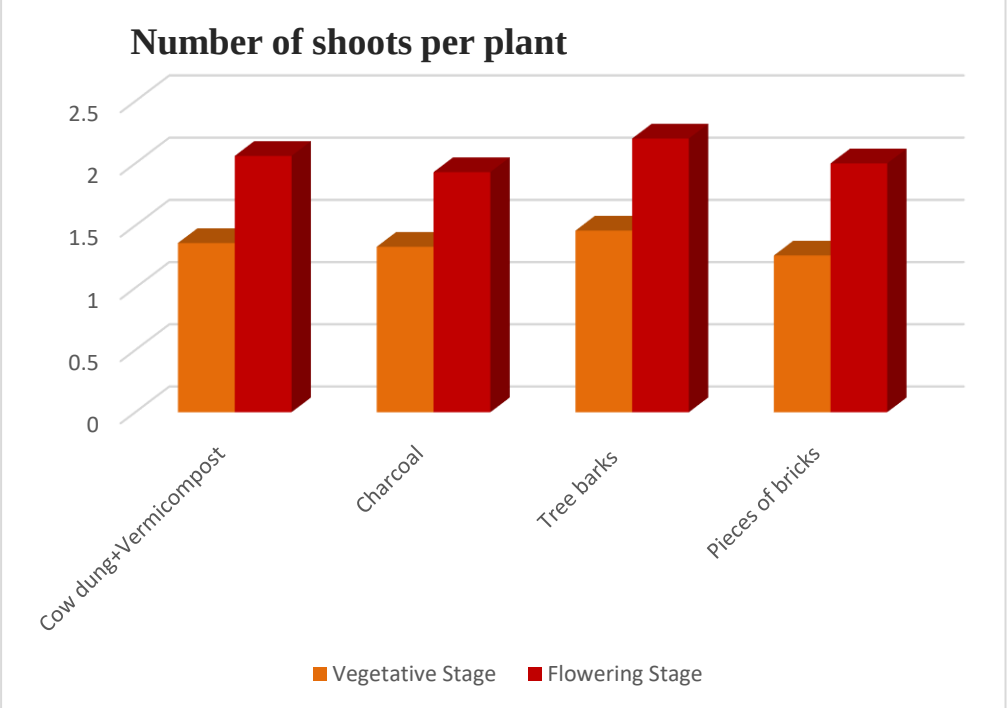


Fig 4.3. Effect of different growth media on the number of shoots per plant of *Dendrobium* L.

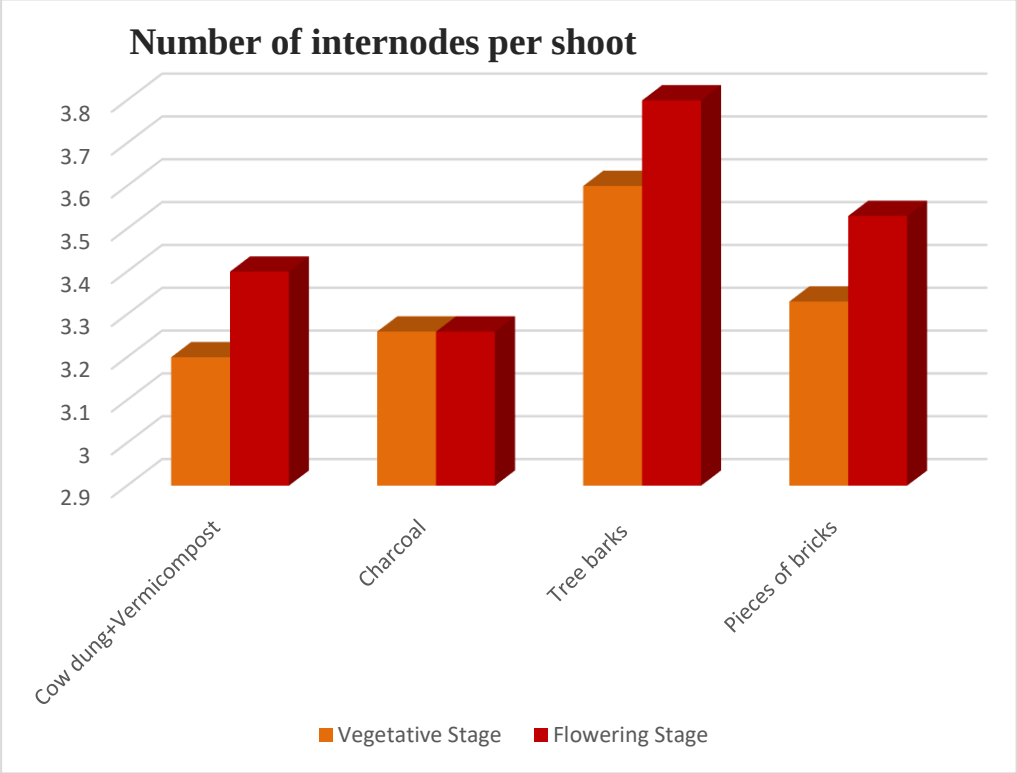


Fig 4.4. Effect of different growth media on the number of internodes per shoot of *Dendrobium* L.

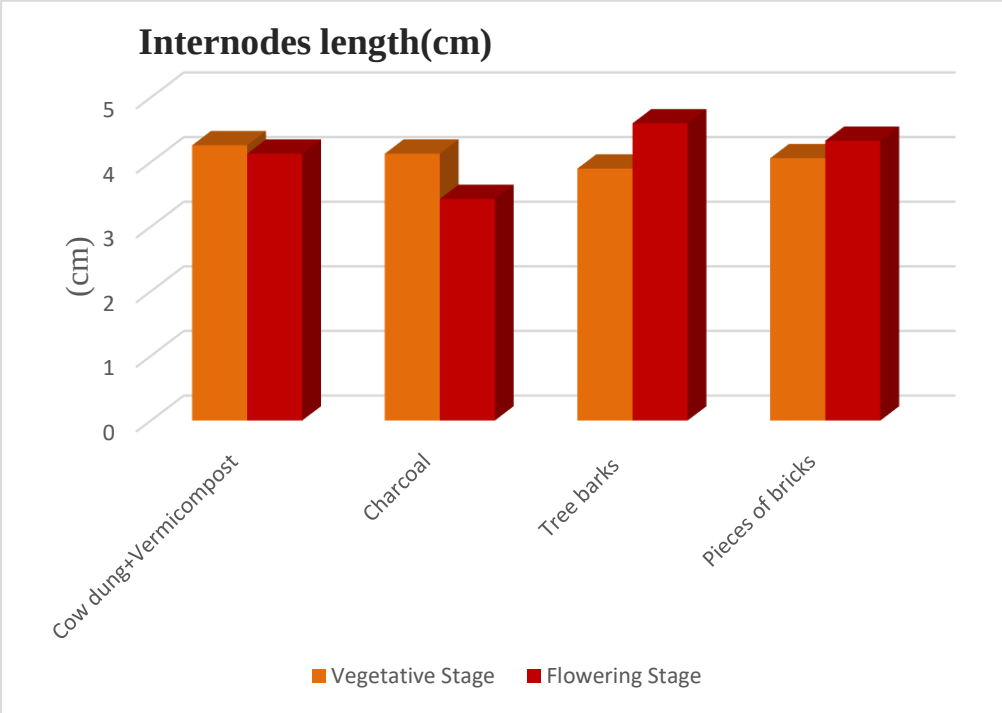


Fig 4.5. Effect of different growth media on the internode length (cm) of *Dendrobium* L.

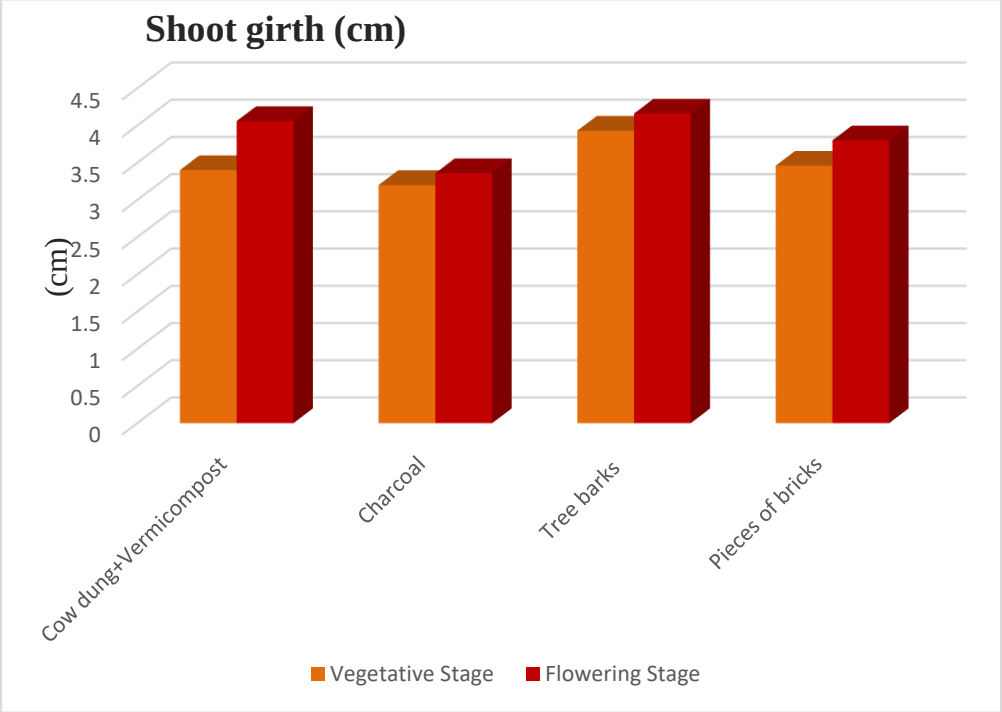


Fig 4.6. Effect of different growth media on the shoot girth (cm) of *Dendrobium* L.

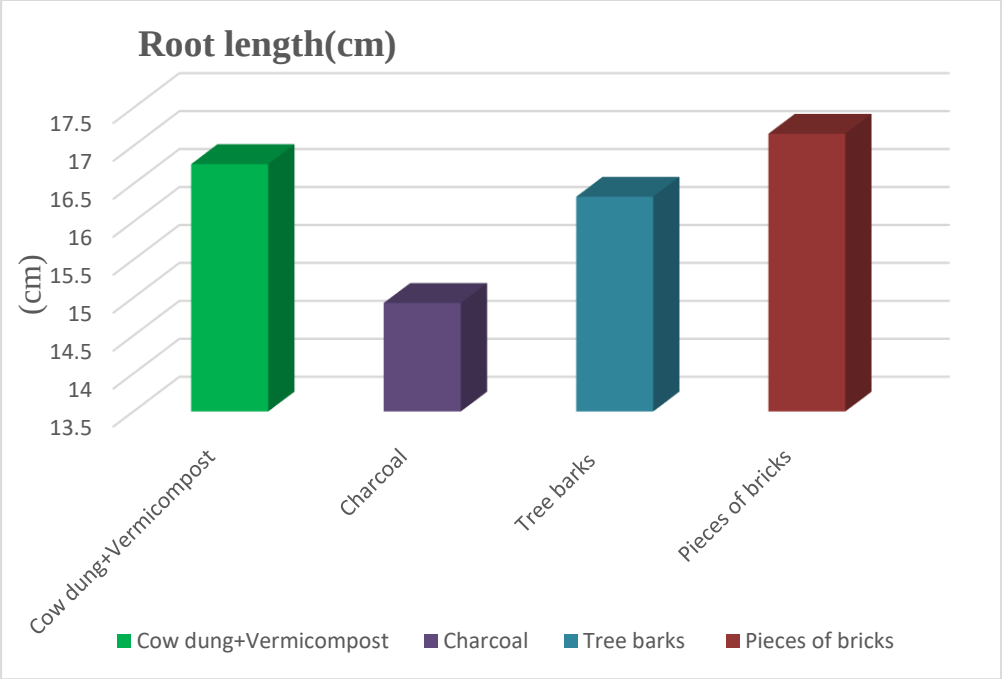


Fig 4.7. Effect of different growth media on root length (cm) of *Dendrobium* L.

