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Harnessing orchids for traditional medicine: Cultivation and biodiversity conservation in Nirmala College campus, Coimbatore, Tamilnadu

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Abstract
This investigation looks at how well orchids grow on a range of substrates, including sawdust, charcoal, coconut shell, and coconut coir, in order to identify the ideal media for orchid growth. Orchids are epiphytic plants requiring well-aerated and moisture – retentive substrates for successful growth. The study involved cultivating orchids on these four substrates under controlled condition, assessing parameters such as plant height, leaf number, root development and flowering rate. Results indicated that charcoal provided excellent aeration and root support, promoting robust root growth and healthier plants. Coconut coir retained moisture effectively but risked overwatering, while sawdust and coconut shell showed moderate growth outcomes. The finding suggests that a combination of these substrates could optimize orchid growth by balancing moisture retention and aeration. This research supports sustainable orchid cultivation by utilizing locally available organic materials, providing insights for both commercial growers and conservationists aiming to enhance orchid propagation.

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INTRODUCTION

Orchids, which are belongs to the orchidaceae family of the kingdom Plantae. Orchids is the second largest group in the world (Willis, 2017) consisting of over 30,000 species grouped in more than 880 genera (Cakova *et al*., 2015) and recognized globally for offering diverse ecosystem services, different parts of these plants are utilized for medicinal applications, including the making of teas, infusions, ointments, and even as food sources (Tamang *et al*., 2021; Wang *et al.*, 2021). This orchid group faces major threats from factors such as habitat

fragmentation, climate change, and commercialization for ornamental use, among others (Wraith &Pickering, 2017; Jimenez-Lopez *et al.,* 2019a)

Orchids help stabilize ecosystems by preventing soil erosion in their natural habitats. In tropical forests, they contribute to canopy biodiversity, supporting microhabitats for insects and small animals. Their presence in wetland ecosystems aids in water filtration and moisture retention. Moreover, orchids serve as ecological indicators, reflecting environmental changes and helping conservationists assess habitat health, (Sachin *et al*., 2020).

An unique and valuable crop, orchids are currently being grown commercially due to their amazing variety of color patterns, excellent storage quality, and alleged medical benefits. Orchids are grown for decorative purposes and have a wide range of traditional uses, recent biotechnology breakthroughs in orchids have significantly contributed to the production of exotic varieties with improved medicinal and aesthetic values (Diksha Choudhary *et al*., 2023). Sphagnum moss is beneficial for orchid cultivation because it holds moisture and encourages airflow. Orchid substrates, such as bark and coconut husk, must drain well to promote strong root development. Rooftop tiles are a sustainable option for orchid cultivation due to their improved drainage and aeration capabilities (Kaveriamma *et al*., 2019).

Cultivation involves optimizing soil, water, light, and temperature for healthy plant growth. Orchids require specific conditions like well-draining media, bright indirect light and controlled humidity. It helps to grow endangered species successfully (Singh *et al*., 2015; Arkan setiaji *et al.,* 2021; Yunanda *et al.,* 2023). Bio-conservation efforts are crucial to preserving orchid biodiversity, with both in-situ (protected areas) and ex-situ (seed banking) methods used to safeguard orchids (Vaishnavi *et al*., 2021).
This study emphasizes the ecological and economic benefits of orchid propagation, highlighting medicinal use and the entrepreneurial potential of cultivating orchids in local communities.

MATERIALS AND METHODS

Study Area

The study focused on orchids from the Orchidaceae family collected from the Nirmala College campus, located in Coimbatore district, Tamil Nadu, India, positioned at 11º North latitude and 76º East longitude. The region is bordered by the Western Ghats and lies at 411 meters above sea level on the banks of the Noyal River. The area experiences temperatures between 11.7°C and 42.6°C. Red calcareous, black, red non-calcareous, alluvial, colluvial brown, and forest soils are among the soil types found in Coimbatore. The area experiences an average annual rainfall of 3107mm and has an average daily temperature of around 37ºC.

