STANDARDIZATION OF GROWING MEDIA FOR DENDROBIUMS (*Dendrobium spp.*)

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled 'Standardization of growing media for Dendrobiums (Dendrobium spp.)' is a bonafide record of research work done by me during the course of research and that this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship, or other similar title of any other University or Society.

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CERTIFICATE

We, the undersigned members of the Advisory Committee of Smt. Anitha Paul, C., a candidate for the degree of Master of Science in Horticulture, majoring in Pomology and Floriculture, agree that the thesis entitled 'Standardization of growing media for Dendrobium (<u>Dendrobium</u> spp.)' may be submitted by Smt. Anitha Paul, C. in partial fulfilment of the requirement for the degree.

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Anitha Paul. C

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To My Mother

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Introduction

INTRODUCTION

Orchids occupy the prime position among all the flowering plants valued for cut flower production and potted plants in the world. Their flowers are known for their long lasting nature and bewitching beauty. They also fetch a very high price in the international market.

The orchid family, Orchidaceae, is regarded as one of the largest groups of flowering plants, which constitues about seven per cent of the species in the category. It is comprised of an estimated number of 750 genera and 18000 species, distributed throughout the world. From India alone about 1300 species have been reported, scattered all over N.E. Himalayas (600 species), N.W. Himalayas (300 species), Maharashtra (130 species), Andaman and Nicobar islands (70 species) and Western ghats (200 species), (Maheshwari, 1980). Certain important species belonging to the genera Dendrobium, Cymbidium, Paphiopedilum, Rhynchostylis etc. are found in the Western ghats.

In spite of being very rich in orchid wealth, the orchid industry in India is still in its infancy. Our sale of native orchids does not exceed a few lakh rupees which is negligible compared to those of Thailand and Singapore who export orchids worth 10.3 million and 6.7 million dollars, respectively, per annum (Chadha, 1980). Moreover, the orchid flora of the country is endangered on account of deforestation, urbanization and over collection for aesthetic and commercial interests. It is high time to provide protection to all orchids by conservation, establishment of natural reserves and application of new technology for rapid multiplication, cultivation and care. India with its abundant native orchid flora, varied climate and cheap labour can certainly contribute much to orchid flower production, for home market and for export.

Based on their habitat, orchids can be broadly grouped into two; the terrestrial orchids and the epiphytic orchids. The latter group is commercially more in demand and is also abundant in tropical countries like India. Therefore it was deemed expedient to limit the study to epiphytic orchids. These orchids grow on the trunks of trees in their natural habitat, extracting nutrients and moisture from the atmosphere. They have fleshy roots specialised in absorbing moisture, nutrients and oxygen, which are highly sensitive to adverse conditions.

Dendrobium is a renowned epiphytic orchid genus, loved by amateurs for a hundred years and it enjoys the greatest degree of popularity. The name *Dendrobium* is derived from 'dendro' meaning tree and 'bios' meaning life. Many species of *Dendrobium* are very showy, attractive and are of great ornamental value. *D. aggregatum*, *D. chrysotoxum* *D. formosum*, *D. nobile*, *D. primulinum* etc. have served as parent plants in hybridisation and have attributed to several hybrids of outstanding value. In the present study, four species of dendrobiums were selected, which were D. farmeri, D. fimbriatum, D. moschatum and D. nobile. The local conditions of Vellanikkara, the location of the study, was also found suitable for this genus.

Once these kinds of orchids are extracted from their natural habitats, special attention is very essential, especially in providing the plants a substrate similar to the one in their natural habitat. Though numerous materials are used as media or components of the media by orchid growers, the aim of this study was to sort out growing media for the given species of Dendrobium from locally available, cheap materials. To satisfy this aim, different combinations of materials like charcoal, brick, gravel, coconut fibre and coconut husk were used.

In the present study the influence of the media on the vegetative phase was taken into account, rather than the flowering phase. Only few reports are available on the use of similar compoonents, alone and in combination, for different epiphytic orchids. (Bose and Bhattacharjee, 1972, Arora et al., 1978, Bhattacharjee, 1981, Bhattacharjee, 1985, Abraham and Vatsala, 1981). Majority of these workers observed the influence of the media on the flowering phase alone, ignoring the vegetative phase. This study will bring to light the influence of the different media on the vegetative parameters, throughout the growing period; good vegetative growth being the preliminary factor for profuse flowering.

The specific objectives of the study are listed below :

i) To unravel the effect of different media on the vegetative growth of the different species of Dendrobium.

ii) To standardise the growing media for different species of Dendrobium.

Review of Literature

REVIEW OF LITERATURE

Collection of orchids from their natural habitats and domestication necessitated suitable growing media which are very much important to the establishment and flowering in the new environment. The selected growing medium should be compatible to the medium in which it would have grown in its natural habitat, providing the requirements like aeration, moisture, nutrition and support. Orchid growers use different media which are often expensive and difficult to obtain. However it is quite important to find out cheap and suitable growing media from the materials available locally, in order to bring down the cost of cultivation. Abroad more and more modern composts are being evolved every day to suit the requirements of orchids. Literature about such experiments are scarce in India. The available literature, with special reference to epiphytic orchids, are reviewed here.

1. Growing media for ornamental crops

Investigations were carried out throughout the world on the use of new and new growing media for various ornamental crops in order to get quicker growth to reduce the cost of cultivation and to minimise the labour involved. Ibbett (1953) reported that sawdust was a good soil mulch and improver, provided it was composted and used. The presence of composted hardwood bark in a bark plus sand medium suppressed root wilt caused by

Fusarium oxysporum f. sp. *chrysanthemi* in pot chrysanthemums compared to the control medium, comprising of peat, sand and perlite (Hoztink and Poole, 1977). Like orchids, a wide variety of plants such as *Anthurium*, *Nephrolepis* and saintpaulias could be grown in a bark based medium (Tesi and Faro, 1985). But Tuefel (1984) evolved an alternative medium to bark and sawdust which he called 'strawdust'. This was resin impregnated granules of wheat straw processed and ground to suit container grown plants. Strawdust was long lasting, sterile and non shrinking, with a pH of 5.8 - 6.0, containing slow release nitrogen. Hydroponic culture of *Anthurium schercerianum*, *Asparagas sprengerii*, *Cyclamen* and carnations with coal as the substrate gave better and earlier crops than when grown in pots, either filled with soil or coal and watered with nutrient solution (Guminska *et. al.*, 1973). A new substrate for cultivating and propagating plants was described by Koehler (1973) which is made of chemically treated rockwool. This is inexpensive, has low weight, 97 per cent pore volume, 3 per cent dry matter and rapid water uptake into almost 90 per cent of the pore volume.

Based on the trials to find out a suitable substrate for *Anthurium andreanum*, Turski *et. al.* (1986) reported that a 2:1:1 mixture of peat, perlite and sphagnum moss was excellent. A new substrate, solite, which is an aggregate manufactured from montmorellonite clay, in combination with peat, in a 3:1 ratio produced good quality *Ficus benjamina* and *Dracaena marginata* plants

(Conover and Poole, 1986). Another foliage plant, Syngonium podophyllum, could be grown in good condition in a substrate of peat and polystyrene in 3:1 ratio, compared to bark and cork media, as reported by Bazzochi et. al. (1987).

2. Growing media for orchids

In order that suitable growing media are developed for orchids, an understanding about their habitat is essential. Orchids can be divided into two major groups, the terrestrial orchids and the epiphytic orchids.

a) Growing media for terrestrial orchids

Terrestrial orchids, as their name imply, grow on the ground, be it in the more open areas of the forest, alongside swamps or in wet meadows where they receive dappled sunlight and the necessary amount of shade they require. Paphiopedilums, the slipper orchids, are good examples of terrestrial orchids. The material in which they grow is composed of humus and there is rarely any danger of the plants being waterlogged, since humus is both light and porous and has excellent draining qualities. These conditions are to be domesticated wherever terrestrial orchids are to be grown (Sessler, 1978). They require a medium richer in organic matter, compared to epiphytic orchids.

i. **Conventional media**

In a trial to select out the best growing medium for Cymbidium orchids, Mott (1954) used clay soil, moss peat, sedge peat, sawdust and manure, alone or in various mixtures, and the standard mixture of osmunda, leaf mould and manure. The orchids performed their best in mosspeat followed by sawdust, sedge peat and a mixture of soil and mosspeat.

Successful germination and growth of the seeds of Disa uniflora was reported by Lindquist (1960) in a medium containing 1/2 sphagnum moss, 1/16 sphagnum peat, 1/16 mixed leaf compost and the rest sterilized sand, by volume. Half of the experiment plants in this medium reached flowering stage in 33 months which was a great success, as compared to the rest of the media tried. For terrestrial orchids like Phaius, Calanthae etc., Bose and Bhattacharjee (1972) recommended a mixture of leafmould, loamy soil, silver sand, dried cowdung manure, charcoal and chopped tree fern fibre. Penningsfeld (1976) standardised a medium for Cymbidium, which medium contained three parts Pinus sylvestris bark chips, three parts crushed and dried oak leaves, three parts milled peatmoss, one part old cow manure, one part sphagnum moss and one part coarse sand. However, repotting once in three years was necessary. Thunia alba, a fascinating orchid, could be successfully cultivated in pots and the compost should be made of three parts loam and one part sphagnum moss or osmunda fibre with a little sand (Jana and Mukherjee, 1979). According to Mukherjee (1979) Phaius, which is otherwise called the 'nun orchid', could be grown as a pot plant in a medium containing two parts loamy soil, one part leaf mould, one part silver sand mixed with cowdung manure and chopped tree fern fibre. Naidu and Rao (1980) opined that a compost of rich soil would be sufficient for cymbidiums, but soil comprising of hoof and bone manure, with a top dressing of fresh sphagnum moss and osmunda fibre, gave better performance. Instead of osmunda fibre, coarse softened coconut fibre could also be substituted. A series of orchid mixes were suggested by Bose and Bhattacharjee (1980) for a number of terrestrial orchids. For cymbidiums they suggested a medium of equal parts of porous loam, chopped tree fern fibre, chopped sphagnum moss, dust free bark preparations, white sand and well rotten cowdung. Paphiopedilums grew best in a mixture of equal parts of fir bark, chopped sphagnum moss and little amount of charcoal. Calanthae, Cymbidium, Phaius and Paphiopedilum on the other hand, responded well to a medium of leafmould, coarse sand, volcanic soil, loam, very old cowdung, broken charcoal and finely broken crocks. Phaius also performed well in an organic mix of 1/3 rich loamy soil, 1/3 well rotten cowdung manure, 1/6 each of shredded osmunda and chopped tree fern. The so called 'lost orchid', Paphiopedilum fairieanum Lindl. Pfitz., is one of the most popular terrestrial orchids known for its exquisite colour, longevity of blooms and curious shape of its flowers. Hegde (1981) standardized two composts for its cultivation. One was a mixture of sandy soil, sterilized and dried cow manure, chopped silver oak leaves, and charcoal pieces in a proportion of 2:1/2:1:1/2. The other compost was made up of sandy soil, tree fern fibre and sterilized and dried cow manure in the proportion of 2:1:½. Bhattacharjee and Mukherjee (1981) suggested a similar compost for the terrestrial orchids Cymbidium aloefolium and Phaius tankervilleae. The compost constituted loam, river sand, leaf mould, charcoal dust and old mortar in the ratio 1:1:1:½:½. Abraham and Vatsala (1981) recommended a potting mixture for terrestrial orchids like Calanthae, Acanthephippium, Arundina, Habenaria, etc. The medium constituted equal parts of coconut husk, broken roofing tiles, coarse sand and well rotten compost of cowdung and leaves. The genera Anoectochilus, Goodyera, Macodes and Zeuxine, which are collectively termed as jewel orchids, are found growing on the floor of deep tropical forests and caves. Arora (1983) suggested that these orchids could be domesticated by potting them in clay pots containing pure leaf mould and little sand. For the cultivation of Australion temperate terrestrial orchids such as Pterostylis nutans, P. coccinea, Diuris punctata and Elythrantera emarginata, a potting compost of coarse sand, rich loam, buzzer chips or small thin wood chips and leaf mould at 2:1:1:1 ratio on volume basis was found ideal under Australian conditions. The same orchids performed best in a compost of loam, coarse gritty sand, leaf mould and bark or soft wood chippings in the ratio 1:1:1:1, under the conditions of U.K. (Richards, 1985). Randhawa and Mukhopadhyay (1986) suggested a general potting mixture for the terrestrial orchids and opined that the grower may vary this a little depending upon the climatic conditions and requirement of the individual plants. The mixture consisted of one part rich humus, one part well decayed leaf mould, half a part decomposed and dried cow or sheep manure and one part chopped sphagnum moss plus osmunda fibre and chopped tree fern fibre.

ii. **Modern media**

Among the modern composts, Oasis foam, which is made by combining phenol and formaldehyde, is being used increasingly as a growing medium for potting orchids. Voogt (1983) had problems of very low pH when cymbidium was cultivated in it; which he overcame by moistening the dry foam with potassium bicarbonate solution of 0.1 per cent concentration. In an experiment with dolomite, limestone and diabas chippings for the culture of Paphiopedilum insigne, Kuhmichel (1986) found that in diabas, which is mainly made up of silicate, the plants had the fastest growth.

Paphiopedilums were successfully grown in a medium comprising both organic and synthetic ingredients (Bose and Bhattacharjee, 1980). A combination of 1/3 part leaf mould, 1/3 part pinebark with

1/6 part each of cork, polystyrene and little dolomite lime was found promising. Another medium recommended was a mixture of sphagnum moss, beech leaves, styrofoam chips, fir bark, calcined clay and leaf mould. Yet another easy combination was a mixture of firbark, charcoal, peatmoss, perlite and washed shell grit.

b) **Growing media for epiphytic orchids**

Epiphyte means 'on a plant' and comprises a group of orchids that grow on the trunks of trees. But these are not parasites. The tree gives them some place to which they can cling. Usually epiphytes can be found clustered together in the very tops of trees, where there is plenty of air and light. Here the only moisture they recieve is from the frequent rains and dews. These have thick leaves and pseudobulbs which are specialised in storing water. The roots are always exposed to the air and during potting of these plants, lack of air is a problem, so the pot is heavily crocked to ensure good drainage. The epiphytic orchids have fleshy roots that are covered with a white coating called velamen. These roots can very easily rot, if the medium is not allowed to dry out between waterings (Sessler, 1978). According to Bose and Bhattacharjee (1980) potting media differ with types of orchids and the climate in which they are grown. In tropical climate, where there is no danger of chilling the roots in winter, a free circulation of air around the roots would facilities absorption of atmospheric moisture, and loose packing with more open compost in the pot is beneficial. In temperate region, tight packing with more fibrous compost is preferred to avoid chilling of root system. From his experience with orchids, Bhattacharjee (1985) suggested that a vigorous and healthy root system in epiphytic orchids is the first step towards ensuring maximum growth and favourable nutrient supply. Hence, selection of ideal rooting media provides a high degree of success for profuse root growth. The materials used as potting media for epiphytic orchids are entirely different from those used for other plants because of their peculiar habitat. Under natural conditions, the orchids receive their nourishment through bird droppings, rain water and decay of organic matter (Randhawa and Mukhopadhyay, 1986). In a survey conducted by White in 1986 on potting media used by orchid growers, an extensive list of materials was obtained. The list included fir and redwood bark, tree fern, osmunda, coconut fibre, cork, sphagnum and peat moss, lava rock, expanded clay or shale, gravel or stones, charcoal, styrofoam oasis, perlite and commercial orchid mixes containing sugarcane waste, charcoal, osmunda fibre and perlite.

i. **Conventional media**

Tree fern fibre

Tree fern logs are ideal for many epiphytic orchids like epidendrums. They come from the fibrous trunks of tropical ferns of Cyatheaceae family. They are available in many lengths and diametres and can easily be sawed into any size. The logs last for many years and need replacing only when their pores have become solidly filled with roots, leaving nothing more for the plant to hold onto. 'Happu', a material used in potting orchids, is the Hawaian word for tree fern. Depending upon the place from which it comes, it can be harder or wiry or softer like some kinds of bark. It comes in slabs, which provide an excellent base on which to fasten the orchids, or in smaller pieces to fill in a pot or basket. Both provide excellent drainage and aeration for the roots (Sessler, 1978).

Polypodium fibre

Black (1980) reported that it was not however until polypodium fibre was introduced, that a well drained compost became easier to mix. This is the root of Polypodium vulgare derived its name from the Greek and meaning 'many little feet' from the appearance of the rhizome branches and roots. This required much labour to prepare the rhizomes, needing it to be removed, leaving only the roots, a tedious and indeed painful job. But polypodium roots collected from the ground, contaminated by fungal spores lead to damping off of seedlings of cattleya as reported by Holquin (1976).

Osmunda fibre

Osmunda was used almost exclusively by the old-time growers because it was the nearest thing they could find to the substrate on which the plants grew in their native habitat (Sessler, 1978). It is the root of Osmunda regalis, the royal fern (Black, 1980) and it revolutionized the growing of orchids. It is expensive because of the labour involved in removing it from its habitats, usually dense bush. Osmunda supplies some nutrients as it disintegrates. Therefore plants potted in osmunda do not require additional feeding, and if at all they are fed, it should be in smaller amounts. Osmunda can be cut into desired lengths. Overnight soaking in water and squeezing before potting, leaves enough moisture. It can retain moisture longer, and by feeling the fibres, watering can be adjusted. If the fibres are crisp, water immediately, if they are springy to touch, watering can be delayed. Osmunda is available in several grades of varying texture and durability and in different colours like yellow, brown and black. Because of its loose and fibrous qualities, it holds orchid roots firmly, has sufficient air space, which allow excess water to drain out. The disadvantage is that it rots and disintegrates, badly damaging the roots if not repotted frequently into fresh osmunda (Bose and Bhattacharjee, 1980). The nutrient content of 100 g osmunda as given by Abraham and Vatsala (1981) is as follows; total ash content 6.60 g, nitrogen 1.59 g, phosphorus 0.04 g, potassium 0.29 g. calcium 0.48 g and magnesium 0.26 g. The pH is about 4.7.

Bark

Hunter in 1958 disclosed the fact that, the demand of orchid growers for fibre of the tree fern Leptopteris superba was denuding the natural vegetation of parts of Newzealand. But he suggested that excellent growth of cattleyas can be obtained in bark. Davidson (1960) also opined the same. Bark is a waste product in paper mills and saw mills. The material cannot be used as such because of the nitrogen immobilization and phytotoxic elements. In an experiment on a phalaenopsis hybrid, Sheehan (1960-61) used different kinds of the tree barks and observed that cedar tan bark and white fir bark produced more flowers on longer stems. Bark of Pinus sylvestris, Abies concolor and Pseudostriga douglasii were found to be the best for orchids (Schumachar, 1970). Europeans tried a variety of materials like osmunda, buckwheat hulls, wood chips, peatmoss and loam and reported that Douglas fir bark is an excellent potting material if chopped into small pieces. In recent years bark has become the number one choice, because of the ease in handling it. A fine grade is used for seedlings, a medium grade for majority of orchids and coarse grade for those with large fleshy roots such as vandas. Bark is less expensive but requires higher nitrogen supply and more frequent irrigation (Sessler, 1978). Bark of fir trees and chips of red wood is considered better than osmunda by Bose and Bhattacharjee (1980). But according to them, bark breaks into small particles when packed in the pot and reduces aeration. According to Verdonck (1984), composting is done prior to potting with certain amount of nitrogen for two to four months, depending on the kind of bark.

Then it can be used alone or mixed up with peat or pine litter. Composted bark has a neutral pH, lower cation exchange capacity but little higher salt content than that of peat. Besides suitable physico-chemical properties, bark also had a slight fungicidal action (Bazzochi et. al., 1985).

Sphagnum moss

Commercial sphagnum moss is the dehydrated young residue of living portion of acid-bog plants in the genus Sphagnum such as S. papillosum, S. capillaceum and S. palustre. It is relatively sterile, light in weight and has a very high water-holding capacity (Hartman and Kester, 1986). Sphagnum moss could hold little more moisture than bark. Live sphagnum moss is a perfect indicator for watering, as it is green when moist and white when dry. It is mould resistant also (Black, 1980). According to Bose and Bhattacharjee (1980), layers of sphagnum moss in the compost of orchids retains more moisture than osmunda and it is a good material for those orchids that require constant moisture supply. In tropical climate, this rots quickly in the compost but in cool climate, it stays fresh for longer duration. Pessoa and Pessoa (1985) recommended sphagnum moss for rooting of newly divided cattleya plants, which produced deep root system in four to five months.

Charcoal

Bose and Bhattacharjee (1972) suggested that large pieces of charcoal alone is excellent as growing medium for Cattleya, Epidendrum, Phalaenopsis, Dendrobium, Rhynchostylis and Vanda. Arora et. al. (1978) also suggested the same medium for dendrobiums. However, addition of some tree fern fibre was beneficial for better growth. Bhattacharjee (1981) obtained good growth and flowering in Dendrobium moschatum when grown in blocks of hardwood charcoal and properly fertilized with nitrogen, phosphorus and potassium. For the culture of Brazilian Cattleya labiata var. warneri, charcoal or fir bark medium was fairly successful in high humid condition , but not in drier condition. In humid and cooler conditions a substrate of small granite stones was successful with powdered castor beans as fertilizer (Pessoa and Pessoa, 1985). In order to select a cheap and easily available ideal potting medium for the epiphytic orchid Rhynchostylis gigantea, Bhattacharjee (1985) tried 12 different potting substrates. Chunks of hardwood charcoal alone as potting medium proved its superiority over the other media for all vegetative and flower characters. Charcoal absorbs gases that tend to rot the roots and that are formed by rotting material. It also allows free air movement, retains moisture and slows down unwanted acid build up. According to Grove (1988) vandas and ascocendas could be grown in excellent condition in plastic pots with lot of drainage holes or slatted wood baskets in a medium of chunks of hardwood charcoal.

Coconut husk products

Various by-products of coconut industry, such as, coconut husk, fibre and fibre dust were used in the media for orchids. Coconut husks were cut into small pieces, washed thoroughly, dried in the sun and stored for preparing orchid compost (Abraham and Vatsala, 1981). Dry coconut husks are used for commercial propagation of Dendrobium hybrid Pompadour by cuttings. These husks hold moisture and supply food to the growing plants and found very suitable for growing monopodial orchids like Phalaenopsis and Vanda (Bose and Bhattacharjee, 1980). Bhattacharjee (1985) tried over-burnt brick pieces and coconut husk alone, and in combination of 1:1 ratio, for the epiphytic orchid Rhynchostylis gigantea. Coconut husk and over-burnt brick pieces as planting substrates resulted in poor growth and flowering of plants. Husk can hold moisture and supply little amount of food to the plants. During the initial stages it enhanced the growth of the plant. But the medium soon rots, disintegrates and kills the roots in them, if not repotted to new husk very often. Brick pieces alone also hinder root development, making the medium alkaline.

Other media

Gravel was suggested as a potential medium on its own by Bateman (1959) who compared it with osmunda and bark, found that plants in gravel culture had more flowers. Broken pieces of oil palm nuts were recommended as orchid growing medium by Luciano (1970). Henderson (1984) reported that even walnut shells and rice hulls were used as major components of the orchid composts by some orchid growers. Pine needles and gravel, though can be used as the medium, salts tend to build up faster, if they are not leached out well (Holquin, 1976). A reasonable substitute for fir bark was suggested by Arp (1980). The new material was red lava rock which was a good medium for Cattleya, Vanda and Dendrobium. This material was uniform in performance and did not assimilate nitrogen as bark did. The medium did not break down, so overwatering was impossible. The rough surface of the rock retained moisture well and evenly. Potting and repotting was quick and easy in this medium, 0.25 to 0.50 inch grade was used for seedlings and fine rooted epiphytes, 0.50 to 1.00 inch grade for cattleyas and 1.00 inch grade for vanda type orchids.

Mixtures of media

A combination of different components was also tried by different orchid growers. In his studies to find out suitable inexpensive media for Cattleya and its hybrids, Davidson (1956) evolved two media that gave satisfactory results. One media contained equal parts of coarse peat moss, dried undecomposed oak leaves and red wood bark fibre, the other media also contained all these components, with an additional quantity of sand. Elle (1960) standardized a compost mixture suitable for all genera of orchids, containing 40 per cent pinebark, 40 per cent sphagnum moss and 20 per cent dry leaves of beech or oak. The optimum grain size of the bark was 0.3 to 0.6 cm for young plants, 1.0 to 2.0 cm for medium plants and 3.0 to 5.0 cm for adult plants. Holquin (1976) noted that a mixture of chopped osmunda and green sphagnum moss was popular in the late 1930s. But this medium was too wet for cattleyas. Singh (1978) proposed brick pieces and shredded fern fibre in 6:1 ratio for growing Dendrobium, Aerides and Vanda. For the best growth of Dendrobium hybrid seedlings, a mixture of sphagnum moss and horse manure in 3:1 ratio was found suitable by Prayitno and Suwanda (1979). Aerides, an epiphytic orchid, was grown to excellence in a mixture of different sized soft charcoal pieces, a little moss and tree fern fibre or coconut husk (Arora and Mukherjee, 1979). Bhattacharjee and Mukherjee (1981) standardised two similar media for Aerides multiflorum and Dendrobium moschatum. In these media, the plants performed best with regard to plant growth, number of flowers per stalk, flower longevity and other indices. One of the media contained charcoal and tree fern fibre in equal proportions. In the other media, equal proportions of charcoal, brick pieces and tree fern fibre were used. However, according to Talukdar and Barooah (1987), Dendrobium densiflorum performed best in a combination of sawdust, charcoal, brick pieces and moss, followed by another medium containing coconut fibre and moss, by showing superiority for length characters, number of flowers per spike and blooming period, compared to the other five media tried.

ii. **Modern media**

Of late, several new materials are being used, alone or in combination with other components, for growing orchids. Perlite, vermiculite, pumice, expanded clay, polyurethane foam, styrofoam, rockwool etc. are some of the examples. The advantages of these substrates, inspite of being costly, are that they can be used repeatedly, are disease free and weed free, light in weight and plants attain quicker growth in these (Wilson, 1984).

Clear styrene pellets of different sizes were reported to give promising results as potting medium for orchid seedlings (Nagel, 1965). Polyurethane foam was a good substrate for cattleya and other orchids (Hahn, 1969). In a trial by Esser (1970), pumice chips proved suitable for epiphytic orchids. Bomba (1975) recommended a new medium for epiphytic orchids which he called 'Orchid chips'. These were strips of styrofoam material, which has closed pores, taking up water only on the surface, rather like a natural epiphytic foundation. It is indecomposible and excess salts could be easily washed off. Henderson (1984) reported about different compost mixes for orchids. One was a mixture of charcoal, peat and styrofoam which provided a long lasting medium for all genera of orchids. Phalaenopsis, Cattleya and Odontoglossum were cultivated by capillary feeding using expanded clay as the substrate. The perforated container with the plant in this substrate was stood in an outer pot containing nutrient solution, which was drawn in by capillarity (Penningsfeld, 1980). Rockwool was the latest medium evolved, suitable for orchids (Lloyd, 1988). This has five per cent inert and permanent fibre with a water holding capacity of 30 per cent and air space 65 per cent. Accelerated growth of orchids was achieved with rapid stem and foliage growth.