4.2. Physiological parameters

4.2.1 Leaf Area

The result related to leaf area (cm^2) has been presented in table 4.2.1 and depicted in figure 4.8. The growth media were significantly different in relation to leaf area.

Among the treatments, highest leaf area was noticed in treatment T_1, cow dung and vermicompost (44.68), followed by T_3, tree barks media (44.01) and T_4, pieces of bricks media (43.66). Lowest leaf area was found in T_2, charcoal media (37.41). The similar results were found by Muraleedharan and Karuppaiah (2015). From this study, it is observed that the cow dung and vermicompost media is highly organic, well aerated with good water retention capacity and drainage.

Table 4.2.1 Effect of different growth media on the leaf area of *Dendrobium* L.

Treatments	Leaf Area
Cow dung+ Vermicompost (T_1)	44.68
Charcoal (T_2)	37.41
Tree barks (T_3)	44.01
Pieces of bricks (T_4)	43.66
SEm±	1.32
CD (P=0.05)	4.39
CV (%)	5.41

4.2.2 Light intensity (kilo lux)

The results related to light intensity (kilo lux) has been presented in Table 4.2.2 and depicted in figure 4.9. The growth media were not significantly different in relation to light intensity.

Among the treatments, maximum light intensity was found in treatment T_1, cow dung and vermicompost (153.90), followed by T_3, tree barks media (149.06) and T_4, pieces of bricks media (144.63). Minimum light intensity was exhibited in T_2, charcoal media (138.53).

Table 4.2.2 Effect of different growth media on the light intensity (kilo lux) of *Dendrobium* L.

Treatments	Light Intensity (kilo lux)
Cow dung+ Vermicompost (T_1)	153.90
Charcoal (T_2)	138.53
Tree barks (T_3)	149.06
Pieces of bricks (T_4)	144.63
SEm±	4.34
CD (P=0.05)	NS
CV (%)	5.13

4.2.3. Chlorophyll fluorescence

The results related to chlorophyll fluorescence has been presented in Table 4.2.3 and depicted in figure 4.10. The growth media were not significantly different in relation to chlorophyll fluorescence.

Among the treatments, maximum F_v / F_m was noticed in treatment T_3, tree barks media (0.769), followed by T_1, cow dung and vermicompost media (0.730) and T_2, charcoal media (0.633). Minimum F_v / F_m was found in T_4, pieces of bricks (T_4) media (0.611).

Table 4.2.3 Effect of different growth media on the chlorophyll fluorescence of *Dendrobium* L.

	Cow dung+ Vermicompost (T1)	**Charcoal (T2)**	**Tree barks (T3)**	**Pieces of bricks (T4)**
F_o	194	110	124	158
F_m	719	300	537	406
F_v / F_m	0.730	0.633	0.769	0.611
qP	0.734	0.647	0.634	0.634
qL	0.567	0.465	0.392	0.489
qN	0.707	0.463	0.584	0.625
NPQ	1.454	0.546	0.960	0.952
Y(NPQ)	0.364	0.233	0.295	0.349
Y(NO)	0.250	0.427	0.307	0.367
F	180	128	165	149
F_m'	293	194	274	208
PAR	190	190	190	190
Y(II)	0.386	0.340	0.398	0.284
ETR	30.8	27.1	31.8	22.7
F_o'	139	92	102	115

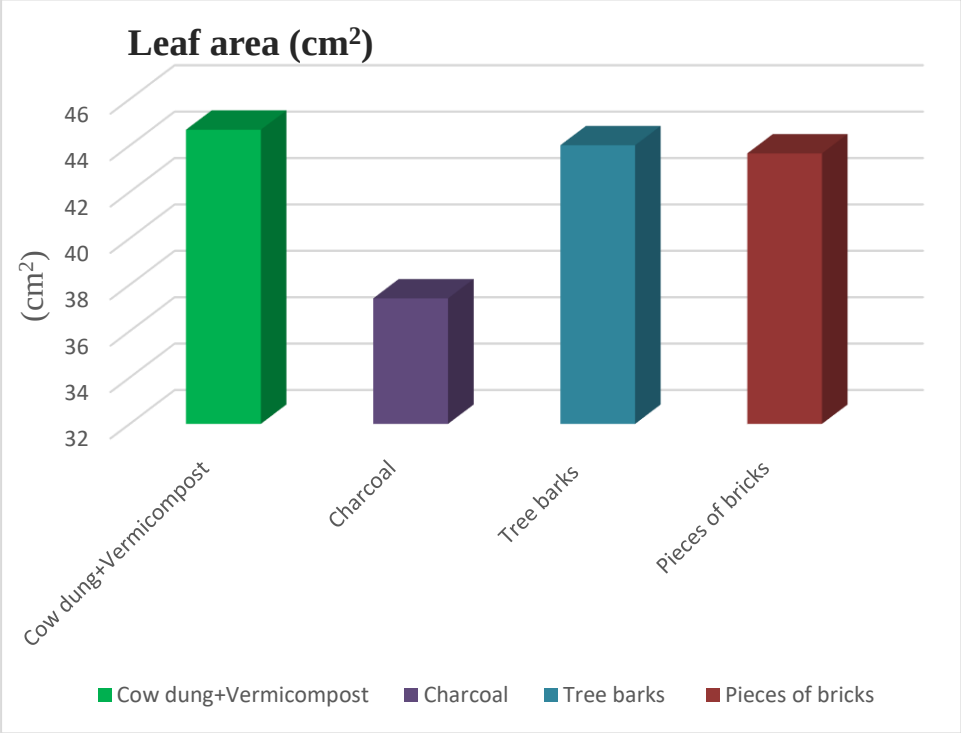


Fig 4.8. Effect of different growth media on leaf area (cm^2) of *Dendrobium* L.

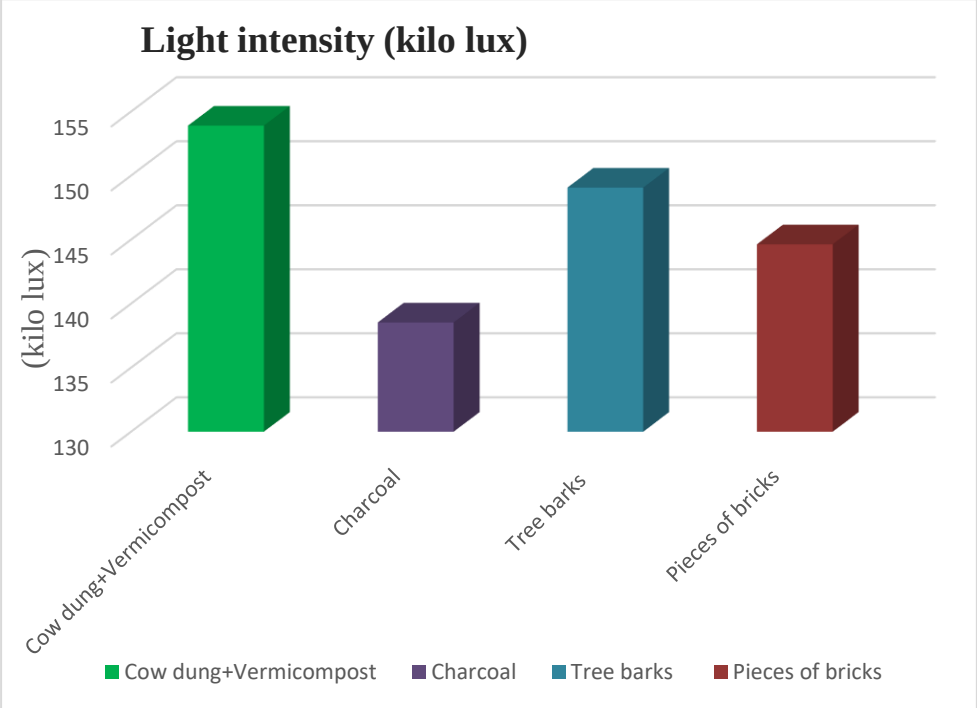


Fig 4.9. Effect of different growth media on light intensity (kilo lux) of *Dendrobium* L.

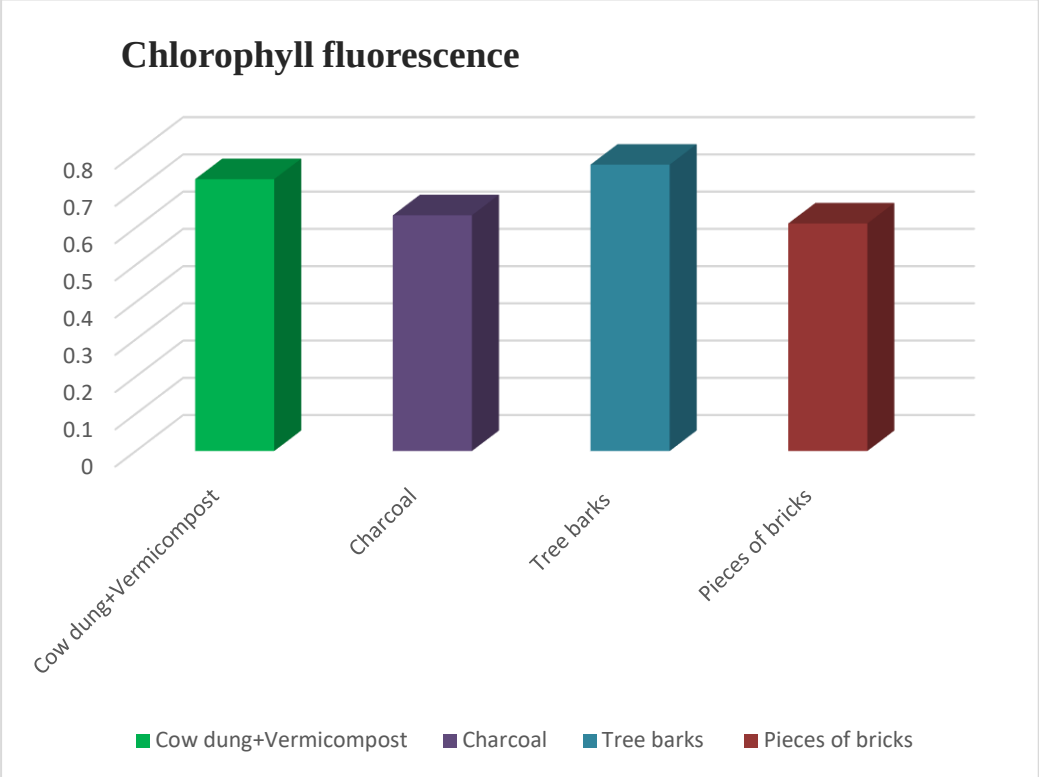


Fig 4.10. Effect of different growth media on chlorophyll fluorescence of *Dendrobium* L.

4.3 Biochemical parameters

4.3.1 Chlorophyll value (SPAD unit)

The results related to SPAD unit has been presented in table 4.3.1 and depicted in figure 4.11. The growth media were significantly different in relation to SPAD unit.

Among the treatments, maximum SPAD unit was observed in treatment T_1, cow dung and vermicompost media (46.70), followed by T_3, tree bark media (44.56) and T_4, pieces of bricks media (43.84). Minimum SPAD unis was exhibited in T_2, charcoal media (39.43). The similar result was found by Baboo and Singh (2006). Cow dung and vermicompost media provides optimum dose of nitrogen received by the plants and nitrogen is the major constituent of chlorophyll and involved in major physiological process like photosynthesis.

Table 4.3.1 Effect of different growth media on the SPAD unit of *Dendrobium* L.