Sample Collection

The orchids studied were collected in December 2024 Nirmala College campus, located in Coimbatore district, Tamil Nadu, India. The species, including *Cattleya trianae* Lindl., *Cattleya warneri* Lou C., *Cymbidium devonianum*, Rchb.f., *Dendrobium anosmum*, L., *Dendrobium burana* Jade, *Dactylorhiza praetermissa*, Rchb.f., *Dendrobium speciosum* Jade., *Oncidium sphacelatum* Lindl., *Phalaenopsis difformis* Wall., and *Vanda coerulea* Giff., were cultivated at Nirmala College using a growth medium consisting of charcoal, sawdust, coconut coir, and coconut shell for proper aeration, moisture retention, and root anchorage.

Materials for Orchid Cultivation

- **Plastic Pots**: Lightweight, durable, and moisture-retentive, plastic pots are ideal for orchids due to their excellent drainage, visibility for root health, and compatibility with various growing mediums.
- **Charcoal**: Used as a substrate for orchids, charcoal improves aeration, drainage, and moisture control while also filtering toxins and maintaining pH balance.
- **Sawdust**: Used as an alternative substrate, sawdust offers moisture retention but requires careful monitoring of aeration and drainage to prevent root rot.
- **Coconut Shell**: A durable and moisture-retentive substrate, coconut shell is ideal for epiphytic orchids. It offers excellent drainage

but requires soaking to reduce acidity before use.

- **Coconut Coir**: A sustainable, moisture-retentive substrate, coconut coir helps maintain proper root hydration and aeration, though it can break down over time and may need mixing with other materials.

Fertilizers and Growth Aids

- **Potato Extract**: Rich in nutrients, it aids in orchid tissue culture, root development, and overall plant growth. It also has antimicrobial properties.

  Garlic Extract: Known for its antifungal and antibacterial properties, garlic extract helps protect orchids from diseases and pests while stimulating root growth.

3. RESULTS AND DISCUSSIONS

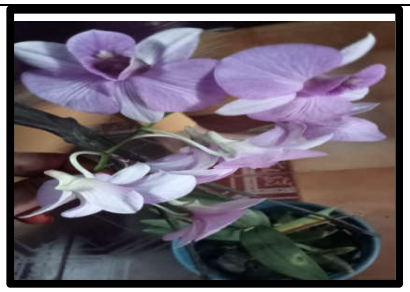
Morphology, uses and figures of selected orchids

Orchids from the Orchidaceae family collected from the Nirmala College campus, located in Coimbatore district, Tamil Nadu, India. They are widely used in landscaping, Campus decor and floral arrangement due their exotic appeal and long-lasting blooms, beyond aesthetics, orchids have medicinal and culinary some traditional medicines use orchids for treating ailments like fever digestive issues. Orchids play a role in perfumery and cosmetics. There are 10 species of orchids in the College campus listed in the table-1 with morphology, uses and figures.

Table 1: Selected Orchid and their Morphology

S. No	Sample	Morphology	Uses	Figure
1	*Cattleya trianae* Lindl.	Glossy dark green leaves, and large, fragrant flowers with pink or purple lips and a yellow-orange throat.	Ornamental uses.	
2	*Cattleya warneri* LouC.	Flowers range from purple to pink.	Ornamental uses.	

3	***Cymbidium devonianum*** Rchb.f	Large green, yellow, and brown flowers with purple/red markings.	Ornamental and supports biodiversity.	
4	***Dendrobium anosmum* L.**	Slender stems with pale pink to lavender flowers, emitting a mild fragrance.	Ornamental, medicinal use and supports pollinators.	
5	***Dendrobium burana*** Jade. (Burana Jade)	Small flowers in white, yellow and pink hues.	Ornamental and medicinal uses.	
6	***Dactylorhiza praetermissa*** Rchb.f.	Pale pink flowers with purple spots, grown in meadows or wetlands.	Ornamental use, biodiversity support and wetland restoration.	
7	***Dendrobium speciosum* Jade.** (Rock Orchid)	Robust pseudo bulbs and waxy flowers in shades of white, cream, yellow, pink or purple.	Ornamental uses.	