Peatmoss alone, and in combination with perlite, has been cited as a potential new medium for epiphytic and terrestrial orchids (Mott, 1954 and Poole and Sheehan, 1977). Penningsfeld (1976) working on orchid nutrition used a medium of equal parts by volume of peat and styromull with good outcome. Mericloned plants of Laeliocattleya when grown in peat and perlite medium produced maximum number of leaves and new shoots. Tree fern fibre, alone or in combination with red wood bark and fir bark, proved superior to peat-perlite medium. Guistiniani and Tesi (1982) proposed that the water holding capacity of a bark substrate could be improved by adding polystyrene and peat to it. Based on an investigation over a period of three years, Bazzochi <u>et. al.</u> (1985) suggested that pinebark and modern composts like expanded clay and cork substrates were more suitable for young cattleya plants in the greenhouse than coal or charcoal. Expanded clay was a suitable alternative to bark; it also modified the root system. Cork with a high decomposition rate was best suited to young plants. They also opined that polystyrene and foam rubber were suitable when combined with readily degradable materials, giving healthy growing plants.

Materials and Methods

MATERIALS AND METHODS

The experiment was conducted in the orchidarium of the College of Horticulture, Vellanikkara, during 1988-89. The orchidarium was equipped with misting facilities and ample ventilation, providing congenial conditions for the growth of orchids.

The experiment had two objectives :

i) To study the effect of growing media on the vegetative growth of the different species of Dendrobium.

ii) To standardise the growing media for different species of Dendrobium.

1. The Species

Considering their good floral characters and suitability to the local conditions, as observed under the All India Coordinated Floriculture Improvement Project, Vellanikkara, four species of Dendrobium were selected. The salient features of these species (Pradhan, 1979) are given below :

a) Dendrobium farmeri. Paxt.

Pseudobulbs distinctly four angled, clavate, 15.0 - 45.0 cm x 2.5 cm. Leaves 2 - 3 per pseudobulb near the apex, 7.5 - 15.0 cm x 3.0 - 5.0 cm, ovate lanceolate, acute shaped. Raceme produced near the apex of pseudobulb, pendulous and many flowered. Flowers 5.0 cm across with pastel pink-mauve - white sepals and petals. Sepals ovate, obtuse, petals orbicular ovate, obtuse, lip orbicular pubescent with deep orange yellow disc and white edges. Flowering time, April-May.

b) **Dendrobium fimbriatum Lindl v. oculata Hook.f.**

Pseudobulbs 75.0 - 150.0 cm long, tapering towards apex. Leaves several, 10.0 - 15.0 cm x 1.5 - 2.8 cm size, oblong lanceolate, acuminate in shape. Racemes produced on leafy or leafless pseudobulbs, lateral, pendulous, 7-12 flowered. Flowers 5.0 - 7.5 cm across, bright yellow, sepals broadly oblong, rounded, entire, petals broader, lip orbicular, fimbriate, pubescent and having large orbicular patch of dark reddish brown at the base. Flowering time, April-May.

c) **Dendrobium moschatum Sw.**

Pseudobulbs 90.0 - 180.0 cm x 1.0 - 1.2 cm, terete, striate, pointed towards the apex. Leaves several, alternate, 10.0 - 15.0 cm x 3.5 cm, acute or faintly notched, 10.0 - 30.0 cm long. Raceme 15 flowered, flowers 5.0 - 7.0 cm across, orange yellow coloured and fragrant. Sepals 3.0 cm long, broadly ovate, obtuse, lip lanceolate. Anterior part very hairy inside and on the outer surface. Base with two dark maroon blotches. Flowering time, May-June.

d) **Dendrobium nobile Lindl.**

Pseudobulbs 30.0 - 60.0 cm long, turning yellow on maturity, somewhat laterally compressed, being narrow at the base. Leaves several, 8.0 - 12.0 cm x 2.5 - 3.0 cm, oblong, apex unequally lobed. Flowers 5.0 - 7.0 cm across in fascicles of 1-4, colour usually white with deep purple tinge, highly variable, rarely pure white. Lip transversely ovate-oblong, pubescent, with a central blotch of very deep purple, surrounded by broad margin of yellow or white. Flowering time, April.

The planting materials were collected from Kalimpong, West Bengal.

2. **The media**

In order to standardise the suitable growing medium, five basic components of the media were first selected, which were easily available locally, cheap but satisfying the growth requirements of epiphytic orchids. The components selected were the following (Plate 1).

a) **Charcoal**

Freshly burnt hardwood charcoal was purchased and cut into one inch sized pieces.

b) **Brick**

Kiln bricks were purchased and broken into one inch sized pieces.

c) **Gravel**

Gravel pieces of one inch size prepared from granite rocks were used.

d) **Coconut fibre**

Coconut fibre shreds were prepared from the fibrous part of the husk of mature coconuts.

e) **Coconut husk**

Husk from mature coconuts were chopped into one inch sized pieces and used.

All possible combinations of these media, excluding their straight use, as well as the combination of all the five, were tried, thus constituting 25 treatments. The components were used in equal proportion by volume.

3. **The treatments**

Following were the 25 treatments tried.

T_1 - Charcoal + brick

T_2 - Charcoal + gravel

T_3 - Charcoal + fibre

T_4 - Charcoal + husk

T_5 - Brick + gravel

T_6 - Brick + fibre

T_7 - Brick + husk

T_8 - Gravel + fibre

T_9 - Gravel + husk

T_{10} - Fibre + husk

T_{11} - Charcoal + brick + gravel

T_{12} - Charcoal + brick + fibre

T_{13} - Charcoal + brick + husk

T_{14} - Charcoal + gravel + fibre

T_{15} - Charcoal + gravel + husk

T_{16} - Charcoal + fibre + husk

T_{17} - Brick + gravel + fibre

T_{18} - Brick + gravel + husk

T_{19} - Brick + fibre + husk

T_{20} - Gravel + fibre + husk

T_{21} - Charcoal + brick + gravel + fibre

T_{22} - Charcoal + brick + gravel + husk

T_{23} - Charcoal + brick + fibre + husk

T_{24} - Charcoal + gravel + fibre + husk

T_{25} - Brick + gravel + fibre + husk

4. **The experimental design**

The design selected for the experiment was completely randomised design with four species and 25 treatments. Each treatment had 10 plants from which five plants were randomly selected for taking observations.

5. **The container**

Round clay pots of size seven inches were used for potting (Plate 2). The pots had long slits on the sides for good aeration and drainage.

Plate 1. Basic components of the media

Plate 2. The container used for the study

Clock wise from top - Charcoal, coconut fibre,
brick, gravel and husk

6. **Preparation of plants**

Uniform sized plants were used for the study. Dry and old roots were cut off from the plants. Rotten pseudobulbs and leaves were also removed leaving two to three healthy old canes/pseudobulbs and leaves, with a clump of trimmed roots. The plants were dipped in 0.2 per cent Bavistin before potting.

7. **Potting of plants**

The pots were half filled with the potting media. The plants were placed in the centre and filled in with the potting media again, pressing down well, filling the pot to the rim. Then the whole pots were dipped in water and allowed to drain.

8. **Cultural management**

The orchid pots were placed in the orchidarium on concrete benches on which water was allowed to stand to a height of one inch, to provide a humid atmosphere. The misting system installed in the orchidarium provided just adequate quantity of water to the plants. Cowdung solution was filtered, diluted and sprayed on the plants at weekly intervals. Inorganic nutrient solution containing the following ingredients was sprayed once in a month.

Ohio W.P. Solution :-

Potassium nitrate	-	2.63	g
Ammonium sulphate	-	0.40	g
Magnesium sulphate	-	2.04	g
Monocalcium phosphate	-	1.09	g
Ferrous sulphate	-	0.50	g
Manganese sulphate (10%)	-	2.50	ml

The solution was made upto one litre and pH adjusted between 5.5 and 6.0

Towards the flowering phase, irrigation was restricted. Necessary plant protection measures were also adopted.

9. **Observations recorded**

The following observations were recorded during the growth phase at monthly intervals, starting from one month after planting.

a) **Number of new shoots**

The number of new shoots produced by each plant, including the off shoots/keikis, was counted and recorded.

b) **Height of the new shoots**

The length of all the new shoots was measured and recorded in cm.

c) **Number of leaves on the new shoots**

The total number of fully opened leaves borne by the new shoots was counted and recorded.

d) **Area of the new leaves**

Total leaf area of the new shoots was measured using a modification of the dot technique of Bleasdale (1978) and recorded in cm^2.

e) **Number of pseudobulbs of the new shoots**

The number of pseudobulbs of the new shoots was counted and recorded.

10. **Statistical analysis**

The data generated from the study were subjected to analysis of variance (Panse and Sukhatme, 1978).

Results

RESULTS

Studies were conducted at the College of Horticulture, Vellanikkara, during 1988 - 89, to examine the effect of different growing media on the vegetative parameters of epiphytic orchids. Four species of Dendrobium, viz., D. farmeri, D. fimbriatum, D. moschatum and D. nobile, selected based on their general performance at Vellanikkara conditions, were utilised for conducting the trial. The results generated from the studies are presented in this chapter.

1. Number of new shoots

a) Number with respect to the species

i) Dendrobium farmeri

Data pertaining to the effect of different media on the number of new shoots with respect to D. farmeri are presented in Table 1.

The influence of the media on the number of new shoots was insignificant in this species throughout the growing period.

ii) Dendrobium fimbriatum

Data pertaining to the effect of different media on the number of new shoots produced in D. fimbriatum are presented in Table 2.

The influence of media on the number of new shoots produced during the growing period was insignificant in this species also.

Table 1

Effect of growing media on the number of new shoots produced in *Dendrobium farmeri*

Treatment	Number of new shoots 1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	0.882 (0.278)	0.882 (0.278)	0.811 (0.157)	*	0.811 (0.157)	0.811 (0.157)	[illegible]
2	0.811 (0.157)	0.914 (0.336)	1.018 (0.536)	1.095 (0.700)	1.095 (0.700)	1.095 (0.700)	[illegible]
3	*	0.914 (0.336)	0.914 (0.336)	0.914 (0.335)	0.811 (0.157)	*	*
4	1.018 (0.536)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	[illegible]
5	1.225 (1.000)	1.192 (0.922)	1.264 (1.097)	1.264 (1.098)	1.264 (1.097)	[illegible]	[illegible]
6	1.089 (0.686)	0.985 (0.471)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	[illegible]	[illegible]
7	1.018 (0.536)	1.393 (1.440)	1.264 (1.097)	1.192 (0.921)	[illegible]	[illegible]	[illegible]
8	1.605 (2.075)	1.721 (2.461)	1.721 (2.461)	1.721 (2.461)	[illegible]	[illegible]	[illegible]
9	1.322 (1.247)	1.264 (1.097)	1.264 (1.097)	1.192 (0.921)	1.192 (0.921)	[illegible]	[illegible]
10	1.121 (0.757)	1.121 (0.757)	1.192 (0.922)	*	0.914 (0.336)	0.811 (0.157)	0.811 (0.157)
11	0.985 (0.471)	0.985 (0.471)	1.057 (0.617)	0.914 (0.335)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)
12	0.985 (0.471)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.160 (0.846)	1.160 (0.846)	1.160 (0.846)
13	*	0.811 (0.157)	*	*	*	0.837 (0.200)	0.837 (0.200)
14	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)
15	1.223 (0.995)	1.165 (0.857)	0.882 (0.278)	0.882 (0.278)	*	*	*
16	0.882 (0.278)	0.985 (0.471)	1.115 (0.742)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)
17	1.089 (0.686)	0.985 (0.471)	0.811 (0.157)	0.985 (0.470)	0.985 (0.470)	0.985 (0.470)	0.914 (0.336)
18	0.811 (0.157)	0.985 (0.471)	1.043 (0.589)	1.043 (0.589)	1.043 (0.589)	1.043 (0.589)	1.043 (0.589)
19	1.043 (0.589)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)
20	*	0.882 (0.278)	0.882 (0.278)	*	*	*	*
21	*	*	0.914 (0.336)	0.811 (0.158)	0.811 (0.158)	0.914 (0.336)	0.914 (0.336)
22	1.089 (0.686)	1.043 (0.589)	1.043 (0.589)	1.043 (0.589)	1.043 (0.589)	1.043 (0.589)	1.043 (0.589)
23	0.882 (0.278)	0.985 (0.471)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)
24	*	*	*	*	*	*	*
25	0.914 (0.336)	*	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)
CD (0.05)	NS	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

Table 2

Effect of growing media on the number of new shoots produced in *Dendrobium fimbriatum*

Treatment	Number of new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	0.985 (0.471)	1.425 (1.531)	1.475 (1.677)	1.475 (1.677)	1.372 (1.382)	1.372 (1.382)	1.372 (1.382)
2	1.018 (0.536)	1.398 (1.453)	1.160 (0.846)	1.160 (0.846)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)
3	0.985 (0.471)	1.313 (1.224)	1.313 (1.224)	1.268 (1.109)	1.313 (1.224)	1.313 1.224)	1.313 (1.224)
4	1.043 (0.589)	1.267 (1.106)	1.138 (0.796)	1.408 (1.481)	1.408 (1.481)	1.408 (1.481)	1.408 (1.481)
5	1.250 (1.064)	1.855 (2.942)	1.747 (2.552)	1.747 (2.552)	1.676 (2.308)	1.618 (2.118)	1.618 (2.118)
6	0.985 (0.471)	1.264 (1.097)	1.296 (1.180)	1.439 (1.570)	1.439 (1.570)	1.439 (1.570)	1.439 (1.570)
7	1.268 (1.109)	1.628 (2.151)	1.525 (1.824)	1.596 (2.047)	1.376 (1.394)	1.376 (1.394)	1.376 (1.394)
8	1.335 (1.282)	1.439 (1.570)	1.510 (1.780)	1.510 (1.780)	1.510 (1.780)	1.510 (1.780)	1.510 (1.780)
9	1.250 (1.064)	1.497 (1.740)	1.425 (1.531)	1.497 (1.740)	1.497 (1.740)	1.425 (1.531)	1.425 (1.531)
10	1.393 (1.440)	1.578 (1.990)	1.483 (1.700)	1.533 (1.851)	1.533 (1.851)	1.475 (1.674)	1.475 (1.674)
11	0.914 (0.336)	1.089 (0.686)	1.147 (0.851)	1.147 (0.815)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)
12	1.089 (0.686)	1.497 (1.740)	1.497 (1.740)	1.497 (1.740)	1.439 (1.570)	1.439 (1.570)	1.439 (1.570)
13	1.264 (1.097)	1.393 (1.440)	1.335 (1.282)	1.335 (1.282)	1.335 (1.282)	1.335 (1.282)	1.335 (1.282)
14	1.457 (1.624)	1.662 (2.264)	1.554 (1.916)	1.554 (1.916)	1.554 (1.916)	1.554 (1.916)	1.554 (1.916)
15	1.160 (0.846)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)
16	0.985 (0.471)	1.223 (0.995)	1.326 (1.259)	1.326 (1.259)	1.276 (1.128)	1.326 1.259)	1.326 (1.259)
17	1.250 [illegible]	1.404 (1.471)	1.404 (1.471)	1.404 (1.471)	1.404 (1.471)	1.354 (1.333)	1.354 (1.333)
18	[illegible] [illegible]	1.515 (1.796)	1.354 (1.333)	1.354 (1.333)	1.354 (1.333)	1.354 (1.333)	1.354 (1.333)
19	[illegible] [illegible]	1.604 (2.072)	1.551 (1.906)	1.609 (2.089)	1.609 (2.089)	1.559 (1.930)	1.559 (1.930)
20	1.232 (1.017)	1.753 (2.572)	1.861 (2.963)	1.766 (2.619)	1.708 (2.417)	1.708 (2.417)	1.708 (2.417)
21	0.882 (0.278)	1.443 (1.583)	1.160 (0.846)	1.346 (1.312)	1.409 (1.484)	1.346 (1.312)	1.346 (1.312)
22	1.384 (1.416)	1.649 (2.220)	1.649 (2.220)	1.649 (2.220)	1.649 (2.220)	1.649 (2.220)	1.649 (2.220)
23	1.160 (0.846)	1.264 (1.097)	1.403 (1.468)	1.403 (1.468)	1.403 (1.468)	1.403 (1.468)	1.403 (1.468)
24	1.147 (0.815)	1.510 (1.780)	1.335 (1.282)	1.335 (1.282)	1.335 (1.282)	1.335 (1.282)	1.335 (1.282)
25	1.121 (0.757)	1.296 (1.180)	1.192 (0.922)	1.192 (0.922)	1.264 (1.097)	1.264 (1.097)	1.264 (1.097)
CD (0.05)	NS	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values.

iii) Dendrobium moschatum

Data on the number of new shoots produced in D. moschatum as influenced by the different treatments are presented in Table 3 and Plate 3.

The media could exert significant influence in this species three months after planting. At this stage, T_2 (charcoal + gravel) was found to be the best treatment (1.370 shoots) which was on par with T_{13} (charcoal + brick + husk), T_9 (gravel + husk), T_7 (brick + husk), T_{22} (charcoal + brick + gravel+ husk), T_6 (gravel + fibre), T_{12} (charcoal + brick + fibre), T_5 (brick + gravel), T_{21} (charcoal + brick + gravel + fibre), T_{18} (brick + gravel + husk), T_3 (charcoal + fibre) and T_{25} (brick + gravel + fibre + husk) and was significantly superior to all other treatments. T_{16} (charcoal + fibre + husk) produced the lowest number of shoots (0.157).

iv) Dendrobium nobile

Data pertaining to the effect of different media on the number of new shoots produced in D. nobile are presented in Table 4.

The influence of the media on the number of shoots produced was insignificant at all stages of growth.

b) Number of new shoots irrespective of the species

The effect of media on the number of new shoots irrespective of species was considered taking the average retransformed values for the four species during the different months (Table 5, Fig.1 and Plate 4.)

Table 3

Effect of growing media on the number of new shoots produced in *Dendrobium moschatum*

Treatment	Number of new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	0.811 (0.157)	0.914 (0.336)	0.914 (0.336)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)
2	1.264 (1.097)	1.367 (1.370)	1.367 (1.370)	1.367 (1.370)	1.367 (1.370)	1.367 (1.370)	1.367 (1.370)
3	1.018 (0.536)	1.192 (0.922)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)
4	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)
5	1.018 (0.536)	1.147 (0.815)	1.147 (0.815)	1.147 (0.815)	1.147 (0.815)	1.147 (0.815)	1.147 (0.815)
6	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)
7	1.404 (1.471)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)
8	1.121 (0.757)	1.225 (1.000)	1.225 (1.000)	1.225 (1.000)	1.225 (1.000)	1.225 (1.000)	1.225 (1.000)
9	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)
10	0.914 (0.336)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)
11	0.914 (0.336)	1.218 (0.984)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)
12	1.089 (0.686)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)	1.192 (0.922)
13	1.483 (1.700)	1.367 (1.370)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)	1.296 (1.180)
14	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)	0.914 (0.336)
15	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)
16	0.985 (0.471)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)
17	1.225 (1.000)	1.018 (0.536)	0.914 (0.336)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)
18	1.018 (0.536)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)
19	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)
20	0.985 (0.471)	1.121 (0.757)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)	1.018 (0.536)
21	0.914 (0.336)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)
22	1.192 (0.922)	1.296 (1.180)	1.225 (1.000)	1.225 (1.000)	1.225 (1.000)	1.225 (1.000)	1.225 (1.000)
23	0.914 (0.336)	0.914 (0.336)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)	0.811 (0.157)
24	1.018 (0.536)	1.089 (0.686)	0.985 (0.471)	0.985 (0.471)	0.985 (0.471)	0.985 (0.471)	0.985 (0.471)
25	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)	1.089 (0.686)
CD 0.05	NS	NS	0.344	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

Table 4

Effect of growing media on the number of new shoots produced in <u>Dendrobium</u> <u>nobile</u>

Treatment	Number of new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	0.882 (0.278)	1.264 (1.097)	1.197 (0.933)	1.242 (1.042)	1.246 (1.053)	1.297 (1.183)	1.389 (1.428)
2	0.811 (0.157)	1.089 (0.686)	1.192 (0.922)	0.914 (0.336)	0.914 (0.336)	1.147 (0.815)	1.345 (1.310)
3	0.882 (0.278)	1.089 (0.686)	0.914 (0.336)	0.914 (0.336)	0.966 (0.433)	0.966 (0.433)	1.127 (0.771)
4	1.268 (1.109)	1.475 (1.677)	1.425 (1.531)	1.264 (1.097)	1.160 (0.846)	1.232 (1.017)	1.335 (1.282)
5	1.624 (2.139)	1.670 (2.289)	1.392 (1.437)	1.242 (1.042)	1.035 (0.571)	1.035 (0.571)	1.035 (0.571)
6	0.985 (0.471)	1.425 (1.531)	1.425 (1.531)	1.425 (1.531)	1.264 (1.097)	1.393 (1.440)	1.393 (1.440)
7	1.296 (1.180)	1.354 (1.333)	1.250 (1.064)	1.250 (1.064)	1.354 (1.333)	1.354 (1.333)	1.018 (0.536)
8	1.398 (1.453)	1.605 (2.075)	1.605 (2.075)	1.655 (2.238)	1.655 (2.238)	1.605 (2.075)	1.547 (1.892)
9	1.464 (1.644)	1.393 (1.440)	1.393 (1.440)	1.335 (1.282)	1.335 (1.282)	1.367 (1.370)	1.367 (1.370)
10	1.147 (0.815)	1.250 (1.064)	1.322 (1.247)	1.322 (1.247)	1.192 (0.922)	1.372 (1.382)	1.160 (0.846)
11	1.089 (0.686)	1.089 (0.686)	0.985 (0.471)	0.985 (0.471)	0.985 (0.471)	1.264 (1.097)	1.192 (0.922)
12	0.811 (0.157)	0.985 (0.471)	1.089 (0.686)	1.055 (0.613)	1.055 (0.613)	1.346 (1.312)	1.184 (0.903)
13	1.268 (1.109)	1.043 (0.589)	1.147 (0.815)	1.322 (1.247)	1.354 (1.333)	1.354 (1.333)	1.626 (2.143)
14	1.018 (0.536)	1.192 (0.922)	1.250 (1.064)	1.192 (0.922)	1.089 (0.686)	1.147 (0.815)	0.914 (0.336)
15	1.160 (0.846)	1.264 (1.097)	1.121 (0.757)	1.225 (1.000)	1.225 (1.000)	1.475 (1.677)	1.386 (1.422)
16	1.018 (0.536)	1.121 (0.757)	1.121 (0.757)	1.018 (0.536)	0.811 (0.157)	*	*
17	0.882 (0.278)	0.914 (0.336)	1.095 (0.700)	1.190 (0.916)	1.218 (0.984)	1.160 (0.846)	1.160 (0.846)
18	1.115 (0.742)	1.322 (1.247)	1.250 (1.064)	1.380 (1.403)	1.173 (0.875)	1.276 (1.128)	1.173 (0.875)
19	0.811 (0.157)	0.985 (0.471)	0.811 (0.157)	0.811 (0.157)	0.966 (0.433)	0.966 (0.433)	1.095 (0.700)
20	1.115 (0.742)	1.089 (0.686)	1.160 (0.846)	1.274 (1.122)	1.171 (0.871)	1.171 (0.871)	1.171 (0.871)
21	1.043 (0.589)	1.197 (0.933)	1.268 (1.109)	1.443 (1.583)	1.488 (1.714)	1.529 (1.837)	1.354 (1.333)
22	1.138 (0.796)	1.138 (0.796)	1.313 (1.224)	1.546 (1.890)	1.546 (1.890)	1.828 (2.841)	1.828 (2.841)
23	0.811 (0.157)	0.811 (0.157)	1.121 (0.757)	1.121 (0.757)	1.121 (0.757)	1.225 (1.000)	1.225 (1.000)
24	1.089 (0.686)	1.192 (0.922)	1.057 (0.617)	1.144 (0.809)	1.055 (0.613)	1.055 (0.613)	1.055 (0.613)
25	1.093 (0.696)	1.283 (1.145)	1.475 (1.677)	1.386 (1.422)	1.386 (1.422)	1.386 (1.422)	1.386 (1.422)
CD (0.05)	NS	NS	NS	NS	NS	NS	NS

$\sqrt{x + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

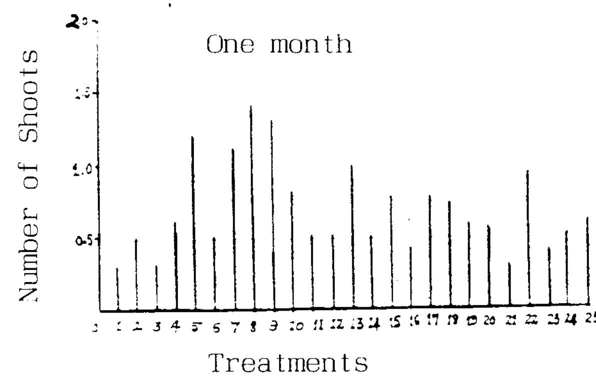
Table 5.

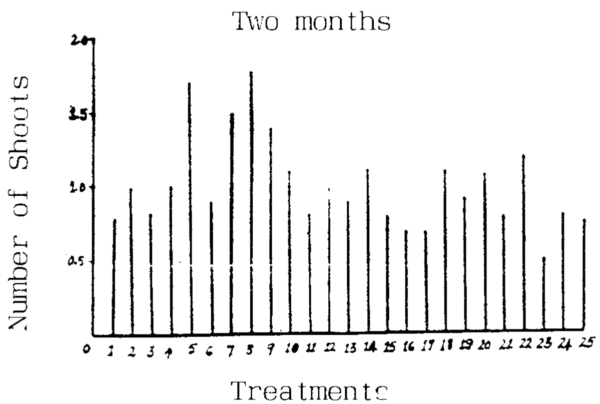
Effect of growing media on the number of new shoots produced irrespective of species

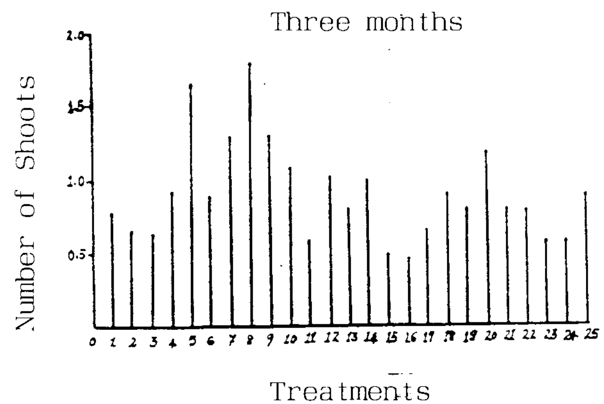
Treatment	Number of new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	0.296	0.811	0.776	0.814	0.782	0.815	0.876
2	0.487	0.961	0.669	0.813	0.773	0.893	1.017
3	0.321	0.792	0.663	0.635	0.643	0.604	0.688
4	0.643	1.010	0.896	0.959	0.914	0.939	1.005
5	1.185	1.742	1.694	1.377	1.198	1.150	1.150
6	0.491	0.859	0.896	0.993	0.885	0.971	0.971
7	1.074	1.526	1.291	1.303	1.251	1.251	1.052
8	1.392	1.777	1.829	1.870	1.656	1.574	1.528
9	1.284	1.364	1.312	1.281	1.281	1.192	1.192
10	0.837	1.087	1.101	1.909	0.911	0.937	0.803
11	0.457	0.707	0.647	0.577	0.500	0.657	0.613
12	0.500	0.955	1.009	0.990	0.988	1.161	1.060
13	0.977	0.889	0.819	0.927	0.949	0.949	1.201
14	0.546	1.052	1.001	0.965	0.906	0.938	0.819
15	0.806	0.803	0.529	0.684	0.615	0.734	0.670
16	0.439	0.727	0.477	0.700	0.532	0.620	0.620
17	0.757	0.735	0.666	0.848	0.866	0.702	0.668
18	0.765	1.068	0.936	0.965	0.889	0.952	0.889
19	0.598	0.941	0.821	0.922	0.936	0.896	0.963
20	0.558	1.073	1.156	1.069	0.956	0.956	0.956
21	0.301	0.818	0.762	0.952	1.028	1.061	0.935
22	0.955	1.196	1.258	1.425	1.425	1.663	1.663
23	[illegible]	0.515	0.635	0.635	0.635	0.696	1.049
24	0.509	0.847	0.593	0.616	0.592	0.592	0.592
25	0.619	0.753	0.905	0.842	0.885	0.885	0.885

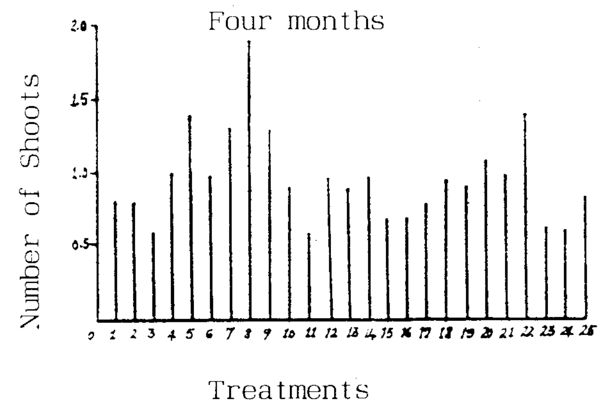
The figures given are mean values of the retransformed values

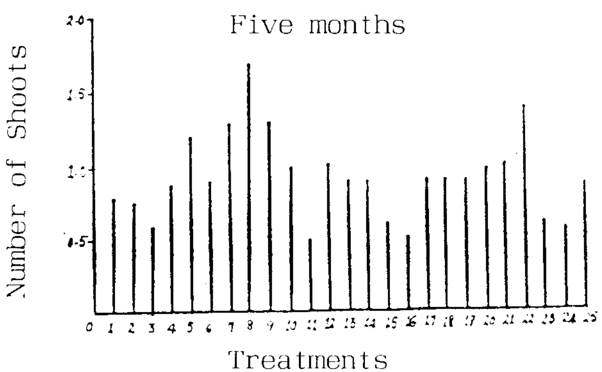
Fig. 1. Effect of growing media on the number of new shoots produced, irrespective of species.