Treatments	SPAD units
Cow dung+ Vermicompost (T_1)	46.70
Charcoal (T_2)	39.43
Tree barks (T_3)	44.56
Pieces of bricks (T_4)	43.84
SEm±	1.30
CD (P=0.05)	4.33
CV (%)	5.19

4.3.2 Wax content (µg/cm^2)

The results related to wax content (µg/cm^2) has been presented in table 4.3.2 and depicted in figure 4.12. The growth media were found significantly different in relation to wax content.

Among the treatments, maximum wax content was noticed in treatment T_3, tree bark media (44.66), followed by T_1, cow dung and vermicompost media (44.33) and T_4, pieces of bricks media (40.66). Minimum wax content was found in T_2, charcoal media (34.33). The similar result was found by Kosma *et al*. (2010) and Xue *et al*. Tree bark media produced more cuticular waxes in plants which provide protection against various biotic and abiotic stresses.

Table 4.3.2 Effect of different growth media on the wax content (µg/cm^2) of *Dendrobium* L.

Treatments	Wax content (µg/cm^2)
Cow dung+ Vermicompost (T_1)	44.33
Charcoal (T_2)	34.33
Tree barks (T_3)	44.66
Pieces of bricks (T_4)	40.66
SEm±	1.48
CD (P=0.05)	4.90
CV (%)	6.25

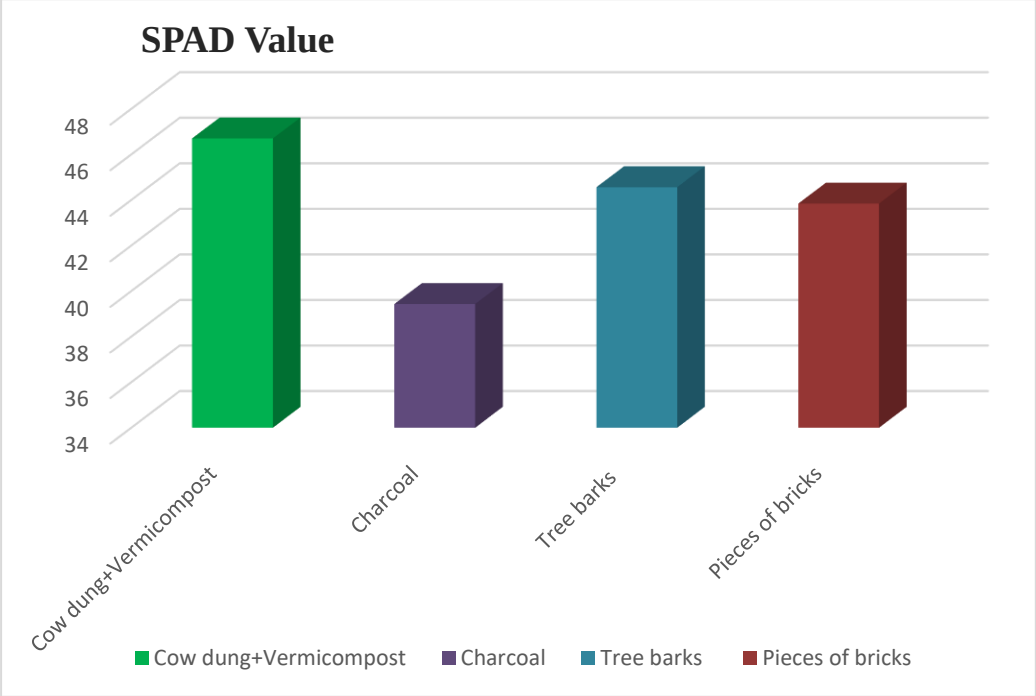


Fig 4.11. Effect of different growth media on SPAD units of *Dendrobium* L.

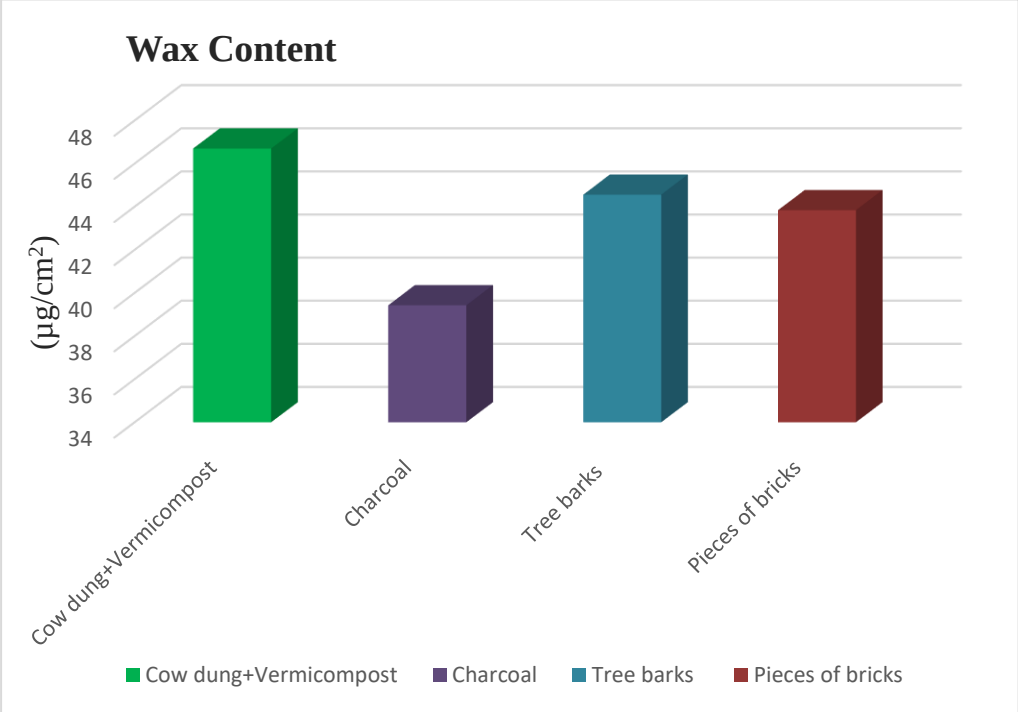


Fig 4.12. Effect of different growth media on wax content of *Dendrobium* L.

4.4 Phenological parameters

4.4.1 Flower bud initiation (days)

The results related to flower bud initiation (days) has been presented in table 4.4.1 and depicted in figure 4.13. The growth media were found significantly different in relation to flower bud initiation.

Among the treatments, maximum days for bud initiation was taken by T_2, charcoal (42.66 days). Minimum days for flower bud initiation was recorded in T_1, cow dung and vermicompost media (38.33 days). The similar results were recorded by Basheer and Thekkeyam (2012) and Hatibarua *et al.* (2003). Cow dung and vermicompost media provides proper availability of nutrients, which increases photosynthesis and respiration rate with enhanced carbon-dioxide fixation, thereby induced early flower bud initiation.

Table 4.4.1 Effect of different growth media on flower bud initiation(days) of *Dendrobium* L.

Treatments	Flower bud initiation (days)
Cow dung+ Vermicompost (T_1)	38.33
Charcoal (T_2)	42.66
Tree barks (T_3)	42.00
Pieces of bricks (T_4)	42.33
SEm±	0.95
CD (P=0.05)	3.17
CV (%)	4.01

4.4.2 Flower bud development (days)

The results related to flower bud development (days) has been presented in table 4.4.2 and depicted in figure 4.14. The growth media were found significantly different in relation to flower bud development.

Among the treatments, maximum days for bud initiation was taken by T_2, charcoal (12.33 days). Minimum days for flower bud initiation was recorded in T_1, cow dung and vermicompost media (9.66 days). The similar results were recorded by Waithaka *et al*., (2001). Early flower bud development in cow dung and vermicompost is accompanied by increase in carbohydrate content of plants and might be due to high level of sugars present in the buds.

Table 4.4.2 Effect of different growth media on flower bud development (days) of *Dendrobium* L.

Treatments	Flower bud development (days)
Cow dung+ Vermicompost (T_1)	9.66
Charcoal (T_2)	12.33
Tree barks (T_3)	10.33
Pieces of bricks (T_4)	11.33
SEm±	0.52
CD (P=0.05)	1.74
CV (%)	8.36

4.4.3 First floret opening (days)

The result related to first floret opening (days) has been presented in table 4.4.1 and figure 4.15. The growth media were found significantly different in relation to first floret opening.

Among the treatments, maximum days for first floret opening was taken by T_2, charcoal (55.86 days). Minimum days for first floret opening was recorded in T_1, cow dung and vermicompost media (47.53 days). The similar results were recorded by Binisha (2003), Dhinesh (2009) and Nambiar *et al*. (2012) in *Dendrobium*. Minimum days taken by media might be due to positive influence of nutrients present in media, which favors early first floret opening.

Table 4.4.3 Effect of different growth media on first floret opening (days) of *Dendrobium* L.

Treatments	First Floret Opening (days)
Cow dung+ Vermicompost (T_1)	47.53
Charcoal (T_2)	55.86
Tree barks (T_3)	48.46
Pieces of bricks (T_4)	47.66
SEm±	1.70
CD (P=0.05)	5.65
CV (%)	5.92

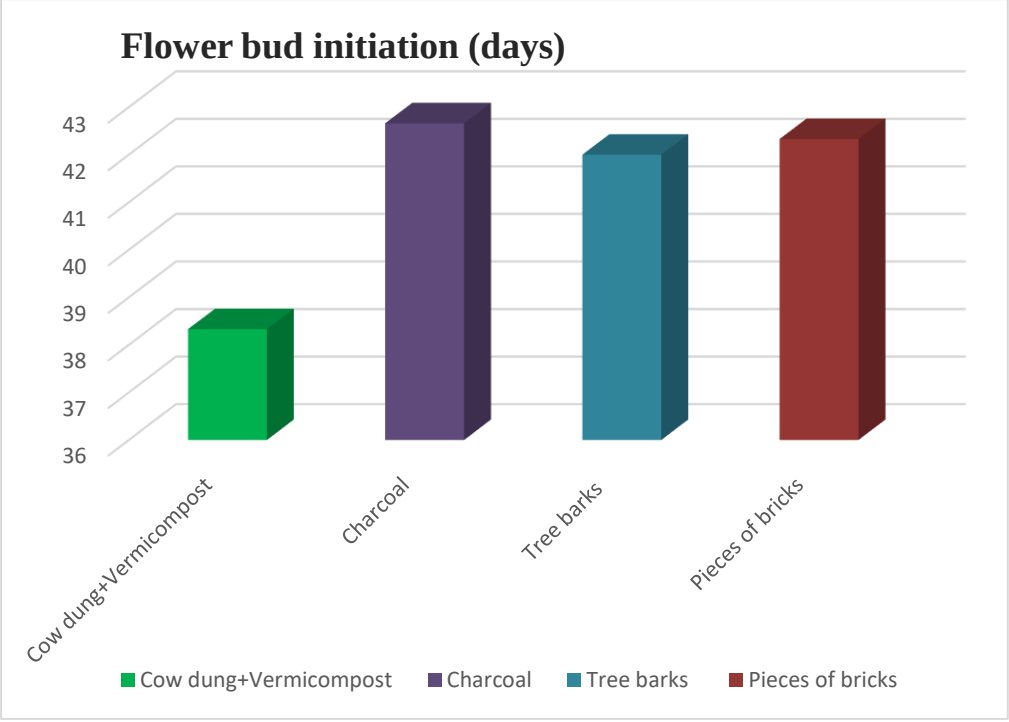


Fig 4.13. Effect of different growth media on flower bud initiation of *Dendrobium* L.