8	***Oncidium sphacelatum*** Lindl.	Small flowers in yellow, brown and red.	Ornamental and Medicinal uses.	
9	***Phalaenopsis differmis*** Wall.	Moth-like flowers in pink, yellow and purple.	Ornamental use.	
10	***Vanda coerulea*** Giff.	Large flowers in blue, purple, and yellow with leathery leaves.	Ornamental and medicinal uses.	

Cultivation of orchids *Dendrobium burana* using different substrate

Charcoal

The use of charcoal in planting an orchid proved to be a wise decision, despite the initial slow growth. It took approximately a month for the orchid to exhibit noticeable sings of development. During the period, orchid received adequate water, nutrients and optimal conditions like temperatures between 18^0C to 30^0C, humidity between 50-70% and indirect light. As the orchid began to thrive, its root developed and leaves unfurled. The wait was worthwhile, as the orchid grew stronger and more vibrant. Charcoal played a crucial role in this process, providing a stable foundation for growth. With patience and proper care, the orchid flourished and its beauty was a reward for the wait.

Sawdust

Sawdust took approximately 37 days (1 month and 7 days) for the orchid to exhibit noticeable signs for growth. Sawdust improves moisture retention, which lessens the frequency of watering. Additionally, it has better drainage, which keeps water logging and root rot at bay. Compared to other potting media, the orchid grows a little more slowly in sawdust, but the root becomes healthier and stronger. Compared to orchids grown in water, orchids planted in sawdust develop 20–30% more slowly. Sawdust lowers the risk of overwatering and root rot by giving the orchid a more stable and reliable habitat.

Coconut Coir

Growing orchids on coconut coir yields impressive results. Germination occurs within 7-10 days, followed by a seedling stage of 1-2 months and maturation stage of 3-6 months.

Coconut coir's excellent water retention, aeration, and neutral pH create an ideal environment for orchid. Additionally, its antifungal properties and eco-friendly nature make it an attractive choice. Compared to other media, coconut coir promotes faster growth rates and better nutrients uptake, resulting in stronger and more robust plants.

Coconut shells

Coconut shell have natural holes and a porous structure, providing excellent drainage and preventing water logging, the holes and pores in coconut shells allow for good air circulation, and promoting health root growth and development. Orchid grown in coconut shells exhibit impressive growth rates, reaching maturity in approximately 2 months and 16 days, are around 80 days. Compared to those grown in water, orchids in coconut shells grow 15-20% faster, demonstrating these benefits of this unique medium. Additionally, coconut shells retime 20-25% more water than water alone, reducing the need for frequent watering and promoting health growth. Root development is also accelerated, with orchid in coconut shells developing roots 10-15% faster, than those in water. While these values are approximate and may vary depending on factors like orchid species, coconut shell quality, and environmental condition, they highlight the advantages of using coconut shells are a growth medium.

Potato extract

Potato extract is a versatile and beneficial product with various uses in gardening and plant care. As an orchid growth promoter, it encourages healthy growth and development in orchids. Additionally, potato extract serves as a natural fertilizer, providing essential nutrients to plants. It can also be used as a soil conditioner to improve soil structure and fertility. Furthermore, its anti-microbial properties make it an effective pest control agent, helping to prevent the growth of harmful bacteria and fungi. The benefits of potato extract are numerous, including in richness in essential nutrients like potassium, magnesium and Sulphur. It also contains plant hormones that regulate cell growth differentiation. Its anti-microbial properties and pH balancing capabilities create an optimal environment for plant growth. As a natural and organic product, potato extract is an environmentally friendly choice, and its cost-effectiveness makes it an attractive alternative to synthetic fertilizer and growth promoters.