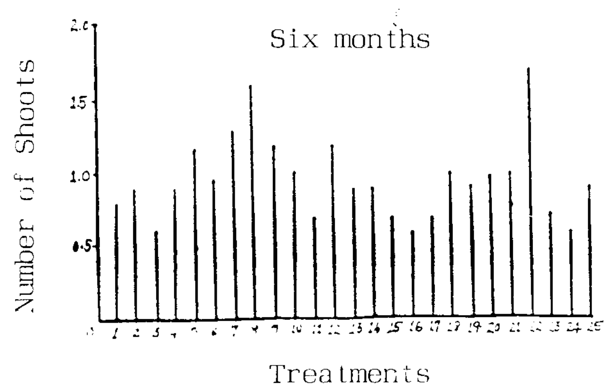












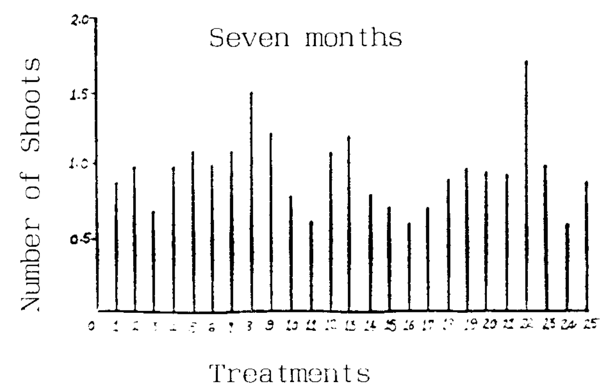
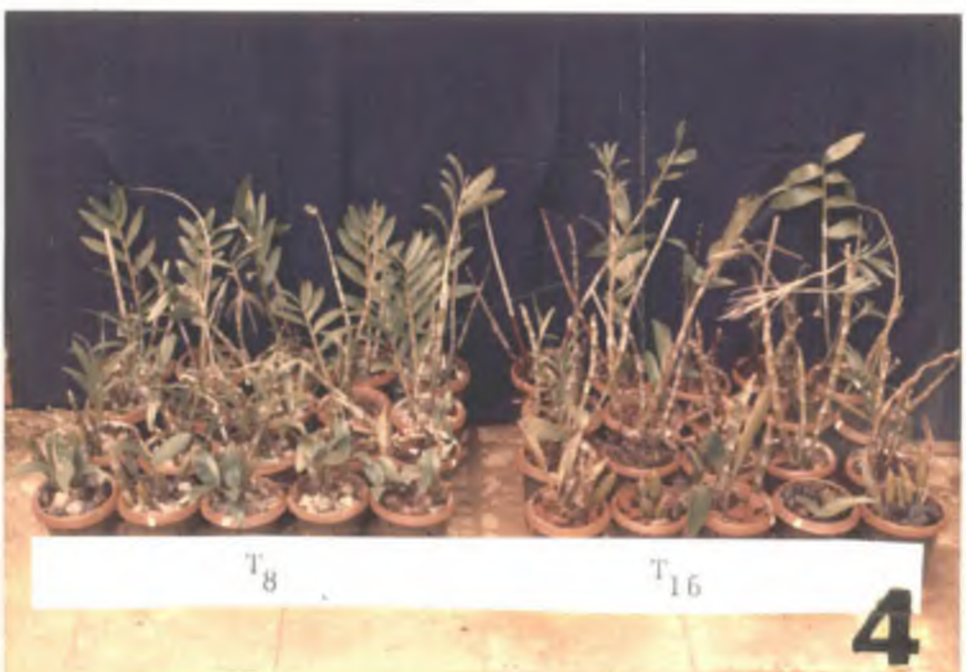


Plate 3. Comparative production of new shoots in *D. moschatum* as influenced by the media

Plate 4. Comparative production of new shoots irrespective of the species, as influenced by the media


T2
D. moschatum
T16
3


T8
T16
4

Among the treatments, T_8 (gravel + fibre), T_{22} (charcoal + brick + gravel + husk), T_5 (brick + gravel), T_1 (charcoal + brick) and T_9 (gravel + husk) gave consistently superior effect on the number of new shoots produced. Some of the media gave poor results for all the four species, throughout the growing period. They were T_{11} (charcoal + brick + gravel), T_{16} (charcoal + fibre + husk), T_{24} (charcoal + gravel + fibre + husk), T_3 (charcoal + fibre) and T_{23} (charcoal + brick + fibre + husk).

2. **Height of the new shoots**

a) **Height with respect to the species**

i) Dendrobium farmeri

Data pertaining to the height of the new shoots produced in D. farmeri are given in Table 6.

The influence of the media on the height of the new shoots was insignificant in this species during the growing period.

ii) Dendrobium fimbriatum

Data pertaining to the influence of the media on the height of new shoots are presented in Table 7.

No significant effects were produced by the different media with respect to height, in this species.

Table 6

Effect of growing media on the height of the new shoots in Dendrobium farmeri

Treatment	Height of the new shoots (cm)						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	0.990 (0.480)	1.214 (0.973)	0.990 (0.480)	*	0.940 (0.383)	1.198 (0.935)	1.198 (0.935)
2	1.057 (0.617)	1.362 (1.356)	2.049 (3.699)	2.385 (5.187)	2.385 (5.187)	2.416 (5.337)	2.416 (5.337)
3	*	1.318 (1.236)	1.926 (3.210)	1.520 (1.810)	1.133 (0.740)	*	*
4	1.730 (2.493)	2.624 (6.383)	2.643 (6.484)	2.643 (6.484)	2.676 (6.661)	2.684 (6.704)	2.666 (6.608)
5	2.762 (7.129)	3.158 (9.470)	3.347 (10.701)	3.411 (11.132)	3.494 (11.707)	3.607 (12.510)	3.607 (12.510)
6	1.698 (2.382)	1.824 (2.828)	1.975 (2.400)	2.025 (3.601)	1.975 (3.400)	2.052 (3.711)	2.052 (3.711)
7	1.746 (2.550)	3.090 (9.049)	2.741 (7.051)	2.381 (5.168)	2.578 (6.145)	2.665 (6.602)	2.665 (6.602)
8	2.790 (7.284)	3.370 (10.855)	3.744 (13.521)	3.732 (13.427)	3.049 (8.796)	2.882 (7.806)	2.882 (7.806)
9	2.682 (6.696)	3.121 (9.239)	3.218 (9.852)	2.889 (7.847)	2.889 (7.847)	2.312 (4.845)	2.312 (4.845)
10	2.190 (4.295)	2.192 (4.305)	2.891 (7.856)	*	1.432 (1.550)	1.327 (1.261)	1.327 (1.261)
11	1.661 (2.259)	1.885 (3.052)	2.271 (4.657)	1.655 (2.240)	1.214 (0.974)	1.214 (0.974)	1.214 (0.974)
12	1.308 (1.212)	1.861 (2.963)	1.951 (3.308)	1.951 (3.308)	2.189 4.294)	2.221 (4.433)	2.221 (4.433)
13	*	0.811 (0.157)	*	*	*	0.998 (0.496)	0.998 (0.496)
14	1.759 (2.595)	2.277 (4.686)	2.316 (4.865)	2.316 (4.865)	2.316 (4.865)	2.400 (5.260)	2.400 (5.260)
15	2.086 (3.853)	1.929 (3.223)	1.633 (2.168)	1.633 (2.168)	*	*	*
16	1.214 (0.973)	1.795 (2.721)	2.091 (3.874)	2.270 (4.655)	2.335 (4.952)	2.335 (4.952)	2.335 (4.952)
17	2.107 (3.940)	2.015 (3.558)	1.986 (3.443)	1.986 (3.443)	1.986 (3.443)	1.810 (2.776)	1.810 (2.776)
18	0.940 (0.383)	1.590 (2.030)	1.909 (3.144)	1.909 (3.144)	1.909 (3.144)	1.909 (3.144)	1.909 (3.144)
19	1.688 ([illegible])	1.821 (2.817)	1.983 (3.433)	1.983 (3.433)	1.983 (3.433)	2.016 (3.564)	2.016 (3.564)
20	*	1.214 (0.973)	1.244 (1.047)	*	*	*	*
21	*	*	1.318 (1.236)	0.990 (0.480)	0.990 (0.480)	1.396 (1.449)	1.396 (1.449)
22	1.779 (2.666)	1.459 (1.629)	1.541 (1.876)	1.582 (2.003)	1.582 (2.003)	1.582 (2.003)	1.582 (2.003)
23	1.273 (1.120)	2.029 (3.615)	1.214 (0.973)	1.214 (0.973)	1.244 (1.048)	1.244 (1.048)	1.244 (1.048)
24	*	*	*	*	*	*	*
25	1.165 (0.857)	*	1.510 (1.779)	1.510 (1.779)	1.551 (1.904)	1.567 (1.955)	1.567 (1.955)
CD 0.05	NS	NS	NS	NS	NS	NS	NS

$\sqrt{x + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

Table 7

Effect of growing media on the height of the new shoots in <u>Dendrobium fimbriatum</u>

Treatment	Height of the new shoots (cm)						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.444 (1.585)	2.157 (9.465)	3.662 (12.908)	4.051 (15.914)	3.767 (13.688)	3.767 (13.688)	3.484 (11.637)
2	1.427 (1.537)	2.036 (3.647)	1.809 (2.771)	2.047 (3.688)	2.071 (3.790)	2.071 (3.790)	2.071 (3.790)
3	1.016 (0.531)	1.734 (2.506)	2.028 (3.611)	2.028 (3.611)	2.073 (3.798)	2.073 (3.798)	2.073 (3.798)
4	1.171 (0.870)	1.844 (2.901)	1.923 (3.197)	2.583 (6.173)	2.600 (6.260)	2.600 (6.260)	2.600 (6.260)
5	2.101 (3.949)	3.626 (12.649)	4.701 (21.598)	4.950 (24.007)	4.752 (22.081)	4.676 (21.361)	4.676 (21.361)
6	1.475 (1.677)	2.923 (8.045)	3.551 (12.112)	3.940 (15.025)	4.024 (15.692)	4.063 (16.006)	4.063 (16.006)
7	1.641 (2.194)	3.649 (12.815)	3.096 (9.088)	3.193 (9.693)	2.467 (5.584)	2.467 (5.584)	2.467 (5.584)
8	1.956 (3.327)	3.406 (11.098)	4.654 (21.160)	4.921 (23.712)	4.845 (22.975)	4.845 (22.975)	4.845 (22.975)
9	2.376 (5.144)	4.414 (18.983)	4.347 (18.399)	4.878 (23.292)	5.097 (25.480)	4.756 (22.119)	4.756 (22.119)
10	1.993 (3.473)	3.598 (12.446)	4.109 (16.381)	4.244 (17.515)	4.358 (18.488)	4.275 (17.778)	4.275 (17.778)
11	1.823 (0.547)	2.152 (4.129)	2.685 (6.711)	2.771 (7.178)	2.635 (6.445)	2.655 (6.546)	2.655 (6.546)
12	1.840 (2.885)	3.117 (9.213)	4.316 (18.128)	4.405 (18.903)	4.370 (18.601)	4.370 (18.601)	4.370 (18.601)
13	1.847 (2.911)	3.312 (10.470)	3.873 (14.501)	3.961 (15.186)	3.961 (15.186)	3.982 (15.356)	3.982 (15.356)
14	2.695 (6.764)	4.434 (19.157)	5.127 (25.791)	5.212 (26.669)	5.358 (28.204)	5.358 (28.204)	8.358 (28.204)
15	1.498 (1.745)	3.457 (11.450)	4.356 (18.477)	4.292 (17.919)	4.392 (18.787)	4.426 (19.089)	4.426 (19.087)
16	1.659 (2.251)	2.343 (4.992)	2.912 (7.982)	2.991 (8.443)	2.866 (7.715)	2.996 (8.474)	2.996 (8.474)
[illegible]	1.856 (2.945)	3.271 (10.202)	4.004 (15.534)	4.111 (16.403)	4.285 (17.860)	4.227 (17.368)	4.227 (17.368)
[illegible]	2.297 ([illegible])	3.164 (9.513)	3.446 (11.375)	3.468 (11.530)	3.491 (11.685)	3.491 (11.685)	3.491 (11.685)
[illegible]	[illegible] ([illegible])	3.893 (14.655)	4.323 (18.189)	4.643 (21.056)	4.733 (21.904)	4.696 (21.551)	4.696 (21.551)
[illegible]	2.773 (7.189)	3.958 (15.168)	4.523 (19.954)	4.589 (20.558)	4.573 (20.411)	4.573 (20.411)	4.573 (20.411)
[illegible]	1.035 (0.571)	1.770 (2.631)	1.532 (1.846)	1.958 (3.335)	2.043 (3.672)	1.936 (3.247)	1.936 (3.247)
[illegible]	2.345 (5.000)	3.366 (10.830)	4.274 (17.771)	4:375 (18.642)	4.375 (18.642)	4.375 (18.642)	4.375 (18.642)
23	1.757 (2.587)	2.639 (6.464)	3.328 (10.579)	4.088 (16.215)	4.161 (16.812)	4.161 (16.812)	4.161 (16.812)
24	1.702 (2.395)	3.492 (11.693)	3.111 (9.180)	3.536 (12.004)	3.571 (12.254)	3.383 (10.946)	3.383 (10.946)
[illegible]	2.249 (4.559)	3.173 (9.570)	3.732 (13.431)	3.896 (14.678)	3.934 (14.977)	3.934 (14.977)	[illegible] (14.977)
[illegible]	NS	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

iii) Dendrobium moschatum

Data pertaining to the effect of different media on the height of the new shoots produced in this species are given in Table 8.

In this species the media could significantly influence the height of the new shoots during one, six and seven months after planting. At one month after planting, T_7 (brick + husk) was found to be the best treatment (14.788 cm) which was on par with T_{13} (charcoal + brick + husk), T_9 (gravel + husk), T_2 (charcoal + gravel), T_8 (gravel + fibre) and T_{17} (brick + gravel + fibre) and was significantly superior to all other treatments. T_{21} (charcoal + brick + gravel + fibre) produced the shortest shoots (0.890 cm). At six months after planting T_2 (charcoal + gravel) produced the tallest shoots (40.508 cm) and T_{23} (charcoal + brick + fibre + husk) the shortest (1.533 cm). T_2 was found to be on par with T_9, T_7, T_{22}, T_8, T_{13}, T_{12}, T_3, T_{18}, T_{21}, T_{10}, T_5, T_{11}, T_{25}, T_{19}, T_{15}, T_1, T_{17} and T_{20} and significantly superior to all others. At seven months after planting also, T_2 proved to be the best medium in increasing the height of shoots (40.508cm) and the medium that gave lowest height was T_{23} (charcoal + brick + fibre + husk) with a mean value of 1.533 cm. Considering the data of above three stages together (one, six and seven months after planting), the treatments T_2, T_9, T_7, T_8, T_{13}, and T_{22} were found to influence significantly the height of the new shoots. On

Table 8

Effect of growing media on the height of the new shoots in Dendrobium moschatum

Treatment	Height of the new shoots (cm)						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.214 (0.973)	2.311 (4.839)	2.685 (6.711)	3.090 (9.048)	3.503 (11.773)	3.616 (12.577)	3.616 (12.577)
2	2.894 (7.874)	5.399 (28.653)	6.106 (36.780)	6.290 (39.063)	6.404 (40.508)¢	6.404 (40.508)	6.404 (40.508)
3	1.578 (1.990)	3.624 (12.632)	4.366 (18.561)	4.501 (19.758)	4.544 (20.152)	4.544 (20.152)	4.544 (20.152)
4	1.510 (1.779)	2.464 (5.570)	2.866 (7.711)	2.866 (7.711)	2.882 (7.805)	2.882 (7.805)	2.882 (7.805)
5	2.125 (4.017)	3.684 (13.069)	3.825 (14.134)	3.909 (14.780)	3.918 (14.853)	3.918 (14.853)	3.918 (14.853)
6	1.779 (2.666)	2.500 (5.752)	2.631 (6.420)	2.631 (6.420)	2.631 (6.420)	2.631 (6.420)	2.631 (6.420)
7	3.910 (14.788)	5.084 (25.346)	5.491 (29.652)	5.554 (30.347)	5.593 (30.783)	5.593 (30.783)	5.593 (30.783)
8	2.861 (7.687)	4.580 (20.480)	5.233 (26.889)	5.391 (28.564)	5.402 (28.677)	5.402 (28.677)	5.402 (28.677)
9	3.033 (8.700)	5.329 (27.900)	6.206 (38.016)	6.254 (38.611)	6.263 (38.724)	6.289 (39.058)	6.289 (39.058)
10	1.898 (3.103)	3.479 (11.605)	3.679 (13.032)	3.995 (15.462)	4.029 (15.731)	4.038 (15.806)	4.038 (15.806)
11	1.907 (3.135)	4.808 (22.614)	3.789 (13.854)	3.847 (14.300)	3.899 (14.700)	3.899 (14.700)	3.899 (14.700)
12	1.840 (2.885)	3.303 (10.412)	4.498 (19.729)	4.590 (20.565)	4.606 (20.719)	4.633 (20.968)	4.633 (20.968)
13	3.288 (10.314)	5.395 (28.604)	4.690 (21.495)	5.327 (27.878)	5.345 (28.070)	5.367 (28.304)	5.367 (28.304)
14	1.714 (2.439)	2.651 (6.526)	2.863 (7.698)	2.863 (7.698)	2.879 (7.788)	2.903 (7.926)	2.903 (7.926)
15	1.789 (2.701)	3.252 (10.072)	3.755 (13.603)	3.770 (13.714)	3.790 (13.862)	3.813 (14.041)	3.813 (14.041)
16	1.301 (1.191)	2.538 (5.939)	1.973 (3.392)	2.001 (3.504)	2.001 (3.504)	2.001 (3.504)	2.001 (3.504)
[illegible]	2.574 (6.125)	3.227 (9.914)	3.455 (11.439)	3.605 (12.495)	3.605 (12.495)	3.605 (12.495)	3.605 (12.495)
[illegible]	1.725 (2.477)	3.173 (9.571)	3.997 (15.476)	4.020 (15.659)	4.045 (15.861)	4.218 (17.293)	4.218 (17.293)
[illegible]	[illegible]	3.462 (11.484)	3.864 (14.433)	3.864 (14.433)	3.864 (14.433)	3.864 (14.433)	3.864 (14.433)
[illegible]	1.869 (2.959)	3.555 (12.135)	3.427 (11.245)	3.427 (11.245)	3.503 (11.768)	3.503 (11.768)	3.503 (11.768)
[illegible]	1.179 (0.890)	3.563 (12.198)	4.146 (16.692)	4.146 (16.692)	4.186 (17.020)	4.186 (17.020)	4.186 (17.020)
[illegible]	2.044 (3.677)	4.729 (21.861)	5.556 (30.368)	5.408 (28.745)	5.398 (28.638)	5.414 (28.816)	5.414 (28.816)
23	1.308 (1.212)	1.610 (2.092)	1.402 (1.467)	1.402 (1.467)	1.426 (1.533)	1.426 (1.533)	1.425 (1.533)
[illegible]	1.289 (1.163)	3.154 (9.446)	2.619 (6.357)	2.642 (6.478)	2.642 (6.478)	2.642 (6.478)	2.642 (6.478)
[illegible]	2.352 (5.030)	3.476 (11.580)	3.815 (14.331)	3.858 (14.386)	3.879 (14.549)	3.879 (14.549)	3.879 (14.549)
[illegible]	1.553	NS	NS	NS	NS	2.923	2.973

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

the other hand, the response of the treatments T_{23}, T_{16}, T_{24}, T_4, T_{14}, and T_{21} on the height of new shoots was poor.

iv) Dendrobium nobile

Data relating to the influence of the media on the height of the new shoots are presented in Table 9 and Plate 5.

Two months after planting, the media could produce significant influence on the height of the shoots. T_6 (brick + fibre) gave the highest mean value for height (43.398 cm) which was significantly superior to all other treatments. On the other hand, significantly shortest shoots (0.897 cm) were produced by T_{23} (charcoal + brick + fibre + husk).

b) **Height of the new shoots irrespective of the species**

Effect of media on the height of the shoots irrespective of species was considered taking the average retransformed values of four species during the different stages of growth and are presented in Table 10 and Fig.2.

Among the treatments, certain media produced tall shoots consistently during the growth period. They were T_8 (gravel + fibre), T_9 (gravel + husk), T_7 (brick + husk), T_5 (brick + gravel) and T_6 (brick + fibre). On the contrary T_{16} (charcoal + fibre + husk), T_{24} (charcoal + gravel + fibre + husk), T_{23} (charcoal + brick + fibre + husk), T_1 (charcoal + brick) and T_4 (charcoal + husk) in general produced shortest shoots.

Table 9

Effect of growing media on the height of the new shoots in <u>Dendrobium nobile</u>

Treatment	Height of the new shoots (cm)						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.214 (0.973)	2.910 (7.966)	2.506 (5.778)	2.528 (5.892)	2.606 (6.294)	2.803 (7.354)	3.000 (8.501)
2	1.076 (0.657)	1.928 (3.219)	2.501 (5.753)	1.655 (2.240)	1.807 (2.766)	2.613 (6.329)	2.365 (5.092)
3	0.998 (0.480)	2.711 (6.847)	2.207 (4.371)	2.509 (5.796)	4.363 (18.536)	3.224 (9.893)	3.511 (9.826)
4	1.843 (2.896)	3.797 (13.915)	4.124 (16.507)	3.698 (13.177)	3.928 (14.927)	3.232 (9.945)	3.294 (10.352)
5	2.598 (6.247)	4.399 (18.849)	3.896 (14.677)	3.450 (11.402)	2.015 (3.560)	2.029 (3.618)	2.029 (3.615)
6	1.828 (2.842)	6.626 (43.398)	5.597 (30.832)	6.067 (36.314)	4.421 (19.045)	4.411 (18.954)	4.482 (19.588)
7	1.900 (3.110)	3.380 (10.926)	3.627 (12.655)	3.876 (14.524)	3.045 (8.771)	4.259 (17.643)	2.824 (7.475)
8	2.313 (4.852)	3.762 (13.652)	4.650 (21.123)	4.975 (24.250)	5.495 (29.694)	5.449 (29.194)	5.193 (26.471)
9	2.531 (5.907)	3.348 (10.708)	3.879 (14.548)	4.117 (16.447)	4.394 (18.808)	4.420 (19.039)	3.812 (14.033)
10	2.231 (4.476)	3.175 (9.581)	4.157 (16.782)	4.506 (19.805)	4.181 (16.983)	4.236 (17.447)	3.451 (11.407)
11	2.877 (7.779)	3.319 (10.517)	3.109 (9.167)	3.213 (9.826)	3.232 (9.944)	3.335 (10.624)	3.689 (13.112)
12	1.013 (0.526)	1.696 (2.376)	2.238 (4.510)	2.174 (4.227)	2.411 (5.313)	2.742 (7.016)	2.958 (8.253)
13	1.802 (2.748)	1.962 (3.349)	2.080 (3.828)	2.508 (5.788)	3.067 (8.908)	3.369 (10.848)	3.460 (11.472)
14	1.986 (3.443)	2.846 (7.600)	3.358 (10.775)	3.609 (12.528)	3.041 (8.748)	3.162 (9.497)	2.655 (6.550)
15	2.299 (4.787)	2.358 (5.061)	2.242 (7.021)	3.234 (9.957)	4.133 (16.582)	4.390 (18.776)	4.547 (20.172)
16	1.621 (2.129)	3.487 (11.659)	3.793 (13.889)	3.180 (9.610)	1.535 (1.857)	*	*
17	1.149 (0.820)	1.477 (1.681)	2.212 (4.393)	1.676 (2.308)	1.809 (2.773)	1.892 (3.082)	1.867 (2.987)
18	1.560 (1.934)	3.906 (14.753)	3.143 (9.378)	3.561 (12.184)	2.377 (5.152)	2.983 (8.399)	2.541 (5.959)
19	1.035 (0.571)	1.404 (1.147)	1.113 (0.740)	1.301 (1.191)	1.899 (3.108)	2.228 (4.464)	2.862 (7.691)
20	1.403 (1.469)	2.102 (3.917)	2.495 (5.726)	3.238 (9.988)	3.089 (9.024)	3.129 (9.292)	2.440 (5.456)
21	1.606 (2.080)	2.787 (7.269)	3.046 (8.778)	3.595 (12.427)	3.862 (14.414)	4.059 (15.976)	3.939 (15.012)
22	1.138 (0.796)	1.594 (2.040)	2.016 (3.566)	3.211 (9.811)	3.398 (11.044)	4.365 (18.555)	4.645 (21.074)
23	0.766 (0.086)	1.182 (0.897)	1.838 (2.879)	2.820 (7.455)	3.258 (10.118)	4.192 (17.074)	4.379 (18.676)
24	2.008 (3.533)	2.489 (5.697)	1.754 (2.577)	2.675 (6.657)	2.618 (6.354)	2.618 (6.354)	2.759 [illegible]
25	1.877 (3.025)	2.472 (5.610)	3.315 (10.487)	3.861 (14.411)	4.077 (16.119)	4.213 (17.252)	[illegible] [illegible]
CD (0.05)	NS	2.175	NS	NS	NS	NS	NS