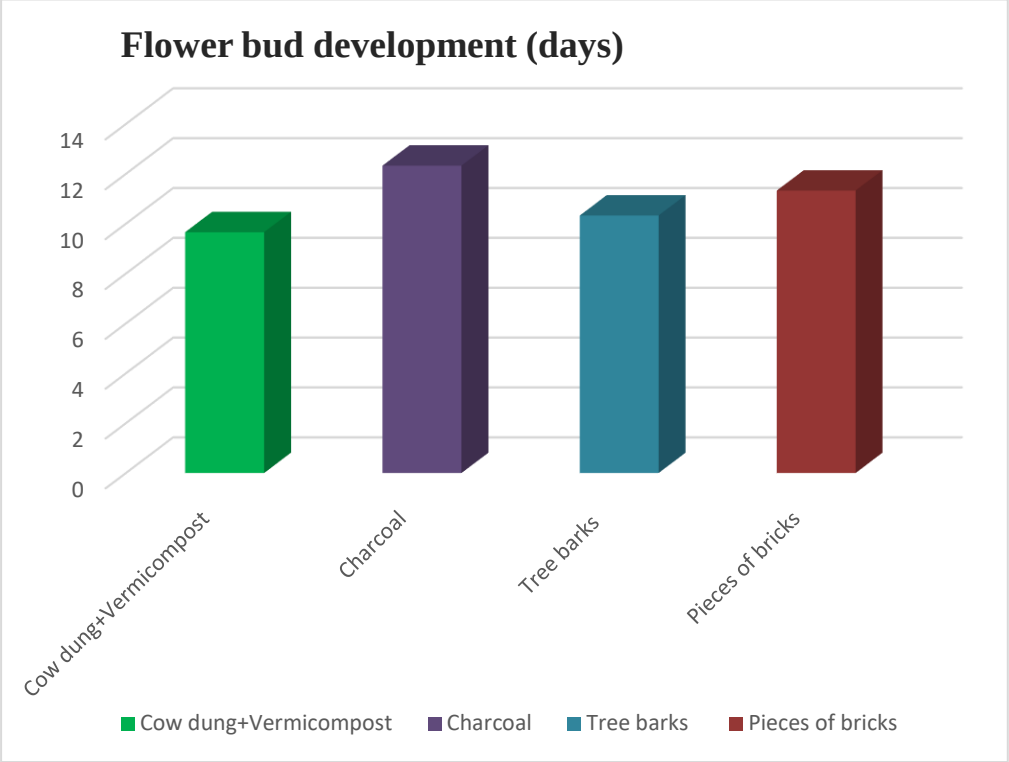


Fig 4.14. Effect of different growth media on flower bud development of *Dendrobium* L.

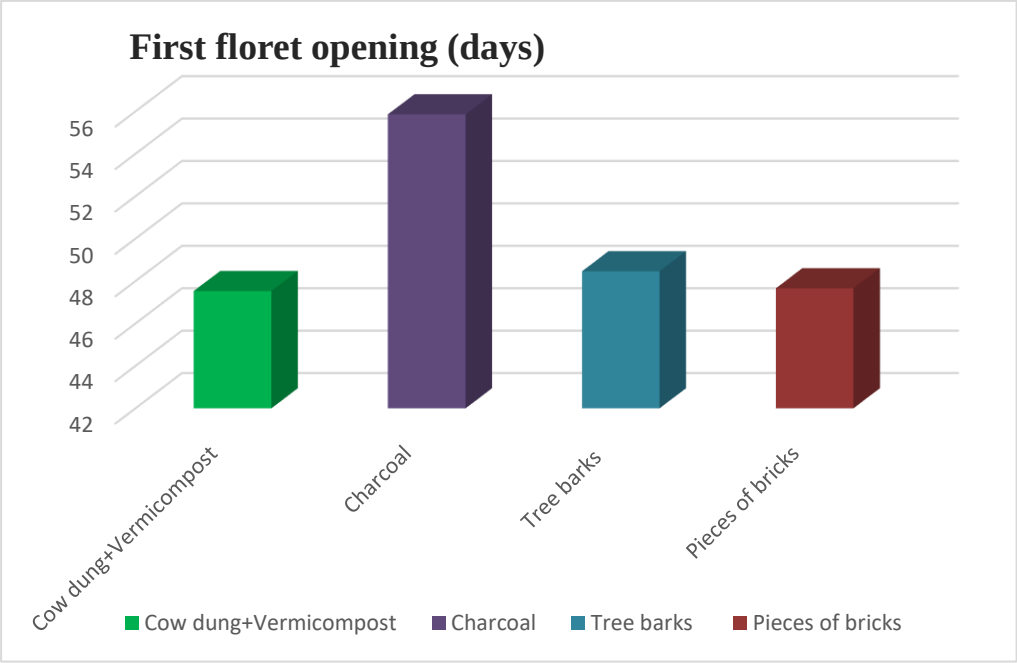


Fig 4.15. Effect of different growth media on first floret opening of *Dendrobium* L.

4.5 Yield and its attributes

4.5.1 Spike length (cm)

The results related to spike length (cm) has been presented in table 4.5.1 and depicted in figure 4.16. The growth media were found significantly different in relation to spike length.

Among the treatments, maximum spike length was noticed in treatment $T_{1,}$ cow dung and vermicompost media (18.40), followed by $T_{4,}$ pieces of bricks media (18.30) and $T_{3,}$ tree barks media (18.13). Minimum spike length was found in T_2, charcoal media (16.50). The similar result was found by Gupta, N. and Saravanan, S. (2017). Cow dung and vermicompost media helps in proper absorption of nutrients and better aeration of roots.

Table 4.5.1 Effect of different growth media on the spike length (cm) of *Dendrobium* L.

Treatments	Spike length (cm)
Cow dung+ Vermicompost (T_1)	18.40
Charcoal (T_2)	16.50
Tree barks (T_3)	18.13
Pieces of bricks (T_4)	18.30
SEm±	0.42
CD (P=0.05)	1.41
CV (%)	4.16

4.5.2 Flower diameter (cm)

The results related to flower diameter (cm) has been presented in table 4.5.2 and depicted in figure 4.17. The growth media were not significantly different in relation to flower diameter.

Among the treatments, maximum flower diameter was observed in treatment T_1, cow dung and vermicompost media (5.80), followed by T_3, tree barks media (5.70) and T_4, pieces of bricks media (5.66). Minimum flower diameter was found in T_2, charcoal media (5.06).

Table 4.5.2 Effect of different growth media on flower diameter (cm) of *Dendrobium* L.

Treatments	Flower Diameter (cm)
Cow dung+ Vermicompost (T_1)	5.80
Charcoal (T_2)	5.06
Tree barks (T_3)	5.70
Pieces of bricks (T_4)	5.66
SEm±	0.57
CD (P=0.05)	NS
CV (%)	18.05

4.5.3 Number of spikes

The result related to number of spikes has been presented in table 4.5.3 and depicted in figure 4.18. The growth media were found significantly different in relation to number of spikes.

Among the treatments, maximum number of spikes was found in treatment T_1, cow dung and vermicompost media (2.06), followed by T_3, tree barks media (1.93) and T_4, pieces of bricks media (1.40). Minimum number of spikes was found in T_2, charcoal media (1.26). The similar results found by Negi (2012) and Kaveriamma (2012). Maximum number of spikes might be due to the synthesis of carbohydrates in a better way and its utilization to enhance plant growth, thereby increasing the number of spikes in plant. Lower number of spikes in bricks and charcoal media is due to low nitrogen and phosphorus resulting in poor vegetative growth that affected the reproductive growth and thus produces lesser amount of spikes/ plant.

Table 4.5.3 Effect of different growth media on number of spikes of *Dendrobium* L.

Treatments	Number of spikes
Cow dung+ Vermicompost (T_1)	2.06
Charcoal (T_2)	1.26
Tree barks (T_3)	1.93
Pieces of bricks (T_4)	1.40
SEm±	0.17
CD (P=0.05)	0.57
CV (%)	18.00

4.5.4 Spike girth (cm)

The result related to spike girth (cm) has been presented in table 4.5.4 and depicted in figure 4.19. The growth media were found non significantly different in relation to spike girth.

Among the treatments, maximum spike girth was observed in treatment T_1, cow dung and vermicompost media (3.03 cm), followed by T_4, pieces of bricks media (2.53 cm) and T_2, charcoal media (2.50 cm). Minimum spike girth was found in T_3, tree barks media (2.43 cm).

Table 4.5.4 Effect of different growth media on spike girth (cm) of *Dendrobium* L.

Treatments	Spike girth (cm)
Cow dung+ Vermicompost (T_1)	3.03
Charcoal (T_2)	2.50
Tree barks (T_3)	2.43
Pieces of bricks (T_4)	2.53
SEm±	0.15
CD (P=0.05)	NS
CV (%)	9.89

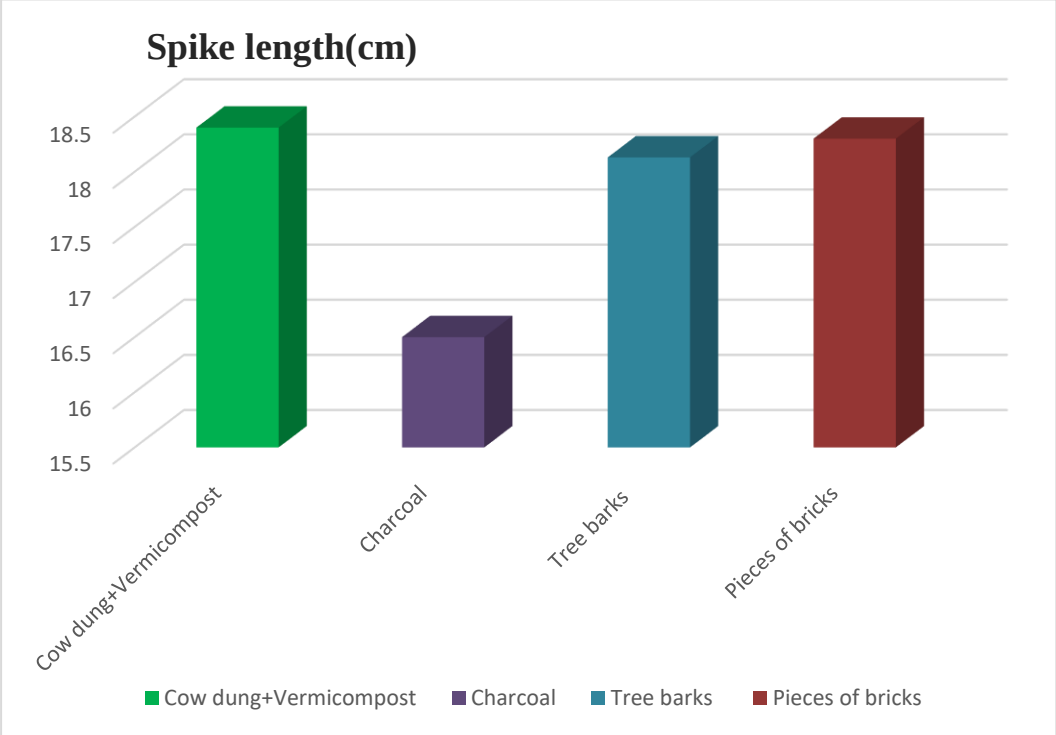


Fig 4.16. Effect of different growth media on spike length (cm) of *Dendrobium* L.

