

Graceful Orchids

INTRODUCTION

Orchids, more than any other plants, exert a mysterious fascination for most people, and all the wild orchids of tropical regions are highly puzzling and peculiar.



Figure 1: *Luisea macrantha*

Orchids exhibit an incredible range of diversity in size, shape and colour of their flowers. They are most pampered of the plants and occupy top position among all the flowering plants valued for cut flower production and as potted plants. They are known for their longer lasting and bewitchingly beautiful flowers, which fetch a very high price in the international market. These plants belong to family Orchidaceae being one of the largest families of flowering plants with both terrestrial, and epiphytic members. Taxonomically, they represent the most highly evolved family among monocotyledons with 600-800 genera and 25,000-35,000 species⁶ in the world and the present figure of the hybrids among these touches around 80,000⁷. Majority of the cultivated orchids are native of tropical countries and occur in their greatest diversity in humid tropical forest of South and Central America, Mexico, India, Ceylon, Burma, South China, Thailand, Malaysia, Philippines, New Guinea and Australia. Brazilian *Cattleyas*, Mexican *Laelias* and Indian *Dendrobiums*, *Cymbidiums* and *Vandas* have played a major role in the development of modern orchid industry

in the world⁶. In this article we will journey into the fascinating world of Orchids of India in general with a preference to Western Ghats.

ORCHIDS IN INDIA

Orchids form 9% of our flora and are the largest family among higher plants in India. It is estimated that about 1,300 species (140 genera) of orchids are found in our country with Himalayas as their main home and others scattered in Eastern and Western Ghats. The following is the distribution of orchids species in different regions of India⁶.

North-Western Himalayas	ca. 800 species
North-Eastern India	ca. 200 species
Western Ghats	ca. 300 species

Northeastern India owing to its peculiar gradient and varied climatic conditions contains largest group of temperate and sub-tropical orchids. In about 132 wild genera nearly 287 species distributed over 71 genera are endemic⁷.



Figure 2: Western Ghats-Evergreen to Semievergreen forests

The high endemism in orchids is perhaps because of certain physiological adaptive condition of the family bringing greater constraints on their existence, spread and replenishment in any particular area, viz.,

1. Their existence in specific niches within the fragile ecosystem.
2. Insect pollination in most of the species, particularly needing specific vectors to visit different species.
3. Inability to achieve fertilization in maximum number of ovules for viable seeds due to the fact that each ovary of the orchid possesses millions of ovules.
4. Presence of an unorganized embryo in the seed, also without any food storage and hence needing infection of a specific strain/race of mycorrhiza as a food supplier before germination.
5. Absence of similar habitats for orchid seedlings/propagules to pass through similar niches for establishment and dispersal.

India has a very large variety of orchids and hilly regions have one or the other orchid flowering almost throughout the year. The diversity is so large that there are terrestrial, epiphytic and also saprophytic orchids. In general terrestrial orchids are more common in Northwestern India, epiphytic orchids in North-Eastern India and small flowered orchids in Western Ghats. The largest terrestrial genus is *Habenaria* (ca. 100 spp.) and the largest epiphytic genus is *Dendrobium* (ca 70 spp.). Most of

the *Paphiopedilum* (lady's slipper) species are restricted to N.E Himalayas except for *P. druryi*. This species, which had been reported from Kerala was thought to be almost extinct from its original habitat and was recently rediscovered.



Figure 3: *Habenaria crenata* (Mesophytes)

HISTORY- Orchid mania

Theophrastus, who is also called the father of botany (370-285 BC), gave the name "ORCHIDS" to the group of bizarre plants on the basis of the resemblance of paired underground tubers of these plants to masculine anatomy (the testes). This resemblance was also responsible for the mistaken belief that the orchids possess aphrodisiac properties and eating of underground tubers might "provoke venus" and they may beget male children. In the Indian Vedic scriptures there is a mention of the plants under the name "VANDA", which has been adapted as a generic name in one of the most beautiful group of orchids⁶.

NICHE PROFILE

Those orchids occupying the highest canopies of the emergent trees are xerophytic and tolerate long periods of high intensity of light that provides steady state for their growth. However between crown canopy and crown base in the understory where

rapid fluctuation of sun and shade often predominate, maximum numbers of orchids are found growing (Sciophytes).

The third category of orchids is truly shade tolerant and occupies the tree trunk or stump portions of the understory (mesophytes-figure 3). The terrestrial orchids forming the fourth ecological group are differentiated in their growth on soil either as an autophyte or saphrophyte (figure 4).