$\sqrt{x + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

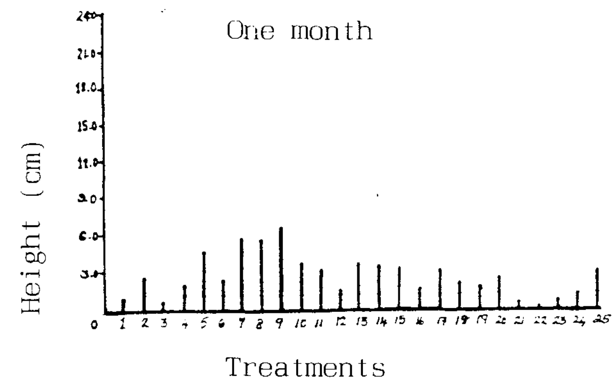
Table 10

Effect of growing media on the height of the new shoots irrespective of species

Treatment	Height of the new shoots (cm)						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.003	5.811	6.469	7.714	8.035	8.639	8.413
2	2.671	9.219	12.251	11.248	13.063	13.991	13.682
3	0.750	5.805	7.438	12.545	10.807	8.461	8.944
4	2.010	7.192	8.475	8.386	8.913	7.679	7.756
5	5.336	13.509	15.278	13.331	13.050	13.085	13.085
6	2.392	15.006	13.191	15.340	11.139	11.273	11.431
7	5.661	14.534	14.603	14.933	12.821	15.153	12.611
8	5.788	14.021	20.673	22.488	22.536	22.163	21.482
9	6.612	16.708	20.204	21.549	22.715	21.265	20.014
10	3.837	9.485	13.513	13.196	13.188	13.073	11.563
11	3.430	10.078	8.597	8.386	8.016	8.211	8.833
12	1.878	6.241	11.419	11.751	12.232	12.755	13.064
13	3.993	10.645	9.956	12.213	13.041	13.796	13.907
14	3.810	9.492	12.282	12.940	12.401	12.722	11.985
15	3.272	7.452	10.371	10.940	12.308	12.976	13.325
16	1.636	6.328	7.284	6.553	4.507	4.233	4.233
17	3.458	6.339	8.702	8.662	9.143	8.930	8.856
18	2.393	9.150	9.843	10.629	8.961	10.130	8.805
19	2.185	7.607	9.199	10.028	10.720	11.003	11.144
20	2.904	8.048	9.493	10.448	10.301	10.368	10.722
21	0.885	5.525	7.138	8.234	8.897	9.423	12.144
22	0.935	0.090	13.395	14.800	15.082	17.004	10.813
23	1.251	3.267	3.975	6.528	7.378	9.117	10.754
24	1.773	6.709	4.529	6.285	6.272	5.945	5.839
25	3.348	6.690	10.007	11.319	11.887	12.183	9.396

The figures given are mean values of the retransformed values

Fig. 2. Effect of growing media on the height of the new shoots, irrespective of species



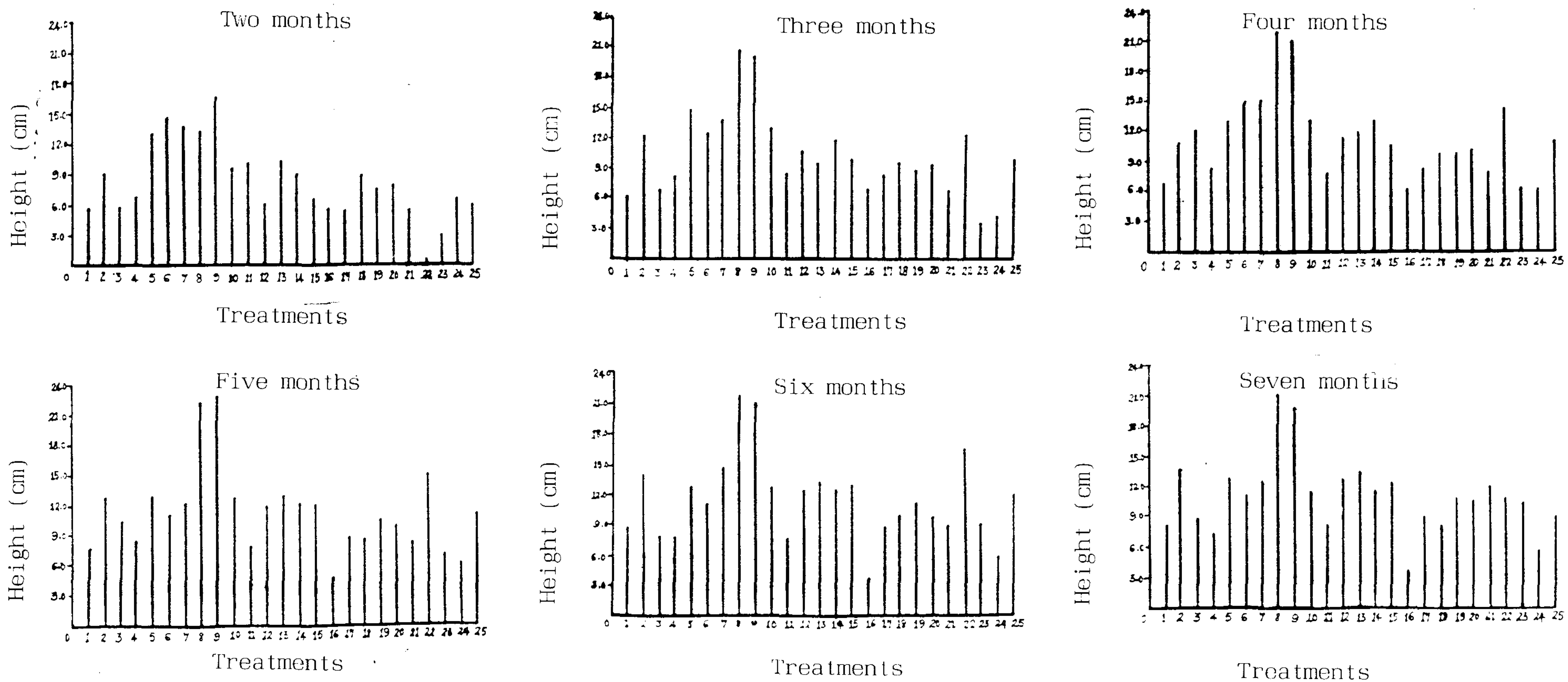


Plate 5. Comparative height of the new shoots in *D. nobile* as influenced by the media

Plate 6. Comparative number of leaves on the new shoots in *D. moschatum*, as influenced by the media

T_6 *D. nobile* T_{23} 5

T_8 *D. moschatum* T_1 6

3. **Number of leaves on the new shoots**

a) **Number with respect to the species**

i) Dendrobium farmeri

Data pertaining to the influence of the media on the number of leaves produced are presented in Table 11.

As could be seen, the influence was not significant with respect to this species.

ii) Dendrobium fimbriatum

Data recorded on the influence of the media on the number of new leaves in this species are presented in Table 12.

It could be seen from the Table that the treatments did not produce any significant effect.

iii) Dendrobium moschatum

Data pertaining to the influence of the media on the number of new leaves produced are presented in Table 13 and Plate 6.

In this species media could exert significant influence at one month after planting. At this stage the medium T_8 (gravel + fibre) produced the highest number of leaves (13.473). This treatment was on par with T_9 (gravel + husk), T_7 (brick + husk) and T_{13} (charcoal + brick + husk) and significantly superior to all other treatments. T_1 (charcoal + brick) was the most inferior medium in this respect, producing only 0.820 leaves.

Table 11

Effect of growing media on the number of leaves on the new shoots in <u>Dendrobium farmeri</u>

Treatment	Number of leaves on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	*	0.990 (0.480)	0.882 (0.279)	*	*	0.940 (0.384)	0.940 (0.384)
2	*	1.057 (0.617)	1.289 (1.162)	1.289 (1.162)	1.218 (0.984)	2.174 (4.226)	2.174 (4.226)
3	*	0.985 (0.470)	1.405 (1.474)	1.217 (0.981)	0.998 (0.496)	*	*
4	1.218 (2.144)	1.617 (2.115)	1.770 (2.633)	1.770 (2.663)	1.770 (2.663)	1.770 (2.633)	1.770 (2.633)
5	1.626 (2.144)	1.617 (2.115)	1.770 (2.633)	1.770 (2.633)	1.770 (2.633)	1.770 (2.633)	1.770 (2.633)
6	1.286 (1.154)	1.223 (0.996)	1.347 (1.314)	1.347 (1.314)	1.347 (1.314)	1.289 (1.162)	1.289 (1.162)
7	1.218 (0.984)	1.878 (3.027)	1.708 (2.417)	1.572 (1.971)	1.725 (2.476)	1.725 (2.476)	1.725 (2.476)
8	1.879 (3.031)	2.450 (5.503)	2.494 (4.720)	2.474 (5.621)	2.012 (3.548)	1.899 (3.106)	1.899 (3.106)
9	1.451 (1.605)	1.708 (2.417)	1.630 (2.157)	1.572 (1.971)	1.572 (1.971)	1.398 (1.454)	1.398 (1.454)
10	1.289 (1.162)	1.218 (0.984)	1.522 (1.816)	*	1.057 (0.617)	0.990 (0.480)	0.990 (0.480)
11	0.990 (0.480)	1.210 (0.964)	1.267 (1.105)	1.057 (0.617)	0.882 (0.278)	1.214 (0.974)	0.882 (0.278)
12	1.165 (0.857)	1.347 (1.314)	1.218 (0.984)	1.218 (0.985)	1.347 (1.314)	1.289 (1.162)	1.289 (1.162)
13	*	0.940 (1.384)	*	*	*	0.837 (0.201)	0.837 (0.201)
14	1.089 (0.686)	1.442 (1.579)	1.442 (1.579)	1.442 (1.579)	1.442 (1.579)	1.442 (1.579)	1.442 (1.579)
15	1.250 (1.063)	1.403 (1.468)	1.076 (0.658)	1.076 (0.658)	*	*	*
16	1.035 (0.571)	1.267 (1.105)	0.441 (1.576)	1.442 (1.579)	1.442 (1.579)	1.442 (1.579)	1.442 (1.579)
17	1.115 (0.743)	1.210 (0.964)	1.138 (0.795)	1.138 (0.795)	1.442 (0.795)	1.138 (0.795)	1.043 (0.795)
18	0.911 (0.158)	1.173 (0.876)	1.308 (1.211)	1.308 (1.211)	1.138 (0.996)	1.223 (0.996)	1.173 (0.876)
19	1.250 (1.063)	1.326 (1.258)	1.326 (1.258)	1.326 (1.258)	1.223 (1.258)	1.326 (1.258)	1.326 (1.258)
20	*	1.165 (0.857)	0.990 (0.480)	*	*	*	*
21	*	*	1.115 (0.743)	0.682 (0.278)	1.326 (0.278)	1.057 (0.617)	1.057 (0.617)
22	1.384 (1.415)	1.250 (1.063)	1.210 (0.964)	1.210 (0.964)	0.882 (0.964)	1.210 (0.964)	1.210 (0.964)
23	0.940 (0.384)	1.165 (0.857)	0.882 (0.278)	0.882 (0.278)	1.210 (0.278)	0.882 (0.278)	0.882 (0.278)
24	*	*	*	*	*	*	*
25	0.985 (0.470)	*	1.115 (0.743)	1.043 (0.588)	0.882 (0.588)	1.043 (0.588)	1.043 (0.588)
CD 0.05	NS	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

Table 12

Effect of growing media on the number of leaves on the new shoots in <u>Dendrobium fimbriatum</u>

Treatment	Number of leaves on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.517 (1.801)	2.993 (8.458)	3.350 (10.723)	3.423 (11.217)	3.102 (9.122)	2.469 (5.596)	3.064 (5.596)
2	2.042 (3.669)	2.588 (6.198)	2.137 (4.067)	2.125 (4.406)	2.042 (3.670)	2.007 (3.528)	2.007 (3.528)
3	1.035 (0.571)	2.108 (3.943)	2.097 (3.897)	2.156 (4.148)	2.122 (4.003)	2.122 (4.003)	2.122 (4.003)
4	1.510 (1.780)	2.161 (4.170)	2.033 (3.633)	2.582 (6.167)	2.595 (6.234)	2.199 (4.336)	2.572 (4.336)
5	2.361 (5.074)	4.178 (16.956)	4.603 (20.688)	4.726 (21.835)	4.459 (19.383)	3.843 (14.269)	4.318 (14.269)
6	1.560 (1.934)	2.882 (7.806)	3.245 (10.030)	3.940 (15.623)	3.492 (11.694)	3.390 (10.992)	3.390 (10.992)
7	1.572 (1.971)	3.613 (12.554)	3.001 (8.506)	3.138 (9.347)	2.486 (5.680)	2.486 (5.680)	2.486 (5.680)
8	2.202 (4.349)	3.369 (10.850)	4.063 (16.008)	4.031 (15.749)	3.821 (14.100)	3.654 (12.852)	3.654 (12.852)
9	2.369 (5.112)	3.838 (14.230)	3.812 (14.031)	3.928 (14.929)	3.953 (15.126)	3.749 (13.555)	3.749 (13.555)
10	2.423 (5.371)	3.279 (10.252)	3.672 (12.984)	3.698 (13.175)	3.596 (12.312)	3.316 (10.496)	3.316 (10.496)
11	1.318 (1.237)	2.148 (4.114)	2.285 (4.721)	2.312 (4.845)	2.213 (4.397)	2.176 (4.235)	2.176 (4.235)
12	1.865 (2.978)	3.441 (11.340)	3.729 (13.405)	4.389 (18.763)	3.734 (13.443)	3.656 (12.866)	3.656 (12.866)
13	2.128 (4.420)	3.428 (11.251)	3.345 (10.689)	3.314 (10.483)	3.211 (9.811)	3.068 (8.913)	3.068 (8.913)
14	2.817 (7.435)	4.016 (15.628)	4.180 (16.972)	4.062 (15.999)	4.062 (15.999)	4.011 (15.588)	4.011 (15.588)
15	1.447 (1.594)	3.014 (8.584)	3.217 (9.849)	3.199 (9.734)	3.115 (9.203)	3.040 (8.742)	3.040 (8.742)
16	1.628 (2.150)	1.378 (1.400)	2.708 (6.833)	2.659 (6.570)	2.594 (6.229)	2.645 (6.496)	2.645 (6.496)
17	2.018 (3.572)	3.436 (11.306)	3.648 (12.808)	3.699 (13.183)	3.357 (10.769)	3.261 (10.134)	3.261 (10.134)
18	2.281 (4.703)	2.930 (8.085)	3.095 (9.079)	2.837 (7.549)	2.923 (8.044)	2.821 (7.458)	2.821 (7.458)
19	2.196 (4.322)	3.797 (13.917)	4.047 (15.878)	4.116 (16.441)	4.019 (15.652)	3.727 (13.391)	3.727 (13.391)
20	2.793 (7.301)	4.321 (18.171)	4.217 (17.283)	4.129 (16.549)	3.842 (14.261)	3.799 (13.932)	3.799 (13.932)
21	1.076 (0.658)	2.579 (6.151)	1.951 (3.306)	2.212 (4.393)	2.453 (5.517)	1.956 (3.326)	2.268 (3.326)
22	2.223 (4.442)	4.042 (15.838)	4.081 (16.155)	4.004 (15.532)	4.034 (15.773)	4.043 (15.846)	4.043 (15.846)
23	2.048 (3.694)	2.986 (8.416)	3.877 (14.531)	3.574 (12.273)	3.612 (12.546)	2.946 (8.179)	3.505 (8.179)
24	1.997 (3.488)	3.714 (13.294)	3.186 (9.651)	3.225 (9.901)	3.199 (9.734)	3.199 (9.734)	3.199 (9.734)
25	2.358 (5.060)	3.108 (9.160)	3.091 (9.054)	3.126 (9.272)	3.267 (10.173)	2.953 (8.220)	2.953 (8.220)
CD 0.05	NS	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ Transformation was used. Values in parentheses indicate retransformed values

Table 13

Effect of growing media on the number of leaves on the new shoots in <u>Dendrobium moschatum</u>

Treatment	Number of leaves on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.149 (0.820)	1.853 (2.934)	1.919 (3.183)	2.218 (4.420)	2.374 (5.136)	2.373 (5.131)	2.373 (5.131)
2	2.426 (5.385)	3.843 (14.269)	4.040 (15.822)	4.042 (15.838)	3.963 (15.205)	3.867 (14.454)	3.867 (15.454)
3	1.442 (1.579)	2.743 (7.024)	2.934 (8.108)	2.871 (7.743)	2.871 (7.871)	2.756 (7.096)	2.756 (7.096)
4	1.403 (1.468)	3.084 (9.011)	2.024 (3.597)	1.998 (3.492)	1.998 (3.492)	1.973 (3.393)	1.973 (3.393)
5	2.125 (4.016)	2.795 (7.312)	2.614 (6.333)	2.555 (6.028)	2.534 (5.921)	2.472 (5.611)	2.472 (5.611)
6	1.444 (1.585)	2.469 (5.596)	1.810 (2.776)	1.781 (2.672)	1.781 (2.672)	1.781 (2.672)	1.781 (2.672)
7	2.738 (6.997)	3.269 (10.186)	3.552 (12.117)	2.958 (8.250)	3.465 (11.506)	3.360 (10.790)	3.360 (10.790)
8	3.738 (13.473)	3.753 (13.585)	3.475 (11.576)	3.321 (10.529)	3.321 (10.529)	3.357 (10.769)	3.357 (10.769)
9	3.033 (8.699)	4.441 (19.222)	4.025 (15.701)	3.997 (15.476)	3.970 (15.261)	3.743 (13.510)	3.743 (13.510)
10	1.217 (0.981)	3.727 (13.391)	2.457 (5.537)	2.475 (5.626)	2.475 (5.626)	2.528 (5.891)	2.528 (5.891)
11	1.362 (1.355)	2.505 (5.775)	2.447 (5.488)	2.422 (5.366)	2.422 (5.366)	2.422 (5.366)	2.422 (5.366)
12	1.629 (2.154)	2.806 (7.374)	3.100 (9.110)	3.108 (9.160)	3.108 (9.160)	2.992 (8.452)	2.992 (8.452)
13	2.502 (5.760)	2.906 (7.945)	3.411 (11.135)	3.381 (10.931)	3.381 (10.931)	3.186 (9.651)	3.186 (9.651)
14	1.358 (1.344)	2.460 (5.552)	1.838 (2.878)	1.838 (2.878)	1.838 (2.878)	1.810 (2.776)	1.810 (2.776)
15	1.657 (2.246)	2.559 (6.048)	2.510 (5.800)	2.430 (5.405)	2.430 (5.405)	2.341 (4.980)	2.341 (4.980)
16	1.308 (1.211)	1.244 (1.048)	1.378 (1.399)	1.378 (1.399)	1.378 (1.399)	1.378 (1.399)	1.378 (1.399)
17	2.211 (4.389)	2.062 (3.752)	2.314 (4.855)	2.344 (4.994)	2.344 (4.994)	2.344 (4.994)	2.344 (4.994)
18	1.5[illegible] (1.[illegible])	2.756 (7.096)	2.699 (6.785)	2.667 (6.613)	2.667 (6.613)	2.667 (6.613)	2.667 (6.613)
19	1.724 (2.472)	1.893 (3.083)	2.400 (5.260)	2.371 (5.122)	2.341 (4.980)	2.314 (4.855)	2.314 (4.855)
20	1.598 (2.022)	3.189 (9.669)	2.306 (4.818)	2.273 (4.667)	2.270 (4.653)	2.216 (4.411)	2.216 (4.411)
21	1.223 (0.996)	2.707 (6.828)	2.846 (7.600)	2.846 (7.600)	2.846 (7.600)	2.792 (7.296)	2.792 (7.296)
22	2.031 (3.625)	3.065 (8.894)	3.295 (10.357)	3.380 (10.924)	3.295 (10.360)	3.259 (10.121)	3.259 (10.121)
23	1.273 (1.121)	1.441 (1.576)	1.214 (0.974)	1.214 (0.974)	1.214 (0.974)	1.657 (2.246)	1.657 (2.246)
24	1.448 (1.597)	2.345 (4.999)	1.810 (2.776)	1.679 (2.319)	1.751 (2.566)	1.689 (2.353)	1.689 (2.353)
25	1.948 (3.295)	2.571 (6.110)	2.665 (6.602)	2.540 (5.952)	2.549 (5.997)	2.494 (5.279)	2.494 (5.279)
CD (0.05)	1.269	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

iv) Dendrobium nobile

Data pertaining to the influence of the media on the number of leaves produced in this species are presented in Table 14 and Plate 7.

Significantly superior influence was shown by T_6 (brick + fibre) one month after planting in which 11.026 leaves were produced. This medium was on par with T_5 (brick + gravel), T_4 (charcoal + husk), T_8 (gravel + fibre), T_{18} (brick + gravel + husk), T_9 (gravel + husk), T_7 (brick + husk), T_{10} (fibre + husk), T_1 (charcoal + husk), T_{16} (charcoal + fibre + husk), T_3 (charcoal + fibre) and T_{21} (charcoal + brick + gravel + fibre) and significantly superior to all other media. T_{23} (charcoal + brick + fibre + husk) produced the minimum number of leaves (0.480).

b) **Number of leaves on the new shoots irrespective of the species**

Effect of the media on the number of new leaves produced irrespective of species was considered, taking the average retransformed values for the four species during the growth. The observations are presented in Table 15 and Fig.3.

Among the treatments there were media which could produce higher number of leaves, like T_8 (gravel + fibre), T_9 (gravel + husk), T_{22} (charcoal + brick + gravel + husk), T_5 (brick + gravel) and T_7 (brick + husk). The media which produced very

Table 14

Effect of growing media on the number of leaves on the new shoots in <u>Dendrobium nobile</u>

Treatment	Number of leaves on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	2.222 (4.437)	1.113 (0.739)	1.899 (3.106)	2.098 (3.902)	2.084 (3.843)	2.142 (4.088)	2.250 (4.563)
2	1.986 (3.444)	0.940 (0.384)	2.029 (3.617)	1.318 (1.237)	1.476 (1.679)	1.476 (1.679)	1.724 (2.472)
3	2.040 (3.661)	1.035 (0.571)	2.207 (4.371)	1.734 (2.507)	2.076 (3.810)	2.116 (3.977)	2.239 (4.513)
4	2.954 (8.226)	1.903 (3.121)	3.112 (9.185)	2.485 (5.675)	2.228 (4.464)	2.415 (5.332)	2.294 (4.762)
5	3.315 (10.485)	2.328 (4.920)	2.843 (7.583)	2.265 (4.630)	1.514 (1.792)	1.514 (1.792)	1.535 (1.856)
6	3.395 (11.026)	1.441 (1.576)	2.617 (6.349)	2.741 (7.013)	2.102 (3.918)	2.312 (4.845)	2.116 (3.977)
7	2.646 (6.501)	1.755 (2.580)	2.624 (6.385)	2.766 (7.151)	3.045 (8.772)	3.082 (8.999)	2.057 (3.731)
8	2.859 (7.674)	1.969 (3.377)	3.386 (10.965)	3.461 (11.479)	3.646 (12.793)	3.511 (11.827)	3.353 (10.743)
9	2.658 (6.565)	2.092 (3.876)	2.975 (8.351)	3.021 (8.626)	2.940 (8.144)	3.159 (9.479)	2.672 (6.640)
10	2.445 (5.478)	1.727 (2.483)	2.842 (7.577)	2.861 (7.685)	2.570 (6.105)	2.405 (5.284)	2.016 (3.564)
11	2.007 (3.528)	1.859 (2.956)	1.686 (2.343)	1.751 (2.566)	1.751 (2.566)	2.033 (3.633)	2.038 (3.653)
12	1.324 (1.253)	0.940 (0.384)	1.748 (2.555)	1.788 (2.697)	1.875 (3.016)	2.278 (4.689)	2.166 (4.192)
13	1.324 (1.253)	1.476 (1.679)	1.760 (2.598)	2.000 (3.500)	2.409 (5.303)	2.532 (5.911)	2.736 (6.986)
14	1.878 (3.027)	1.579 (1.993)	2.357 (5.055)	2.389 (5.207)	2.095 (3.889)	2.164 (4.183)	1.689 (2.353)
15	1.854 (2.937)	1.878 (3.027)	1.958 (3.338)	2.297 (4.776)	2.609 (6.307)	2.661 (6.581)	2.691 (6.741)
16	2.178 (4.244)	1.340 (1.296)	2.287 (4.730)	1.878 (3.027)	1.076 (0.658)	*	*
17	1.250 (1.063)	1.182 (0.897)	1.797 (2.729)	1.267 (1.105)	1.537 (1.862)	1.657 (2.246)	1.709 (2.421)
18	2.665 (6.602)	1.497 (1.741)	2.084 (3.843)	2.454 (5.522)	1.884 (3.053)	2.198 (4.331)	1.915 (3.167)
19	1.288 (1.159)	0.990 (0.480)	0.990 (0.480)	1.076 (0.658)	1.324 (1.253)	1.654 (2.236)	1.945 (3.283)
20	1.641 (2.193)	1.358 (1.342)	1.923 (3.198)	2.064 (3.760)	2.113 (3.965)	2.113 (3.965)	1.790 (2.704)
21	2.016 (3.564)	1.273 (1.121)	2.239 (4.513)	2.530 (5.901)	2.716 (6.877)	2.759 (7.112)	2.55[illegible] ([illegible])
22	1.378 (1.399)	1.149 (0.820)	1.946 (3.287)	2.579 (6.151)	2.675 (6.657)	3.185 (9.644)	3.185 (9.644)
23	0.990 (0.480)	0.882 (0.278)	1.354 (1.333)	2.042 (3.670)	2.363 (5.084)	2.821 (7.458)	2.821 (7.458)
24	1.893 (3.083)	1.465 (1.646)	1.553 (1.912)	1.943 (3.275)	1.761 (2.601)	1.761 (2.601)	1.720 (2.458)
25	1.954 (3.318)	1.403 (1.468)	2.476 (5.631)	2.618 (6.354)	2.875 (7.766)	2.933 (7.526)	2.914 (7.991)
CD 0.05	1.384	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

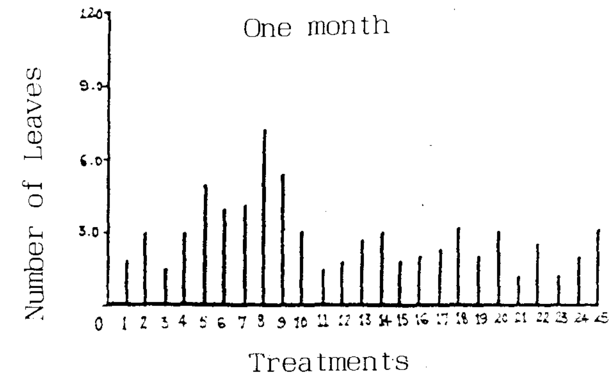
Table 15

Effect of growing media on the number of leaves on the new shoots irrespective of species

Treatment	Number of leaves on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.765	3.153	4.323	4.885	4.525	3.800	3.919
2	3.125	5.367	6.167	5.661	5.385	5.972	6.170
3	1.453	3.002	4.463	3.845	4.045	3.769	3.903
4	3.115	4.604	4.633	4.362	4.076	3.794	3.652
5	5.431	7.926	9.310	8.782	7.432	6.076	6.092
6	3.925	3.994	5.117	6.506	4.900	4.918	4.701
7	4.113	7.087	7.356	6.680	7.109	6.986	5.700
8	7.132	8.329	11.067	10.845	10.243	9.639	9.368
9	5.495	9.936	10.060	10.251	10.126	9.500	8.790
10	3.248	6.778	6.979	6.622	6.165	5.538	5.108
11	1.650	3.452	3.414	3.349	3.152	3.553	3.383
12	1.811	5.103	6.514	7.901	6.733	6.792	6.668
13	2.858	5.565	6.106	6.229	6.511	6.169	6.438
14	3.123	6.188	6.621	6.416	6.086	6.032	5.574
15	1.960	4.782	4.911	5.143	5.229	5.076	5.116
16	2.044	1.212	3.635	3.144	2.466	2.394	2.369
17	2.442	4.230	5.297	5.020	4.605	4.542	4.534
18	3.342	4.450	5.230	5.224	4.677	4.850	4.529
19	2.254	4.685	5.719	5.870	5.786	5.435	5.697
20	2.879	7.510	6.445	6.244	5.720	5.577	5.262
21	1.305	3.525	4.041	4.543	5.068	4.588	4.31[illegible]
22	2.720	6.654	7.691	8.393	8.439	9.144	9.1[illegible]
23	1.420	2.782	4.279	5.799	4.720	4.540	4.54[illegible]
24	2.042	4.985	3.585	3.099	3.725	3.672	3.636
25	3.036	4.185	5.508	5.542	6.131	5.403	5.52[illegible]

The figures given are mean values of the retransformed values

Fig. 3. Effect of growing media on the number of leaves on the new shoots, irrespective of species.