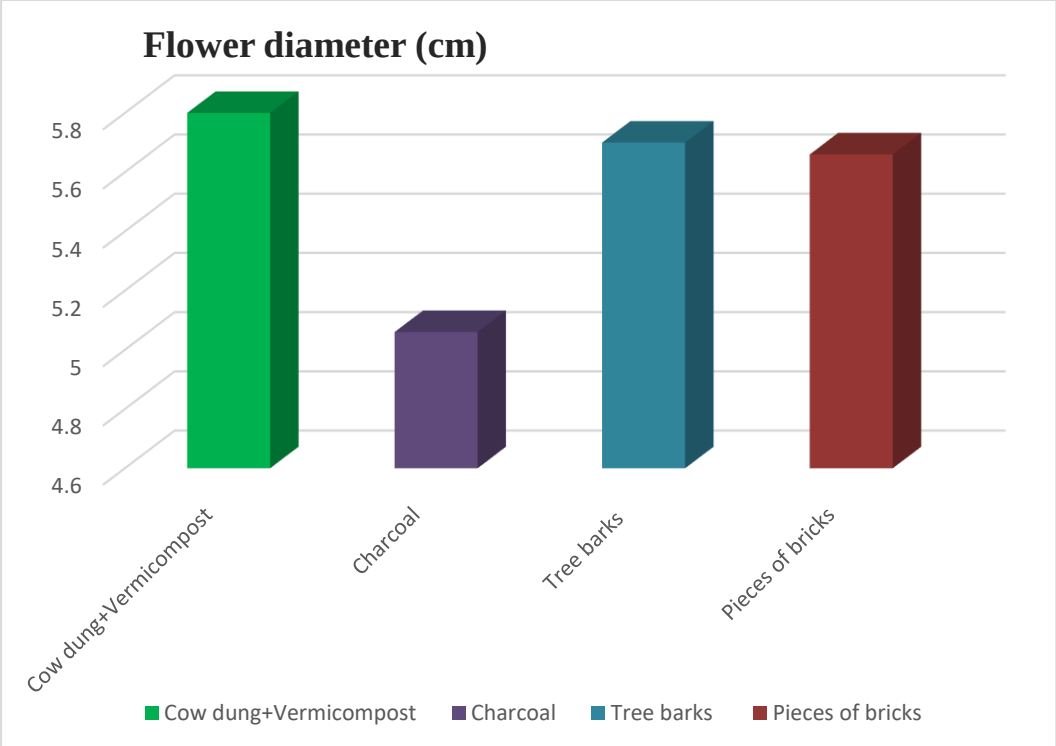


Fig 4.17. Effect of different growth media on flower diameter (cm) of *Dendrobium* L.

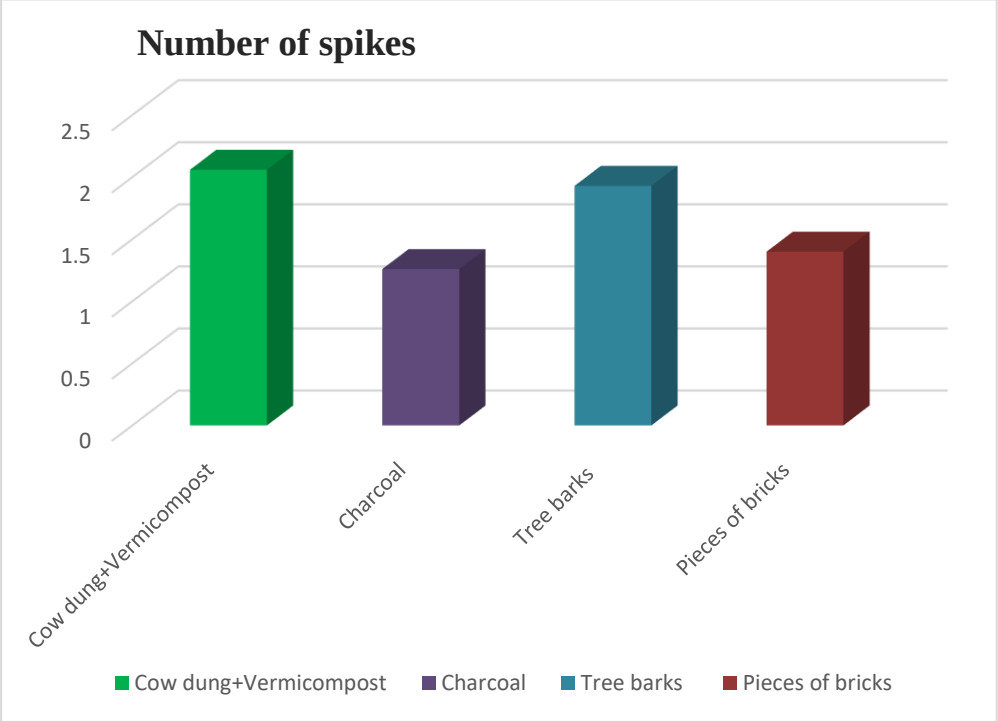


Fig 4.18. Effect of different growth media on number of spikes of *Dendrobium* L.

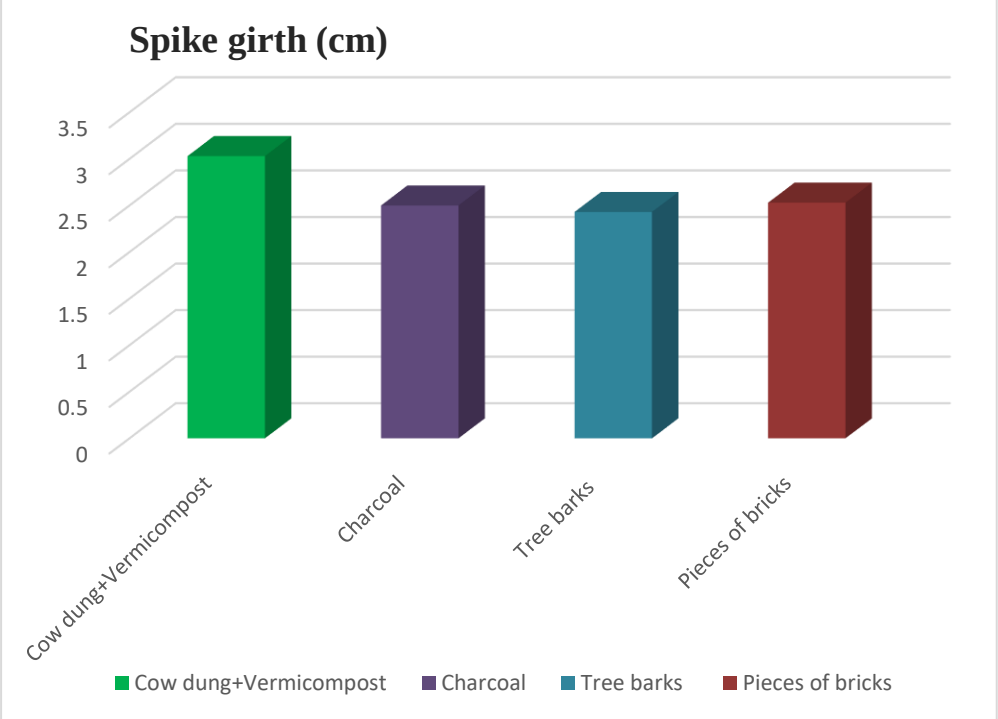


Fig 4.19. Effect of different growth media on spike girth (cm) of *Dendrobium* L.

4.5.5 Number of florets per spike

The result related to number of florets per spike has been presented in table 4.5.5 and depicted in figure 4.20. The growth media were found significantly different in relation to number of florets per spike.

Among the treatments, maximum number of florets was noticed in treatment T_1, cow dung and vermicompost media (1.73), followed by T_4, pieces of bricks media (1.60) and T_3, tree barks media (1.40). Minimum number of florets was exhibited in T_2, charcoal media (1.33). The similar result was found by Fageria *et al.* (2007). Maximum number of florets might be due to potassium available in plants is directly linked to root growth, flowering and morphology, nutrient uptake efficiency, translocation and utilization efficiency and application of high phosphorous used during the development of the inflorescence gave the best flowering in orchids.

Table 4.5.5 Effect of different growth media on the number of florets per spikes of *Dendrobium* L.

Treatments	Number of florets per spike
Cow dung+ Vermicompost (T_1)	1.73
Charcoal (T_2)	1.33
Tree barks (T_3)	1.40
Pieces of bricks (T_4)	1.60
SEm±	0.07
CD (P=0.05)	0.24
CV (%)	8.51

4.5.6 Size of flower (cm^2)

The results related to size of flower (cm^2) has been presented in table 4.5.6 and depicted in figure 4.21. The growth media were found significantly different in relation to size of flower.

Among the treatments, maximum size of flower was found in treatment T_1, cow dung and vermicompost media (18.20), followed by T_4, pieces of bricks media (17.86) and T_3, tree barks media (17.10). Minimum flower size was noticed in T_2, charcoal media (16.30). The similar result was found by Bharathi. U. (2014). Maximum size of flower might be due to the accumulation of carbohydrates and water uptake have direct effect on increase in cell volume and thereby increases the size of the flowers.

Table 4.5.6 Effect of different growth media on size of flower (cm^2) of *Dendrobium* L.

Treatments	Size of flower (cm^2)
Cow dung+ Vermicompost (T_1)	18.20
Charcoal (T_2)	17.86
Tree barks (T_3)	17.10
Pieces of bricks (T_4)	16.30
SEm±	0.40
CD (P=0.05)	1.35
CV (%)	4.06

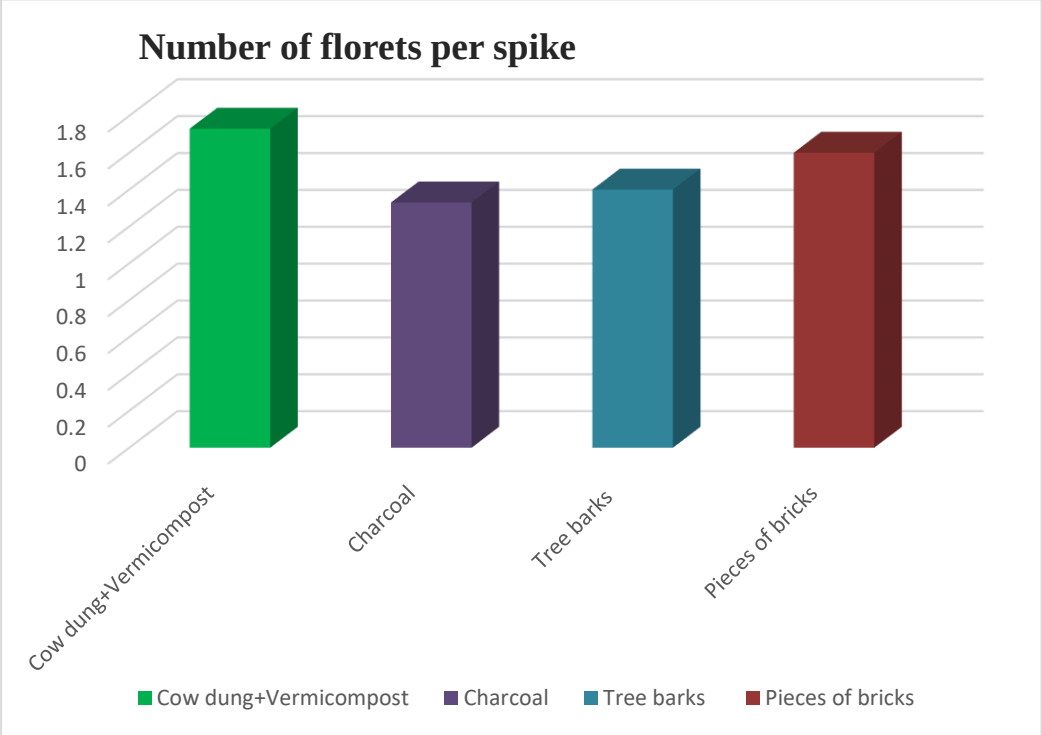


Fig 4.20. Effect of different growth media on number of florets per spike of *Dendrobium* L.

