

Orchids, the Marvelous Plants

PRASENJIT PAUL¹& SUMAN KUMARIA²

Abstract

Orchidaceae is one of the world's largest groups of flowering plants with diverse range of floral morphology. The distribution of orchids is worldwide with Columbia and Indo-Malaysian region representing the world's richest areas in terms of their distribution. In India, the two most prominent orchid habitat regions are the Eastern Himalayas and the northeastern region. The northeastern part of India is believed to be the place of origin of orchids as they form a very perceptible feature of the vegetation of this region. Orchids have varying habits and are classified as holomycotrophic or saprophytic, terrestrials and epiphytic. They are economically very important primarily because of their horticultural and floricultural significance. Apart from their ornamental value, orchids are also known for their medicinal application. Hence, conservation of orchids in their natural habitat as well as through in vitro techniques is of utmost importance.

Keywords: Orchids, Ornamental, Medicinal, Conservation

Introduction

Orchidaceae forms one of the world's largest families of flowering plants of angiosperms. Orchids are outstanding in many ways as they have diverse shapes, forms, colours and represent the most highly evolved family among monocotyledons with 600-800 genera and 25,000-35,000 species. The distribution of orchids is worldwide, except Antarctica and a few isolated islands. Columbia and Indo-Malaysian region

¹Mr. Prasenjit Paul is a research scholar at the Department of Botany, North-Eastern Hill University, Shillong 793 022, India

²Prof. Suman Kumaria teaches at the Department of Botany, North-Eastern Hill University, Shillong 793 022, India

*Corresponding author: Prof. Suman Kumaria (sumankhatrikumaria@gmail.com)

represent the world's richest areas in terms of distribution of orchids. As many as 1331 species of orchids belonging to 186 genera have been reported from India. Of these, northeast India harbours the highest number of about 850 orchid species. In India, the two most prominent orchid regions are the Eastern Himalayas and the northeastern region. It is believed that the orchids have evolved in this region (Kumaria and Tandon, 2007) and the orchid species forms a very perceptible feature of the vegetation here. Orchids have varying habits and are classified as holomycotrophic or saprophytic (found to grow on dead and decaying matter), terrestrials (found to grow on ground) and epiphytic (growing on trees or shrubs) but none are reported to be aquatic in nature. The widespread altitudinal variations from the foothills to high Himalayan mountains and deep river valleys with high rainfall and humidity, typical soil conditions, etc, have played a significant role in the development of highly rich orchid diversity in the North- Eastern region (Chowdhery, 1998; Hynniewta, 2000). Depending on the occurrence of orchids, the region has been classified into the following orchid habitats: (1) tropical forests (between 100-1000 m), (2) subtropical forests (between 1000-2000 m), (3) temperate forests (between 2000-3500 m), and (4) alpine forests (3500-5000 m). Arunachal Pradesh harbours maximum number of orchid species followed by Sikkim and Meghalaya while Tripura has the lowest number of orchid species in the region. The northeastern region of India also has the highest concentration of monotypic orchid genera. Some of these are: *Arundina*, *Anthogonium*, *Bulleyia*, *Cremastra*, *Cleisocentron*, *Dickasonia*, *Diglyphosa*, *Eriodes*, *Herpysma*, *Jejosephia*, *Neogyna*, *Ornithochilus*, *Risleya*, *Renanthera*, *Stereosandra*, *Tipularia*, *Thecostele*, *Trachoma*, *Vandopsis*, etc. Many of these do not occur anywhere else except in India. Another noteworthy feature of the orchid flora of the northeastern region is the presence of a large number of saprophytic orchid species belonging to the genera *Aphyllorchis*, *Cymbidium*, *Eulophia*, *Gastrodia* etc. It has also been reported that as many as 34 species of orchids from northeast India are documented among the threatened plants of India (Nayar and Sastry, 1987, 1988, 1990; Ahmedullah *et al.*, 1999) and 85 species of orchids are endemic to Northeastern region of India (Das and Deori, 1983). Some of these are listed in Table 1.

