Biotechnology for Sustainable Development: Achievements and Challenges
Editors: S.E. Hasnain, Rashmi. B. Jha and R.N. Sharan; McGraw Hill Education, India; 2010

ORCHID RESOURCES OF THE NORTH EAST INDIA AND THEIR SUSTAINABLE UTILIZATION

11

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Abstract: The Northeast region of India boasts of a rich biodiversity treasuring invaluable genetic resources that can be put to use for the economic growth of the region in particular and to the nation in general. The region has a remarkable diverse flora and is known as the 'Cradle of Flowering Plants'. About 8000 species of the flowering plants are known to occur in this distinct biogeographic zone of which orchids form an important group. Amongst the Northeastern states, Arunachal Pradesh and Sikkim have the maximum diversity of orchids while Tripura exhibits the lowest. The orchids of the region are extensively used by the people for various socio and economic activities of the states. However, due to over-exploitation and unmindful collections of these resources from their natural habitats, there is an increasing decline of the orchid populations in the region. This rapid depletion of the orchids calls for immediate and concerted efforts for their conservation, proper management and utilization.

11.1 INTRODUCTION

The mosaic of geo-climatic conditions occurring in India has resulted in a great range of habitats for rich plant diversity. This is true for the diversity of ecosystems, species and diversity of the genetic pool within the species. India figures with two hotspots; the Himalaya and the Indo-Burma among the listed hotspots of the world. These hotspots are considered data-deficient, existing knowledge about plant and animal biodiversity provide some indication of their value (Tandon et al., 2009). In case of the Himalayas, about 32% of the plants known from the region, are endemic, whereas in the Indo-Burma hotspot, 52% of vascular plant species are endemic (Pawar et al., 2007). The plant wealth of India is estimated to be over 49,000 species, which is 12% of the known plant species of the world.

The Northeast region of India which lies between 87°32'E to 97°52'E latitude and 21°34'N to 29°50'N latitude comprises Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim and is connected with the rest of India through a narrow corridor in North Bengal, popularly known as the 'chicken's neck'. This region with about 2.55 lakh sq km is made up of mountains above the snowline and plains a little higher than the sea

level and accounts for 7.8% of the total land space of the country. It forms the main region of tropical forests in India containing the species-rich tropical rain forests. The region receives a significantly higher annual rainfall of about 1080 cm around Cherrapunjee and Mawsynram in Meghalaya (areas with highest rainfall in the world) and lower in the rain shadow area of Nagaon district of Assam. This region boasts of a rich biodiversity treasuring invaluable genetic resources that can be put to use for the economic growth of the region in particular and to the nation in general. As the region has a remarkable diverse flora, it is known as the 'Cradle of Flowering Plants'. About 8000 species of the flowering plants are known to occur in this distinct biogeographic zone of which orchids form an important group.

Orchids are highly specialized biologically with incredible shapes and are able to grow on a variety of substrata. They belong to the family Orchidaceae, which is not only the most specialized families of the flowering plants, but also is one of the largest families. Orchidaceae includes 800 genera and between 25,000 to 30,000 species spread all over the world (Chowdhery, 2001). Orchids are the most fascinating and beautiful of all the flowers. They constitute an order of royalty in the world of ornamental plants and are of immense horticultural importance. They have attracted floriculturists since time immemorial due to their fads, fancies and fashions and have thus led to "orchid mania" throughout the world. The orchids are known to mankind for the last several centuries for their beautiful, attractive flowers and as medicinal plants. The majority of orchids are epiphytes that prefer growing being perched on trees and sometimes even on moss covered boulders. However, lithophytes, terrestrials and saprophytes growing on rocks, ground and organic matter respectively are also found. Orchids are perennial plants having flowers on long, short or highly reduced floral axis in the leaf axil or opposite to leaf at the tip of the stem or from the pseudobulb; either solitary or 2–100 or even more in number. The petals are the most colourful and showy part of orchid flowers; of the three petals; one is typically quite different from the others, forming the distinctive lip or the labellum. Orchids also have distinctive reproductive or sex organs (stamens and stigma) which are fused to form one structure called the "Column", found at the centre of the flower. The orchid seeds lack an endosperm and have undeveloped embryo covered only by a thin protective wall. This lack of food reserves and protection makes the seeds extremely vulnerable to their environment, resulting in a high mortality rate unless optimum conditions are found for germination (Zeigler et al., 1967). In majority of the orchids the embryo is few-celled at the time of seed maturation and its proper development takes place only during seed germination (Senthilkumar, 2001). As the seeds do not have sufficient reserve food materials to take care of the growth of embryo during germination (Richardson et al., 1992), they have to depend on mycorrhizal fungi which form the major external source of nutrients for the development of undifferentiated embryo into a protocorm. However, it was possible to carry out *in vitro* asymbiotic germination of orchid seeds after the isolation of the root infecting fungus by Bernard (1909).