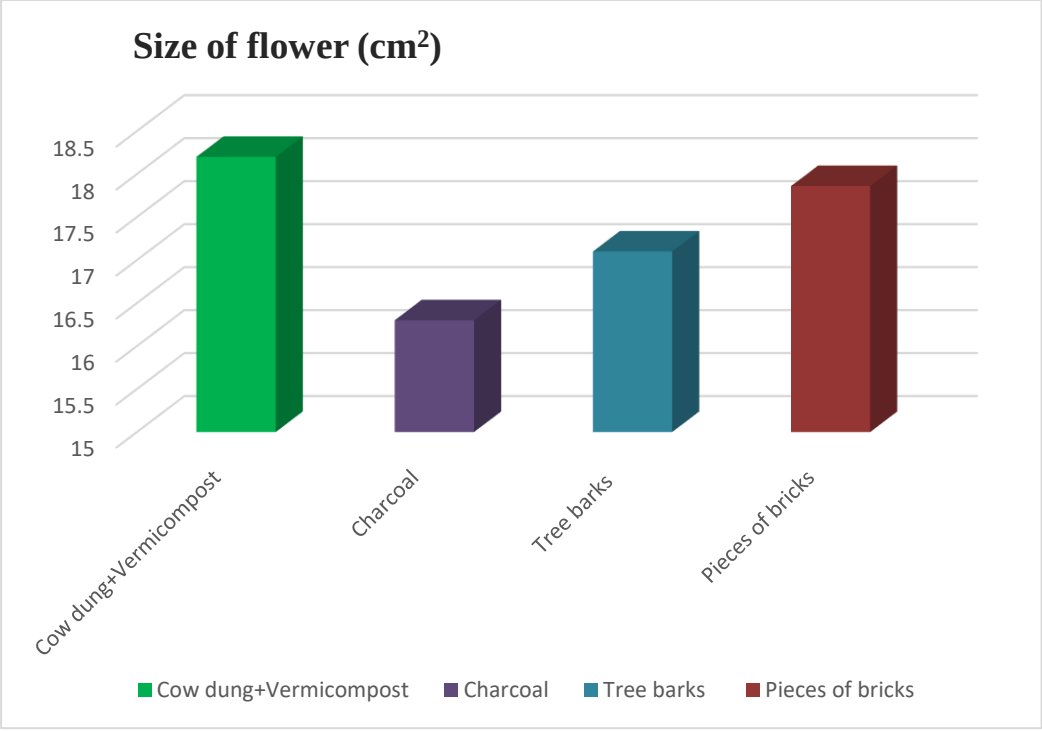


Fig 4.21. Effect of different growth media on size of flower (cm^2) of *Dendrobium* L.

4.5.7 Longevity of flower (days)

The results related to longevity of flower has been presented in table 4.5.7 and depicted in figure 4.22. The growth media were found significantly different in relation to longevity of flower.

Among the treatments, maximum longevity of flower was observed in treatment T_1, cow dung and vermicompost media (8.13 days), followed by T_3, tree barks media (8.06) and T_2, charcoal media (7.20). Minimum longevity of flower was found in T_4, pieces of bricks media (7.06). The similar result was found by Mohanty *et al*. (2011) in rose and Naik and Kumar (2014) in *Dendrobium*. The maximum longevity of flower might be due to higher levels of photosynthates in pseudobulbs.

Table 4.5.7 Effect of different growth media on longevity of flower (days) of *Dendrobium* L.

Treatments	Longevity of flower(days)
Cow dung+ Vermicompost (T_1)	8.13
Charcoal (T_2)	7.20
Tree barks (T_3)	8.06
Pieces of bricks (T_4)	7.06
SEm±	0.23
CD (P=0.05)	0.76
CV (%)	5.25

4.5.8 Vase life of cut flower (days)

The results related to vase life of flower (days) has been presented in table 4.5.8 and depicted in figure 4.23. The holding solutions used for *Dendrobium* orchid were found significantly different in relation to vase life of cut flower.

Among the treatments, maximum vase life (days) was observed in H_4, $AgNO_3$ solution (11.66 days), followed by H_3, kinetin solution (11.00 days) and H_2, GA_3 solution (10.66 days). Minimum vase life of flower was noticed in H_1, control (9.33 days). The similar result was found by Akon, M.R. and Mondal, M.F. (2009). $AgNO_3$ enhances the vase life of flower due to sugar content of the spikes. Sugars used in preservative solutions often extend the vase life of flowers. They contribute to the osmotic pressure of tissues maintain the respiration rate and cell membrane integrity while shorter vase life is the result of the rapid decline in water uptake.

Table 4.5.8 Effect of holding solution on vase life (days) of *Dendrobium* L.

Treatments	Vase life of cut flower (days)
Control (H_1)	9.33
GA_3 (H_2)	10.66
Kinetin (H_3)	11.00
$AgNO_3$ (H_4)	11.66
SEm±	0.40
CD (P=0.05)	1.35
CV (%)	6.62

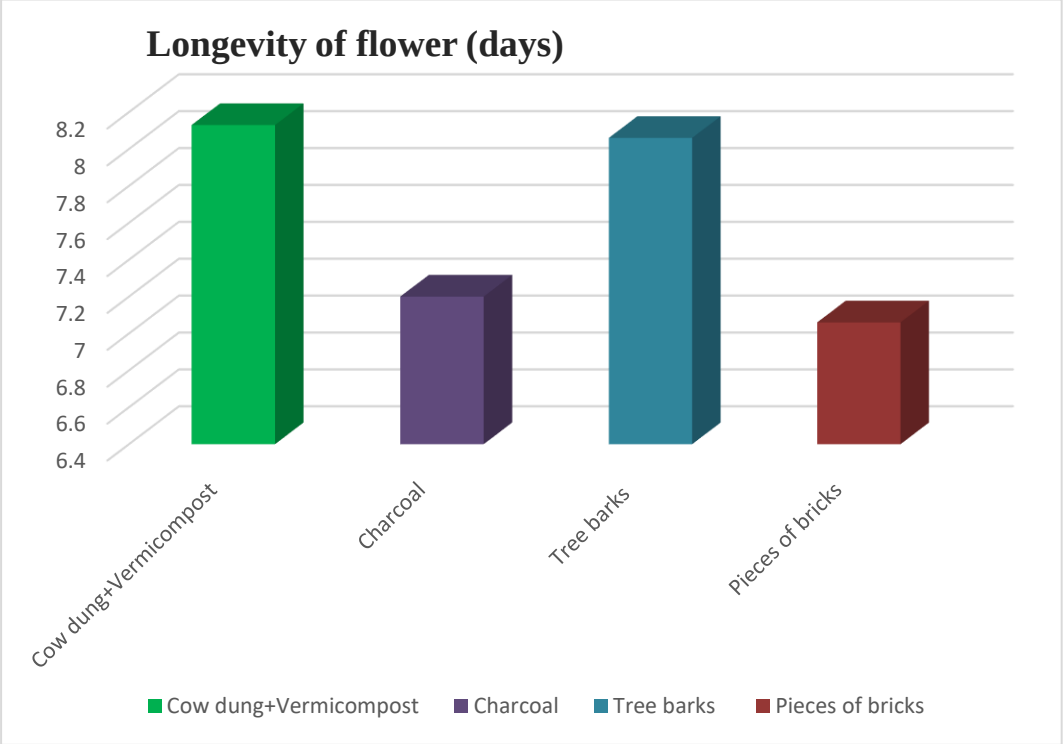


Fig 4.22. Effect of different growth media on longevity of flower (days) of *Dendrobium* L.

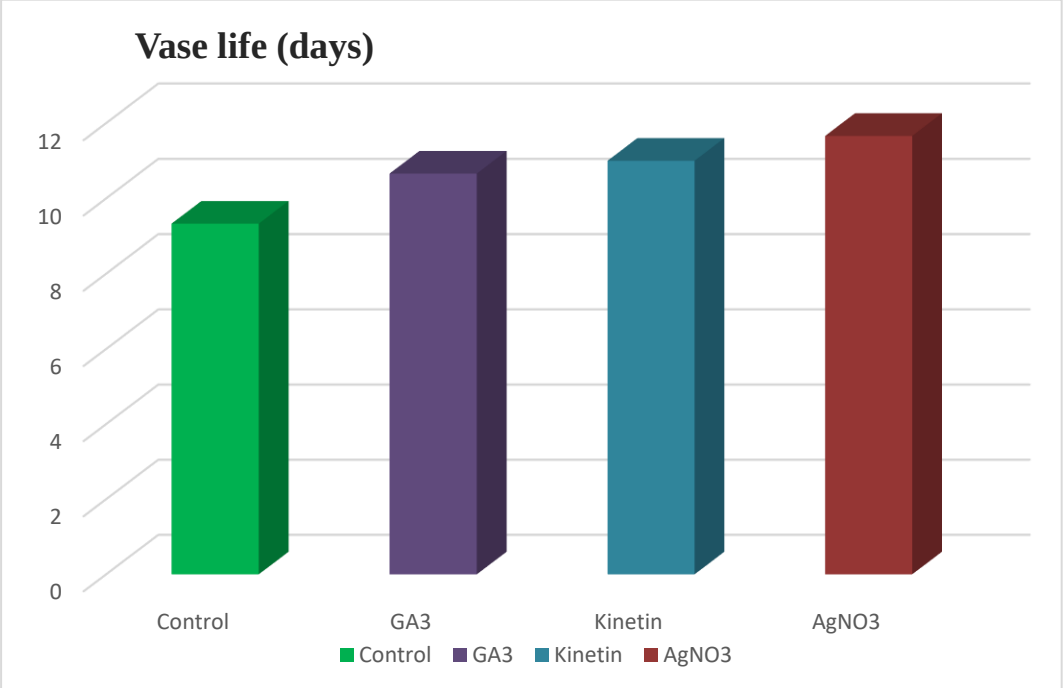


Fig 4.23. Effect of different holding solutions on vase life (days) of *Dendrobium* L.

4.6 Correlation Analysis

The correlation values for different months as presented in Table 4.6.1 and Table 4.6.2. Flower yield is non significantly positively correlated with maximum temperature (0.132), minimum temperature (0.072) and photoperiod (0.166) for months from December (2020) to March (2021), and flower yield is non significantly positively correlated with maximum temperature (0.071), and non significantly negatively correlated with minimum temperature (-0.872) and photoperiod (-0.088) for months from April (2021) to July (2021).

Table 4.6.1 Correlation coefficient of maximum temperature, minimum temperature and photoperiod (sunshine) with flower yield from December (2020) to March (2021)

	Maximum temperature (^{0}C)	**Minimum temperature (^{0}C)**	**Sunshine (hrs)**	**Flower yield**
Maximum temperature (^{0}C)	1			
Minimum temperature (^{0}C)	0.971^{*}	1		
Sunshine (hrs)	0.541^{NS}	0.325^{NS}	1	
Flower yield	0.132^{NS}	0.072^{NS}	0.166^{NS}	1

Table 4.6.2 Correlation coefficient of maximum temperature, minimum temperature and photoperiod (sunshine) with flower yield from April (2021) to July (2021)

	Maximum temperature (^{0}C)	**Minimum temperature (^{0}C)**	**Sunshine (hrs)**	**Flower yield**
Maximum temperature (^{0}C)	1			
Minimum temperature (^{0}C)	-0.474^{NS}	1		
Sunshine (hrs)	0.969*	-0.278^{NS}	1	
Flower yield	0.071^{NS}	-0.872^{NS}	-0.088^{NS}	1

CHAPTER-V
SUMMARY AND CONCLUSION

5.1 Summary

An experiment was conducted on **'Effect of different growing media on orchid (*Dendrobium nobile* L.) under shade net house'** in Rabi season 2020-21 at the Department of Plant Physiology, AB & MAP, College of Agriculture, IGKV, Raipur, Chhattisgarh. There were four treatments used as planting media, viz., T_1, Cow dung+ Vermicompost, T_2, Charcoal, T_3 Tree barks and T_4 Pieces of bricks, it replicated thrice. The investigation was carried out in Completely Randomized Design (CRD). And above four media was used as potting media. The results of the experiments are summarized below:

- Tree bark media gave superior performance for plant height (19.20 cm), number of leaves plant^{-1} (5.26), number of internodes per shoot (3.80), internode length (4.60), shoot girth (4.16) and wax content (44.66). Tree bark media contains higher concentrations of mineral nutrients with conductive root environment which led to proper nutrient uptake in the organic substrates resulted in greater accumulation of food matter, leading to increase in all vegetative traits.
- Pieces of bricks media found to be effective for root length (17.16) because media provides good aeration and allowed free growth of roots.
- Cow dung and Vermicompost media found to be effective for SPAD units (46.70), leaf area (44.68), flower bud initiation (38.33 days), flower bud development (9.66 days), first floret opening (47.53), number of spikes (2.06), spike length (18.40 cm), number of florets per spike (1.73), size of flower (18.20), longevity of flower in plants (8.13 days). Cow dung and Vermicompost media helps in synthesis of carbohydrates in a better way and potassium available in the plants is directly linked to morphology and flowering, nutrient uptake efficiency, translocation and utilization

efficiency and application of high phosphorus used during the development of flowers gave best flowering in orchids.