Garlic extract

The Sulphur compounds in garlic stimulate root development and improve nutrient absorption, which results in stronger, more resilient plants. Additionally, garlic extracts boost soil microbial activity, which improves the growing conditions for orchids. You can use garlic extract as a natural insecticide, foliar spray, or root soak by diluting it with water. Frequent spraying guarantees bright blooms and general plant health in addition to increasing orchid immunity. An all-natural and efficient way to encourage the healthy growth of orchids is to use garlic extract.

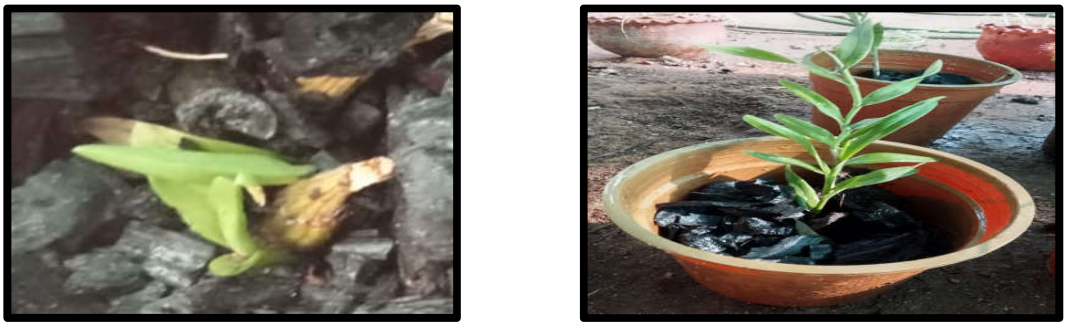


Figure 1: Cultivation of *Dendrobium burana* in charcoal

Figure 2: Cultivation of *Dendrobium burana* in sewdust

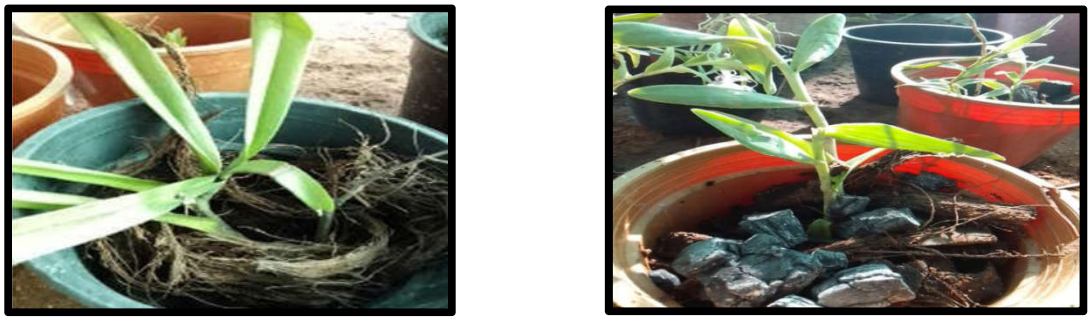
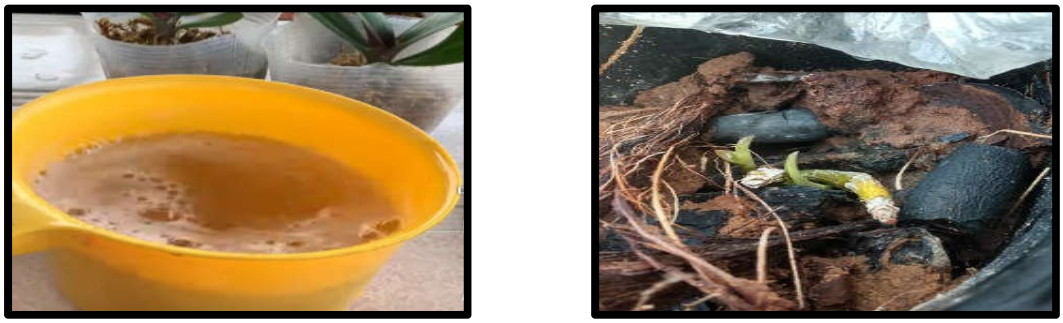


