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COMPARATIVE MORPHOLOGICAL AND ECOLOGICAL STUDY ON THE GENUS *VANDA* WITH REFERENCE TO THE SPECIES *Vanda tessellata* (ROXB.) HOOK. EX G. DON. AND *Vanda testacea* (LINDL.) RCHB. F. IN JHARKHAND, INDIA

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ABSTRACT

Orchidaceae is one of the largest and most evolutionarily advanced families of angiosperms. The genus *Vanda* is derived from the Sanskrit word "Vandaka," referring to its natural epiphytic habit of growing on the trunks and branches of host trees. The present study was conducted during 2023-2025 to document the morphological and ecological characteristics of two important medicinal epiphytic orchids belonging to the genus *Vanda* through an extensive survey across the study areas. The survey included identification of the plant species and associated host plants, phenological data collection and ethnomedicinal discussion with the local communities. Later, the data were compiled and presented in this paper. The study area was Jharkhand, which is a geographically distinct upland region with undulating terrain, dissected plateaus, hills, valleys and diverse habitats that support a rich flora. *Vanda tessellata* and *Vanda testacea* are the two species of *Vanda* found here. The study revealed considerable ecological variation in the distribution and growth of both species across Jharkhand. *V. tessellata* exhibited an extended flowering period, with flowering recorded for almost the entire year across different study sites. Significant variations in floral size, colour and other phenotypic characteristics were observed among the observed populations. *V. testacea* has a relatively shorter flowering period and its phenology is strongly influenced by climatic factors, like rainfall and temperature. Variations in plant size and lip colour were also recorded. In addition, both species were seen to hold significant ethnomedicinal value, as it is widely used by local communities for the treatment of various diseases like earache, fungal infection and bone-related ailments. The findings highlight the distribution, diversity, ecology, ethnomedicinal and conservation importance of these two *Vanda* species of Jharkhand.

***Key words*:** Angiosperm, Chotanagpur, epiphyte, phenology, *Vanda*

Introduction

Orchids belong to the family Orchidaceae, one of the most diverse and highly evolved families among the angiosperms (Givnish *et al*., 2015). Members of this family exhibit remarkable adaptive and evolutionary traits, including their exceptional capacity for interspecific and intergeneric hybridization, as well as great morphological diversity among floral structures (Evans *et al*., 2023). The family displays extensive habitat diversity, encompassing epiphytic, terrestrial, semi-aquatic, heteromycotrophic and lithophytic habitats (Kumar *et al*., 2007). The genus *Vanda* derives its name from the Sanskrit word "Vandaka". The name reflects its natural habitat, where it is seen growing on the trunk and branches of host trees (Mani *et al*., 2021). It represents 89 accepted species worldwide exhibiting a cosmopolitan distribution, except in marine and Arctic regions (Chase *et al*., 2015). They are predominantly found across tropical Asia, extending eastward of northern Australia (Baby *et al*., 2019). The native range of *Vanda* extends

from the Himalayas to China and Indo-China (Govaerts *et al*., 2021). In India, the genus comprises 17 entities, most abundantly distributed in the Northeastern states and Himalayan ranges. Among them, Arunachal Pradesh harbours the highest species diversity with 13 species (Nyorak 2023). In contrast, the Chotanagpur plateau represents a biodiversity bridge zone, where only two species have been previously recorded by Haines (1924). It *is* particularly notable for its remarkable hybridisation potential (Baby *et al*., 2019) and (Sourabh *et al*., 2024), large and long-lasting flowers and significant ornamental and horticultural value, making it one of the most preferred orchid genera globally (Jitsopakul *et al*., 2026). They are very common and are widely distributed throughout the state. Among local communities, the species *Vanda tessellata* is traditionally believed to be effective in treating Otalgia (earache) (Kumar and Kumar 2021). In Ayurvedic medicine, it is highly valued for its medicinal properties (Biswas *et al*., 2024). The plant is described as having a bitter taste and hot potency (Ushna virya), making it effective in treating various vata-related disorders such as joint pain, arthritis and inflammation (Goswami *et al*., 2013). Thus, it holds significance not only as a beautiful epiphytic orchid but also as a plant of rich traditional and medicinal importance, deeply rooted in the cultural heritage; therefore, an active effort was made through this study to compile various morphological and ecological aspects of the *Vanda* species in Jharkhand, India. The present research focuses on the taxonomic treatment and comparative study of both *Vanda* species, along with plasticity in their phenological and phenotypic characters. Furthermore, it aims to assess molecular studies for better understand their phylogenetic relationships and evolutionary adaptations and explore contributing to the broader conservation of orchid diversity in the Jharkhand region of India.