11.2 ORCHIDS IN NORTHEAST INDIA

The Northeast region of India has been recognized as a 'mega diversity' area for rich flora and fauna. The region is reported to possess one of the richest reservoirs of genetic variability in a wide group of plants including rich diversity in medicinal plants, orchids, rhododendrons, bamboos, balsams and primulas. There are approximately 1,300 orchid species growing throughout India. About 70% of the country's orchid wealth harbouring around 876 orchid species in 151 genera is found in the Northeastern India (Jain, 1985). A large number of them are ornamental, rare, endangered and threatened. Figure 11.1 depicts some of these orchid species found in the region.

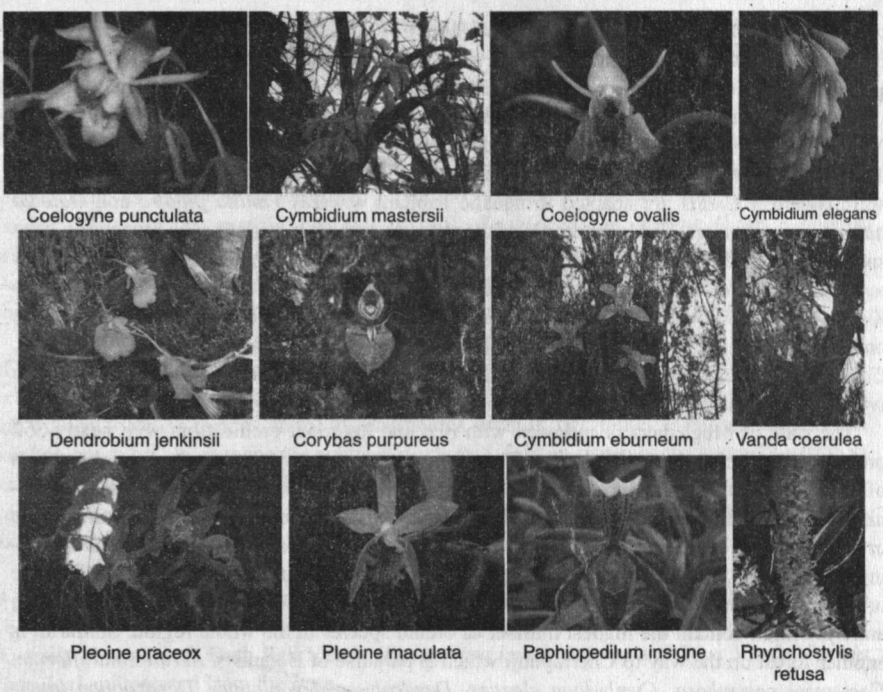

Fig. 11.1

The important genera of the orchids such as *Aerides, Arundina, Bulbophyllum, Calanthe, Coelogyne, Cymbidium, Dendrobium, Eria, Phaius, Phalaenopsis, Paphiopedilum, Renanthera, Rhynchostylis, Thunia, Vanda* are concentrated in the region (Hegde, 1984; Nayar and Sastry, 1997–98,1999; Ahmedullah, 2000). However, the orchid populations of Northeast India are fast declining due to varied factors. According to the recent survey of orchids in the region, it was found that about seventy orchid species out of a total number which grow in the region are on the verge of extinction. Arunachal Pradesh and Sikkim in the Northeastern states have the maximum diversity of orchids while Tripura exhibits the lowest orchid population (Medhi and Chakrabarti, 2009).