Figure 3: Cultivation of *Dendrobium burana* in Coconut Coir

Figure 4: Cultivation of *Dendrobium burana* in Coconut shells



Potato extract *b. Dendrobium burana*

Figure 5: Cultivation of *Dendrobium burana* in soil with potato extract

Garlic extract

Dendrobium burana

Figure 6: Cultivation of *Dendrobium burana* in soil with garlic extract

Table 2: Growth of orchid *Dendrobium burana* in different substrate after a month

S. No	Substrate	Shoot elongation (cm)	Root elongation (cm)
1	**Charcoal**	3	5
2	**Sawdust**	2	3
3	**Coconut Coir**	2	5
4	**Coconut shells**	1	2
5	**Potato extract**	2	4
6	**Garlic extract**	3	3

Table 3: Growth of orchids in mixing of all the substrate (Charcoal, Sawdust, Coconut Coir, Coconut shells, Potato extract, Garlic extract) after a month

S. No.	Sample	Shoot elongation (cm)	Root elongation(cm)
1	***Cattleya trianae***	5	7
2	***Cattleya warneri***	5	7
3	***Cymbidium devonianum***	5	6
4	***Dendrobium anosmum***	2	7
5	***Dendrobium burana***	3	5
6	***Dactylorhizapraetermissa***	4	3
7	***Dendrobium speciosum***	6	7
8	***Oncidium sphacelatum***	4	5
9	***Phalaenopsis difformis***	Didn't show any growth	Didn't show any growth
10	***Vanda coerulea***	6	3

Dendrobium burana shows better growth in charcoal than all other substrates link sawdust, Coconut coir, Coconut shells, potato extract, garlic extract. In the mixture of substrates orchids shows better growth than the individual substrate because it enhances aeration, retains moisture, improves drainage and promotes healthy root growth.

Rooting System

Orchids plants are epiphytic plant, they frequently grow on trees rather than in soil-they have a special root system. Usually, orchids grow aerial roots that can take in nutrients and moisture from the atmosphere. A protective layer of velamen covers these roots, preventing the plant from drying out and aiding in water retention also involves in the photosynthesis (Luca *et al.,* 2023).

Figure 7: Special Rooting of Epiphytes

In order to support photosynthesis, orchid roots may also absorb light. Because these roots enable orchids to flourish in settings with little direct soil contact, their development is essential to the plant's survival. When healthy, orchid roots have a characteristic greenish or silvery colour and are usually flexible and cylindrical. The velamen, which covers the roots, feels spongy and is essential for water absorption. Beneath the velamen is the cortex, which is where water and nutrients are stored. The vascular system, located at the core of the root, carries these materials throughout the plant. For orchids to adhere firmly to their growing surface, they require a strong root system. Additionally, the growth and function of orchids roots can be impacted by environmental factors including light and humidity (Roth *et al*., 2017).

SUMMARY AND CONCLUSION

Using charcoal, sawdust, coconut shell and coconut coir as substrates for their growing orchids offer several benefits. Charcoal enhances aeration, absorbs toxins and prevents root rot. Sawdust retains moisture and provides a stable growing medium. Coconut shell is durable, improves drainage and resists decomposition. Coconut coir retains water while allowing proper airflow and promoting healthy root growth. *Dendrobium burana* shows better growth in charcoal than all other substrates link sawdust, Coconut coir, Coconut shells, potato extract, garlic extract

Research suggests that optimal conditions include temperatures between 18^0C to 30^0C, humidity between 50-70% and indirect light needed for the better growth of orchids. Studies also highlight the necessity of well-chosen potting media to provide adequate aeration and moisture retention. Furthermore, using specific fertilizers such as potato extract and garlic encourages strong root and leaf growth. These organic substrates are sustainable, cost-effective and widely available. They support strong orchid development by maintaining proper moisture balance, preventing fungal infections and enhancing nutrients absorption. Overall, they create an ideal environment for orchids to thrive in both home and commercial cultivation.

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Conflict of Interest
The authors declare that they have no conflict of interest.

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