

COMMERCIALISATION AND CONSERVATION ASPECTS OF ORCHIDS

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Abstract

Orchids are known for their wide range of diversity in forms, size, colour, delightful appearance, long lasting qualities and texture of flowers which are highly fascinating. These constitute an order of royalty in the world of ornamental plants and rank first in the global tropical cut flower trade. These plants are an integral part of forest ecosystem and have a major role in ecological balance of forest environment. Cultivation of orchids has become an important income earning sector in many of the developed and developing countries. There is a dynamic shift from sustenance production to commercial production in orchids in many of the nations and there is a significant increase in trade of orchids at domestic level and profit to farmers because of rapid urbanization. The demand for orchids as cut flower in both domestic and international market is growing fast and hence a large number of people sustain their livelihood by either producing or marketing of orchids. The basic requirements in flower trade are novelty, uniqueness and rarity, to attract the consumer demand. The orchid species and hybrids play a major role in bringing these export oriented traits for consumer satisfaction. The significance of orchids is figured internationally as State or National flowers like *Cattleya skinneri* by Costa Rica and *Cypripedium reginae* by Minnesota. With the potential available in the country in terms of climate and human resources, India can go a long way to be in the forefront of the international orchid trade. It is high time to address the relevant technological and infrastructure issues to reap this potential.

History and Distribution

THE ORCHID family is one of the largest in the flowering plant kingdom, with estimates ranging from 20,000 to 35,000 species in five subfamilies (Dressler, 1993; Mabberley, 1997). They belong to the family Orchidaceae, reported to comprise over 600 genera and over one lakh man-made hybrids. These are an ancient group, with their present distribution suggesting an origin that probably predates the break-up of Gondwana land 125 million years ago, yet they are still an actively evolving family (Chase, 2001; Raven and Axelrod, 1974). As a family, they are almost ubiquitous and occur on all vegetated continents (Dressler, 1981). However, their distribution is not uniform, but skewed markedly towards the tropics. Even within the tropics, the distribution varies widely between continents and within regions. Areas of particular species abundance follow closely those of high plant diversity outlined by Barthlott *et al.* (1996) and Myers *et al.* (2000). The Northern Andes of South America, Sumatra, Borneo, New Guinea, and Temperate South West Australia are all particularly rich in orchids. The Andes of Colombia and Ecuador are the richest places on earth for orchid diversity, with perhaps a quarter of all known species found there. Over 720 species of orchids are recorded as growing on Mt. Kinabalu in Sabah, North East Borneo (Wood *et al.*, 1993). This is as many orchids, as are found in the whole of East Africa, three times the number found in North America, and fifteen times the number found in Britain. Over 1,200 species of orchids have been

reported from the Island of Sumatra (Comber, 2001) and almost 1,000 from Madagascar (Du Puy *et al.*, 1999). An estimated 500 or more orchids can be found in the Himalayan Kingdom of Bhutan (Pearce and Cribb, 2002). Only a few orchid species are found common across regions and there is an existence of wide diversity due to the influential factors like habitat, geology, climate and degree of isolation.

Importance and Potential of Orchids

Orchids may be utilized for different purposes like cut flowers, potted plants, medicinal compound extraction, and other industrial applications. Those belonging to genera *Aerides*, *Anoectochilus*, *Ascocentrum*, *Bulbophyllum*, *Coelogyne*, *Cymbidium*, *Dendrobium*, *Eria*, *Goodyera*, *Paphiopedilum*, *Phaius*, *Phalaenopsis*, *Pleione*, *Rhynchostylis*, *Vanda*, *etc.* have very good potential as potted plants. *Arundina*, *Cymbidium* hybrids, *Paphiopedilum*, and *Vanda* are useful for cut flower production. The hybrids of orchids have high potential for commercialization. Hence, orchid breeding is an important and lasting area of research for production of novel orchid hybrids.