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| <i>Aerides longicornu</i> Hook.f. (eR) <i>Anoectochilus grandifloris</i> Lindl. (R) <i>Bulbophyllum hookeri</i> (Duthie) J. J. Sm. (En,R) <i>B. moniliforme</i> Par. & Reichb.f. (En,R) <i>B. obrienianum</i> Rolfe (eR) <i>Bulleyia yunnanensis</i> Schltr. (eR,T) <i>Calanthe alpina</i> Hook.f. ex Lindl. (En,R) <i>C. herbacea</i> Lindl. (R) <i>Ceratostylis himalaica</i> Hook.f. (R) <i>C. subulata</i> Blume. (En,R) <i>Coelogyne arunachalensis</i> Choudhery & Pal. (eR) <i>C. cristata</i> Lindl. (R) <i>C. nitida</i> (Wall. ex D. Don) Lindl. (R) <i>C. treutleri</i> Hook.f. (eR) <i>Cymbidium cochleare</i> Lindl. (R,T) <i>C. simonsianum</i> King & Prantl. (eR) <i>C. devonianum</i> Paxt. (R,T) <i>C. giganteum</i> Wall. ex Lindl. (En,R) <i>C. tigrinum</i> Par. ex Hook. (eR,T) <i>Dendrobiumaqueum</i> Lindl. (eR) <i>D. densiflorum</i> Wall. ex Lindl. (eR,T) <i>D. chrysotoxum</i> Lindl. (R,T) <i>D. wardianum</i> Warner (eR,T) <i>D. folconeri</i> Hook. (R,T) <i>D. ochreatum</i> Lindl. (eR) <i>Diplomeris pulchella</i> D. Don. (R) <i>Epigeneium rotundatum</i> (Lindl.) Summerh. (R,T) <i>Eria crassicaulis</i> Hook.f. (R,T) <i>E. fragrans</i> Reichb.f. (R,T) <i>Eulophia candita</i> (Lindl.) Hook.f. (En,R) <i>E. manni</i> (Reichb.f.) Hook.f. (R) | <i>Galeola cathcarii</i> Hook.f. (R) <i>Habenaria cumminsiana</i> King & Prantl. (R) <i>H. khasiana</i> Hook.f. (R) <i>Herminium haridasanii</i> A. N. Rao. (R) <i>Liparis pulchella</i> Hook.f. (En,R) <i>Listera divaricata</i> Panigr & P. Taylor. (eR) <i>Malaxis aphylla</i> (King & Prantl.) Tang & Wang. (R) <i>Nervilia scottii</i> (Reichb.f.) Schltr. (En,R) <i>Oberonia clarkei</i> Hook.f. (R) <i>Paphiopedilum fairrieanum</i> (Lindl.) Stein (eR,En,T) <i>P. insigne</i> (Wall. ex Lindl.) Stein. (eR, En,T) <i>P. villosum</i> (Lindl.) Stein. (eR,En,T) <i>P. spicerianum</i> (Reichb.f.) Pfitz. (eR, En,T) <i>P. venustum</i> (Sims.) Pfitz. (eR,En,T) <i>Phaius tancarvilleae</i> (Banks ex L'Herit) Bl. (En,R) <i>Phalaenopsis mastersii</i> King & Prantl. (R) <i>Pleione maculata</i> (Lindl.) Lindl. (eR) <i>P. praecox</i> (J. E. Sm.) D. Don. (R) <i>Renanthera imschootiana</i> Rolfe. (eR,En,T) <i>Taeniophyllum khasianum</i> Joseph & Yogan. (R) <i>Tainia khasiana</i> Hook.f. (R) <i>Thunia marchalliana</i> Rolfe. (R) <i>Vanda coerulea</i> Griff. ex Lindl. (eR,T) <i>V. pumila</i> Hook.f. (eR,T) <i>V. parviflora</i> Lindl. (R) <i>Vanilla pilifera</i> Holtt. (R,T) <i>Zeuxine longifolia</i> (Benth.) Hook.f. (R) |
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Orchids of ornamental importance

Orchids occupy top position among all flowering plants marketed as cut flowers and potted plants, fetching a very high price in the international market. Commercial importance of orchids has led to their tremendous production in recent years (Tokuhara and Mii, 2003). The worldwide demand in 1995 for orchids as cut flowers and potted plants production was 1.3 billion units of plant stock (Hew and Yong, 2004). The world consumption of orchids was valued at more than \$500 million in 2000 (Wang, 2004). The United States of America, China, Germany, Japan, Netherlands, Taiwan and Thailand are amongst the countries leading to the large scale potted orchid production (Griesbach, 2000). Some of the ornamentally important orchids are *Aerides multiflorum*, *A. odoratum*, *Arundina graminifolia*,