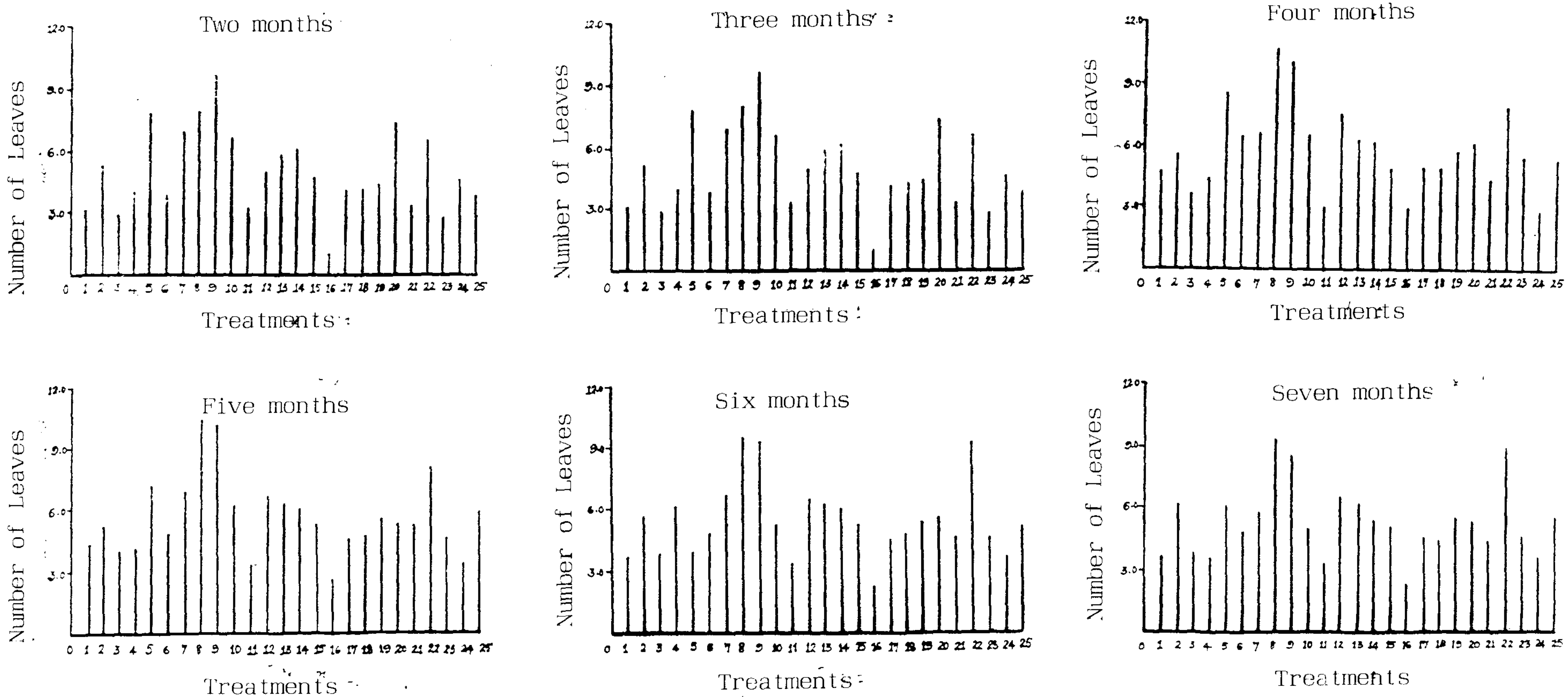
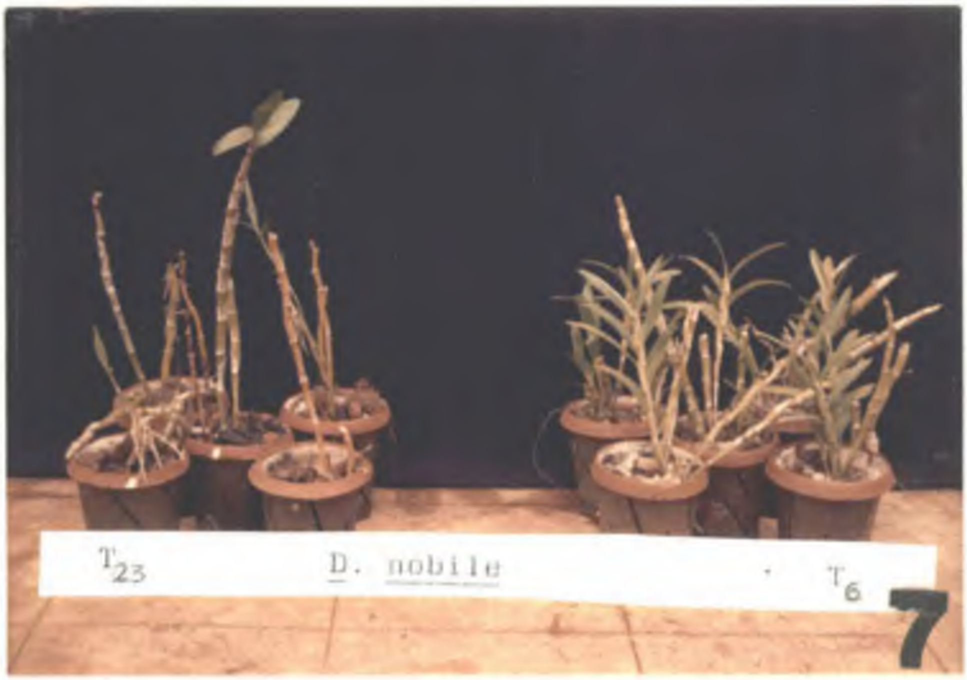
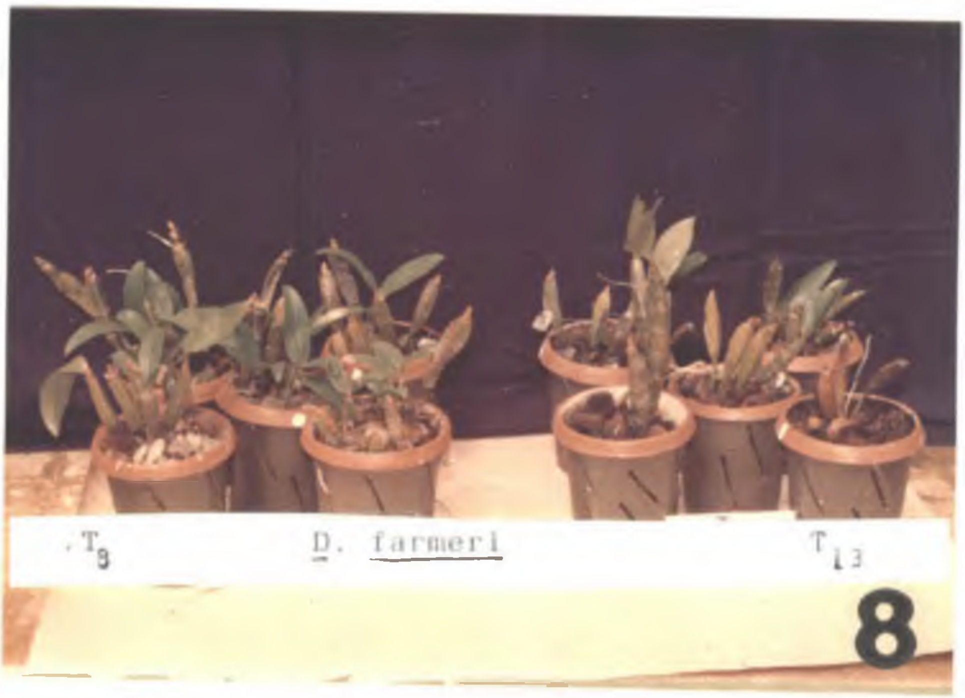


Plate 7. Comparative number of leaves on the new shoots in *D. nobile*, as influenced by the media

Plate 8. Comparative area of the new leaves in *D. farmeri*, as influenced by the media


T_{23}
D. nobile
T_6
7


T_8
D. farmeri
T_{13}
8

low number of leaves were T_{16} (charcoal + fibre + husk), T_{11} (charcoal + brick + gravel), T_3 (charcoal + fibre), T_{21} (charcoal + brick + gravel + fibre) and T_{24} (charcoal + gravel + fibre + husk).

4. **Area of the new leaves**

a) **Area with respect to the species**

i) Dendrobium farmeri

Influence of the media on the leaf area of the new leaves is evident from the data presented in Table 16 and Plate 8.

The media exerted significant influence two months after planting only. T_8 (gravel + fibre) gave the highest leaf area per plant (96.011 cm^2) at the stage, which was on par with T_9 (gravel + husk), T_{10} (fibre + husk), T_4 (charcoal + husk), T_7 (brick + husk) and T_{14} (charcoal + gravel + fibre) and significantly superior to all other treatments. Leaf area per plant was the least in T_{13} (charcoal + brick + husk), which recorded a value of 1.331 cm^2.

ii) Dendrobium fimbriatum

Data pertaining to the influence of different media on the leaf area of new leaves in this species are presented in Table 17 and Plate 9.

Significant influence was exhibited four, five, six and seven months after planting. At all these stages, T_5 (brick + gravel)

Table 16

Effects of growing media on the area of new leaves in Dendrobium farmeri

Treatment	Leaf area of the new shoots (cm^2)					
	2 months	3 months	4 months	5 months	6 months	7 months
1	2.388 (5.203)	2.468 (5.591)	*	*	2.338 (4.966)	2.338 (4.966)
2	4.230 (17.393)	4.811 (22.646)	3.903 (14.733)	4.965 (24.151)	3.969 (15.253)	3.969 (15.253)
3	1.740 (2.538)	4.530 (20.209)	2.936 (8.120)	2.056 (3.727)	*	*
4	6.634 (43.600)	7.163 (50.809)	7.284 (52.557)	7.368 (53.787)	7.373 (53.861)	7.373 (53.861)
5	4.274 (17.767)	6.602 (43.086)	7.742 (59.439)	7.834 (60.872)	8.352 (69.256)	8.352 (69.256)
6	3.921 (14.874)	3.966 (15.229)	4.484 (19.606)	4.484 (19.606)	4.399 (18.851)	4.399 (18.851)
7	6.141 (37.212)	6.620 (43.324)	5.838 (33.582)	5.874 (34.004)	6.469 (41.348)	6.469 (41.348)
8	9.824 (96.011)	10.528 (110.339)	10.071 (100.925)	7.983 (63.228)	7.472 (55.331)	7.472 (55.331)
9	7.458 (55.122)	7.022 (48.808)	6.522 (42.036)	6.536 (42.219)	5.174 (26.270)	5.174 (26.270)
10	6.667 (43.949)	6.058 (36.199)	*	*	2.902 (7.922)	2.902 (7.922)
11	3.795 (13.902)	4.229 (17.384)	3.437 (11.313)	2.338 (4.966)	2.338 (4.966)	2.338 (4.966)
12	3.994 (15.452)	4.305 (18.033)	4.356 (18.475)	4.367 (18.571)	4.597 (20.632)	4.597 (20.632)
13	1.353 (1.331)	*	*	*	*	1.414 (1.499)
14	6.074 (36.393)	7.223 (51.672)	6.270 (38.813)	6.299 (39.177)	6.299 (39.177)	6.299 (39.177)
15	1.605 (2.076)	2.902 (7.922)	3.744 (13.518)	*	*	*
16	4.526 (19.985)	4.784 (22.387)	4.332 (18.266)	4.803 (22.569)	4.803 (22.569)	4.803 (22.569)
17	2.761 (7.123)	4.081 (16.155)	4.101 (16.318)	4.101 (16.318)	4.101 (16.318)	3.610 (12.532)
18	3.586 (12.359)	3.774 (13.743)	4.121 (16.483)	3.796 (13.910)	3.796 (13.910)	3.662 (12.910)
19	4.206 (17.190)	5.104 (25.551)	4.650 (21.123)	4.650 (21.123)	4.650 (21.123)	4.650 (21.123)
20	1.807 (2.765)	1.823 (2.823)	*	*	*	*
21	1.807 (2.765)	1.782 (2.676)	1.807 (2.765)	2.938 (8.132)	2.938 (8.132)	2.938 (8.132)
22	3.301 (10.397)	2.928 (8.073)	3.301 (10.397)	3.365 (10.823)	3.365 (6.323)	3.345 (10.823)
23	3.278 (10.245)	1.854 (2.937)	1.854 (2.937)	1.854 (2.937)	1.854 (2.937)	1.854 (2.937)
24	*	*	*	*	*	*
25	1.353 (1.331)	3.068 (8.913)	3.124 (9.259)	3.185 (9.644)	3.190 (9.676)	3.190 (9.676)
CD (0.05)	4.522	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

Table 17

Effect of growing media on the area of new leaves in Dendrobium fimbriatum

Treatment	Leaf area of the new shoots (cm^2)					
	2 months	3 months	4 months	5 months	6 months	7 months
1	5.220 (26.748)	7.785 (60.106)	6.943 (47.705)	6.914 (47.303)	6.914 (47.303)	6.914 (47.303)
2	1.366 (1.366)	3.303 (10.410)	4.085 (16.187)	4.084 (16.179)	4.091 (16.236)	4.091 (16.236)
3	2.186 (4.279)	3.189 (9.670)	2.946 (8.179)	3.473 (11.562)	3.473 (11.562)	3.473 (11.562)
4	2.905 (7.939)	5.013 (24.630)	5.345 (28.069)	5.272 (27.294)	5.272 (27.294)	5.272 (27.294)
5	9.339 (86.717)	11.462 (130.877)	14.436 (207.898)	14.694 (215.414)	14.714 (216.002)	14.714 (216.002)
6	5.136 (25.878)	9.693 (93.454)	9.589 (91.449)	9.812 (95.775)	9.823 (95.991)	9.823 (95.991)
7	5.377 (28.412)	6.247 (38.525)	5.992 (35.404)	4.973 (24.231)	4.973 (24.231)	4.973 (24.231)
8	8.754 (76.133)	11.562 (133.180)	11.819 (139.189)	11.393 (129.300)	11.398 (129.414)	11.398 (129.414)
9	10.162 (102.766)	11.710 (136.624)	12.489 (155.475)	12.743 (161.884)	12.192 (148.145)	12.192 (148.145)
10	9.288 (85.967)	11.137 (123.533)	11.650 (135.222)	11.488 (131.474)	10.729 (114.611)	10.729 (114.611)
11	4.891 (23.422)	5.583 (30.670)	5.763 (32.712)	5.857 (33.804)	5.864 (33.886)	5.864 (33.886)
12	10.349 (106.602)	10.679 (113.541)	12.694 (160.638)	12.932 (166.737)	12.947 (167.125)	12.947 (167.125)
13	6.891 (46.986)	8.617 (73.753)	9.798 (95.501)	9.915 (97.807)	9.921 (97.926)	9.921 (97.926)
14	9.052 (81.439)	10.325 (106.106)	13.476 (181.103)	13.717 (187.656)	13.721 (187.766)	13.721 (187.766)
15	10.072 (100.945)	12.724 (161.400)	12.724 (161.400)	12.989 (168.214)	12.989 (168.214)	12.989 (168.214)
16	4.320 (18.162)	6.054 (36.151)	6.692 (44.283)	6.949 (47.789)	6.960 (47.942)	6.960 (47.942)
17	9.107 (82.437)	11.321 (127.665)	12.970 (167.721)	13.737 (188.205)	13.735 (188.150)	13.735 (188.150)
18	5.738 (32.425)	7.277 (52.456)	7.654 (58.084)	7.406 (54.349)	7.406 (54.349)	7.406 (54.349)
19	9.277 (85.563)	11.220 (125.388)	11.233 (125.680)	12.428 (153.955)	12.457 (154.677)	12.457 (154.677)
20	8.080 (64.786)	10.348 (106.581)	10.486 (109.456)	10.149 (102.502)	10.172 (10.172)	10.172 (10.172)
21	*	3.017 (8.602)	3.810 (14.016)	3.008 (8.548)	3.041 (8.748)	3.041 (8.748)
22	8.404 (70.127)	11.959 (142.518)	12.541 (156.777)	12.908 (166.116)	12.908 (166.116)	12.908 (166.116)
23	4.714 (21.722)	8.155 (66.004)	8.623 (73.856)	6.926 (47.469)	10.289 (47.469)	10.289 (105.364)
24	6.310 (39.316)	7.884 (61.657)	9.111 (82.510)	9.895 (97.411)	7.291 (97.411)	7.291 (52.659)
25	7.825 (60.731)	9.096 (82.237)	9.794 (95.422)	10.423 (108.139)	10.430 (108.139)	10.430 (108.285)
CD (0.05)	NS	NS	S*	S*	S*	S*

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values, S* CD matrix appended

was found to be the best medium with leaf area of 207.898 cm^2, 215.414 cm^2, 216.002 cm^2 and 216.002 cm^2, respectively. At four months, T_5 was on par with T_{14} (charcoal + gravel + fibre), T_{17} (brick + gravel + fibre), T_{15} (charcoal + gravel + husk), T_{12} (charcoal + brick + fibre), T_{22} (charcoal + brick + gravel + husk), T_9 (gravel + husk), T_8 (gravel + fibre), T_{10} (fibre + husk), T_{19} (brick + fibre + husk), T_{20} (gravel + fibre + husk), T_{13} (charcoal + brick + husk), T_{25} (brick + gravel + fibre + husk), T_6 (brick + fibre), T_{24} (charcoal + gravel + fibre + husk), T_{23} (charcoal + brick + fibre + husk) and T_{18} (brick + gravel + husk) and was significantly superior to all other treatments. At five months, T_5 was on par with T_{17}, T_{14}, T_{15}, T_{12}, T_{22}, T_9, T_{19}, T_{10}, T_8, T_{25}, T_{20}, T_{13}, T_{24}, T_6, and T_{18} and significantly superior to the other treatments. At six and seven months T_5 was on par with T_{17}, T_{14}, T_{15}, T_{12}, T_{22}, T_{19}, T_9, T_8, T_{10}, T_{25}, T_{23}, T_{20}, and T_6 and significantly superior to the other treatments. At four months after planting T_3 (charcoal + fibre) was the most inferior medium with respect to the leaf area (8.179 cm^2). At five, six and seven months after planting T_{21} (charcoal + brick + gravel + fibre) had the lowest leaf area, with mean values 8.548 cm^2, 8.748 cm^2 and 8.748 cm^2, respectively.

At these four stages (four, five, six and seven months after planting) the treatments T_5, T_{17}, T_{14}, T_{15}, T_{12}, T_{22}, T_{19}, T_9, T_8 and T_{25} were found to be significantly superior, where as T_{21},

T_3, T_2, T_7, T_4, T_{11}, T_1, T_6 and T_{18} belonged to the consistently inferior group in influencing the leaf area.

iii) Dendrobium moschatum

The influence of the media on the leaf area is evident from the data presented in Table 18.

The treatment could not exert significant influence on this species at any of the stages of growth.

iv) Dendrobium nobile

Data pertaining to the leaf area in the species are presented in Table 19.

The media could not produce any significant influence on the leaf area.

b) **Area of the new leaves irrespective of the species**

The effect of media on leaf area of the new shoots was considered irrespective of species, taking the average retransformed values for the species, the data and the graphical representation of which are presented in Table 20 and Fig.4, respectively.

The media that could produce a favourable effect on the leaf area, in all the four species were T_9 (gravel + husk), T_8 (gravel + fibre), T_{22} (charcoal + brick + gravel + husk), T_5 (brick + gravel) and T_2 (charcoal + gravel). The media which could not

Table 18

Effect of growing media on the area of new leaves in <u>Dendrobium moschatum</u>

Treatment	Leaf area of the new shoots (cm^2)					
	2 months	3 months	4 months	5 months	6 months	7 months
1	6.239 (38.425)	7.166 (50.852)	7.921 (62.242)	9.140 (83.040)	9.143 (83.094)	9.143 (83.094)
2	14.484 (209.286)	16.447 (270.004)	17.060 (290.544)	17.618 (309.894)	17.624 (310.105)	17.624 (310.105)
3	9.107 (82.437)	10.881 (117.896)	11.809 (138.952)	12.029 (144.197)	12.179 (147.828)	12.179 (147.828)
4	6.633 (43.496)	7.403 (54.304)	7.402 (54.290)	7.402 (54.290)	7.679 (58.467)	7.679 (58.467)
5	7.057 (49.301)	9.913 (62.116)	8.731 (75.730)	8.731 (75.730)	9.231 (84.711)	9.231 (84.711)
6	2.877 (7.777)	5.703 (32.024)	6.027 (35.825)	6.331 (39.582)	6.331 (39.582)	6.331 (39.582)
7	12.392 (153.062)	12.945 (167.073)	13.538 (182.777)	14.390 (206.572)	14.390 (206.572)	14.390 (206.572)
8	12.285 (150.421)	13.200 (173.74)	13.208 173.951)	13.758 (188.782)	13.887 (192.349)	13.887 (192.349)
9	17.144 (293.417)	15.899 (252.278)	17.367 (301.113)	17.918 (320.555)	17.702 (312.861)	17.702 (312.816)
10	7.257 (52.164)	8.085 (64.867)	9.037 (81.167)	9.413 (88.105)	9.547 (90.645)	9.547 (90.645)
11	8.035 (64.061)	8.621 (73.822)	8.258 (67.694)	8.661 (74.513)	8.661 (74.513)	8.661 (74.513)
12	7.331 (53.244)	8.427 (70.514)	11.175 (124.381)	11.752 (137.610)	11.703 (136.460)	11.703 (136.460)
13	10.414 (107.951)	11.952 (142.350)	12.195 (148.218)	12.916 (166.323)	12.830 (164.109)	12.830 (164.109)
14	6.026 (35.813)	6.289 (39.052)	6.767 (45.292)	6.868 (46.669)	6.843 (46.327)	6.843 (46.327)
15	7.768 (59.842)	8.774 (76.483)	9.325 (86.456)	9.649 (92.603)	9.605 (91.756)	9.605 (91.756)
16	4.202 (17.157)	4.310 (18.076)	4.421 (19.045)	4.431 (19.134)	4.431 (19.134)	4.431 (19.134)
17	8.130 (65.597)	8.736 (75.818)	9.080 (81.946)	9.479 (89.351)	9.486 (89.484)	9.486 (89.484)
18	5.828 (33.466)	9.331 (86.568)	10.234 (104.235)	11.008 (120.676)	11.008 (120.676)	11.008 (120.676)
19	8.675 (74.756)	9.374 (87.372)	9.173 (83.644)	9.305 (86.083)	9.295 (85.897)	9.295 (85.897)
20	7.043 (49.103)	7.953 (62.750)	7.972 (63.053)	8.407 (70.178)	8.387 (69.842)	8.387 (69.842)
21	8.364 (69.456)	10.249 (104.542)	10.922 (118.790)	10.994 (120.368)	10.973 (119.907)	10.973 (119.907)
22	10.896 (118.223)	13.127 (171.818)	13.416 (179.489)	13.598 (184.406)	13.613 (184.814)	13.613 (184.814)
23	2.233 (4.486)	2.692 (6.747)	2.535 (5.926)	2.644 (6.491)	2.649 (6.517)	2.649 (6.517)
24	4.667 (21.281)	4.694 (21.534)	4.951 (24.012)	5.441 (29.104)	5.382 (28.466)	5.382 (28.466)
25	8.558 (72.739)	10.221 (103.739)	9.440 (88.614)	9.473 (89.238)	9.397 (87.804)	9.397 (87.804)
CD (0.05)	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

Table 19

Effect of growing media on the area of new leaves in Dendrobium nobile

Treatment	Leaf area of the new shoots (cm^2)					
	2 months	3 months	4 months	5 months	6 months	7 months
1	4.728 (21.854)	4.110 (16.392)	3.542 (12.046)	5.212 (26.665)	5.212 (26.665)	5.316 (27.760)
2	2.695 (6.763)	4.174 (16.922)	3.128 (9.284)	3.957 (15.158)	3.957 (15.158)	4.871 (23.227)
3	5.206 (26.602)	3.158 (9.473)	7.877 (61.547)	5.061 (25.114)	8.298 (68.357)	8.503 (71.801)
4	6.282 (33.964)	8.303 (68.440)	7.011 (48.654)	6.158 (41.984)	6.526 (42.089)	6.429 (40.832)
5	6.980 (48.220)	8.696 (75.120)	6.596 (43.007)	3.474 (11.569)	3.474 (11.569)	3.522 (11.904)
6	7.401 (54.275)	6.738 (44.901)	11.115 (123.043)	9.069 (81.747)	9.074 (81.837)	9.297 (85.934)
7	7.049 (49.188)	8.217 (67.019)	8.197 (66.691)	9.727 (94.115)	10.020 (99.900)	6.804 (45.794)
8	8.173 (66.298)	9.899 (97.490)	11.588 (133.782)	13.660 (186.096)	13.447 (180.320)	12.939 (166.918)
9	7.594 (57.169)	8.405 (70.144)	8.578 (73.082)	10.288 (105.343)	10.622 (112.327)	9.884 (97.193)
10	6.752 (45.090)	7.897 (61.863)	9.031 (81.059)	9.270 (85.433)	8.680 (74.842)	6.310 (39.316)
11	4.959 (24.092)	4.391 (18.781)	5.547 (30.269)	5.956 (34.974)	6.010 (35.620)	6.459 (41.2190
12	1.973 (3.393)	4.044 (15.854)	3.986 (15.388)	5.099 (25.500)	5.534 (30.125)	5.534 (30.125)
13	2.203 (4.353)	3.439 (11.327)	4.414 (18.983)	6.060 (36.224)	6.984 (48.276)	6.932 (47.553)
14	4.669 (21.216)	6.331 (39.582)	7.388 (54.083)	6.073 (36.381)	6.215 (38.126)	7.592 (57.138)
15	2.705 (6.817)	5.026 (24.761)	6.502 (41.776)	8.973 (80.015)	9.170 (83.589)	9.387 (87.616)
[illegible]	6.615 (43.258)	7.470 (55.391)	4.500 (19.750)	3.027 (8.663)	*	*
[illegible]	2.042 (3.670)	2.712 (6.855)	1.280 (1.138)	2.487 (5.685)	3.020 (8.620)	3.349 (10.716
[illegible]	4.755 22.110	5.482 (29.552)	4.741 (21.977)	3.579 (12.309)	4.914 (23.647)	4.243 (17.503)
[illegible]	1.707 2.413	2.069 (3.781)	2.069 (3.781)	2.815 (7.424)	4.362 (18.527)	5.303 (27.622)
[illegible]	3.602 (12.474)	4.950 (24.003)	5.133 (25.849)	6.286 (39.014)	4.891 (23.422)	5.582 (30.659)
21	4.209 (17.216)	5.372 (28.358)	6.603 (43.100)	7.460 (55.152)	7.622 (57.595)	7.622 (57.595)
22	1.740 (2.528)	3.217 (9.849)	5.223 (26.801)	6.233 (38.350)	8.151 (65.939)	8.151 (65.939)
23	1.846 (2.908)	2.970 (8.321)	6.607 (43.152)	7.901 (61.926)	10.922 (118.790)	10.963 (119.687)
24	3.646 (12.793)	4.541 (20.121)	5.834 (33.536)	6.044 (36.030)	6.044 (36.030)	5.977 (35.225)
25	4.252 (17.580)	6.311 (39.329)	8.333 (68.939)	9.397 (87.804)	9.505 (89.845)	9.654 (92.700)
CD (0.05)	NS	NS	NS	NS	NS	NSS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

Table 20

Effect of growing media on the area of new leaves irrespective of species

Treatment	Leaf area of the new shoots (cm^2)					
	2 months	3 months	4 months	5 months	6 months	7 months
1	20.558	33.235	30.498	39.252	40.507	40.874
2	58.702	79.996	82.687	91.346	89.188	91.205
3	28.964	39.312	54.200	46.150	56.937	57.798
4	33.500	49.546	45.893	44.339	45.428	45.114
5	50.501	77.800	96.519	90.896	95.385	95.468
6	24.429	46.402	67.418	59.178	59.065	60.090
7	66.969	78.985	79.614	89.731	93.013	79.486
8	97.216	128.687	136.962	141.852	139.354	136.003
9	127.119	126.964	142.927	157.500	149.901	146.106
10	56.743	71.616	74.362	76.253	72.005	63.124
11	31.369	35.164	35.497	37.064	37.246	38.646
12	44.673	54.486	79.721	87.105	88.586	88.586
13	40.155	56.858	65.676	75.089	77.578	77.772
14	43.715	59.103	79.823	77.471	77.849	82.602
15	42.420	67.642	75.788	85.208	85.890	86.897
16	24.641	32.979	25.336	24.539	22.411	22.411
17	39.707	56.623	66.781	74.890	75.643	75.221
18	25.090	45.578	50.195	50.311	53.146	51.360
19	44.377	60.523	58.557	67.146	70.056	72.330
20	32.282	49.039	49.589	52.924	49.059	50.868
21	22.359	36.045	44.668	48.050	48.596	49.594
22	60.319	83.065	93.366	99.924	105.789	[illegible]
23	9.840	21.002	31.468	29.706	58.402	[illegible]
24	19.348	25.828	35.015	40.636	29.289	[illegible]
25	39.095	58.612	65.559	73.706	73.903	[illegible]

The figures given are mean values of the retransformed values

Fig. 4. Effect of growing media on the area of new leaves, irrespective of species.