Material and Methods

Study area

Jharkhand state is located in the eastern part of India at 21°58'02" N to 25°08'32" N latitude and 83°19'05" E to 87°55'03" E longitude (Firoz *et al*., 2018). The name "Jharkhand" literally means "Land of Forests and Shrubs." The state is known for its rich floral diversity, mainly because it lies in the Chotanagpur Plateau. The state has an approximate forest area of 23,605 square kilometres, making it one of India's greenest regions. The region is primarily dominated by dry deciduous forests, with Sal (*Shorea robusta*) being the most dominant species. Jharkhand's landscape comprises hills, plateaus, rivers and waterfalls, which support a wide range of biodiversity. The state shares its borders with West Bengal, Odisha, Bihar and Chhattisgarh. Apart from natural diversity, Jharkhand is also known for its indigenous cultural diversity. The state is home to 32 tribal communities (Forest Survey of India 2019), including 8 Primitive Tribal Groups (PTGs), which together constitute about 26.11% of the total population as per the 2011 Census (Rani *et al*., 2024). *Vanda* is not widely used for medicinal purposes among the local people in Jharkhand, some traditional healers (Vaidyas) possess traditional knowledge of its medicinal properties.

Methodology

The present study was conducted from 2023 to 2025; an extensive exploratory survey was conducted across various districts of Jharkhand, India, to document and study the diversity of *Vanda* species. During the survey, plant specimens were collected by the authors along with their photographs, geographical coordinates and detailed habitat information. Observations were made on the host plants, phenological behavior and phenotypic plasticity directly at the habitat site. The morphological characteristics of the collected specimens were recorded in the habitat. In the laboratory, the floral parts were dissected and examined under a stereo microscope and compound microscope for detailed morphological and diagnostic studies. Standard herbarium preparation techniques by Jain and Rao (1977) were used for specimen processing and the prepared herbarium sheets were deposited in the University Department of Botany, Dr. Shyama Prasad Mukherjee University, Ranchi, Jharkhand, India. For taxonomic identification, various resources such as regional flora (Haines 1924), pictorial guides, online databases like PubMed, Google Scholar, Web of Science, Scopus, ScienceDirect and expert consultations were utilised to ensure accurate species identification. During the fieldwork, interactions and interviews were conducted with indigenous communities residing in the study areas. With the help of semi-structured questionnaires, valuable information regarding the local diversity, traditional uses and ethnobotanical significance of orchids was collected, compiled and presented in the present study.

Results

The genus *Vanda* was first described in the Botanical Register, Vol. 6. Pp: 506 (1821). It belongs to the family Orchidaceae; sub-family Epidendroideae; tribe Vandeae; and subtribe Vandiinae. In Jharkhand, two species of *Vanda* have been recorded: *Vanda tessellata* (Roxb.) Hook. ex G. Don. (Fig. 1) and *Vanda testacea* (Lindl.) Rchb. f. (Fig. 2). They are epiphytic and widely distributed throughout the state; however, during field surveys, they

were also observed growing on rock and soil. Their occurrence does not necessarily indicate a terrestrial or lithophytic habit. Rather, such growth represents an adaptive strategy that enhances their survival under varying environmental conditions. They are highly opportunistic in nature and exhibit remarkable adaptability. These orchids have a large host diversity, but they show a preference for certain host trees like *Madhuca indica* (Mahua), *Mangifera indica* (Aam), *Diospyros melanoxylon* (Kendu) and *Shorea robusta* (Sal).