- $AgNO_3$ was found superior for vase life of flower (11.66 days) due to sugar content present in flower spikes. Sugars in preservative solutions frequently contribute to tissue osmotic pressure, which helps to preserve respiration rate and cell membrane integrity, while a quick fall in water absorption results in a shorter vase life.

5.2 Conclusion

On the basis of results obtained from the present investigation, the conclusion is following:

1. Tree bark media have been identified better performance for height of plant, number of leaves plant^{-1}, maximum number of internodes shoot^{-1}, internode length, shoot girth. Therefore, the increase in all vegetative parameters could be attributed to optimum dose of nitrogen received by the plants that increased synthesis of proteins and consequence of which there is an increased meristematic activity leading to higher plant growth
2. Pieces of bricks media found to be effective for root length.
3. Cow dung and Vermicompost media found to be effective for SPAD value, leaf area, flower bud initiation, flower bud development, first floret opening, number of spikes, spike length, number of florets per spike, size of flower, longevity of flower in plants.
4. Cow dung and vermicompost media were shown to be beneficial for root and shoot development because they offer an appropriate quantity of nutrients and water for plant growth, whereas charcoal media was found to be ineffective for potting media because it restricts drainage and aeration after watering. Aeration for aerial roots is limited since the pores are densely packed.

5. $AgNO_3$ reduced ethylene synthesis in *Dendrobium* orchid by acting as a competitive inhibitor with glucose. The sugar content of the spikes has an economic impact on orchid postharvest deterioration. Sugars used as a

holding solution help cut flowers last longer in the vase because they help maintain the plant cell's osmotic pressure, which keeps the respiration rate and cell membrane intact.

5.3 Suggestion for future work

Some suggestions for future work may be following:

1. The similar experiment can be repeated for one or more years to get some precise information.
2. The experiment should be practiced with different growth media and their different ratios for better performance on orchid growth and development.
3. The experiment should be implemented on some different varieties of orchid for getting concrete findings.
4. The media should be used with the application of plant growth regulators for quality improvement of flower orchids.

REFERENCES

Adhikari, D and Bahadur, A. 2015. Climatic requirements of major cut flowers in Nepalese context. Floriculture Association Nepal (FAN), Battishputali-9, Kathmandu, Nepal. 2015;20-21.

Akon, M.R. and Mondal, M.F. 2009. Extending vase life of orchid. *Journal of the Bangladesh Society for Agricultural Science and Technology,* 6: 71-76.

Anand, S. and Jawaharlal, M. 2003. Effect of water-soluble nutrients and growth regulator on plant characters of *Anthurium andreanum* var. Temptation. Nat. Symp. Recent Adv. Indian Floriculture, November 12-14, 2003. Indian Society of Ornamental Horticulture, New Delhi. *Abstract*: 1.

Arancon, N.Q., Edwards, C.A., Babenko, A., Cannon, J., Galvis, P. and Metzger, J.D. 2008. Influences of vermicomposts, produced by earthworms and microorganisms from cattle manure, food waste and paper waste, on the germination, growth and flowering of petunias in the greenhouse. *Appl. Soil Eco.* **39**, 91-99.

Arthagama, I.D.M., Dana, I.M. Wiguna. P.P.K. 2019. Effect of various types of growing media and application of liquid organic fertilizer on the growth of *Dendrobium* orchids. *International Journal of Biosciences and Biotechnology*. 10.24843/IJBB.v08i02.p07.

Arumugam, T. and Jawaharlal, M. 2004. Effect of shade levels and growing media on growth and yield of *Dendrobium* orchid cultivar Sonia-17. *Journal of Ornamental Horticulture,* 7(1): 107-110.

Baboo, R. and Singh, R.D. 2006. Response of nitrogen, phosphorus and corm size on flowering and corm production in gladiolus. *Journal of Ornamental Horticulture*, **9**(1): 66–8.

Bahadur, A. 2018. Growth and Flowering Response of *Cymbidium* Orchid (*Cymbidium erythrostylum*) in Different Potting Media, NPK and Sucker Management. 2(2): 1-6, 2018; Article no. AJRAF.46143.

Barad, A.V., Patel, A.P. and Chandore, H.D. Effect of nitrogen through urea and castor cake on growth, flowering and yield of chrysanthemum (*Chrysanthemum morifolium* Ram.) Cv. IIHR-6. National Symposium on Recent Advances in Floriculture. 2008; p.61.

Barathi, T.U., Barman, D., Naik. S.K. 2014. Effect of harvesting stages and chemical preservatives on post-harvest life of *Cymbidium* hybrid Red Princess.Vol27(1):188-194.

Barman, D., Bharathi, T. U., and Medhi, R. P. 2012. Effect of media and nutrition on growth and flowering of *Cymbidium* hybrid ‗H.C. Aurora'. *Indian Journal of Horticulture*, 69(3): 395-398.

Basheer, S.N. and Thekkayam, S.G. 2012. Effect of growing media and organic nutrition on vegetative growth in *Anthurium* plants (*Anthurium andreanum* cv. TROPICAL). The Asian Journal of Horticulture, Volume 7(2): 354-358.

Bichsel, R.G. and Starman, T.W. 2008. Nitrogen, phosphorus and potassium requirements for optimizing growth and flowering of the *Dendrobium nobile* as a potted orchid. *Hortic. Sci*. 43(2): 328-332.

Binisha, S. 2003. Supplementary effect of bio-fertilizers in *Dendrobium*. M.Sc. (Ag) Thesis, Kerala Agricultural University, Thrissur, KERALA (INDIA).

Blanchard, M.G. and Runkle, E.S. 2006. Temperature during the day, but not during the night, controls flowering of two *Phalaenopsis* orchids. *Journal of Experimental Botany*,57(15):4043-9.

Chaturvedi, A. Tripathi, A.N. and Chaturvedi, S.K. 2016. Effect of plant growth regulators and floral preservatives on plant growth, spike yield and vase life of *Dendrobium* orchid hybrid Sonia-17. ISSN.Vol:48,2249-5258.

Cheamuangphan, A., Panmanee, C. and Tanusuchat, R. 2013. Value chain analysis for orchid cut flower business in Chiang mai. Business and information, July 7-9.

Chowdhery, H.J. 2001. Orchid diversity in north- east India. *Journal of Orchid society in India*.15:1-17.

Chugh, S., Guha, S. and Rao, I.U. 2009. Micropropagation of orchids: a review on the potential of different explants. Scientia Horticulturae. 122(4):507-520.

De, I.C., Singh, R. Singh, D.R. 2018. Studies on organic nutrient management in *Cymbidium* orchid through both spray and media treatment.

Deb, C.R. and Imchen, T. 2010. An efficient *in vitro* hardening technique of tissue culture raised plants. Biotechnology 9(1): 79-83.

Dhinesh, D. 2009. Influence of nutrients and plant growth promoting root endophyte (PGPRE) on growth and development of *Dendrobium* cv. EARSAKUL. M.Sc. (Ag) Thesis, Kerala Agricultural University, Thrissur, KERALA (INDIA).

Fageria, N.K., Baliger, V.C. and Clark, R.B. 2007. Physiological functions of nutrients. (In) *Physiology of Crop Production*. pp 206-51. IDBC, Lucknow.

Fausey, B.A. 2005. The effects of light quantity and vernalization on growth and flowering of *Arabidopsis*, *Achillea*, *Gaura*, *Isotoma*, *Lavandula and Veronica*. PhD dissertation, Michigan State University, USA.

Gohil. P., Gohil, M., Rajatiya, J., Halepotara, F. 2018. Role of growing media for ornamental pot plants. *International Journal of Pure and Applied Biosciences,* ISSN: 2320-7051.

Gowda, J.V.N., Gowda, M.C. & Gowda, A.P.M. 2005. Influence of different growing media on vegetative growth of *Anthurium* cv. Lady Jane. *Crop research,* 30(2): 283.

Gufran, A. and Saravanan, S. 2014. Effect of NPK and potting media on plant growth and spike yield of *Dendrobium* orchid cv. Sonia Hiskula. Hort Flora Research Spectrum, 3(4): 383-385.

Gupta, N. and Saravanan, S. 2017. Effect of different potting media on plant growth and spike yield of *Dendrobium*. *J. Orchid Soc. India, 31: 61-64.*

Hariyanto, S., Jamil, A. and Purnobasuki, H. 2019. Effects of Plant Media and Fertilization on The Growth of Orchid Plant (*Dendrobium sylvanum rchb. F*.) in Acclimatization Phase. *Planta Tropika: Journal of Agro Science. 7(1)* :66-72.

Hatamazadeh, A. 2011. The influence of vermicompost on the growth and productivity of *Cymbidiums*. Caspian journal environmental sciences 2011, Vol.9 No.2 pp. 125-132.

Hatibarua, P., Machahary, R.K., Bharati, R., and Paswan, L. 2003. Effect of some growing media on production of *Anthurium andreanum* Lind. under Assam conditions. (In). *Compendium of papers of the National Symposium on Recent Advances in Indian Floriculture*, 12-14, November 2003, New Delhi, pp 79–82.

Hew, C.S. and J.W.H. Yong. 2004. The physiology of tropical orchids in relation to the industry. 2nd ed. World Scientific, River Edge, N.J.

Hynniewta, T.M., S.K. Kataki and B.M. Wadhwa. 2000. *Orchids of Nagaland*. BSI. Calcutta.

Indhumati, K., Kannan M., and Jawaharlal, M. 2003. Standardisation of pre hardening and hardening techniques for in vitro derived plantlets of *Dendrobium* orchid hybrid Sonia-17. *Journal of Ornamental Horticulture*. Vol 6(3): 212-216.

Kaveriamma. 2012. Comparative performance of eight *Phalaenopsis* varieties of different growing condition. Ph.D. (Hort) Thesis, Kerala. Agric. Univ., Thrissur.

Kreji, De., C. and Berg, V.D. 1990. Effect of electrical conductivity of the nutrient solution and fertilization regime on spike production and quality of *Cymbidium.* Scientia Hort. 44:293–300.

Kumar, P., Singh, P., Bhardwaj, A. and Kumar, R. 2019. Effect of Foliar Spray of Primary Nutrients and their Frequency on Anthurium (*Anthurium*

andreanum L.) var. Xavia under Protected Condition. BAU Communication No. 760.

Lakshanthi, J.M.T. and Seran, T.H. 2019. Survival rate and growth performance of in vitro raised plantlets of Orchid (*Dendrobium* sp.) in different hardening substrates. *International Journal of Advanced Research and Review*, 4(3): 01-09.

Lavanya, M., Venkateshwarlu, B. and Devi, B.P. 2009. Acclimatization of neem micro shoots adaptable to semi-sterile conditions. *Indian Journal of Biotechnology*, 8: 218-222.

Leonhardt, K.W. 2000. Potted, blooming *Dendrobium* orchids. *Hort. Technol.* 10: 431.

Lopez, R.G., Runkle, E.S., Heins, R.D., Whitman, C.M. 2003. Temperature and photoperiodic effects on growth and flowering of *Zygopetalum* Redvale 'Fire Kiss' orchids. ActaHortic.624:155-162.

Lopez, R.G. and Runkle, E.S. 2004. The effects of temperature on leaf and flower development and flower longevity of *Zygopetalum* Redvale 'Fire Kiss' Orchid. HortScience 39(7):1630-1634.