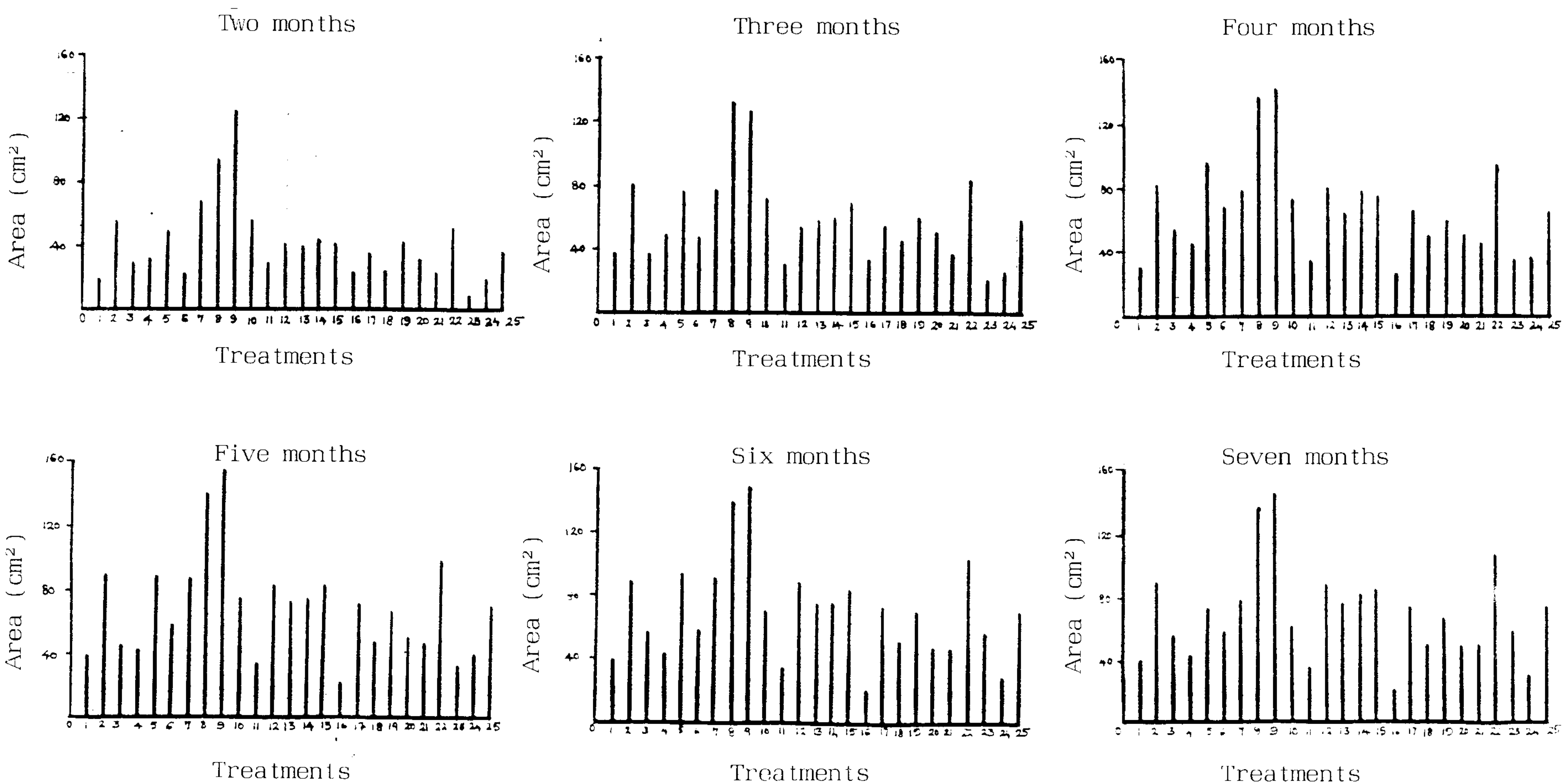


Plate 9. Comparative area of the new leaves in *D. fimbriatum*, as influenced by the media

Plate 10. Comparative number of pseudobulbs of the new shoots in *D. farmeri*, as influenced by the media


T_5
D. fimbriatum
T_{21}
9


T_8
D. farmeri
T_1
10

influence the leaf area favourably were T_{16} (charcoal + fibre + husk), T_{24} (charcoal + gravel + fibre + husk), T_1 (charcoal + brick), T_{11} (charcoal + brick + gravel) and T_{21} (charcoal + brick + gravel + fibre).

5. Number of pseudobulbs of the new shoots

a) Number with respect to the species

i) Dendrobium farmeri

Data pertaining to the influence of the media on the number of pseudobulbs are presented in Table 21 and Plate 10.

The media produced significant influence at three months after planting only. At this stage T_8 (gravel + fibre) gave the highest mean value for pseudobulbs (7.940), which was on par with T_5 (brick + gravel), T_9 (gravel + husk) and T_4 (charcoal + husk) and significantly superior to all other treatments. T_1 (charcoal + brick) gave the lowest mean value (0.480 pseudobulbs).

ii) Dendrobium fimbriatum

Data pertaining to the influence of different media on the number of pseudobulbs produced are presented in Table 22.

No significant influence of the media could be observed on the number of pseudobulbs produced in this species.

Table 21

Effect of growing media on the number of pseudobulbs of the new shoots in Dendrobium farmeri

Treatment	Number of pseudobulbs on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	*	1.149 (0.820)	0.990 (0.480)	*	*	0.990 (0.480)	0.990 (0.480)
2	*	1.223 (0.995)	1.541 (1.875)	1.750 (2.561)	1.750 (2.561)	1.750 (2.561)	1.750 (2.561)
3	*	1.273 (1.120)	1.173 (0.875)	1.273 (1.120)	0.990 (0.480)	*	*
4	1.492 (1.727)	1.992 (3.468)	2.042 (3.670)	2.042 (3.670)	2.042 (3.670)	2.042 (3.670)	2.042 (3.670)
5	1.949 (3.297)	2.076 (3.808)	2.845 (7.592)	2.554 (6.021)	2.554 (6.021)	2.554 (6.021)	2.554 (6.021)
6	1.455 (1.618)	1.358 (1.345)	1.492 (1.727)	1.550 (1.903)	1.550 (1.903)	1.550 (1.903)	1.550 (1.903)
7	1.492 (1.727)	2.475 (5.626)	2.130 (4.038)	2.007 (3.527)	2.166 (4.190)	2.166 (4.190)	2.166 (4.190)
8	2.504 (5.771)	3.104 (9.133)	2.905 (7.940)	2.926 (8.063)	2.387 (5.197)	2.387 (5.197)	2.387 (5.197)
9	2.218 (4.417)	2.070 (3.785)	2.320 (4.882)	2.173 (4.220)	2.173 (4.220)	1.804 2.754)	1.804 (2.754)
10	1.783 (2.679)	1.550 (1.920)	2.042 (3.670)	*	1.223 (0.995)	0.990 (0.480)	0.990 (0.480)
11	1.506 (1.767)	1.556 (1.923)	1.588 (2.023)	1.223 (0.995)	0.990 (0.480)	0.990 (0.480)	0.990 (0.480)
12	1.173 (0.875)	1.614 (2.106)	1.591 (2.032)	1.591 (2.032)	1.765 (2.614)	1.765 (2.614)	1.765 (2.614)
13	0.940 (0.383)	*	*	*	*	*	0.926 (0.357)
14	1.541 (1.875)	1.541 (1.875)	1.714 (2.439)	1.714 (2.439)	1.759 (2.595)	1.759 (2.595)	1.759 (2.595)
15	1.689 (2.352)	1.657 (2.246)	1.273 (1.120)	1.273 (1.120)	*	*	*
16	1.149 (0.820)	1.432 (1.550)	1.650 (2.223)	1.674 (2.302)	1.674 (2.302)	1.674 (2.302)	1.674 (2.302)
17	1.636 (2.176)	1.396 (1.450)	1.476 (1.680)	1.476 (1.680)	1.476 (1.680)	1.476 (1.680)	1.318 (1.236)
18	0.940 (0.383)	1.358 (1.345)	1.527 (1.831)	1.527 (1.831)	1.527 (1.831)	1.527 (1.831)	1.527 (1.831)
19	1.465 (1.646)	1.591 (2.032)	1.591 (2.032)	1.714 (2.439)	1.714 (2.439)	1.714 (2.439)	1.714 (2.439)
20	*	1.149 (0.820)	1.076 (0.657)	*	*	*	*
21	*	*	1.115 (0.742)	0.940 (0.383)	0.940 (0.383)	1.173 (0.875)	1.173 (0.875)
22	1.483 (1.700)	1.396 (1.450)	1.346 (1.312)	1.396 (1.450)	1.396 (1.450)	1.396 (1.450)	1.396 (1.450)
23	1.182 (0.897)	1.582 (2.003)	1.076 (0.657)	1.076 (0.657)	1.076 (0.657)	1.076 (0.657)	1.076 (0.657)
24	*	*	*	*	*	*	*
25	1.057 (0.617)	*	1.210 (0.963)	1.267 (1.106)	1.267 (1.106)	1.267 (1.106)	1.267 (1.106)
CD 0.05	NS	NS	1.131	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

Table 22

Effect of growing media on the number of pseudobulbs of the new shoots in <u>Dendrobium fimbriatum</u>

Treatment	Number of pseudobulbs on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.358 (1.345)	2.714 (6.865)	3.518 (11.876)	3.838 (14.230)	3.541 (12.039)	3.541 (12.039)	3.541 (12.039)
2	1.483 (1.700)	2.391 (5.219)	1.833 (2.860)	2.054 (3.719)	2.047 (3.690)	2.047 (3.690)	2.047 (3.690)
3	1.550 (1.903)	2.034 (3.639)	2.226 (4.455)	2.236 (4.500)	2.303 (4.804)	2.303 (4.804)	2.303 (4.804)
4	1.415 (1.502)	2.072 (3.793)	1.788 (2.697)	2.505 (5.775)	2.527 (5.886)	2.527 (5.886)	2.527 (5.886)
5	1.999 (3.496)	3.557 (12.151)	4.073 (16.089)	4.524 (19.967)	4.258 (17.631)	4.342 (18.353)	4.258 (17.631)
6	1.415 (1.502)	2.530 (5.901)	2.947 (8.185)	3.383 (10.945)	3.427 (11.244)	3.427 (11.244)	3.427 (11.244)
7	1.966 (3.366)	3.486 (11.653)	2.933 (8.102)	3.136 (9.334)	2.498 (5.740)	2.498 (5.740)	2.498 (5.740)
8	1.969 (3.377)	2.986 (8.416)	3.843 (14.269)	4.185 (17.014)	3.776 (13.758)	3.776 (13.758)	3.776 (13.758)
9	1.839 (2.883)	3.422 (11.213)	3.862 (14.415)	4.095 (16.269)	4.122 (16.491)	4.122 (16.491)	4.122 (16.491)
10	2.007 (3.528)	2.609 (6.305)	3.463 (11.492)	3.845 (14.284)	3.585 (12.352)	3.822 (14.108)	3.585 (12.352)
11	1.173 (0.875)	1.752 (2.571)	2.235 (4.495)	2.300 (4.790)	2.262 (4.617)	2.262 (4.617)	2.262 (4.617)
12	1.709 (2.422)	2.724 (6.918)	3.512 (11.834)	3.590 (12.388)	3.517 (11.869)	3.517 (11.869)	3.517 (11.869)
13	1.738 (2.522)	2.749 (7.059)	3.156 (9.460)	3.314 (10.483)	3.314 (10.483)	3.314 (10.483)	3.314 (10.483)
14	2.419 (5.349)	3.506 (11.791)	4.066 (16.032)	4.292 (17.921)	4.292 (17.921)	4.292 (17.921)	4.292 (17.921)
15	1.165 (0.857)	2.472 (5.609)	3.155 (9.203)	3.397 (11.047)	3.468 (11.527)	3.397 (11.040)	3.468 (11.527)
16	1.308 (1.212)	2.008 (3.532)	2.529 (5.896)	2.780 (7.228)	2.841 (7.571)	2.697 (6.774)	2.841 (7.571)
17	1.464 (1.644)	2.653 (6.537)	3.410 (11.128)	3.700 (13.190)	3.613 (12.554)	3.700 (13.190)	3.613 (12.554)
18	1.884 (3.049)	2.846 (7.599)	3.071 (8.931)	3.144 (9.385)	3.144 (9.385)	3.144 (9.385)	3.144 (9.385)
19	1.578 (1.990)	3.113 (9.193)	3.758 (13.623)	4.059 (15.975)	3.974 (15.293)	4.059 (15.975)	3.974 (15.293)
20	2.081 (3.831)	3.848 (14.310)	1.800 (2.740)	2.078 (3.818)	4.307 (18.050)	4.307 (18.050)	4.307 (18.050)
21	1.076 (0.657)	2.312 (4.847)	3.885 (14.593)	4.042 (15.838)	2.420 (5.356)	2.278 (4.689)	2.420 (5.356)
22	1.813 (2.785)	3.136 (9.332)	3.668 (12.954)	3.921 (14.874)	4.101 (16.318)	4.101 (16.318)	4.101 (16.318)
23	1.750 (2.563)	2.532 (5.911)	2.821 (7.407)	3.081 (8.993)	3.921 (14.874)	2.939 (8.138)	3.921 (14.874)
24	1.384 (1.416)	3.084 (9.009)	2.812 (7.407)	3.341 (10.662)	3.081 (8.993)	3.081 (8.993)	3.081 (8.993)
25	1.675 (2.306)	2.724 (6.921)	1.983 (3.432)	2.297 (4.776)	3.341 (10.662)	3.341 (10.662)	3.341 (10.662)
CD (0.05)	NS	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

iii) Dendrobium moschatum

Data with respect to the effect of the different media on the number of pseudobulbs produced are presented in Table 23.

It could be seen from the data that no significant influence could be produced in this species.

iv) Dendrobium nobile

Data pertaining to the influence of the media on the number of pseudobulbs produced in this species are presented in Table 24.

The media could exert significant influence two months after planting only. T_6 (brick + fibre) gave the highest mean value (15.088 pseudobulbs), which was on par with T_5 (brick + gravel), T_4 (charcoal + husk), T_8 (gravel + fibre) and T_{18} (brick + gravel + husk) and significantly superior to all other treatments. T_{19} (brick + fibre + husk) produced shoots with lowest number of pseudobulbs (0.278).

b) **Number of pseudobulbs of the new shoots irrespective of the species**

Effect of media on the number of pseudobulbs was considered irrespective of the species taking the average retransformed values.

Table 23
Effect of growing media on the number of pseudobulbs of the new shoots of <u>Dendrobium moschatum</u>

Treatment	Number of pseudobulbs on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.035 (0.571)	1.769 (2.629)	2.023 (3.591)	2.329 (4.924)	2.579 (5.149)	2.692 (6.747)	2.692 (6.747)
2	2.128 (4.027)	3.718 (13.322)	4.244 (17.511)	4.359 (18.500)	4.408 (18.933)	4.408 (18.933)	4.408 (18.933)
3	1.267 (1.106)	2.411 (5.311)	2.965 (8.293)	3.129 (9.293)	3.129 (9.293)	3.129 (9.293)	3.129 (9.293)
4	1.223 (0.995)	1.781 (2.671)	2.121 (3.999)	2.145 (4.100)	2.145 (4.100)	2.145 (4.100)	2.145 (4.100)
5	1.455 (1.618)	2.818 (7.443)	2.722 (6.910)	2.961 (8.261)	2.961 (8.261)	2.988 (8.426)	2.988 (8.426)
6	1.362 (1.356)	1.810 (2.775)	1.947 (3.292)	1.947 (3.292)	1.947 (3.292)	1.947 (3.292)	1.947 (3.292)
7	2.534 (5.920)	3.487 (11.656)	3.893 (14.659)	4.040 (15.821)	4.040 (15.821)	4.040 (15.821)	4.040 (15.821)
8	2.154 (4.140)	3.271 (10.202)	3.652 (12.834)	3.878 (14.542)	3.878 (14.542)	3.878 (14.542)	3.878 (14.542)
9	2.087 (3.854)	3.624 (12.631)	4.239 (17.468)	4.297 (17.960)	4.297 (17.960)	4.297 (17.960)	4.297 (17.960)
10	1.210 (0.963)	2.368 (5.107)	2.430 (5.404)	2.707 (6.826)	2.707 (6.826)	2.707 (6.826)	2.707 (6.826)
11	1.165 (0.857)	2.562 (6.061)	2.705 (6.815)	2.767 (7.158)	2.767 (7.158)	2.767 (7.158)	2.767 (7.158)
12	1.629 (2.154)	2.521 (5.856)	3.419 (11.190)	3.534 (11.988)	3.534 (11.988)	3.573 (12.264)	3.573 (12.264)
13	2.390 (5.212)	3.777 (13.768)	3.775 (13.749)	3.852 (14.340)	3.852 (14.340)	3.852 (14.340)	3.852 (14.340)
14	1.273 (1.120)	1.866 (2.983)	2.024 (3.597)	2.048 (3.696)	2.048 (3.696)	2.048 (3.696)	2.048 (3.696)
15	1.492 (1.727)	2.282 (4.708)	2.639 (6.467)	2.685 (6.708)	2.685 (6.708)	2.685 (6.708)	2.685 (6.708)
16	1.210 (0.963)	1.471 (1.664)	1.493 (1.729)	1.514 (1.793)	1.514 (1.793)	1.514 (1.793)	1.514 (1.793)
17	2.008 (3.532)	2.279 (4.694)	2.561 (6.061)	2.613 (6.327)	2.613 (6.327)	2.613 (6.327)	2.613 (6.327)
18	1.448 (1.596)	2.676 (6.663)	2.964 (8.286)	2.964 (8.286)	2.964 (8.286)	2.964 (8.286)	2.964 (8.286)
19	1.591 (2.032)	2.314 (4.854)	2.642 (6.479)	2.642 (6.479)	2.642 (6.479)	2.642 (6.479)	2.642 (6.479)
20	1.517 (1.802)	2.508 (5.792)	2.478 (5.641)	2.478 (5.641)	2.478 (5.641)	2.478 (5.641)	2.478 (5.641)
21	1.165 (0.857)	2.505 (5.776)	3.006 (8.534)	3.006 (8.534)	3.006 (8.534)	3.006 (8.534)	3.006 (8.534)
22	1.658 (2.249)	3.298 (10.379)	3.774 (13.743)	3.828 (14.150)	3.774 (13.743)	3.774 (13.743)	3.774 (13.743)
23	1.115 (0.742)	1.482 (1.696)	1.214 (0.973)	1.214 (0.973)	1.720 (2.460)	1.214 (0.973)	1.214 (0.973)
24	1.289 (1.163)	1.720 (2.460)	2.042 (3.671)	1.978 (3.412)	2.042 (3.671)	1.986 (3.443)	1.986 (3.443)
25	1.709 (2.421)	2.591 (6.212)	2.879 (7.788)	2.879 (7.788)	2.879 (7.788)	2.879 (7.788)	2.876 (7.788)
CD (0.05)	NS	NS	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

Table 24

Effect of growing media on the number of pseudobulbs of the new shoots in <u>Dendrobium nobile</u>

Treatment	Number of pseudobulbs on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	1.113 (0.740)	2.222 (4.439)	1.983 (3.432)	2.297 (4.776)	2.197 (4.327)	2.349 (5.018)	2.197 (4.327)
2	1.223 (0.995)	1.698 (2.382)	2.025 (3.601)	1.403 (1.468)	1.482 (1.696)	1.483 (1.696)	1.765 (2.615)
3	1.076 (0.657)	1.983 (3.434)	1.655 (2.239)	1.722 (2.465)	1.853 (2.934)	2.179 (4.248)	2.062 (3.752)
4	1.730 (2.494)	2.880 (7.796)	3.107 (9.153)	2.779 (7.223)	2.484 (5.670)	2.539 (5.947)	2.812 (7.407)
5	2.141 (4.084)	3.106 (9.145)	2.732 (6.964)	2.531 (5.906)	1.688 (2.349)	1.723 (2.469)	1.723 (2.469)
6	1.308 (1.212)	3.948 (15.088)	3.684 (13.072)	4.050 (15.903)	3.048 (8.790)	2.815 (7.424)	3.098 (9.098)
7	1.406 (1.478)	2.360 (5.072)	2.395 (5.236)	2.650 (6.523)	2.815 (7.424)	3.018 (8.608)	1.972 (3.389)
8	1.788 (2.698)	2.825 (7.482)	3.141 (9.366)	3.725 (13.376)	4.028 (15.725)	3.957 (15.158)	3.779 (13.781)
9	1.886 (3.056)	2.549 (5.996)	2.403 (5.274)	3.034 (8.705)	3.093 (9.067)	3.299 (10.383)	3.211 (9.811)
10	1.686 (2.343)	2.370 (5.116)	2.951 (8.208)	3.115 (9.203)	2.809 (7.390)	2.809 (7.390)	2.436 (5.434)
11	2.079 (3.820)	2.243 (4.531)	1.755 (2.580)	2.245 (4.540)	2.298 (4.781)	2.298 (4.781)	2.763 (7.134)
12	0.882 (0.278)	1.432 (1.550)	1.714 (2.438)	1.824 (2.827)	1.909 (3.144)	2.200 (4.340)	2.263 (4.621)
13	1.600 (2.061)	1.475 (1.677)	1.729 (2.489)	2.229 (4.468)	2.583 (6.172)	2.633 (6.433)	2.961 (8.268)
14	1.057 (0.617)	1.267 (1.106)	2.491 (5.705)	2.632 (6.427)	2.384 (5.183)	2.475 (5.537)	1.909 (3.144)
15	1.765 (2.614)	1.830 (2.851)	1.942 (3.271)	2.540 (5.952)	2.723 (6.915)	2.908 (7.956)	2.893 (7.864)
16	1.289 (1.163)	2.206 (4.366)	2.454 (5.522)	2.121 (3.999)	1.149 (0.820)	*	*
17	1.035 (0.571)	1.346 (1.312)	1.750 (2.563)	1.802 (2.747)	1.795 (2.722)	1.830 (2.849)	1.716 (2.445)
18	1.689 (2.352)	2.637 (6.454)	2.251 (4.567)	2.603 (6.276)	1.986 (3.444)	2.195 (4.318)	1.963 (3.353)
19	0.882 (0.278)	0.882 (0.278)	0.990 (0.480)	1.076 (0.658)	1.613 (2.102)	1.613 (2.102)	1.966 (3.365)
20	1.358 (1.345)	1.250 (1.063)	2.033 (3.633)	2.510 (5.800)	1.909 (3.144)	2.310 (4.836)	1.740 (2.528)
21	1.308 (1.212)	2.023 (3.594)	2.212 (4.393)	2.854 (7.645)	3.045 (8.772)	3.138 (9.347)	2.78[illegible] (7.251)
22	1.273 (1.120)	1.378 (1.399)	2.041 (3.666)	2.765 (7.145)	3.143 (9.378)	3.752 (13.578)	3.143 (9.378)
23	0.811 (0.157)	0.990 (0.480)	1.733 (2.503)	1.997 (3.488)	2.288 (4.735)	2.774 (7.195)	2.361 (5.074)
24	1.288 (1.159)	1.788 (2.698)	1.679 (2.319)	2.067 (3.772)	1.972 (3.389)	1.972 (3.389)	1.972 (3.389)
25	1.760 (2.596)	2.038 (3.652)	2.602 (6.270)	2.954 (8.226)	2.972 (8.333)	3.014 (8.584)	3.091 (9.054)
CD (0.05)	NS	1.381	NS	NS	NS	NS	NS

$\sqrt{X + 1/2}$ transformation was used. Values in parentheses indicate retransformed values

* Treatments eliminated as all the replications gave zero values

The information obtained is presented in Table 25 and Fig.5.