Bulbophyllum, *Calanthe masuca*, *Coelogyne elata*, *C. flavida*, *C. corymbosa*; *Cymbidium aloifolium*, *C. lowianum*, *C. devonianum*, *C. hookerianum*, *C. lancifolium*, *Dendrobium aphyllum*, *D. nobile*, *D. chrysanthum*, *D. farmeri*, *D. chrysanthum*, *D. densiflorum*, *D. moschatum*, *D. fimbriatum*, *D. jenkinsii*, *Paphiopedilum venustum*, *P. spicerianum*, *P. hirsutissimum*, *P. insigne*, *Phaius wallichii*, *Pleione praecox*, *Renanthera imschootiana*, *Rhyncostylis retusa*, *Thunia alba*, *Vanda cristata*, *V. coerulea* and *V. coerulescens*.



Fig. 1. Ornamental Orchids: a) *Dendrobium chrysanthum* b) *Vanda coerulea* c) *Coelogyne fimbriata* d) *Paphiopedilum insigne* e) *Dendrobium lituiflorum* and f) *Dendrobium hookerianum*.

Orchids of medicinal importance

Apart from their ornamental value, orchids are also known for their medicinal usage especially in the traditional systems of medicine. It is believed that the Chinese were the first to cultivate and describe orchids for medicinal purposes (Bulpitt, 2005). Also, in ancient Indian literature, orchids are mentioned as medicinal and aromatic plants. The medicinal usages of orchids have been there since Vedic period. "Ashtawarga" is a group of eight drugs in Ayurvedic systems used for preparation of tonics, such as 'Chyavanparas', which consists of 4 orchid species, viz., *Malaxis muscifera*, *M. acuminata*, *Habenaria intermedia* and *H. edgeworthi* (Jalal *et al.*, 2008). The Chinese pharmacopoeia, "Sang Nueng Pen Tsao Ching" illustrated the significant

role played by the dendrobates as a source of tonic, analgesic, astringent and anti-inflammatory compounds dating back to 200 B.C. (Singh and Tiwari, 2007). Apart from that, *Herba Dendrobii* is one of the most precious classes of Traditional Chinese Medicine (TCM), comprising the stems of various dendrobates. Based on the morphological characteristics and processing methods of the orchids, *Herba Dendrobii* is classified into two broad categories i.e. “*Fengdou Shihu*” and “*Huangcao Shihu*” (Yuan *et al.*, 2011). *Huangcao Shihu* is the predominant form of *Herba Dendrobii*, having an extensive usage because of its potential to enhance immunity, treatment of pulmonary and lung disorders, and cough and cold (Kuang *et al.*, 2005; Zhang *et al.*, 2005). *Huangcao Shihu* constitutes extracts of 27 dendrobates of which *Dendrobium thyrsiflorum*, *D. fimbriatum*, *D. nobile*, *D. chrysotoxum* and *D. capillipes* are the most important ones. They have been used for therapeutic values all over the world owing to the presence of phytoconstituents such as alkaloids, flavonoids, terpenes and glycosides (Hossain and Rahman, 2011). The presence of various secondary metabolites viz., flavonoids, tannins, alkaloids and phenols etc have been reported to be present in *Dendrobium nobile* (Bhattacharyya *et al.*, 2014), *D. thyrsiflorum* (Bhattacharyya *et al.*, 2015), *D. crepidatum* (Bhattacharyya *et al.*, 2016). Apart from the *Dendrobium* species, some of the other orchid species of medicinal importance includes *Acampe papillosa*, *Bulbophyllum neilgherrense*, *Calanthe triplicate*, *Coelogyne punctulata*, *Cymbidium aloifolium*, *C. ensifolium*, *Eria panna*, *Eulophia spp.*, *Habenaria spp.*, *Malaxis acuminata*, *Pholidota articulate*, *Rhynchostylis retusa*, *Vanda testacea*, *V. coerulea*, *V. tessellate* and *Zeuxine strateumatica*.



Fig. 2. Medicinal Orchids: a) *Dendrobium fimbriatum* b) *Renanthera imschootiana* c) *Dendrobium chrysotoxum* d) *Dendrobium nobile* e) *Dendrobium jenkinsii* and f) *Calanthe sylvatica*.