Mohapatra, S. and Saravanan, S. (2006). Effect of different potting media on growth and flowering of *Dendrobium* orchid cv. Flamme. Orissa Journal of Horticulture; 2006. 34(2):65-68.

Makhanya, T. 2002. Influence of floral preservatives on vase life of different rose cultivars. B.Sc. in Agriculture Research Project Report submitted to the submitted to the Faculty of Agriculture, Luyengo flowers. Bull. Nat. Inst. Flor. Sci., 2: 1-8. Campus, University of Swaziland.

Mani, S.K. and Nagaraju, V. 2005. Influence of potting media on acclimatization and growth of in vitro plantlets of Cymbidium hybrids. *Journal of Ornamental Horticulture*. 7 (1): 23-30.

Marschner, H. 2003. Functions of mineral nutrients: macronutrients, p. 229-312. In: Mineral nutrition of higher plants. Academic Press, Boston, Mass.

Mehraj, H., Shikha, K.J., Nusrat, A., Shiam, I. H. and Jamal Uddin, F. M. 2014. Growth and flowering behavior of Dendrobium cultivars. *J. Bioscie. Agri. Res.*, 2(2): 90-95.

Miano, T. F., Rabbani, M. G., Mondal, M. F. 2015. Vase life of *Dendrobium* Sonia under various holding solutions and packing materials. ISSN 1013-5316; CODEN: SINTE 8.

Mirani, A.A, Abul-Soad, A.A. and Markhand, G.S. 2017. Effect of different substrate on survival and growth of transplanted orchids (*Dendrobium nobile* cv.) into net house. *International Journal of Horticulture and Floriculture*, 5(4), 310-317.

Mohanthy, C.R., Mohanthy, A., Das, A.B. and Kar, D.S. 2011. Comparative performance of some rose varieties under open and protected environment. Asian. J. Hort. 6(2): 288-293.

Monda, T., Dash, P.K., Ahmed, M., Islam, Md. M. and Ali, Md. H. 2014. Growth performance of orchid (*Dendrobium* sp.) as influenced by different NPK spray concentration. *International Journal of Biosciences*, 4(7), 15-27.

Muraleedharan, A. and Karuppaiah, P. 2015. Studies on the effect of shade and growing media on the growth and yield of *Anthurium* (*Anthurium andreanum*) cv. Tropical. *International Journal of Advance Research in Engineering, Science and Technology,* 2(10): 2394–444.

Naik, S., Maurya, S. and J. Choudhary. 2014. *Growing orchid: An Overview*. ICAR Research Complex for Eastern Region, India.

Nambiar, N., Siang, T.C. and Mahmood, M. 2012. Effect of 6- benzylamonipurine on flowering of a *Dendrobium* orchid. *Australian J. Crop Sci*, 6 (2): 225-231.

NEG. 2012. Performance of *Phalaenopsis* varieties on different growing condition. M.Sc. (Hort) Thesis, Kerala. Agric. Univ., Thrissur.

Norman, Q. Arancon, C., Edwards, A., Lee, S. and Byrne, R. (2006). Effect of humic acid from vermiconposts on plant growth. *European Journal of Soil Biology,* 42(2006)., 565-569.

Özer S., Yılmaz H, Kaya Y, 2009. Determination of The Diversity of Grassy and Woody Plant Species in Sarıkamış/Turkey District and Evaluation of Their Usability in Planning and Design Attempts. BioDiCon 2/3:75-81.

Puchooa, D. 2004. Comparison of different culture media for the *in vitro* culture of *Dendrobium* (Orchidaceae). *International Journal of Agriculture and Biology*, 6(5): 884-888.

Ramachandrudu, K. 2006. Performance of *Dendrobium* orchids under agro-climatic conditions of Goa. *J. Ornt. Hort.*, 11(3): 232-236.

Ramya, P. 2007. *Micronutrient Studies in Orchid Dendrobium cv. Sonia 17*. M.Sc. (Hort.) thesis, Tamil Nadu Agricultural University, Coimbatore, India.

Rebecca G. B. 2006. Determining the nutritional requirements for optimizing flowering of the Dendrobium nobile as a potted orchid. M.Sc. Thesis. Texas A and M University.

Reid, M.S., 2012. Handling of cut flowers for air transport. *http://ucce.ucdavis.edu/file/datastore/234-1373.pdf.*05/09/2012.

Roberto, G.L. and Runkle, E.S. 2005. Environmental Physiology of growth and flowering of orchids. HortScience. 40(7): 1969-1973.

Robinson, K.A. 2002. Effects of temperature on the flower development rate and morphology of *Phalaenopsis* orchid. MS thesis. Milch. State Univ., East Lansing.

Saeed, M., Xianliang, S., Xuezhen, S., Riaz, M. 2018. Leaf cuticular wax content is involved in cotton leaf curl virus disease resistance in cotton (*Gossypium hirsutum* L.). Spanish Journal of Agricultural Research. 16(4), e0705, 8 pages (2018).

Samseemoung, G., Soni, P. and Sirikul, C. 2017. Monitoring and Precision Spraying for Orchid Plantation with Wireless WebCAMs. *Agriculture 7, 87*: 1 – 14.

Sanghamitra, M. Babu, D.J., Bhagavan, B.V.K., Suneetha, D.R.S. 2019. Role pf potting media in the cultivation of orchids-A Review. International Journal of Current Microbiology and Applied Science. ISSN: 2319-7706. Volume 8 Number 01.

Saravanan, S. and Amit, K. 2009. Standardization of Agro-Techniques of *Dendrobium* Orchids under protected condition. *New agriculturist.* 20(1,2): 141-45.

Sardoei, A. S. 2014. Vermicompost effects on the growth and flowering of marigold (*Calendula officinalis*). *European Journal of Experimental Biology*, ISSN: 2248-9215.

Sayed, O. H. 2001. Crassulacean Acid Metabolism a check list, *Photosynthetica* 5:748–754.

Schmilewski, G. 2008. The role of peat in assuring the quality of growing media, Klasmann-Deilmann GmbH, Germany Mires and Peat, Volume 3, Article 02, © 2008 International Mire Conservation Group and International Peat Society.

Singh, R., Sharma, R.R., Kumar, S., Gupta, R.K. and Patil, R.T. 2008. Vermicompost substitution influences growth, physiological disorders, fruit yield and quality of strawberry (Fragaria x ananassa Duch.). Biores. Tech. 99, 8507-8511.

Srinivasulu, G.B, Harshavardhan, M. and Chandhan, K. 2017. Comparative effect of different potting media on vegetative and reproductive growth of *Dendrobium* Orchid cv. Sonia 17. Environment and Ecology. 35(2): 1252-1255.

Sudeep, H.P., Seetharamu, G.K., Aswath, C., Munikrishnappa, P. M., Sreenivas, K. N., Basavaraj, G. and Gowda, D. M. 2018. Comparative Performance of Dendrobium Orchid Varieties on Floral Quality and Flower Yield under Different Growing Conditions. *Int. J. Pure App. Biosci.* 6 (2): 114-121.

Sumathi, T., S.L. Chawla, T.R. Ahlawat, S. Patil and R.A. Gurjar. 2018. Effect of media and foliar spray of primary nutrients (NPK) on growth and yield of *Anthurium* var. Tropical under greenhouse. Indian Journal of Agricultural Sciences. 88(9): 1403-6.

Suradinata, Y.R., Nuraini, A. & Setiadi, A. 2012. Effect of plant media and concentrations of foliar fertilization on growth of orchids *Dendrobium* sp. On acclimatization. *J. Agrivigor*, 11(2), 104- 116.

Swapna, S. 2000. *Regulation of Growth and Flowering in Dendrobium cv. Sonia 17.* Ph.D. thesis, Kerala Agricultural University, Thrissur, Kerala, India.

Teixeira da Silva, J., Hossain, M., Sharma, M., Dobránszki, J., Cardoso, J. and Zeng, S. 2017. Acclimatization of in Vitro-derived *Dendrobium*. *Horticultural Plant Journal.* 3: 110-124.

Trimanto & A. Rahadiantoro. 2017. Acclimatization of plant collection from Moyo Island Forest, West Nusa Tenggara, Indonesia at Purwodadi Botanic Garden. *Tropical Drylands* 1 (1) :43-49.

Vaz, A.P.A., Rita de Cássia L., Kerbauy, G.B. 2004. Photoperiod and temperature effects on in vitro growth and flowering of *P. pusilla*, an epiphytic orchid. Plant Physiology and Biochemistry. 2004;42(5):411-415.

Verdonck and Demeyer. 2004. The influence of the particle sizes on the physical properties of growing media.

Waithaka, K., Dodge, L.L. and Reid M.S. 2001. Carbohydrate traffic during opening of gladiolus florets. J Hort Sci Biotech 76: 120-125. *http://ucce.ucdavis.edu/files/datastore/234- 840.pdf.*

Wang, Y.T. 2000. Timing of fertilizer termination and a high P fertilizer on vegetative growth and flowering of the moth orchids. HortScience. 35:60-62.

Wang, Y.T. 2004. Effects of reversed day/night temperatures on a *Doritaenopsis* hybrid orchid. HortScience 39, 834.

Wang, Y.T. and Konow, E. A. 2002. Fertiliser source and medium composition affect vegetative growth and mineral nutrition of a hybrid moth orchid. J. AMER. SOC. HORT. SCI. 127(3): 442-447.

Wang, Y.T., Tsai, W.T. and Dai, T.E. 2006. Heavy shading- An effective, low-cost alternative to high temperatures for inhibiting spiking in *Phalaenopsis.* Proc. Taiwan Intl. Orchid Symp.p.164-173.

Yen, C.Y.T., Starman, T.W., Wang, Y.T. and Niu, G. 2008. Effects of cooling temperature and duration on flowering of the nobile Dendrobium orchid. HortScience 43(6):1765-1769.

Zheng, B.Q., Deng XiMei., Li Kui., Miao Kun., and Yan, Wang. 2017. Effects of temperature treatment on flower bud differentiation and development of *Dendrobium*. 2017 Vol.30 No.3 pp.460-464 ref.14.

Znidarcic, D., Valic, N., Trdan, S. 2008. Epicuticular wax content in the leaves of cabbage (*Brassica oleracea* L. var. *capitata*) as a mechanical barrier against three insects' pests. Acta agriculture Slovenica, 91-2.

Appendix-A

Appendix A: Table: Agro-meterological data of Raipur during the period of experimentation from August December 2020 to July 2021.

Month	Max. Temp. (°C)	Min. Temp. (°C)	Rainfall (mm)	RH I%	RH II%	WS (kmph)	SS (hr)
December	29.3	12.0	0.0	87	31	2.0	5.4
January	30.2	13.9	4.6	81	31	2.5	4.0
February	31.0	12.9	2.4	79	27	2.7	7.6
March	36.2	18.7	0.24	64.8	21.2	3.6	7.1
April	39.6	22.8	1.0	53	19	4.8	7.2
May	38.8	26.2	2.23	61	33	6.6	7.9
June	34.3	25.7	8.20	80	60	8.2	4.3
July	32.3	25.5	10.06	88	70	8.0	3.6

RESUME

Name : Twinkle Ratre

Date of birth : 24/09/1995

Present address : Sai Colony, Jora, Raipur

Contact no. : (+91) 7000286066

Email : twinkleratre24@gmail.com

Permanent address : Street no. 30, Block 16/C, Sector-4, Bhilai Nagar, Chhattisgarh.

Academic Qualification:

Degree	Year	University/Institute
B.Sc. (Ag.)	2019	Sant Kabir College of Agriculture, Kawardha
M.Sc. (Ag.)	2021	COA, IGKV, Raipur

Work Experience (If any): RAWE (rural agriculture work experience)/(READY)

Membership of Professional Societies (If any):

Awards/ Recognitions (If any):

Publications (If any):-

Signature