The international *Cymbidium* flower trade is solely based on the modern hybrids bred from 5 or 6 larger flowered species originated from Himalayan orchid belt at elevations about 1,000 to 2,000 m. The smaller flowered *Cymbidium* hybrids are usually the result of breeding between the miniature *Cymbidium* species and the modern complex standard hybrid. Some of them are as given below:

- i. *Cymbidium devonianum* is currently most extensively used for developing potted *Cymbidium*.
- ii. *Vanda coerulea*, *V. cristata*, *V. stangeana*, and *V. tessellata*, form the backbone of international *Vanda* breeding programme.
- iii. *Ascocentrum* was used extensively to produce some finest hybrids both for cut flower as well as potted plants.
- iv. All the species of *Paphiopedilum* are extensively used for developing hybrid varieties. Three *Phalaenopsis* species are also very popular with international breeders for developing promising varieties.
- v. Some of the *Coelogyne* and *Dendrobium* types have also shown promise in breeding programme.

Table 1. Some commercial orchid hybrids.

Genus	Name of the varieties
<i>Cymbidium</i>	Amesbury, Bergadium Sydney, Bertha Peter Shot, Cooks Bridge, Pine Clash, Jung Frau Dos Poblos, Close Melody Freakout, Sleeping Nymph, Evening Star, Red Star, Coco Jim Starquest, etc.
<i>Dendrobium</i>	Sonia galaxy, Sonia 17m, Pramont, Toshiko, Intuwong, Nantavarn, Joan kushima, Karen no. 4 Asahi pink, Sakura pink, Pompadour, Kiyomi beauty, Boonchoo gold, Kimiyo kondo, Ahulani Hinojosa, Burana green, B. B. White, Water Oumae, Jaquelyn Thomas Mary Mak, Lowana Nivoka Hiang Beauty, Masako, Orange Red, Genting Blue, Lavender, Wooleng, etc.
<i>Mokara</i>	MK Chark Kuan Orange, MK Chark Kuan Pink, MK Chark Kuan Yellow, MK Chark Kuan Red, MK New Nora Blue
<i>Aranda</i>	Iskander Christine Alba K. C. Pink, Pata, Pani, etc.
<i>Oncidium</i>	Onc. Gower Ramsey. Onc. Taka, Onc. Sharon Baby Pink with spots.

International Scenario

Orchids have emerged as a leader in the international market and have immensely contributed to the economy of several developed and developing countries especially as cut flowers. Orchid genera grown in ground bed for cut flower production are *Vanda* in Hawaii, *Arachnis* and *Aranda* in Singapore and Thailand and *Cymbidium* in the Netherlands, New Zealand and Australia. *Cymbidium* ranks first in orchid cut flower trade which accounts for 2.7% of the total cut flower production. The major importer of orchids is The

European Economic Community. Germany is the major importer of *Cymbidium* and *Dendrobium* orchids. These orchids are imported to Germany from The Netherlands, Thailand, Italy, Singapore and Costa Rica. In the United Kingdom, large flowered *Cymbidium* and new varieties of *Dendrobium* are in demand. The U.K. imports temperate orchids of nearly 2,891,000 species from the Netherlands, Colombia, Zimbabwe and Kenya. The major orchid growing countries in the world are Singapore, Thailand, Malaysia, Indonesia, Japan and Australia. The processed beans of orchid spice crop, *Vanilla planifolia* are produced in Madagascar (50 per cent), Indonesia (25 per cent), Comoro Island (8 per cent) and others (17 per cent). The importing countries of *Vanilla* beans are U.S.A., Germany, Saudi Arabia, Switzerland, Canada, Japan, Denmark, United Kingdom and Netherlands. *Dendrobium* orchids are in huge market demand compared to cymbidiums, thus the international market scenario shows that the domestic market for orchids is growing rapidly which creates more opportunities for Indian floriculture sector.