Key to the species:

1a: Plant size more than 40cm, stem erect or pendulous, inflorescence erect or sub-pendulous longer than leaves, leaf deeply channelled, flower large, tessellated, fruit pod more than 6cm.……...…… *V. tessellata*

1b: Plant size small, less than 40cm, stem erect, stout, inflorescence erect, leaves less channelled, flowers small, yellow, fruit pod not more than 4cm.……..…. *V. testacea*

Taxonomic treatments

1. *Vanda tessellata* (Roxb.) Hook. ex G. Don. Loudon's Hortus Britannicus. A catalogue. Pp: 372. 1850.

Basionym:

Epidendrum tessellatum Roxb. Plants of the Coast of Coromandel, Volume 1, Pp: 34. 1795.

Cymbidium tessellatum (Roxb.) Sw. Nova Acta Regiae Societatis Scientiarum Upsaliensis, ser. 2 6, Pp: 75. 1799.

Aerides tessellata (Roxb.) Wight ex Wall. A Numerical List of Dried Specimens 7318. 1832.

Type: India: West Bengal 1795. Specimen is deposited in Royal Botanical Garden, Kew, as *Epidendrum tessellatum*.

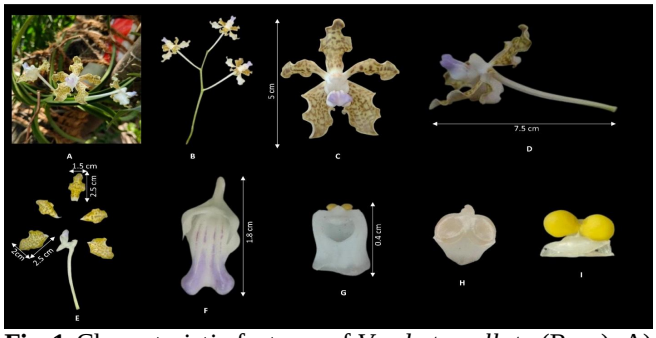


Fig. 1: Characteristic features of *Vanda tessellata* (Rox.): A) Habit, B) Inflorescence, C) Flower front view, D) Flower side view, E) Petals and sepals spur with pedicel, F) Lip, G) Front view of column, H) Ventral view of operculum and I) Dorsal view of pollinarium

Etymology: The species name refers to the tessellated petals of the flowers. The word "*tessellata*" is derived from the Latin word "tessella," which means a mosaic pattern on flower petals and sepals.

Description:

A monopodial epiphytic herb about 40- 80 cm, stem erect or pendulous, unbranched, thick 0.7- 1.5 cm in diameter, woody, covered with leaf sheaths; Leaves cauline, alternate, sessile, coriaceous, deeply channelled, linear- oblong with unequal apex, 10-20 cm × 0.5- 1.3 cm. Inflorescence: raceme, longer than leaves, erect or sub-pendulous, 6-12-flowered. Bracts persistent, oblong-suborbicular, with acute apex, 1- 2 mm. Flower pedicellate, 4- 6 cm long with ovary, 4- 6 cm flower in diameter, greenish yellow with brick-red mosaic pattern, thick and coriaceous, unpleasant fragrance. Petals and Sepals scattered, coriaceous, tessellated, waved or twisted on margin, shape obovate obtuse. Dorsal sepals 2.5 × 1.5cm. Lateral sepals 2.5 × 1.7cm. Petals 2.5 × 1.5 cm. Lip trilobed, fleshy, 1.7cm long, lateral lobes adnate to column, oblong- ovate, wing-like, mid-lobe bright ink-lilac colour with 2 straight ridges from middle to base. Spur cylindrical, conical apex, 5mm. Column white shout cylindrical, 5 × 2.3mm. Stigma subcircular, Pollinia 2, yellow, globular, 2.5 × 2.5mm. Fruit: 12 cm capsule.

Specimen Examined:

India, Jharkhand, Giridih district, Parashnath, 23°58'16.68"N latitude, 86°06'13.67"E longitude, 674 m elevation, 23-05-2024, (Herbarium No. OVT01).