Figure 4: *Epipogon roseum* (Saphrophytes)

The epiphyte is generally tolerant to changes or vagaries of climatic changes by their adaptive habits and specialized roots, in addition to waxy coatings and succulence of varying dimensions. These have made them tolerant to xerophytic amplitudes of varying degree. The heavy rainfall and high temperature prompt the atmosphere to reach saturation point. The optimum condition for good growth for orchids hovers around 25⁰ C which is the normal condition in the equatorial region with very little variation.

FLOWERING

As the south-west monsoon clouds the entire area with its insistent rain, most of the hilly slopes once dry is soon draped in the graceful velvet of grassy blanks with dappled sprouting of terrestrial orchids such as the *Habenaria grandifloriformis*, *H.longicorniculata*, *H.heyneana* etc. Among the epiphytic orchids magnificent blooms of *Aerides* *sps.*, *Rhynchostylis retusa*, hangs out in the drizzling rain from their arboreal abodes of tree branches. Many smaller orchids such as *Eria dalzellii* blooms late in the rainy season from trees and bigger shrubs such as *Phyllanthus emblica*, *Careya arborea*, *Randia dumetorum* etc. As the rain calms down and the cold wind starts prevailing through valleys and hills, orchids such as *Dendrobium barbatulum*, *Oberonia brunoniana*, *Bulbophyllum neilgherrense* etc., blooms from their perched corners of the trees in their myriads of colours. Many small creatures including the scorpions safely make their homes in these bunchy orchids. With the winter coming to a close and the valleys becoming more hotter, it is summer time and epiphytes like *Acampe praemorsa*, *Dendrobium lawnianum*, *D.macrostachyum*, *D.crepidatum*, *Cymbidium aloifolium* etc., starts flowering, becoming a cynosure to the eyes of the onlooker.

ORCHID MORPHOLOGY

Most of the orchids are perennial herbs with simple leaves. Although the specialized flower structure conforms to a standard plan, the vegetative parts are shown great variation, a large number of them being epiphytes, or terrestrial and a few saprophytes and leafless in nature.



Figure 5-monopodial-Rhyncostylis or other

Orchids can be divided into two groups - monopodial or sympodial depending upon their habit of growth⁶. Monopodial orchids such as *Vanda* have a main stem which continues to grow year after.

Sympodial orchids such as *Cymbidium* have a main stem, which terminates growth at the end of each season. A new shoot then grows from the base forming it's own bulbous stem called pseudo-bulb, which eventually flowers. The pseudo-bulb or thickened stem is a very useful device for the storage of food and water and function like bulbs.

In addition to the epiphytic orchids, there are also ground orchids or terrestrial orchids, which grow like ordinary plants with their roots in soil. Most of the temperate zone orchids are terrestrial and tropical orchids are epiphytes.

Orchid flower

The orchid flowers are extremely variable in size and shape with plain to sparkling textures. They may be solitary or in drooping flowering branches emitting various fragrance of lemons, cloves or fresh lavender oil. A few are, however, having highly stinking odor. Orchids have bilaterally symmetrical (Zygomorphic) flowers with an inferior ovary. The floral parts are in threes, i.e. 3 sepals and 3 petals collectively called as tepals due to their resemblance in texture and colour, to petals.



Figure 6: *Aerides maculosa*

It is, however, the third petal, which is different and distinctive and is called labellum or the lip. The lip is highly distinct and is responsible for the different names of the

orchids like 'Frog orchid', 'Dove orchid', 'Spider orchid', 'Lady slipper orchid' etc. The reproductive organs of the orchids, the stamens and pistil, are condensed and form a consolidated complex body, the 'column', the male and female part being separated by a flap or projection of a tissue called rostellum. Each flower has one, two or rarely three stamens. These stamens are mostly attached to the style. In most genera, their pollen grains are cohering in the pollinia.

POLLINATION

Orchids reproduce by cross-pollination with birds, insects, and other animals carrying pollen from the stamen of one orchid to the pistil of another. Cross-pollination between different plants, rather than self-pollination, has helped orchids evolve and adapt to their environment

Orchids have evolved some of the most complicated pollination systems of all plants. Many orchids look like or smell like bees, which is what attracts bees to them. *Ophrys insectifera* emits a chemical mixture that attracts male hymenopteras of the genus *Argogorytes*. The smell of this orchid resembles female insects and hence male insect tries to copulate with the plant. During this time particles of pollen attach themselves to the male insect to be deposited at its next visit on a different orchid plant. Some parts of orchid plants resemble female insects encouraging male insects to try to mate with them thereby spreading pollen. The mirror orchids of the western Mediterranean also emit a pheromone very similar to that of female bees, which sends the male bees into an excited frenzy.