Indian Scenario

India is endowed with an ideal climate for growing all types of tropical, sub-tropical and temperate orchids. The demand for orchids is increasing day by day and in the period of last six years (from 2009-2015), the import of fresh cut orchids and buds, of a kind, suitable for bouquets or for ornaments has increased to more than seven fold. However, our export still remains negligible and stagnant in comparison to import. India is home to 1,331 species, including 400 endemics (Misra, 2007) representing approximately 5.98% of the world orchid flora and 6.83% of the flowering plants in India. It is very interesting that most of the modern day orchid hybrids leading in the world were taken from India during the colonial rule. Some of the orchids like *Aerides*, *Arundina*, *Coelogyne*, *Cymbidium*, *Dendrobium*, *Paphiopedilum*, *Renanthera*, *Rhynchostylis*, and *Vanda* are in great demand for their ornamental potential throughout the world. India is known for its rich orchid flora. The geographical locations of orchid diversity and distribution in India are North Eastern States, Andaman and Nicobar Islands, Andhra Pradesh (Eastern Ghats), Karnataka (Kodachadri, Kemmannagundi), Kerala (Travancore), Maharashtra (Mahendragiri, Sigaraja), West Bengal (Kalimpong and Darjeeling forest areas), Tamil Nadu (Nilgiris), and Uttar Pradesh (Kaflani, Dafia Dhoora). Orchid hybrids are commercially cultivated on a large scale in Kalimpong, Darjeeling, Sikkim, Guwahati, Thiruvananthapuram and Chennai. Collection, conservation, breeding and propagation of some of the orchid species mainly the cymbidiums were the major research progress of orchids in India. Off late, exotic

Dendrobium hybrids are introduced from other countries and their production is done in large scale to meet the domestic demand. Few corporate sectors have also ventured into this lucrative business of orchid growing on a large scale, mainly for export markets. Thus, India with its varied climatic conditions provided a suitable platform for development of orchid industry.

Whereas export is concerned, there is a demand for few of the Indian species of orchids. However, the size of consignment remains very small and thus, both volume and value of total export is negligible. To meet the export demand, many time, the natural populations of the orchids are exploited which creates a major threat to this already endangered group of plants. Wherever the species are multiplied, thus are done through conventional methods like keikis or cuttings that are not suitable for large scale multiplication. Besides live plants of species, our country started exporting large quantity of tissue culture plants of *Phalaenopsis* at average price of US \$ 0.13 per unit to the Netherlands and U.S.A., under Merchandise Export from India Scheme (MEIS) as per Indian Foreign Trade Policy 2015-20 from the last two years. It is worthwhile to mention that the Andaman and Nicobar Islands is a treasure house of orchid diversity and there are about 152 species of orchids from 59 genera. 16 species of orchids and one variety are endemic, out of which *Grosourya*, *Macropodanthus*, *Malleola*, and *Plocoglottis*, recorded are not found in mainland India. The Burmese-Thai elements represented by *Bulbophyllum crassipes*, *B. rufinum*, *Cleisostoma elegans* and *Coelogyne quadratiloba* are recorded from Andamans. Malaysian elements represented by *Appendicula reflexa*, *Dendrobium pensile*, *Phalaenopsis tetrapsis* and *Schoenorchis minutiflora*, are recorded from Nicobars. The local conditions existing in the Island are extremely suitable for the growth and survival of orchids, which can be exploited commercially and also to maintain a gene pool of the orchids in this Island biosphere.

Commercial Cultivation of Orchids in India

India is bestowed with rich biodiversity of orchid flora. Though monopodial orchid genera like *Arachnis*, *Aranda*, *Mokara*, and *Vanda* are cultivated in India, greater emphasis is given to the hybrids of *Cymbidium* and *Dendrobium* as they have great potential as cut flowers in the world trade. The Netherlands and New Zealand, the world's largest producers of cymbidiums, supply the cut flowers from May to August whereas, our crops are available from October to March. Hence, there is a good export market for cymbidiums from India, which have a conducive climate for producing *Cymbidium* cut flowers.

At present, hardly 30,000 to 40,000 cut flowers are produced from these areas, whereas there still exists a huge export potential. The U.S.A. mostly imports *Dendrobium* and some temperate orchids from Australia and New Zealand. India being in the strategic location in the world with ideal agro-climatic conditions for growing varieties of orchids boosts export by bringing large areas under the cultivation of tropical and temperate orchids. Thus, cultivation of *Cymbidium*, *Dendrobium* and other commercial orchids in India is a gainful venture that provides an alternative source of income to the government of India in the form of foreign exchange.