Taxonomical observation

V. tessellata generally grows erect or pendulous, about 30-60 cm. However, during recent surveys at Jiling Sarai (Ranchi), Parasnath Hill (Giridih) and Bolba Block (Simdega), some individuals were observed attaining heights of up to approximately 1 meter. These plants were found growing on *Shorea robusta* (Sal), particularly on

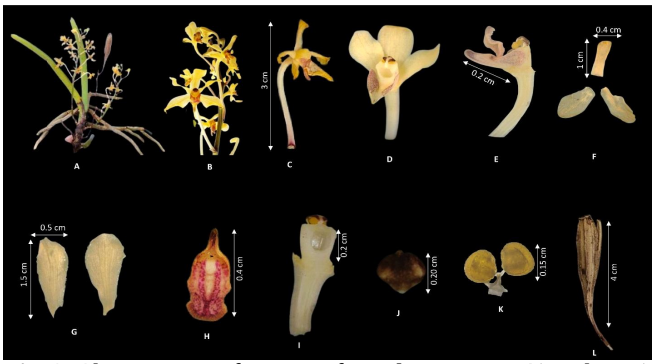


Fig. 2: Characteristic features of *Vanda testacea*: A) Habit, B) Inflorescence, C) Single flower, D) Flower with lip, E) Lip with spur, F) Sepals, G) Petals, H) Lip, I) Column, J) Dorsal view operculum, K) Pollinarium and L) Fruit.

the upper branches and trunk portions exposed to ample sunlight. The species exhibits a notable degree of phenological plasticity. Although flowering typically occurs between April and July, blooming has also been recorded throughout the year, possibly due to favourable microclimatic conditions. Considerable variation was also observed in flower morphology, with flower sizes ranging from 2 to 6 cm and in colour patterns, including shades of pink, purple, lilac and yellow. Due to this extensive colour and size variation, *V. tessellata* is sometimes misidentified with closely related taxa.

Ecological notes

V. tessellata has been recorded throughout Jharkhand and it is considered one of the most common and frequently observed orchid species in the region. It grows abundantly even along roadsides, showing a high degree of dominance in suitable habitats. This species generally prefers host trees such as *Madhuca indica* (Mahua), *Mangifera indica* (Mango), *Diospyros melanoxylon* (Kendu) and *Shorea robusta* (Sal). In the absence of these preferred hosts, it can also grow on other available tree species, demonstrating its ecological adaptability. The flowers emit an unpleasant odour, which plays a significant role in attracting pollinators to facilitate pollination.

Conservation status

In Jharkhand, *Vanda tessellata* is one of the most common orchid species when compared with other orchid taxa of the region. However, its population has declined significantly over the years. The major causes behind this decline include climate change, road and infrastructure development, deforestation and frequent forest fires, which are prevalent throughout the state. According to the IUCN Red List, *V. tessellata* is classified under the "Least Concern" category, yet the continued decline in its natural population highlights the need for regular monitoring and potential reassessment of its conservation status in Jharkhand.

Distribution- India, Bangladesh, Myanmar, Nepal, Sri Lanka and Vietnam.

Flowering- Generally flowers from April to September. But some individuals are recorded throughout the year at different places.

Fruiting- August- October and after fruiting, it takes the whole year for the pod to mature.

Ethnomedicinal uses

V. tessellata is primarily used for the treatment of various ailments, such as earache and fungal infections. Different indigenous groups (Munda, Oraon, Mahto, Santhali) follow distinct preparation and application methods. In most communities, fresh plant material is crushed to extract the juice, which is directly instilled into the ear to relieve pain. In some regions of Jharkhand, particularly among different tribal groups (Oraon, Ho and Kharia), the plant is first converted into ash and then mixed with a base oil, commonly mustard or coconut oil, to prepare an extract. This preparation is applied as ear drops. For external ear infections, the plant is also used as a paste, which is applied directly to the affected area.

2. *Vanda testacea* (Lindl.) Rchb. f. The Gardeners' Chronicle, new series 8: 166. 1877.

Basionym- *Aerides testaceum* Lindl. The Genera and Species of Orchidaceous Plants 238. 1830-1840[1833].