Another orchid, the dead horse arum, emits a smell similar to that of rotting flesh in order to attract flies to assist in its pollination.

Another orchid species, the Oncidiums of South America, attract bees by a process called as pseudoantagonism. That is, parts of the plant resemble an enemy insect and the bee attacks it and try to drive it away. During the assault pollen adheres to the attacking bee!⁴

A large number of natural hybrids both intergeneric and interspecific have been reported in different genera like *Odontoglossum*, *Phalaenopsis*, *Cattleya*, *Laelia*, *Miltonia* and *Oncidium*. *Cattleya guatemalensis* collected from Guatemala in 1861 by Skinner was found to be a natural hybrid between *Epidendrum aurantiacum* and

Cattleya skinneri. It was later named as *Epicattleya*. Similarly, *Phalaenopsis intermedia* is a natural hybrid between *P. aphrodite* and *P. rosea*⁷.

SEED STRUCTURE

The most interesting and adaptive feature of the family Orchidaceae is the physiology of its seed germination. Orchid seeds are unique in several respects. They are exceedingly small and dust like and are produced in very large numbers. As many as 1,300 to 4,00,000 seeds per capsules are produced. Their colour may be white, cream, pale green, reddish orange or dark brown and have very diverse shapes⁶.

Orchid embryo consists of relatively undifferentiated, most isodiametric cell with dense granulated cytoplasm and loses their viability very fast.

SYMBIOTIC SEED GERMINATION

Under natural conditions, the orchid seeds germinate after being infected by fungus, the orchid mycorrhiza which term was coined by Frank in 1885⁴. Most of the Mycorrhizal fungi of orchids fall into a non-sporing group known as *Rhizoctonia*, the major species being *R. repens*, *R. mucoroides* and *R. languinosa*. Subsequent isolates were known as *Mycelium radialis*. For quite some time these fungi were called as *Orcheomyces*. Later on, however, other fungi were also isolated from orchid cultures. In Japan 54 different fungi were isolated from 20 orchid species⁶.

Orchid seeds cannot utilize their own reserve or do so very slowly. They can also not hydrolyze large molecules like starch or cellulose. As a result asymbiotic germination in the absence of sugar proceeds only to the early protocorm stage, after which they wait for external supply of simple sugars through the help of mycorrhizal fungus. This technique was carefully exploited by commercial growers for the rare plants and hybrids which while could not be propagated by any other means, responded very well to tissue culture at a much faster speed. Vacherot and Lecoulfe firm in France has developed a new technique of virus-free plants of *Cymbidium*. Today tissue culture is preferred for commercial propagation of orchids.

ORCHID CULTURE

In nature, orchids obtain their supply of inorganic nutrients like calcium, magnesium, iron, potassium, nitrogen and traces of manganese, boron, copper, zinc etc. from the tree on which they are growing and also from atmosphere and decaying vegetables

and dropping of birds. The evolution of orchid culture from hobbyist to commercial grower was very slow, as most of the orchids collected from different regions did not adapt to local conditions and died. The methods of propagation were not known and most of the orchids, which flowered under utmost care, were found to be self-sterile. Further, it was difficult to germinate the seeds, which lacks any functional endosperm. The seeds sown in the nursery beds required long period of germination and any disturbance to the soil or physical environment destroyed the whole population.

It was only in 1821 when Conrad Loddiges and sons started growing orchid plants commercially at their nursery in Hackney, followed by John Daminy of M/s Veitch & Sons who produced the first orchid hybrid between two *Calanthe* species in 1852, which flowered in 1856 in Veitch Nursery Exeter, England. This was followed by a large number of man made hybrids produced by hobbyists and small growers. In 1913, Sun Kee Nursery, Singapore, started the first cut-flower production of *Arachnis* type hybrids.

The major developments in cultivation of orchids in the world have been due to modern scientific technology, which has been suitably used in case of orchid seed germination and meristem culture. Today orchids are grown on assembly-line method in extensive glasshouses with controlled environment and the sale of orchid flowers runs in millions of dollars. The modern methods of propagation have brought orchid cultivation on par with other commercial crops⁶.

ORNAMENTAL INDIAN SPECIES

Some of the Indian orchid species which are of high ornamental value are : *Aerides crispum*, *A. fieldingii*, *A. multiflorum*, *A. odoratum*, *Anaectochilus roxburghii* , *Arachnis clarkei*, *Arundina graminifolia*, *Bulbophyllum leopardinum*, *Calanthe masuca*, *Coelogyne elatn*, *C. devonianum*, *Cymbidium pendulum*, *C. longifolium*, *C. munronianum*, *Dendrobium aggregatum*, *D. aphyllum*, *D. fimbriatum*, *D. jenkinsii*, *D. moschatum*, *D. nobile*, *Paphiopedilum faireanum*, *P. venustum*, *P. hirsutissium*, *p. insigne*, *Phaius wallichii*, *Pleione praecox*, *Rhynchostylis retusa*, *Thunia alba*, *Vanda cristata*, *V. coerulea* and *V. coerulescens*⁶.