There are large number of areas in North Eastern Hill region where many commercially important indigenous and exotic orchid species may be grown besides commercial hybrids of *Dendrobium* and *Phalaenopsis*, which can create the foundation of orchid industry in our country like other Asian country, Thailand. *Dendrobium* may be easily grown in wider geographical area ranging from low altitude hills, foothills and plain areas with milder climate. Many parts of Southern India, Maharashtra, West Bengal, Jharkhand, Assam, Tripura, Mizoram, Kerala, Karnataka, and Maharashtra have taken some initiatives to grow *Dendrobium* mostly through Government supported programmes creating newer opportunities. Several native orchid species are well-known for their medicinal properties. A Popular tonic like 'Chyawanprash', has four species of orchids as its components namely, Riddhi (*Habenaria intermedia* D. Don), Vriddhi (*Habenaria edgeworthii* J. D. Hook.), Jeevak [*Malaxis muscifera* (Lindl.) Ktze.], and Rishbhak [*Malaxis acuminata* D. Don] (cf. Pathak *et al.*, 2010). Besides these species, many orchid species are widely used as traditional medicines by people and used in pharmaceutical industries to isolate phytochemicals (Singh and Duggal, 2009). However, in most cases, these are done through exploitation of natural population which creates threat for their survival. Taking an appropriate initiative for their commercial cultivation may open newer avenues. Likewise, there are many orchids which produce pleasant scent like *Coelogyne*, *Zygopetalum*, and some dendrobiums, *etc.* Their use through value addition in perfumery industry may create alternate opportunities for orchid commercialization. Though India has strength to commercialize orchid cultivation, there are a few constraints which are limiting factors in commercial cultivation of orchids such as: i) Non-availability of quality planting material of internationally accepted varieties/hybrids; ii) Lack of infrastructure for supply of quality planting material throughout the country as per requirement; iii) Comparatively higher production cost when compared with imported flowers of the same orchids; iv) Non-judicious use of climatic variation in the country to grow appropriate genotypes; v) Less

availability of expert scientific manpower and skilled workers for orchid growing which are pre-requisites for orchid commercialization; vi) Majority of the farmers of our country are small and marginal with less financial capabilities. They don't want to take risk with these crops with long juvenile period; vii) Less developed infrastructure for proper post-harvest handling and transportation from areas of production to niche markets; viii) High initial investment and maintenance cost; ix) Very long gestation period; x) Very little information on existing market; and xi) Lack of suitable packaging material.

To develop orchid cultivation on commercial scale in India, the following strategies are to be followed which may pave a way for developing export hubs for orchids.

- i) It is high time that the indigenous orchid taxa should be screened for favourable characteristics and the promising ones be bred for unique hybrids for sale in both the domestic and international markets.
- ii) Steps should be taken to introduce new varieties and identify location specific suitable hybrids at affordable cost.
- iii) Construction of low cost polyhouses for orchid growers.
- iv) The orchid industry may be developed as a cottage industry with involvement of small growers supported by training, technical help and supply of planting stocks from R & D institutes.
- v) Research and Development support:
 - a) To explore, identify and document the orchid genetic diversity of the country.
 - b) Collection, conservation, characterization, evaluation and utilization, of available germplasm for developing export worthy hybrids.
 - c) Standardization of micropropagation techniques for large scale production of quality planting material.
 - d) Initiate research programmes on mycorrhizal associations in orchids with a view to identifying specific fungal strains that can promote better survival and growth of *in vitro* raised plantlets.
 - e) Standardization of agro-techniques.
 - f) Standardise compost and fertilizer requirement for growing orchids and develop potting media based on locally available materials.
 - g) Standardization of post-harvest management practices.
- h) Initiate centrally sponsored schemes for creating necessary infrastructural facilities for the orchid growers.
- i) Build up repository of up to date information on production technologies, post-harvest management and marketing.
- vi) Post-harvest management:
 - a) Develop suitable technologies for the post-harvest handling, grading and packaging.
 - b) Strengthening infrastructural facilities like pre-cooling and cold storage.
 - c) There should be proper outlets for promotion of orchid flowers and potted plants to metropolitan cities, for their proper auction, houses where grading and packaging could be ensured.
- vii) Financial support to growers through various government agencies like Industrial Development Bank of India (IDBI), Industrial Credit and Investment Corporation of India (ICICI), Industrial Finance Corporation of India (IFCI), National Bank for Agriculture and Rural Development (NABARD) and National Horticulture Board (NHB).
- viii) Market information:
 - a) Publicity of orchids as potential cut flowers and their other commercial utilities may be popularized through print, electronic media and consumer exhibitions.
 - b) Development of product promotion activities at International markets.
 - c) Advising and coordinating new starters in the industry.
 - d) Increasing flow of information to the industry.