Type- India; Specimen is deposited in Royal Botanical Garden, Kew, as *Aerides testaceum*

Etymology- The species name is derived from the Latin word "testaceus", referring to the lip of the flower, which is brick-colored.

Description:

A monopodial epiphytic herb, about 20-30 cm. Stem erect, stout, covered with leaf sheaths, 0.4- 1.2 cm thick. Leaves cauline, sessile, coriaceous, linear-oblong, channeled, unequally bilobed apex, 15 × 0.8cm. Inflorescence racemose, erect, terete, 10-25 cm long, 6-10-flowered. Bracts brownish, triangular, acute, 3-veined, 0.4cm. Flower small 1.5-2cm across, yellow; pedicel with ovary 2.6cm long. Dorsal sepal and Lateral sepal are obovate-oblong, obtuse apex, 1 × 0.4 cm. Petals 1.5 × 0.5cm, obovate- oblong, margin slightly wavy. Lip trilobed, lateral lobes triangular and adnate to column foot, mid lobe decurved, apex dilated, 2 lilac carunculate ridges, 0.4cm. Spur conical, pale yellow, obtuse, 0.2cm. Column pale yellow, cylindrical, 0.3 × 0.4 cm. Stigma sub-quadrangular. Pollinia 2, sub-globose, 2 × 2mm. Fruit capsule, elliptic, 4 cm long.

Specimen examined:

India, Jharkhand, Ranchi district, Angra (Guridih), 23°20'34.79"N latitude 85°37'11.08"E longitude, 442 m elevation, 18-04-2024, (Herbarium No. OVP06)

Taxonomical observation

V. testacea exhibits an erect, stout habit, about 20-30 cm in height. However, variation in plant size has been observed; for instance, specimens collected from the hilly regions around Ramgarh district were found to grow up to more than 50 cm tall. The flowers of *V. testacea* are predominantly bright yellow, though pale yellow to whitish forms have also been recorded. The flower size varies

depending on the climatic conditions. Considerable variation in the lip (labellum) colouration has been observed, ranging from purplish-brick red to dirty white. Some individuals display a creamy-white shade.

Ecological notes

In Jharkhand, *V. testacea* is very common. It is predominantly found in regions like Ramgarh, Ranchi, Simdega, Gumla, Latehar and West Singhbhum. The species generally grows as an epiphyte on trees such as *Madhuca longifolia*, *Mangifera indica* and *Shorea robusta*. Due to climatic conditions, particularly excessive rainfall, the flowering duration is greatly affected. When rainfall is higher than usual, the flowering period becomes significantly shorter. *V. testacea* is growing abundantly in areas surrounding open-cast mining sites in Ghato (Ramgarh), in a dormant or stressed state. This suggests that the species may have developed adaptive mechanisms that allow it to survive and adjust its growth strategies even under highly polluted and disturbed environments such as those associated with mining activities.

Conservation status:

The wild population of *V. testacea* appears to be declining in several parts of Jharkhand. Although the species is still locally common in certain areas, markedly lower population densities have been observed in some districts, like Deoghar, Dumka, Simdega and Lohardaga. Several interacting factors may be contributing to this decline, including habitat degradation, deforestation, climatic fluctuations and changes in local environmental conditions. The species observed a relatively short or altered flowering period under changing climatic conditions. Therefore, a comprehensive population assessment is urgently required, particularly in areas where the species has become locally scarce. The resulting information would be valuable for identifying population-level threats and developing appropriate long-term conservation and management strategies for the species.

Distribution- India, Nepal, Myanmar, Thailand, Bhutan, Bangladesh and Sri Lanka.

Flowering - Late March to May.

Fruiting - June-July and after fruiting, it takes the whole year for the pod to mature.

Ethnomedicinal uses

Whole plant of *V. testacea* is used in remedies for pain and bone-related ailments by the Ho and Birhor tribal communities of Jharkhand. The plant is used in combination with *Tinospora cordifolia*, where both plant materials are ground together to form a paste. This paste is applied externally to affected parts and is believed to significantly aid in bone healing, pain relief and fast recovery.