Conservation Aspects

The natural populations of orchids are at great risks of extinction due to various anthropogenic pressures. Looking at the commercial as well as medicinal importance of orchids, conservation of orchids has now become a major concern. The modern tools of Biotechnology can be utilized for propagation and conservation of plant genetic resources. In general, these could be accomplished both by *in situ* and *ex situ* methods. *In situ* conservation involves an ideal and dynamic approach that allows plants to interact and co-evolve, involves protection of genetic resources in the natural environment through the protection of the environment itself (Tandon, 2004). The government, in order to encourage the grounds of *in situ* conservation, has already declared many areas in North-Eastern India as national parks, wildlife sanctuaries and biosphere reserves. However, *ex situ* conservation techniques involve *in vitro* technologies, cryopreservation, molecular marker technology and molecular diagnostics (Tandon and Kumaria, 2007). *Ex situ* conservation programmes have played an important role in acclimatization, rehabilitation, multiplication and judicious exploitation of the plant resources. In the recent past, tissue culture techniques have been developed for the large-scale propagation of orchids using various types of available explants. Some of the orchids that have been propagated through *in vitro* techniques in the Plant Biotechnology Laboratory, Department of Botany, North-Eastern Hill University, Shillong, Meghalaya, India are listed in Table 2.

Table 2. List of some orchids propagated through *in vitro* techniques.

| Name | Explants Used | References |
|---|---|------------------------------|
| <i>Dendrobium fimbriatum</i> var. <i>oculatum</i> Hk.f. | Seeds | Kumaria and Tandon (1991) |
| <i>Dendrobium fimbriatum</i> var. <i>oculatum</i> Hk.f. | Axillary buds; Apical meristem | Kumaria and Tandon (1994) |
| <i>Dendrobium wardianum</i> | Nodal buds; leaf bases | Kumaria <i>et al.</i> (2005) |
| <i>Cymbidium giganteum</i> | Shoot tips; root tips; rhizome segments | Kumaria <i>et al.</i> (2005) |
| <i>Cymbidium devonianum</i> Paxt. | Seeds | Das <i>et al.</i> (2007) |
| <i>Coelogyne ovalis</i> Lindl. | Seeds | Nongrum <i>et al.</i> (2007) |
| <i>Coelogyne nitida</i> (Wall. ex Don) Lindl. | Seeds | Nongrum <i>et al.</i> (2007) |
| <i>Dendrobium longicornu</i> Lindl. | Seeds | Dohling <i>et al.</i> (2008) |

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| <i>Dendrobium formosum</i> Roxb. | Seeds | Dohling <i>et al.</i> (2008) |
| <i>Dendrobium lituiflorum</i> Lindl | Axillary buds | Das <i>et al.</i> (2008) |
| <i>Dendrobium chrysanthum</i> | Seeds | Hajong <i>et al.</i> (2010) |
| <i>Vanda coerulea</i> Griff ex Lindl. | Juvenile roots | Manners <i>et al.</i> (2010) |
| <i>Dendrobium densiflorum</i> Lindl. | Seeds | Bhattacharjee <i>et al.</i> (2010) |
| <i>Cymbidium devonianum</i> | Apical meristem; leaf bases | Das <i>et al.</i> (2011) |
| <i>Vanda coerulea</i> | Seeds | Manners <i>et al.</i> (2012) |
| <i>Dendrobium hookerianum</i> | Seeds | Paul <i>et al.</i> (2012) |
| <i>Cymbidium eburneum</i> Lindl. | Seeds | Gogoi <i>et al.</i> (2012) |
| <i>Cymbidium mastersii</i> | Seeds | Mohanty <i>et al.</i> (2012) |
| <i>Dendrobium longicornu</i> | Axillary buds | Dohling <i>et al.</i> (2012) |
| <i>Dendrobium chrysanthum</i> Wall. ex Lindl. | Nodal buds | Hajong <i>et al.</i> (2013) |
| <i>Dendrobium nobile</i> Lindl. | Seeds | Bhattacharyya <i>et al.</i> (2014) |
| <i>Dendrobium nobile</i> | Nodal buds | Bhattacharyya <i>et al.</i> (2016) |
| <i>Dendrobium crepidatum</i> | Nodal buds | Bhattacharyya <i>et al.</i> (2016) |

Conclusion

Orchids have assumed an enormous commercial importance from the ornamental as well as medicinal point of view. Because of their immense importance, they have been exploited in an intuitive manner by the humans for various social, economical and medicinal purposes. Conservation, sustainable utilization and management of orchids is the key feature to ensure the natural growth and proliferation of these beautiful members of the plant kingdom as they are diminishing alarmingly at low levels.

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