Need for Conservation of Orchids

Orchids are one such group of plants which grow in a variety of habitats throughout the globe. Orchids are a highly specialized group of plants and have modified themselves in such a way that they occur in almost every ecosystem. They have a peculiar habit of interdependence on mycorrhiza for germination and nutrition. Any imbalance in the habitat can cease the germination and growth of orchids. Thus, they are more vulnerable to the destruction of habitat loss, degradation and fragmentation; this may be caused by natural threats, anthropogenic pressures and threats posed by invasive species. A number of species are rare and threatened throughout the world, including Western Himalayas owing to many factors.

Factors Affecting the Habitat Loss of Orchids

Natural Threats

Due to the undulating topography and the varying geological set up of Western Himalayas, several areas have been identified that are prone to landslides, floods, etc., which affect the natural population of many terrestrial and epiphytic orchids leading to their extinction. Many host trees growing along the river banks at lower and mid altitudes are swept away by floods, thus removing several orchids. In many areas, landslides were seen to carry away the hill-slopes with them, during rainy season. The terrestrial orchids carried down by landslides are dumped into soil, thus destroyed. The global climatic variations bring a lot of variations in the local climate. The local rainfall patterns are changing and most of the terrestrial orchids are affected by this change. They show active growth at the beginning of rainfall. If the rain is delayed, it hampers the life cycle of most of the rain dependent orchids like *Nervilia* spp. Most of the orchids are pollinated by insects, which may be specific for orchids. Lack of pollinators in nature can affect the survival of orchids.

Anthropogenic Threats

The anthropogenic influences also lead to habitat loss in many orchid species. As most of the orchids are insect pollinated, depletion in the population of insect pollinators may also lead to depletion in the population of particular orchid species. The various anthropogenic factors like habitat fragmentation, over exploitation and overgrazing has resulted in major threats to orchid distribution in many geographical locations.

Habitat Fragmentation

Habitat destruction is identified as the main threat to orchid diversity. It is often a cause of species becoming threatened. The main habitats for orchids are sal forests, riverine forests and oak forests in Western Himalayas. Increasing demand of the local people and their dependency on the forests are identified as the main threats to the orchid habitats. Both terrestrial and epiphytic orchids are affected by habitat fragmentation. Many orchids, especially mycoheterotrophic orchids require dense forest cover. Little canopy exposure can wipe out the population. Epiphytic orchids are mainly inhabitants of the riverine forests. These forests provide a suitable climate and humidity for the growth of epiphytic orchids. Deforestation activities coupled with the lopping of host plants for fodder, fuel and timber causes the

riverine forests to change rapidly. Lopping and cutting of the host trees for fodder and fuel are a regular phenomenon in the hills. Therefore, the occurrence and growth of most of the epiphytic orchids are adversely affected. Epiphytic orchids growing on fodder trees have been removed due to the excessive and unscientific ways of lopping. In Western Himalayas, Oak forests are predominant. Among the oaks, *Quercus leucotrichophora* has been identified as an excellent tree host particularly in many epiphytic orchid dominated areas and its supports fairly large number of orchid species. But this tree is a good source of fodder and fuel too. Branches along with leaves are lopped to a great extent making the trees almost naked. Therefore lopping of banj-oak and other fodder species that support a high number of epiphytic orchids have reduced the abundance of these epiphytic orchids. New roads, dams, mines, buildings, and other developments strongly contribute to habitat loss in this region, not only directly by damaging forests but also indirectly by displacing them. A typical example is the snow orchid *Diplomeris hirsuta* which was reported from Dogaon near Nainital and this was the only locality in Western Himalayas where it was found at the time. In 1996, the state government took a decision to widen national highway 87, the rocks where the species was growing were destroyed and the only surviving population of the species was wiped out from the area.