Discussion

The present study was conducted to carry out a morphological and ecological comparative analysis of *V. tessellata* and *V. testacea* (Table 1). *V. testacea* was observed to grow well and maintain good populations even in harsh coal mining areas, indicating its strong adaptability. However, in dense Sal Forest, both species were found to have a low population. When comparing both species, *V. tessellata* appeared to be more dominant and frequently observed than *V. testacea*. Interestingly, no signs of interspecific competition for habitat or host plants were observed between them. In many instances, both species were found growing together on the same host. *V. tessellata* exhibited significant phenological plasticity and variations in its phenotype, which is common among orchids. Noticeable differences were recorded in flower size and colour, ranging from yellow, blue, pink and brick-red shades with mosaic patterns, with flower diameters varying between 3 and 6 cm. In contrast, *V. testacea* showed comparatively less variation, predominantly exhibiting yellowish to creamy-white flowers, a pattern that has been consistently observed in previous studies. Additionally, colour variation was also observed in the lip of *V. testacea*. It is usually brick-red to pink in colour; however, in some specimens, the lip was found to be completely creamy or dirty white. Similar colour variations were previously reported by Goswami *et al*., (2013).

Morphological characteristics of plant species can change depending on the environmental influences (Frank 1971; Misra 2019) and plants growing in different habitats often exhibit variations that reflect ecological differences. Abiotic factors such as temperature, salinity and water availability significantly influence seed germination by affecting physiological and metabolic processes involved in germination (Noe and Zedler 2000).

Previously, only two *Vanda* species, *V. tessellata* and *V. testacea* were documented from the Jharkhand region (Haines, 1924). Later, four *Vanda* species were documented in the "Flora of Bihar Analysis" based on earlier literature, including *V. tessellata*, *V. testacea*, *V. cristata* and *V. coerulea*. (Singh *et al*., 2001). Focused research on orchids in Jharkhand was limited until 2006, when Kumar *et al*., (2007) conducted a detailed survey, documenting two *Vanda* species, *V. tessellata*, *V. testacea*. They suggested that some previously recorded species might have become locally extinct due to

Table 1: Comparative analysis of *Vanda tessellata* and *Vanda testacea*.

Characters	*Vanda tessellata*	*Vanda testacea*
Habit & habitat	Monopodial epiphytic herb, found in dry and moist deciduous forests	Monopodial epiphytic herb, found in dry and moist deciduous forests
Plant size	Generally, about 40- 80 cm, but in some cases, they are recorded to be more than 1m	About 20- 30 cm
Stem	Erect or pendulous, covered with leaf sheath, woody, stout, about 0.7-1.5 cm	Always erect, covered with leaf sheath, woody, stout, about 0.4-1.2 cm
Leaves	Sessile, linear-oblong, deeply channeled with unequal bilobed apex, coriaceous, about 10-20 × 0.5- 1.3 cm	Sessile, linear-oblong, slightly channeled with unequal bilobed apex, coriaceous, about 15×0.8 cm
Inflorescence	Raceme, erect-subpendulous, Teret, usually longer than leaves, about 30-35 cm, 6-12 flowered	Raceme, erect, Teret, about 10-25 cm, 6-10 flowered
Floral bract	Persistent, oblong-suborbicular, acute, brownish, about 0.1- 0.2 cm	Triangular, acute, 3-veined, about 0.4 cm.
Flower	Large, dirty yellow with brownish mosaic pattern, pedicle with ovary 4-6 cm, large flower about 4- 6 cm across, unpleasant aroma	Small, Yellow flower, pedicle with ovary 2-3 cm across, small flower about 1.5- 2 cm
Dorsal sepal	Obovate-oblong, obtuse, tessellated, margin twisted, 2.5-1.5 cm	Obovate-oblong, obtuse, yellow, immaculate, 1 × 0.4 cm
Lateral sepals	Obovate-oblong, obtuse, tessellated, margin twisted, 2.5×1.7 cm	Obovate-oblong, obtuse, yellow, immaculate, 1×0.5 cm
Petals	Oblong-obovate, obtuse, tessellated, margin twisted, 2.5×1.5 cm	Oblong-obovate, obtuse, yellow, immaculate, wavy, 1.5×0.5 cm
Lip	Trilobed, 1.7cm, fleshy lateral lobes adnate to column foot, mid lobe purple with 2 straight ridges from middle to base	Trilobed, 0.4cm, lateral lobes adnate to column foot, triangular, mid lobe decurved or reflexed, 2 lilac ridges
Spur	Cylindrical, conical, obtuse apex, white, 0.5 cm. Shorter than ovary	Conical, obtuse, pale yellow, 0.2 cm
Column	White, cylindrical, 0.5×2.3.	Faded yellow, cylindrical, 0.3×0.4 cm
Stigma	Sub-orbicular	Sub-quadrangular
Pollinia	2 pollinia, yellow, globular, 2.5×2.5 mm	2 pollinia, yellow, sub-globular, 2×2cm
Fruit	Capsule, elliptic, 12 cm long	Capsule, elliptic, 4 cm long
Flowering season	Generally, flowers from April to September. But some individuals are recorded throughout the year in different places.	Late March to May
Fruiting	August-October and after fruiting, it takes the whole year for the pod to mature.	June-July and after fruiting, it takes the whole year for the pod to mature
Distribution	Throughout Jharkhand	Throughout Jharkhand