The media T_8 (gravel + fibre), T_9 (gravel + husk), T_5 (brick + gravel), T_{22} (charcoal + brick + gravel + husk) and T_7 (brick + husk) were the consistently superior media. On the contrary, T_{16} (charcoal + fibre + husk), T_{24} (charcoal + gravel + fibre + husk), T_3 (charcoal + fibre), T_{23} (charcoal + brick + fibre + husk) and T_{11} (charcoal + brick + gravel) produced consistently low number of pseudobulbs in all the four species, during the different growth stages.

6. **Mortality of plants**

Data collected on the mortality of plants as influenced by the species and treatments are presented in Table 26.

The mortality per cent, when taken irrespective of species, varied very much between the treatments. In T_8 (gravel + fibre) and T_{13} (charcoal + brick + husk) the mortality per cent was zero. But in certain treatments, T_1, T_2, T_{14}, T_{17}, T_{20}, T_{22}, T_{23} and T_{25}, the mortality was more than ten per cent. When the different species were considered, irrespective of the treatments, certain species showed definite superiority in the survival percentage. In D. moschatum, the per cent of mortality was zero and in D. farmeri, 2.4. But in D. nobile and D. fimbriatum, the mortality was relatively high (18.8% and 10.4%, respectively).

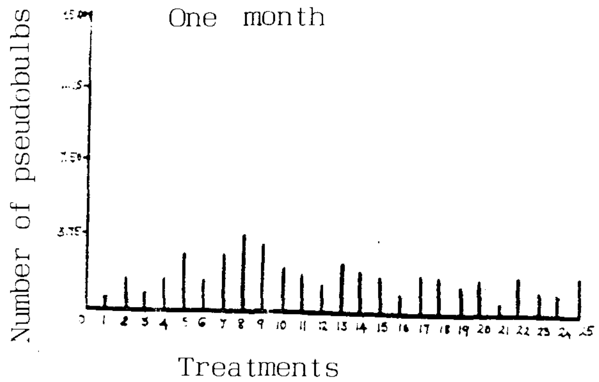
Table 25

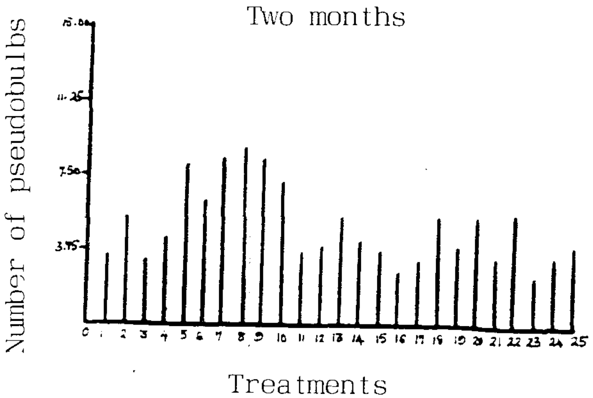
Effect of growing media on the number of pseudobulbs of the new shoots irrespective of species

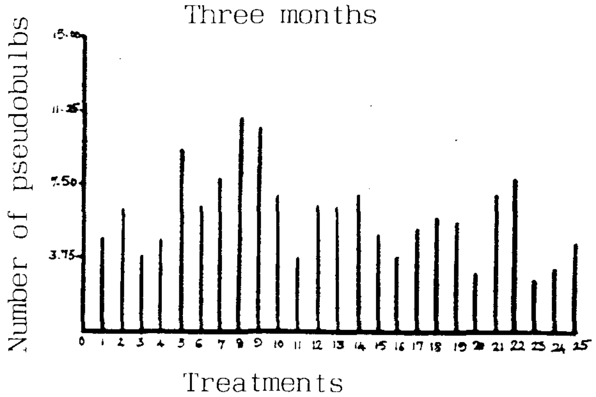
Treatment	Number of pseudobulbs on the new shoots						
	1 month	2 months	3 months	4 months	5 months	6 months	7 months
1	0.664	3.688	4.844	5.983	5.629	6.071	5.598
2	1.680	5.455	6.462	6.562	6.720	6.720	6.950
3	0.931	3.376	3.966	4.345	4.378	4.586	4.462
4	1.679	4.432	4.880	5.192	4.832	4.901	5.266
5	3.124	8.137	9.390	10.025	8.567	8.817	8.637
6	1.422	6.277	6.569	8.011	6.307	5.966	6.384
7	3.123	8.502	8.009	8.801	8.294	8.590	7.285
8	3.996	8.802	11.102	13.249	12.306	12.164	11.820
9	3.552	8.406	10.510	11.789	11.935	11.897	11.754
10	2.378	7.112	7.194	7.578	6.891	7.201	6.273
11	1.830	3.771	3.978	4.371	4.259	4.259	4.847
12	1.432	4.108	6.874	7.309	7.403	7.772	7.842
13	2.544	5.626	6.425	7.323	7.749	7.814	8.362
14	2.240	4.439	6.943	7.621	7.349	7.437	6.839
15	1.887	3.854	5.015	6.205	6.288	6.426	6.525
16	1.039	2.778	3.843	3.831	3.122	2.717	2.917
17	1.981	3.498	5.358	5.986	5.821	6.012	5.641
18	1.845	5.515	5.904	6.445	5.737	5.955	5.714
19	1.486	4.089	5.654	7.388	6.578	6.749	6.894
20	1.744	5.496	3.168	3.815	6.709	7.132	6.555
21	0.681	3.554	7.066	8.100	5.761	5.861	5.504
22	1.963	5.640	7.919	9.405	10.222	11.272	10.222
23	1.090	2.523	2.885	3.528	5.682	4.241	5.395
24	0.934	3.542	3.349	4.462	4.013	3.956	3.956
25	1.985	4.196	4.613	5.474	6.972	7.035	7.153

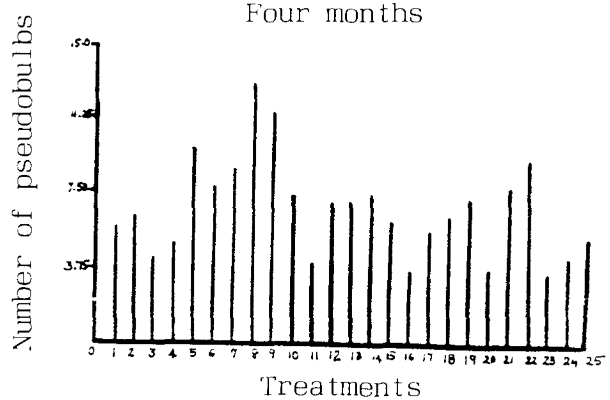
The figures given are mean values of the retransformed values

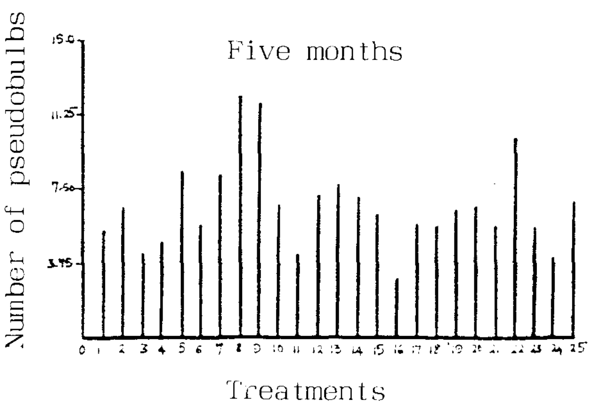
Fig. 5. Effect of growing media on the number of pseudobulbs of the new shoots, irrespective of species.

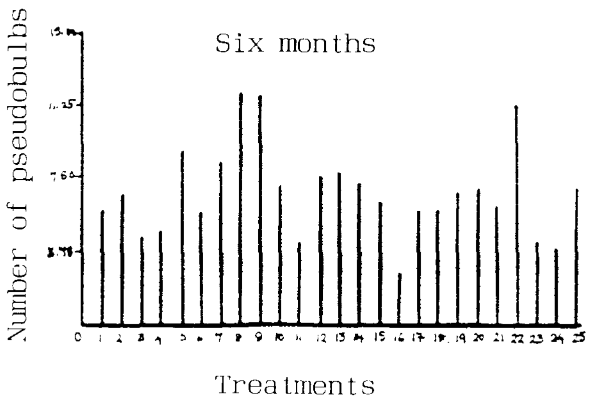












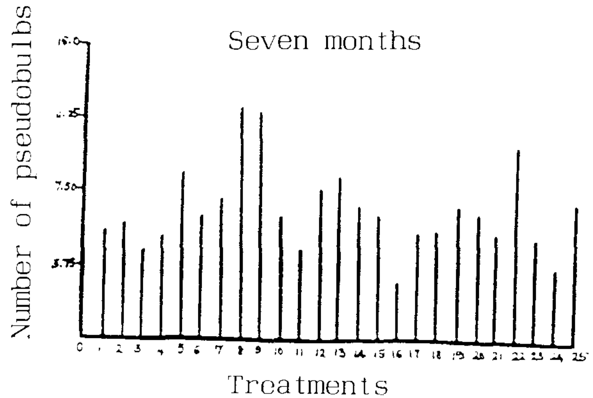


Table 26. Mortality of plants in different species and treatments

Treatment		Number of plants died*				
No.	Components	D. farmeri	D.fimbriatum	D.moschatum	D.nobile	Total
1	Charcoal+brick	0	2	0	3	5 (12.5)
2	Charcoal+gravel	0	1	0	6	7 (17.5)
3	Charcoal+fibre	1	1	0	1	3 (7.5)
4	Charcoal+husk	0	2	0	1	3 (7.5)
5	Brick+gravel	0	1	0	3	4 (10.0)
6	Brick+fibre	0	0	0	1	1(2.5)
7	Brick+husk	0	2	0	0	2(5.0)
8	Gravel+fibre	0	0	0	0	0(0.0)
9	Gravel+husk	0	0	0	1	1(2.5)
10	Fibre+husk	0	0	0	1	1(2.5)
11	Charcoal+brick+gravel	0	1	0	2	3(7.5)
12	Charcoal+brick+fibre	1	1	0	1	3(7.5)
13	Charcoal+brick+husk	0	0	0	0	0(0.0)
14	Charcoal+gravel+fibre	1	0	0	4	5(12.5)
15	Charcoal+gravel+husk	0	0	0	2	2(5.0)
16	Charcoal+fibre+husk	0	0	0	1	1(2.5)
17	Brick+gravel+fibre	0	3	0	3	6(15.0)
18	Brick+gravel+husk	0	1	0	2	3(7.5)
19	Brick+fibre+husk	0	0	0	1	1(2.5)
20	Gravel+fibre+husk	0	1	0	4	5(12.5)
21	Charcoal+brick+gravel+fibre	0	1	0	1	2(5.0)
22	Charcoal+brick+gravel+husk	2	2	0	3	7(17.5)
23	Charcoal+brick+fibre+husk	1	2	0	2	5(12.5)
24	Charcoal+gravel+fibre+husk	0	1	0	1	2(5.0)
25	Brick+gravel+fibre+husk	0	4	0	3	7(17.5)
	Total	6(2.4)	26(10.4)	0(0)	47(18.8)	

* Ten plants were tried/treatment

Figures given in parentheses indicate percentage to total

7. Economics of the media

The economics of the different treatments was worked out taking into consideration the cost of different components of the media as well as the labour charges incurred in preparing the components to suitable size. The data are presented in Table 27.

As evidenced from the Table, the cheapest component was gravel (Rs. 0.35 per pot) followed by charcoal (Rs. 0.56 per pot), brick (Rs. 0.65 per pot), fibre (Rs. 1.20 per pot) and finally, husk (Rs. 1.25 per pot). When the media were taken into consideration T_2 (charcoal + gravel) was the cheapest medium (Rs. 0.45 per pot) and T_{10} (fibre + husk), the costliest (Rs. 1.23 per pot).

Table 27. Economics of different media as influenced by different treatments

Treatment No./components	Cost of components					
	Charcoal (C) @ Rs.0.56/ pot	Brick (B) @ Rs.0.65/ pot	Gravel (G) @ Rs.0.35/ pot	Fibre (F) @ Rs.1.20/ pot	Husk (H) @ Rs.1.25/- pot	Total (Rs.)
1. C + B	0.28	0.32	-	-	-	0.60
2. C + G	0.28	-	0.17	-	-	0.45
3. C + F	0.28	-	-	0.60	-	0.88
4. C + H	0.28	-	-	-	0.63	0.91
5. B + G	-	0.32	0.17	-	-	0.49
6. B + F	-	0.32	-	0.60	-	0.92
7. B + H	-	0.32	-	-	0.63	0.95
8. G + F	-	-	0.17	0.60	-	0.77
9. G + H	-	-	0.17	-	0.63	0.80
10. F + H	-	-	-	0.60	0.63	1.23
11. C + B + G	0.19	0.22	0.12	-	-	0.53
12. C + B + F	0.19	0.22	-	0.40	-	0.80
13. C + B + H	0.19	0.22	-	-	0.42	0.83
14. C + G + F	0.19	-	0.12	0.40	-	0.71
15. C + G + H	0.19	-	0.12	-	0.42	0.73
16. C + F + H	0.19	-	-	0.40	0.42	1.01
17. B + G + F	-	0.22	0.12	0.40	-	0.74
18. B + G + H	-	0.22	0.12	-	0.42	0.76
19. B + F + H	-	0.22	-	0.40	0.42	1.04
20. G + F + H	-	-	0.12	0.40	0.42	0.94
21. C + B + G + F	0.14	0.16	0.09	0.30	-	0.69
22. C + B + G + H	0.14	0.16	0.09	-	0.31	0.70
23. C + B + F + H	0.14	0.16	-	0.30	0.31	0.91
24. C + G + F + H	0.14	-	0.09	0.30	0.31	0.84
25. B + G + F + H	-	0.16	0.09	0.30	0.31	0.86

Discussion

DISCUSSION

Results generated from the studies conducted to examine the effect of different growing media on the growth parameters of Dendrobium are discussed here under.

Orchids exhibit very wide range of plants belonging to innumerable genera and species. There are both epiphytic and terrestrial groups, of which, the epiphytic types are of more importance commercially. From the preliminary studies conducted under All India Co-ordinated Floriculture Improvement Project, Vellanikkara, dendrobiums were found to come up well. Hence, for the present study, four species of Dendrobium, viz., D. farmeri, D. fimbriatum, D. moschatum and D. nobile were used.

Selection of a suitable medium for epiphytic orchids depends not only on its efficiency but also on the availability and cost. Based on the practical experience and easy availability, five components, namely, charcoal, brick, gravel, coconut fibre and husk were used for the preparation of the media.

In order to unravel the possible influence of 25 combinations of media on the above species of Dendrobium, five vegetative parameters, viz., number of new shoots, height of shoots, number of leaves, leaf area and number of pseudobulbs of the new shoots were studied. Among these, the number and height of new shoots, as well as the number of pseudobulbs directly indicate the vigour of the plant. These characters also determine the number of spikes produced by the plant. The number of leaves and leaf area are the factors which contribute towards the developmental aspects of the plant, which in turn will be reflected on the production of flowers.

1. **Number of new shoots**

In a sympodial orchid like Dendrobium, the number of new shoots and keikis produced determine the extent of flower production. When small plants are transplanted in a new medium, immediate response will be to produce new sprouts rather than continuing the growth of the existing shoots.

The results pertaining to the effect of different media on the number of new shoots, show that there was differential response with respect to the species tried. Moreover, significant results were obtained only in D. moschatum, that too at three months after planting. At this stage T_2 (charcoal + gravel) outdid the other treatments by producing an average of 1.370 shoots per plant. This was on par with several other treatments in which all other components were present in one combination or other, along with gravel. It is worth noting that in the media found to be best for each of the four species, gravel was one of the components. The beneficial response shown by the above treatment may be because gravel provides good support for the plants. Bateman (1957) had reported the superiority of gravel over osmunda and bark, observing that plants in gravel culture had more flowers. Similar reports were also made by Pessoa and Pessoa (1985), that small granite stones are potential medium for orchids in high humid conditions. On the other hand, charcoal which forms the other component of the medium provides moisture and aeration. T_{16} (charcoal + fibre + husk) produced the lowest number of shoots in D. moschatum (0.157). Compared to other species, no new shoots were produced by some treatments in D. farmeri. These included T_3 (charcoal + fibre), T_{15} (charcoal + gravel + husk), T_{20} (gravel + fibre + husk) and T_{24} (charcoal + gravel + fibre + husk). In D. nobile, T_{16} (charcoal + fibre + husk) alone exhibited a similar response. In T_{20}, T_{24} and T_{16}, fibre and husk together, was present. In T_3 and T_{15} also, the proportion of moisture holding components might be higher than sufficient. The excess moisture and relatively low aeration provided by fibre and husk might be the reasons for the production of low number of shoots in these treatments. Bhattacharjee (1985), in an experiment with husk and brick media for Rhynchostylis, stated that the husk can hold a lot of moisture. During the initial stages it may enhance the growth, later the rotting and disintegration of husk kill the roots in them. Bose and Bhattacharjee (1980) also found out that, if plants are not repotted frequently into fresh osmunda, the rotting and disintegration of the fibre may lead to badly damaged roots. The findings of the present study could be seen in similar lines.

When the number of new shoots produced during different months of growth was taken into consideration, the active production of shoots was confined to the first two or three months. Thereafter, till seven months after planting, after which the recording of observations was stopped, negligible number of shoots was produced in all the four species tried. This might be because the initial thrust was on the production of new shoots, which was shifted to the growth of shoots in the subsequent months.

The influence of the treatments on the number of shoots produced irrespective of species was also assessed based on retransformed values for all the species during the different months. The aim was to sort out the treatments based on their influence in general to the genus Dendrobium. In general, the treatment T_8 (gravel + fibre) was found to be the best which produced the highest number of shoots followed by T_{22} (charcoal + brick + gravel + husk). The results indicate that, a good support system is as essential as a good supply system, especially during the initial stages of growth in dendrobiums. Taking into consideration the fact that production of new roots and shoots is the first step in the establishment of epiphytic orchids in particular, a judicious mixture of components is of prime importance (Bhattacharjee, 1985). Moreover, in a sympodial orchid, like Dendrobium, the potentiality for the production of new shoots is also dependent upon the initial growing conditions. In orchids, the most important conditions that the media can provide are optimum moisture and aeration. Battacharjee (1980) also highlighted the importance of free circulation of air around the roots, as it facilitated the absorption of atmospheric moisture and hence he suggested loose packing of an open compost in the pots of orchids. With regard to shoot production the inferior treatments were T_{11} (charcoal + brick + gravel), T_{16} (charcoal + fibre + husk), T_{24} (charcoal + gravel + fibre + husk), T_3 (charcoal + fibre) and T_{23} (charcoal + brick + fibre + husk). In T_{11} the possible reason for low number of shoots might be the low moisture content below the optimum requirement. In the other three treatments, a higher moisture content of the media might have lead to the poor performance of the media.

2. Height of the new shoots

The growth habit of a sympodial orchid like Dendrobium is such that the new shoots produced initially grow and bloom after attaining sufficient growth and maturity. So the media which can favourably influence the height and maturity of the shoots in shorter period can be selected as better media.

As in the case of number of shoots, in the height of new shoots also, the species showed differential response to the media tried. Significant response was obtained only in two species, viz., D. moschatum and D. nobile. In D. moschatum, significant influence was obtained one, six and seven months after planting. At one month after planting, T_7 (brick + husk) was the most superior medium producing tallest shoots (14.788 cm). But, both at six and seven months after planting, T_2 (charcoal + gravel) outdid T_7, producing shoots of 40.508 cm height. Both the treatments were on par with several other treatments. In the species D. nobile, the media could exhibit significant influence, two months after planting only. At this stage, the medium T_6 (brick + fibre) proved to be the most superior, differing significantly from all other treatments. In D. moschatum, during the initial stages of growth, media with higher moisture holding capacity proved superior, though later on the preference was for low water holding media. This could be explained by the switching over of the superiority from medium T_7 (brick + husk) during the initial stages to T_2 (charcoal + gravel) during the final stages. The superiority of the media in the different species could be further explained in the light of a good support and supply system provided by the media in conjunction with the response of the different species to the media. This is in confirmation with the reports of Bose and Bhattacharjee (1980) who stated that the potting media differed with the types of orchids. The adequate moisture holding capacity of brick and husk are also to be taken into account. As to charcoal, it could absorb gases that tend to rot the roots, can retain enough moisture and air, preventing unwanted acid buildup (Bhattacharjee, 1985). It is also reported that vandas and ascocendas could be grown in excellent condition in a medium of chunks of hardwood charcoal (Grove, 1988).

The treatments which significantly and adversely affected the growth of the shoots also showed differential response with respect to the species. In D. moschatum, T_{21} (charcoal + brick + gravel + fibre) produced the shortest shoots (0.890 cm), one month after planting, T_{23} (charcoal + brick + fibre + husk) produced the shortest shoots at six and seven months after planting in D. moschatum (1.533 cm) and two months after planting in D. nobile (0.897 cm). Besides the moisture status, the interaction between the media and species could also be attributed to the above response.

If the progressive influence of the media on the height of the shoots is observed, it could be seen that, the rapid increase in height started just two months after planting, by which time the production of new shoots was almost over. The height reached a maximum, five to six months after planting in all the four species. This cessation of growth probably denotes a transitional stage between vegetative growth and flowering. Infact, in D. fimbriatum and D. moschatum, sparse flowering was noticed from seventh month onwards. The influence of the media on the height of the shoots, in general, on the genus Dendrobium was also looked into. The retransformed values for all the four species during the different months of growth was used as the tool. The media which favourably influenced the height of shoots in all the four species were T_8 (gravel + fibre) and T_9 (gravel + husk). The other treatments which exhibited relatively better performance were T_7 (brick + husk), T_5 (brick + gravel) and T_6 (brick + fibre). In T_7 and T_6 there is better balance between the supporting and moisture holding components, whereas, from the favourable response shown by T_5 (brick + gravel), it could be assumed that the moisture held by brick is sufficient for the growth. The influence of different media on the height of the shoots, further highlighted the fact that a good balance between the support and supply systems is important for epiphytic orchids. The treatments which produced shorter shoots were T_{16} (charcoal + fibre + husk), T_{24} (charcoal + gravel + fibre + husk), T_{23} (charcoal + brick + fibre + husk), T_1 (charcoal + brick) and T_4 (charcoal + husk). In the treatments T_{16}, T_{24}, T_{23} and T_4, excess moisture content and poor aeration might be reasons for the failure. In T_1, the components are charcoal and brick. The poor results in this medium could be due to some unfavourable interaction between charcoal and brick. From the experience of Bhattacharjee (1985), brick pieces could hinder root development, making the medium alkaline. Charcoal is also not a good component here, since this would further aggravate the situation by absorbing the acids.

3. Number of leaves on the new shoots

The leaves of epiphytic orchids are specialised for water retention as the leaves are thick and leathery with a glossy coating, which reduces evapotranspiration. The number of leaves is basically a genetic factor which could be modified by agro-climatic conditions. In the present study too, the different media expressed their efficiency in terms of the number of leaves produced. The highest number of leaves borne by a shoot ranged from eight to twelve in the case of D. fimbriatum, D. moschatum and D. nobile, whereas this was only two to four in D. farmeri. The number of leaves reached their maximum at about five months after planting. During the subsequent months one or two oldest leaves were dried up and shed. As leaves are the photsynthesizing units of a plant, apart from the leaf area, higher the number of leaves, higher the benefit to the plant in the form of stored food materials, which help in producing good quality spikes as well as new shoots in the next season. Hence, a medium which could produce shoots with higher number of leaves is to be selected for commercial cultivation.

In this character also differential reponse was exhibited by the four species as influenced by the different media. The two species, namely, D. moschatum and D. nobile, which showed significant response to the media with respect to height, exhibited significant reponse for leaf number also, at one month after planting. In D. moschatum, T_8 (gravel + fibre) produced the highest number of leaves (13.473). This medium was on par with some other media which contained gravel or brick or charcoal as one of the components and fibre or husk, the other. In D. nobile, T_6 (brick + fibre) produced shoots with highest number of leaves (11.026), which was on par with several other media which contained the five components in one combination or other. The above superior media has a supporting component and a supplying component. Bhattacharjee, (1985) has also reported that brick has added advantages, in that it not only provides good support but also holds enough moisture in the pore spaces.

In terms of the inferiority also, the treatments differed with species. In two species, namely, D. moschatum and D. nobile, where the influence was significant, the treatments were T_1 (charcoal + brick) and T_{23} (charcoal + brick + fibre + husk), respectively, producing 0.820 and 0.480 leaves, respectively. In T_{16} no shoot was produced, which in turn had reflected on the number of leaves too. In T_{23} the relatively lesser height of shoots, resulted probably due to the higher proportion of husk, fibre etc, resulted in the production of low number of leaves too. In T_1 (charcoal + brick), on the one hand, the moisture content might have been below the optimum and, on the other hand, some unfavourable interaction between the two components might have taken place, making the medium relatively undesirable.

The influence of the media on the number of leaves, irrespective of species, was also assessed based on retransformed values for all the four species during the different stages of growth. The treatment T_8 (gravel + fibre) gave the highest average value, followed by T_9 (gravel + husk). In both the treatments, gravel was the common component, providing good anchorage. Fibre or husk in the above media provides adequate aeration and moisture to the plants. The other successful media were T_{22} (charcoal + brick + gravel + husk), T_5 (brick + gravel) and T_7 (brick + husk). In these too, a good balance could be seen in respect of anchorage, moisture holding capacity, aeration etc. The media which produced low number of leaves in all the species were T_{16} (charcoal + fibre + husk), T_{11} (charcoal + brick + gravel), T_3 (charcoal + fibre), T_{21} (charcoal + brick + gravel + fibre) and T_{24} (charcoal + gravel + fibre + husk). The probable reason for poor performance in T_3, T_{16} and T_{24} which had high water retention, is suggested elsewhere. It may further be noted that, when the treatments T_{22} (charcoal + brick + gravel + husk) and T_{21} (charcoal + brick + gravel + fibre) are compared, T_{22} was a relatively successful medium in terms of the number of leaves produced. The only difference between these two is the difference between husk and fibre of which husk proved to be a better component than fibre. The reason must be the better water holding capacity because of the more compact nature. The process of disintegration that might have taken place in the case of fibre, might also be a reason. In T_{11} and T_{21}, the unfavourable interaction between charcoal and brick might have aggravated the unfavourable conditions.

4. Area of the new leaves

Leaves are the photosynthetic apparatus of the plants which synthesize carbohydrates and store for the developmental aspects of plants. Hence, more the leaf area, more would be the photo-interception and stored energy. So, the media which could help the plants in producing larger leaves could be called better media. Each species has got a maximum leaf area which it can achieve during the course of its growth. It should not, however, be forgotten that, the size of leaves are to be considered along with the total number of leaves. In the present trial, D. farmeri produced larger leaves as compared to the other three species. But the number of leaves are lower in this species leading to low total leaf area. In D. moschatum the leaves are large and also more in number, thus having highest leaf area per plant, among the four species.

The differential response of species to media is exhibited in the case of leaf area also. In two species, viz., D. farmeri and D. fimbriatum, a significant influence could be produced on the leaf area by the media. In D. farmeri, the significant influence was noticed two months after planting, T_8 (gravel + fibre) giving the highest leaf area of 96.011 cm^2. In D. fimbriatum, significant influence was noticed during four, five, six and seven months after planting, the medium T_5 (brick + gravel) giving the highest leaf area (207.898 cm^2, 215.414 cm^2, 216.002 cm^2 and 216.002 cm^2, respectively). Thus, gravel, which is a *component* in the treatments, once again proved its superiority as a potential component of the medium for orchids.