Over Exploitation

Although very few orchid species are medicinally important, over exploitation of these species coupled with a lack of awareness, has resulted in their becoming very rare and endangered in natural population and they are bound to become extinct in the near future. Terrestrial orchids such as *Crepidium acuminatum*, *Dactylorhiza hatagirea*, *Eulophia dabia*, *Malaxis muscifera*, and *Platanthera edgworthii* are used in the preparation of various medicines by pharmaceutical companies.

Overgrazing

The high altitude grasslands, pastures and meadows are very important habitats for many alpine orchids. The foothills of the study area are inhabited by small groups of nomadic pastoral communities such as Gujjars in Shiwalik zone, Himachal Pradesh and Jammu, and Bokshasand Tharus in the Eastern Tarai zone. The cattle were often found eating not only young flowering buds but also the whole orchid plants.

Forest Fires

Forest fires are another cause of the destruction of orchid host trees and of the thick layer of humus as

well as of the pollinators. During the study, many orchid rich localities were found to be affected by fire. For epiphytic orchids, fires at any time of the year can cause a drastic change in plant abundance. In many places, which were affected by previous fires, this phenomenon was observed, but this has hardly affected the terrestrial orchids such as *Nervilia* spp., which were seen in good abundance.

Threats by Invasive Species

Many invasive species such as *Ageratum conyzoides*, *Eupatorium adenophorum*, *E. odoratum*, *E. riparium*, *Lantana camara*, and *Parthenium hysterophorus* are threats for orchid distribution. Their multifaceted adaptability and fast replicating characteristics have created a serious threat to the indigenous flora including orchids. Orchids that face threats by these alien species are *Eulophia* spp., *Goodyera procera*, *Habenaria marginata*, *H. plantaginea*, *H. pubescens*, *Pachystoma pubescens*, *Peristylus constrictus*, *P. goodyeroides*, *P. lawii* etc. Various dead host species were seen heavily loaded with epiphytic orchids in the biodiversity rich hot spot areas.

Conservation Strategies

For their long term survival in nature, they need to be protected through *in situ* and *ex situ* conservation.

- i) *In situ* orchid conservation and habitat preservation is the first line of defence for safeguarding orchid species for the future.
- ii) In order to conserve the orchids, orchid conservation areas may be selected from particular geographical areas. Endemic and near endemic species need special attention. For example, *Peristylus kumaonensis* is an endemic orchid reported by Dr. J. Renz in 1983 from a locality that is 5 km from Nainital towards the North, on the right way to Ratighat at an altitude of 1800 m and it is restricted to this area alone.
- iii) There is an urgent need to conduct a population monitoring program together with orchid ecology so that we can use this information to design orchid conservation plan for the intact regions of habitat where orchids still thrive.
- iv) There is an urgent need to conserve the commercially important and/or endangered orchid species by propagating them *in vitro* and develop efficient mass propagation protocols. Though, some attempts have already been made in this direction (Arora *et al.*, 2016; Chauhan *et*

al., 2015; Kaur and Pathak, 2014; Pathak *et al.*, 2001, 2016; Sabin and Gangaprasad, 2016; Vij and Pathak, 2012), these are meagre in terms of the size of the orchid family. In this connection, orchid seed banks and germplasm banks need to be established.

- v) Local people should be made aware of this wealth by means of awareness programs. Orchid conservation areas can be developed for tourists and college students so that they may visit these areas during their educational trips.

Conclusion

The orchid industry is recognized as a potential venture in the country very recently and efforts are being made to compete with the international trade. Our position globally is not very significant when compared to other orchid growing nations. But with judicious use of modern technologies, we may become an effective competitor in the global orchid industry. Besides indigenous research, bilateral as well as multilateral cooperation between India and leading countries in orchid commercialization for low cost technology transfer in terms of hybridization, cloning techniques, packaging and transportation may help in rapid future growth and development. With the potential available in the country in terms of climate and human resources, India can go a long way to be in the forefront of the international orchid trade. It is high time to address the relevant technological and infrastructural issues to reap this potential.

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