Figure 7: *Aerides ringens*

ORCHIDS WITH MEDICINAL IMPORTANCE

In India, orchids are employed for a variety of therapeutic use in different systems of traditional medicines like Ayurveda, Siddha and Unani. *Acampe praemorsa*, an epiphytic orchid is used in rheumatism. Tubers of many *Habenaria*'s are being used to treat for unconsciousness, vermicide and as blood purifier. Locals in the form of salep are using *Cymbidium aloifolium* as emetic and purgative. *Dendrobium ovatum* for stomach ache, *Eulophia nuda* for tumors and bronchitis, *Flickingeria nodosa* (Purusharatna) is astringent, aphrodisiac, expectorant etc. *Luisia zeylanica* is being used as emollient for boils, abscess and burns. *Habenaria acuminata*, *Nervilia aragoana*, *Satyrium nepalense*, *Vanda testacea*, *Zeuxine strateumatica* are some of the other orchids, which are also medicinally important.

ORCHIDS EXPLOITATION

Of the world's 30,000 orchid species, some 10% (3,000) are believed to be endangered in their native habitats. There are two major causes; the primary threat is from the physical destruction of habitat. Clearance of natural vegetation for timber, crop cultivation or forestry, or for industrial or urban development has decimated uncounted species from Indonesia to Brazil. Habitat destruction not only destroys the places for the plants to live, but also causes loss of the orchid's

pollinators, other plants, and fungi that they depend on. The other threat is also man-caused such as over-collection. Despite bans in many countries on the collection and export of native plants, in many cases the damage to the population is already beyond repair and there is still a trade from unscrupulous orchid growers. A large number of orchid species, which were present in plenty in Indian forests, are now at the verge of extinction and some of them have become so rare that a large number of botanical teams were unable to trace them. To cite an example *Paphiopedilum druryi*, which was once found in plenty in Agastaya Hills in south India, is now difficult to locate.



Figure 8:Evergreen to semievergreen forests- clearing way to paddy fields and electric lines (right top).

Some orchids are endemic to India are so ornamental and in demand that their natural populations have been over exploited. Some species in the genera like *Arundina* , *Cymbidium*, *Coelogyne*, *Dendrobium*, *Paphiopedilum*, *Renanthera*, and *Vanda* are almost extinct. The provisional list of 150 endangered plants of India includes many orchids like *Acanthephippium sylhetense*, *Anoectochilus sikkimensis*, *Aphyllorchis montana*, *Arachnanthe clarkei*, *Arundina graminifolio*, *Cymbidium macrorhizon*, *Dendrobium densiformum*, *Didiciea cunninghamii*, *Eria crassicaulis*, *Galeola lindleyana*, *Gastrodia Exilis*, *Paphiopedilum fairanum*, *P. druryi*, *Pleione humilis*, *Renanthera imschootiana*, *Vanda coerulea*, *V. pumila* and *V. roxburghi*.⁶



Figure 9: Dendrobium ovatum

CONSERVATION OF ORCHIDS

The list of plants banned or restricted for export from India formerly included a few orchids but now include all orchids growing wild. The convention of International Trade in Endangered Species of Fauna and Flora (CITES), ratified by India, places all species of Orchidaceae under Appendix II, meaning thereby that their trade will be only through export permits. Steps have also been taken to conserve Indian native species by establishing Orchidaria, sanctuaries and germplasm conservation centres. Botanical survey of India has established two Orchidaria one at Shillong and other at Yercaud to conserve rare and endangered species. The ICAR research complex at Shillong, the Indian Institute Of Horticultural Research at Hessaraghatta and the Indian Botanic Gardens at Calcutta maintain collections of orchids in their Orchidaria. Some states have also established orchid sanctuaries in Sikkim at Singtom and Deorali and in Arunachal Pradesh at Tapi⁶. However, the concept of in situ conservation in the wild condition of the existing rich orchid flora at their nativity is

rather lacking. Hence there should be selection of areas rich in orchids as 'orchid preserves' at sectoral levels in the hot spot areas to prevent deforestation, habitat destruction, and indiscriminate collection by orchid lovers and exploitation by tradesman.

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