The poor media were also different for the different species. In the case of D. farmeri at two months after planting, leaf area of the new shoots was the least in T_{13} (charcoal + brick + husk) which recorded a leaf area of 1.331 cm^2. In D. fimbriatum, in which case the influence was significant, the least leaf area (8.179 cm^2 per plant) was produced in T_3 (charcoal + fibre) four months after planting and T_{21} (charcoal + brick + gravel + fibre) gave the lowest leaf area of 8.548 cm^2, 8.784 cm^2 and 8.748 cm^2, during five, six and seven months, respectively. As explained earlier, the poor performance of these treatments might be because of the imbalance (below or above optimum) of moisture and aeration.

The trend of increase in leaf area through different months was similar in all the four species. The leaf area could be recorded only from the second month onwards after planting, as the leaves were unfolded after one month of planting only.

From the retransformed values for the different characters for all the species, taken during the different stages of growth, the influence of the media in general on the genus Dendrobium was assessed. The treatment T_9 (gravel + husk) produced the highest leaf area, followed by T_8 (gravel + fibre), T_{22} (charcoal + brick + gravel + husk), T_5 (brick + gravel) and T_2 (charcoal + gravel). In all the treatments, one of the components was gravel, which again proved its beneficial effects for the growth of epiphytic orchids. Husk and fibre provided good water retention and aeration in combination with gravel, which could not retain any moisture. In T_{22} and T_5, charcoal and brick might have held enough moisture for the orchid roots. The treatments which consistently gave low leaf area for all the four species were T_{16} (charcoal + fibre + husk), T_{24} (charcoal + gravel + fibre + husk), T_1 (charcoal + brick), T_{11} (charcoal + brick + gravel) and T_{21} (charcoal + brick + gravel + fibre). In the first two treatments, viz., T_{16} and T_{24}, high per cent of water holding components might be the drawback of the media. The roots can very easily rot if the medium is not allowed to dryout between waterings (Sessler, 1978) which can happen in the case of a medium with half or more of fibre and husk. In T_{21} (charcoal + brick + gravel + fibre), though fibre is present, the content is only 25 per cent, which might have lead to a moisture depletion below the optimum. Moreover, in T_1, T_{11} and T_{21}, charcoal and brick are common components which are thought to have some unfavourable interactions.

5. Number of pseudobulbs of the new shoots

The stems/canes of most of the orchids are made of numerous segments called pseudobulbs, which can be compared to internodes.

The leaves are produced at the junction of two pseudobulbs. Further, the vegetative buds and the floral buds are produced from the axils of these leaves. In pseudobulbs, the plants store the carbohydrates and water which are used for the further development of the plant. A plant in good growth will have long, thick and more number of pseudobulbs. But each species has pseudobulbs, characteristic of it. In D. fimbriatum, D. moschatum and D. nobile the stems are cane like and the number of pseudobulbs are more as compared to that in D. farmeri. The number of pseudobulbs on the shoot reached its maximum four to five months after planting. The length and thickness of these pseudobulbs may increase further, and then cease .

When the number of pseudobulbs as influenced by the different treatments was considered a differential response was observed with respect to the species. However, the media could produce a significant influence in two of the species, namely, D. farmeri at three months and D. nobile at two months, after planting. In D. farmeri, T_8 (gravel + fibre) gave the highest number of pseudobulbs (7.940). In D. nobile, the treatment that gave highest number of pseudobulbs (15.088) was T_6 (brick + fibre). In these media there were good support and supply systems, the benefits of which were discussed earlier in this chapter.

The media which recorded poor response were different for different species. In D. farmeri and D. nobile, where the differences were significant, the poorest media were T_1 (charcoal + brick) and T_{19} (brick + fibre + husk), producing 0.480 and 0.278 pseudobulbs, respectively. In treatment T_1, the poor response could be due to the inadequate moisture content and unfavourable interaction between charcoal and brick. In T_{19} the reason for poor performance must be high content of fibre and husk, where the moisture status might be above the optimum level.

The influence of the media on all the four species together was assessed based on the retransformed values for the four species during different months of growth. The medium T_8 (gravel + fibre) topped the list, producing the maximum number of pseudobulbs. This treatment was followed by T_9 (gravel + husk), T_5 (brick + gravel), T_{22} (charcoal + brick + gravel + husk) and T_7 (brick + husk). In all these treatments, except one, gravel was one of the components. Similarly in all except one, husk or fibre was a component. Husk can enhance the growth of the plant in the initial stages, apart from retaining enough moisture and aeration (Bose and Bhattacharjee, 1980). But husk and fibre together did not form the components of any of the superior media. There was a perfect balancing between solid, supporting components and fibrous, water retaining components , leading to the superior performance of the media. This also explains why some other treatments produced inferior influence. These treatments were T_{16} (charcoal + fibre + husk) T_{24} (charcoal + gravel + fibre + husk), T_3 (charcoal + fibre), T_{23} (charcoal + brick + fibre + husk) and T_{11} (charcoal

+ brick + gravel). The unfavourable interaction between charcoal and brick in treatment T_{11} repeated in the case of number of pseudobulbs also. In the other treatments, the reason must be, again, excess moisture and poor aeration.

6. Mortality of plants

In the cultivation of a crop, the extent of mortality is an important criterion. Thus, the percentage of survival also becomes important in assessing the suitability of the media. The physico-chemcial nature of the components used, the management practices, climatic conditions, the plant material used etc. contribute towards this aspect. If the results of the present study are analysed critically, it would become clear that, the percentage of survival not only depends on the media, but also on the species. Thus, taken irrespective of the species, it was found that in T_8 (gravel + fibre) and T_{13} (charcoal + brick + husk) the survival was 100 per cent, which again shows the superiority of the former. In eight treatments, T_1, T_2, T_{14}, T_{17}, T_{20}, T_{22}, T_{23} and T_{25}, the mortality was more than ten per cent. When the species were considered irrespective of the media, D. moschatum was found to be the best species in which none of the plants was lost. In D. nobile, on the other hand, about 20 per cent of the plants (47 out of 250) was lost. This indicates that D. moschatum is the hardiest among all the four species tried.

7. Economics of the media

Studies oriented towards practical agriculture will not be complete without taking into consideration the cost of inputs. Hence, the superiority of a medium is to be considered, along with its cost. While estimating the economics of different media, besides the cost of the components, the labour charges for making the components into desirable size was also taken into account. Accordingly, when considered singly, the cheapest material was gravel, which had costed Rs.0.35 per pot, followed by charcoal (Rs. 0.56 per pot). Husk was the costliest material (Rs. 1.25 per pot) while fibre and brick costed Rs. 1.06 and Rs. 0.65, respectively. The components charcoal and gravel were directly used, whereas labour charges were involved in making the other three components into suitable size. When the cost of different treatments was worked out, the range was from Rs. 0.45 in T_2 to Rs. 1.23 in T_{10}. Media used in T_5 (brick + gravel) and T_{11} (charcoal + brick + gravel) were also relatively cheap. The cost was highest in the case of T_{10} because the two components having the highest cost, namely husk and fibre, were used in this treatment. Considering the superiority of treatments in respect of all the five characters studied, as well as the cost, it could be found that T_5 (brick + gravel) was the cheapest medium, costing only Rs.0.49 per pot. This was followed by T_8 (gravel + fibre) and T_9 (gravel + husk), costing

Rs.0.77 and Rs.0.80 per pot, respectively. Among the combinations tried, the above three media have the added advantage that the number of components of the media is the minimum.

Summary

SUMMARY

A study was conducted at the College of Horticulture, Vellanikkara, during 1988-89, to examine the effect of different growing media on the vegetative parameters of four species of *Dendrobium*, viz., *D. farmeri*, *D. fimbriatum*, *D. moschatum* and *D. nobile*. The salient results of the study are summarised below.

1. In producing new shoots, the media could exert a significant influence only in the species *D. moschatum*, three months after planting. In T_2 (charcoal + gravel) maximum number of shoots was produced. Media, with gravel as one of the components, were favouring the production of new shoots. T_{16} (charcoal + fibre + husk) produced the minimum number of shoots. When the influence of the media was considered irrespective of species, it was T_8 (gravel + fibre) which showed superiority, whereas T_{16} (charcoal + fibre + husk) was the most inferior medium.

2. The media could significantly influence the height of the plants in two species, viz., *D. moschatum* and *D. nobile*. In *D. moschatum* the influence was significant during three stages of growth. At one month after planting, T_7 (brick + husk) produced tallest shoots and T_{21} (charcoal + brick + gravel + fibre) produced the shortest shoots. In the other superior media, gravel was one of the components. At six and seven months after planting, T_2

(charcoal + gravel) produced the tallest shoots and T_{23} (charcoal + brick + fibre + husk), the shortest. In D. nobile, significant influence was noticed two months after planting and the media T_6 (brick + fibre) produced the tallest shoots. The medium was significantly superior to all other media. In this species also, the medium T_{23} produced the shortest shoots. When the influence of the media was considered irrespective of species, certain media proved superior and certain others, inferior. As in the case of the number of shoots here also T_8 (gravel + fibre) was the medium that consistently gave good performance, whereas in T_{16} (charcoal + fibre + husk), all the species produced short shoots.

3. In D. moschatum and D. nobile, the media significantly influenced the number of leaves on the new shoots produced at one month after planting. In D. moschatum, T_8 (gravel + fibre) produced the maximum number of leaves , whereas, T_1 (charcoal + brick) was the most inferior medium. In D. nobile, T_6 (brick + fibre) proved to be the most superior treatment. T_{23} (charcoal + brick + fibre + husk), which had produced the shortest shoots in this species, also produced the lowest number of leaves. When the influence of the media on the production of leaves, in general, was considered irrespective of species, T_8 proved to be the most superior and T_{16} (charcoal + fibre + husk) the most inferior medium. In the other vegetative parameters like number and height of the

new shoots also, T_8 was the most superior and T_{16} was the most inferior media.

4. Area of the new leaves was also significantly influenced by the media in two species, viz., D. farmeri and D. fimbriatum. In D. farmeri, the influence was significant two months after planting. The medium that produced maximum leaf area was T_8 (gravel + fibre) and the medium that produced the minimum leaf area was T_{13} (charcoal + brick + husk). In D. fimbriatum, significant influence was observed four, five, six and seven months after planting. During these months, T_5 (brick + gravel) produced the highest leaf area. Most of the other media with superior performance contained gravel as one of the components. At four months, T_3 (charcoal + fibre) produced the least leaf area and during five, six and seven months, T_{21} (charcoal + brick + gravel + fibre) proved to be the consistently inferior medium. When the influence of the media on leaf area was considered irrespective of species, T_9 (gravel + husk) proved to be most superior, closely followed by T_8. The medium T_{16} (charcoal + fibre + husk) was relatively inferior.

5. The media could significantly influence the number of pseudobulbs in two species, viz., D. farmeri and D. nobile. In D. farmeri, significant influence was exhibited three months after

planting, whereas it was two months after planting in D. nobile. In D. farmeri, T_8 (gravel + fibre) excelled the other media. In most of the other superior media, gravel was one of the components. In this species, T_1 (charcoal + brick) produced the lowest number of pseudobulbs. In D. nobile, the medium that produced the highest number of pseudobulbs was T_6 (brick + fibre). In most of the other superior media, gravel was one of the components. T_{19} (brick + fibre + husk) produced the lowest number of pseudobulbs in this species. When the effect of the media on the number of pseudobulbs of the new shoots was considered irrespective of the species, the medium T_8 proved to be consistently superior and T_{16} (charcoal + fibre + husk), consistently inferior. The medium T_8 was the superior medium for all the vegetative parameters considered. Similarly T_{16} was the most inferior medium for all the vegetative parameters considered, irrespective of the species.

6. The extent of mortality of the plants also exhibited variation. When the treatments were considered irrespective of the species, T_8 (gravel + fibre) and T_{13} (charcoal + brick + husk), recorded no mortality. But in treatments T_1 (charcoal + brick), T_2 (charcoal + gravel), T_{14} (charcoal + gravel + fibre), T_{17} (brick + gravel + fibre), T_{20} (gravel + fibre + husk), T_{22} (charcoal + brick + gravel + husk), T_{23} (charcoal + brick + fibre + husk) and T_{25} (brick + gravel + fibre + husk), the mortality was more

than ten per cent. When the species were considered irrespective of treatments, in D. moschatum, the mortality was zero. In D. farmeri, D. fimbriatum and D. nobile, the mortality per cent was 2.4, 10.4 and 18.8, respectively.

7. The economics of different components of the media revealed that, the cheapest was gravel and the costliest one, husk. Considered as media, T_2 (charcoal + gravel) was the cheapest and T_{10} (fibre + husk) the costliest. For the media with superior performance, like T_8 (gravel + fibre), T_9 (gravel + husk) and T_5 (brick + gravel), the expense was Rs.0.77, Rs.0.80 and Rs.0.49, respectively, per pot.

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* Originals not seen.

Appendices

Appendix I. Meteorological parameters of the experimental site at the College of Horticulture, Vellanikkara, for the period from July 1988 to February 1989

Year and month	Mean temperature(°C)		Mean relative humidity (%)	Rainfall (mm)	Number of rainy days per month	Mean sunshine (hours)
	Maximum	Minimum				
1988						
July	29.0	23.2	88	545.0	26	3.0
August	29.2	24.3	86	507.8	25	3.7
September	29.9	23.2	85	700.0	24	5.1
October	31.7	23.3	78	116.6	9	7.1
November	32.6	22.9	68	11.0	1	7.9
December	32.6	22.3	57	14.9	2	9.0
1989						
January	33.4	22.2	54	0	0	8.1
February	36.3	21.2	45	0	0	9.8

Appendix II Abstract of analysis of variance for the effect of different media at different months after planting

Months after planting	Source			
	Treatment		Error	
	df	MSS	df	MSS
(1)	(2)	(3)	(4)	(5)
1. Number of new shoots				
a) Dendrobium farmeri				
One	19	0.179	80	0.144
Two	21	0.199	88	0.153
Three	22	0.209	92	0.136
Four	19	0.200	79	0.126
Five	20	0.159	83	0.124
Six	19	0.137	79	0.127
Seven	20	0.141	82	0.121
b) Dendrobium fimbriatum				
One	24	0.140	100	0.216
Two	24	0.172	100	0.239
Three	24	0.179	99	0.224
Four	24	0.145	97	0.224
Five	24	0.131	97	0.232
Six	24	0.116	97	0.236
Seven	24	0.116	97	0.236
c) Dendrobium moschatum				
One	24	0.141	100	0.092
Two	24	0.123	100	0.083
Three	24	0.123*	100	0.075
Four	24	0.114	100	0.075
Five	24	0.114	100	0.075
Six	24	0.119	100	0.075
Seven	24	0.119	100	0.075

Appendix II (Contd ....)

(1)	(2)	(3)	(4)	(5)
d) Dendrobium nobile				
One	24	0.230	100	0.218
Two	24	0.211	100	0.185
Three	24	0.162	98	0.187
Four	24	0.200	95	0.185
Five	24	0.200	91	0.194
Six	23	0.176	85	0.217
Seven	23	0.196	85	0.229
2. Height of the new shoots				
a) Dendrobium farmeri				
One	19	1.628	80	1.210
Two	21	2.450	88	1.800
Three	22	2.565	92	1.960
Four	19	2.367	79	1.803
Five	20	2.526	83	1.662
Six	20	2.172	82	1.811
Seven	20	2.166	82	1.811
b) Dendrobium fimbriatum				
One	24	1.190	100	1.391
Two	24	2.976	100	2.485
Three	24	4.846	99	3.559
Four	24	4.342	97	3.727
Five	24	4.806	97	4.008
Six	24	4.622	97	3.995
Seven	24	4.641	97	4.059

Appendix II (Contd ....)

(1)	(2)	(3)	(4)	(5)
c) Dendrobium moschatum				
One	24	2.469*	100	1.494
Two	24	5.476	100	4.410
Three	24	7.465	100	5.506
Four	24	7.811	100	5.539
Five	24	7.804	100	5.618
Six	24	9.079*	100	5.432
Seven	24	8.141*	100	5.619
d) Dendrobium nobile				
One	24	1.636	100	1.772
Two	24	6.909*	100	3.007
Three	24	5.353	98	3.849
Four	24	5.383	95	4.463
Five	24	4.946	91	4.941
Six	23	3.884	85	5.173
Seven	23	3.678	85	5.480
3. Number of leaves on the new shoots				
a) Dendrobium farmeri				
One	17	0.326	72	0.364
Two	21	0.590	88	0.442
Three	22	0.605	92	0.431
Four	19	0.637	79	0.395
Five	19	0.499	79	0.382
Six	20	0.564	82	0.491
Seven	20	0.622	82	0.420

Appendix II (Contd ....)

(1)	(2)	(3)	(4)	(5)
b) Dendrobium fimbriatum				
One	24	1.167	100	1.611
Two	24	2.653	100	2.087
Three	24	2.884	99	2.340
Four	24	2.680	97	2.360
Five	24	2.259	97	2.435
Six	24	2.199	100	2.392
Seven	24	2.040	97	2.282
c) Dendrobium moschatum				
One	24	2.100*	100	1.025
Two	24	2.743	100	2.611
Three	24	2.844	100	1.871
Four	24	2.623	100	1.851
Five	24	2.627	100	1.802
Six	24	2.166	100	1.715
Seven	24	2.166	100	1.715
d) Dendrobium nobile				
One	24	2.142*	100	1.219
Two	24	0.781	100	0.837
Three	24	1.596	97	1.603
Four	24	1.584	96	1.445
Five	24	1.792	92	1.592
Six	23	1.439	85	1.560
Seven	23	1.149	85	1.563

Appendix II (Contd ....)

(1)		(2)	(3)	(4)	(5)
4.	Leaf area of the new shoots				
a)	*Dendrobium farmeri*				
	Two	23	23.713*	96	13.001
	Three	22	23.226	92	16.967
	Four	19	21.026	79	16.625
	Five	18	17.850	75	15.679
	Six	19	17.064	79	17.059
	Seven	20	18.245	82	15.946
b)	*Dendrobium fimbriatum*				
	Two	23	33.641	94	22.100
	Three	24	43.841	99	30.503
	Four	24	54.522*	97	32.466
	Five	24	61.856*	97	34.663
	Six	24	60.636*	97	33.922
	Seven	24	60.636*	97	33.922
c)	*Dendrobium moschatum*				
	Two	24	58.466	100	36.994
	Three	24	57.471	100	43.462
	Four	24	64.167	100	44.823
	Five	24	68.502	100	46.676
	Six	24	67.657	100	46.895
	Seven	24	67.657	100	46.895

Appendix II (Contd ....)

	(1)	(2)	(3)	(4)	(5)
d)	<u>Dendrobium nobile</u>				
	Two	24	23.461	100	15.546
	Three	24	23.656	99	20.153
	Four	24	30.694	95	25.632
	Five	24	36.105	91	32.121
	Six	23	33.008	86	31.039
	Seven	23	26.525	84	32.169
5.	Number of pseudobulbs of the new shoots				
a)	<u>Dendrobium farmeri</u>				
	One	18	0.838	76	0.715
	Two	20	1.120	84	0.940
	Three	22	1.391*	92	0.821
	Four	19	1.207	79	0.835
	Five	19	1.112	79	0.819
	Six	19	1.033	79	0.837
	Seven	20	1.082	82	0.792
b)	<u>Dendrobium fimbriatum</u>				
	One	24	0.546	100	0.856
	Two	24	1.440	100	1.565
	Three	24	2.738	99	1.977
	Four	24	2.755	98	2.343
	Five	24	2.321	97	2.675
	Six	24	2.476	97	2.728
	Seven	24	2.321	97	2.675

Appendix II (Concl ....)

c) Dendrobium moschatum

One	24	0.892	100	0.611
Two	24	2.398	100	1.834
Three	24	3.337	100	2.266
Four	24	3.568	100	2.410
Five	24	3.210	100	2.450
Six	24	3.532	100	2.434
Seven	24	3.532	100	2.434

d) Dendrobium nobile

One	24	0.892	100	0.611
Two	24	2.398	100	1.834
Three	24	3.337	100	2.266
Four	24	3.568	100	2.410
Five	24	3.210	100	2.450
Six	24	3.532	100	2.434
Seven	24	3.532	100	2.434

* Significant at 5% level

Appendix III. CD Matrix at 5% level

A. Area of the new leaves in Dendrobium fimbriatum, four months after planting

	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
24	7.146																							
23	7.580	7.580																						
22	7.146	7.146	7.580																					
21	7.580	7.580	7.990	7.580																				
20	7.146	7.146	7.580	7.146	7.580																			
19	7.146	7.146	7.580	7.146	7.580	7.146																		
18	7.146	7.146	7.580	7.146	7.580	7.146	7.146																	
17	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146																
16	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146															
15	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146														
14	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146													
13	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146												
12	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.466	7.146	7.146	7.146	7.146											
11	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146										
10	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146									
9	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146								
8	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146							
7	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146						
6	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146					
5	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146				
4	7.580	7.580	7.990	7.580	7.990	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580	7.580			
3	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.580		
2	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.580	7.146	
1	7.146	7.146	7.580	7.146	7.580	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.146	7.580	7.146	7.146

Appendix III. CD Matrix at 5% level (Contd.)

B. Area of the new leaves in <u>Dendrobium fimbriatum</u>, five months after planting

	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
24	7.384																							
23	7.832	7.832																						
22	7.384	7.384	7.832																					
21	7.832	7.832	8.255	7.832																				
20	7.384	7.384	7.832	7.384	7.832																			
19	7.384	7.384	7.832	7.384	7.832	7.384																		
18	7.384	7.384	7.832	7.384	7.832	7.384	7.384																	
17	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384																
16	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384															
15	7.384	7.384	7.382	7.384	7.832	7.384	7.384	7.384	7.384	7.384														
14	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384													
13	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384												
12	7.384	7.384	7.382	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384											
11	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384										
10	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384									
9	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384								
8	7.384	7.384	7.382	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384							
7	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384						
6	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384					
5	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384				
4	7.832	7.832	8.255	7.832	8.255	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832	7.832			
3	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.832		
2	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.832	7.384	
1	7.384	7.384	7.832	7.384	7.832	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.384	7.832	7.384	7.384

Appendix III. CD Matrix at 5% level (Contd.)

C. Area of the new leaves in Dendrobium fimbriatum, six months after planting

	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
24	7.305																							
23	7.748	7.748																						
22	7.305	7.305	7.748																					
21	7.748	7.748	8.167	7.748																				
20	7.305	7.305	7.748	7.305	7.748																			
19	7.305	7.305	7.748	7.305	7.748	7.305																		
18	7.305	7.305	7.748	7.305	7.748	7.305	7.305																	
17	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305																
16	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305															
15	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305														
14	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305													
13	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305												
12	7.305	7.305	7.488	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305											
11	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305										
10	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305									
9	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305								
8	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305							
7	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305						
6	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305					
5	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305				
4	7.748	7.748	8.167	7.748	8.167	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748			
3	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.748		
2	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.748	7.305	
1	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.748	7.305	7.305

Appendix III · CD Matrix at 5% level (Concl.)

D. Area of the new leaves in Dendrobium fimbriatum, seven months after planting

	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
24	7.305																							
23	7.748	7.748																						
22	7.305	7.305	7.748																					
21	7.748	7.748	8.167	7.748																				
20	7.305	7.305	7.748	7.305	7.748																			
19	7.305	7.305	7.748	7.305	7.748	7.305																		
18	7.305	7.305	7.748	7.305	7.748	7.305	7.305																	
17	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305																
16	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305															
15	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305														
14	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305													
13	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305												
12	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305											
11	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305										
10	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305									
9	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305								
8	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305							
7	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305						
6	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305					
5	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305				
4	7.748	7.748	8.167	7.748	8.167	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748	7.748			
3	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.748		
2	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.748	7.305	
1	7.305	7.305	7.748	7.305	7.748	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.305	7.748	7.305	7.305

STANDARDIZATION OF GROWING MEDIA FOR DENDROBIUMS (*Dendrobium spp.*)

By

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ABSTRACT OF THE THESIS

Submitted in partial fulfilment of
the requirement for the degree

Master of Science in Horticulture

Faculty of Agriculture
Kerala Agricultural University

Department of Horticulture
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COLLEGE OF HORTICULTURE

VELLANIKKARA - TRICHUR

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1989

ABSTRACT

The study was conducted at the College of Horticulture, Vellanikkara, during 1988-89. The object of the study was to examine the effect of different growing media on the vegetative parameters of epiphytic orchids. Four species of Dendrobium, viz., D. farmeri, D. fimbriatum, D. moschatum and D. nobile, selected based on their general performance at Vellanikkara conditions, were utilized for conducting the study. As the components of the media, five materials, viz., charcoal, brick, gravel, coconut fibre and husk, which were available locally, cheap and satisfying the growth requirements of epiphytic orchids were selected. All possible combinations of these media, excluding their straight use, as well as the combination of all the five, were tried, thus constituting 25 treatments. The plant growth was observed based on five salient parameters recorded at monthly intervals, for seven months. There were ten plants in each treatment, from which five plants were randomly selected for taking the observations. The experiment was laid out in a completely randomised design. The results revealed that the media could significantly influence all the five vegetative characters, viz., number of new shoots, height, leaves, leaf area and number of pseudobulbs of the new shoots, in one species or other.

The number of new shoots was significantly influenced by the media in D. moschatum alone. Maximum number of shoots was

produced in the medium charcoal + gravel, three months after planting, which was on par with some other media, majority of which contained gravel.

The media could significantly influence the height of the new shoots in D. moschatum and D. nobile. In the former, brick + husk produced the tallest shoots after one month, and charcoal + gravel, at six and seven months after planting. In D. nobile, the medium brick + fibre produced the tallest shoots, two months after planting. The medium gravel + fibre could favourably influence the height of the shoots throughout the growing period, when considered irrespective of species.

Significant influence was exhibited by the media on the number of leaves in two species, viz., D. moschatum and D. nobile, one month after planting. In D. moschatum, the medium gravel + fibre produced the highest number of leaves whereas it was in brick + fibre where the highest number of leaves was produced in D. nobile. Gravel + fibre recorded the highest number of leaves when the effect of media was considered irrespective of the species.

The media could significantly influence the leaf area in D. farmeri and D. fimbriatum. The medium gravel + fibre produced the maximum leaf area in D. farmeri, at two months after planting. In D. fimbriatum, brick + gravel produced the maximum leaf area at four, five, six and seven months after planting. Irrespective of species, in gravel + husk the maximum leaf area was recorded throughout the growing period.

Significant influence of the media could be observed on the number of pseudobulbs in D. farmeri and D. nobile. The medium gravel + fibre produced the highest number of pseudobulbs in D. farmeri, three months after planting. In D. nobile, brick + fibre produced the maximum number of pseudobulbs two months after planting. The medium gravel + fibre produced consistently high number of pseudobulbs, when the influence of the media was considered irrespective of species.

The mortality of the plants was taken into consideration, with respect to treatments and also with respect to species. In the media gravel + fibre and charcoal + brick + husk, the survival was 100 per cent. In respect of the species, mortality was zero in D. moschatum, when considered irrespective of the treatments, indicating the species to be the hardiest among the four species tried.

As to the economics of the media, gravel was the cheapest and husk was the costliest. The media with superior performance, like gravel + fibre, gravel + husk and brick + gravel costed Rs. 0.77, Rs. 0.80 and Rs. 0.49, respectively, per pot.