environmental degradation and habitat loss.

Over time, forest cover in Jharkhand has declined considerably, leading to a reduction in orchid populations. *V. testacea* has become increasingly less common compared to *V. tessellata*. Both species are considered highly rich in medicinal properties across Central India and in various regions of the world where they are traditionally used in medicinal systems. Their applications are predominantly associated with the treatment of ear disorders and bone-related ailments. This knowledge has been transmitted orally across generations from the ancestors of traditional healers and continues to be a basis for present-day folk medicinal practices. In addition to traditional knowledge systems, several ethnobotanical studies and reports published in national and international journals have documented the use of *Vanda* species for the management of similar ailments in different parts of the world. (Mehta 1949; Singh *et al*., 2001; Blinova 2012; Chowdhury *et al*., 2014 and Chakraborty *et al*., 2022). These findings provide supportive evidence for their widespread medicinal relevance. The convergence of indigenous knowledge, classical texts and modern ethnobotanical literature highlights the significant therapeutic potential of *Vanda* species and points towards the need for further pharmacological and clinical validation.

Therefore, conservation efforts are essential to prevent further local extinction, which could negatively impact biodiversity and ecosystem balance, as many organisms are ecologically linked with these orchids (Wieczorkowski *et al*., 2026). Moreover, *Vanda* species possess significant ornamental and commercial value in the floriculture industry (Anumala *et al*., 2026). Their conservation and sustainable utilisation could benefit local communities and enhance regional economies.

Conclusion

The present study focused on the taxonomical, ethnomedicinal and ecological analysis of *V. tessellata* and *V. testacea*, emphasising their phenology and phenotypic plasticity. Throughout the survey, *V. tessellata* was found flowering almost the whole year across different study sites, with notable variations in flower size and colours. In contrast, *V. testacea* displayed flowers predominantly yellow to creamy white in colour, with the lip showing variations. Differences in flower size were also recorded between the two species. Seasonal and environmental factors, such as heavy rainfall, appeared to influence the flowering duration of *V. testacea*, while anthropogenic pressures like deforestation, construction and habitat disturbance have contributed to a significant decline in their wild populations. However, *V. testacea* was observed growing well in coal mining areas, suggesting the species has developed certain adaptive traits enabling it to survive under harsh and polluted conditions. In addition, both species hold significant ethnomedicinal value, as it is widely used by local communities for the treatment of various diseases. This research provides valuable insights into the correct identification and comparative assessment of both species, which can assist in planning and implementing effective conservation and monitoring strategies. Future molecular studies will help to better understand their phylogenetic relationships and evolutionary adaptations, contributing to the broader conservation of orchid diversity in the Jharkhand region of India.

Conflict of Interest: The authors declare no conflict of interest.

Data Availability Statement

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

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