The orchids are found to be existing naturally in diverse habitats in Arunachal Pradesh. The luxuriant green forests found spread over numerous hills rising from about 100 m to a height of about 7000 m make a congenial environment to different forms of life. The Arunachal Pradesh state government has set up the Orchids Research and Development Center at Tipi, a remote village. Clusters of beautiful blue vanda (*Vanda coerulea*) adorn the rich tropical forests of the Tipi district in Arunachal Pradesh. In the Tipi Orchid Research Center over 500 species of orchids are found to occur. Sessa, the "Orchid Paradise" of our country, is 15 miles from Tipi, and it has an Orchid Sanctuary which abounds in a variety of species including the white *Coelogyne nitida* (which grows on moss covered rocks), the tree-borne yellow *Cymbidium elegans*, and *Dendrobium chrysanthum*, the bright yellow flowers. *Dendrobium aphyllum, Dendrobium fimbriatum var occulatum, Dendrobium densiflorum, Calanthe masuca, Cymbidium ensifolium, Coelogyne corymbosa. Phaius flavus, Paphiopedilum fairrieanum, Paphiopedilum*

venustum, Paphiopedilum spicerianum, Rhynchostylis retusa, Renanthera imschootiana, Vanda coerulea, etc. feature among the prominent species of this region. Arunachal Pradesh with 126 genera and 550 orchid species has the highest number orchids reported from India.

In Assam as many as 293 species of orchids are reported which represent 44.39% of the total Northeast species and 24.42% of species occurring in India. Assam orchids show all the habits and growth forms found in Orchidaceous taxa. Mostly they are epiphytes. *Goodyera procera* and *Spiranthis sinesis* are adapted to aquatic habitant whereas *Vanilla pilifera* and *Galeola altissima* are climbers. The local people of the state use orchids in various social functions. Two specific species of Orchids, *Rhynchostylis retusa*, known locally as Kapou phool and *Ornithocalyx teres* are found to be present in this part of the region. Assam's most celebrated flower, the Kopou Phool, is known to the orchid enthusiast of the West as the Foxtail Orchid. Some of the orchids like *Aerides multiflora, Aerides odorata, Acampe papillosa, Arundina graminifolia, Calanthe angusta, Cymbidium aloifolium, Dendrobium aphyllum, Eulophia mannii, Goodyera procera, Rhynchostylis retusa*, etc. are found in the semi-evergreen forests of Assam.

The state of Meghalaya is endowed with rich and luxuriant orchid flora with nearly 352 orchid species belonging to 98 genera. They form a very noticeable element of the vegetation of the State and these hills have been the classical collection centres of many celebrated botanists and horticultural plant-collectors. They are, as a result, becoming scarce and some of the ornamental species are nearing extinction. The orchids of Meghalaya have distributions extending up to Sikkim, Bhutan, Nepal, and China on one hand and Burma, Malaya, Thailand on the other. Few species are only confined to Meghalaya. In Cherrapunji, the two forests - Mawsmai and Mawmluh contain the highest number of orchid species in the whole region. Sohrarim is another forest on the way to Cherrapunji which is paradise of Botanists. *Aerides multiflorum, Coelogyne corymbosa, Cymbidium elegans, Dendrobium devonianum, Dendrobium longicornu, Pahiopedilum insigne, Pahiopedilum venustum, Rhynchostylis retusa, Phaius tankervilliae, Thunia marshalliana*, and *Vanda coerulea* are few of the exotic orchids of Meghalaya.

Mizoram being a small state in Northeast India is endowed with an exotic treasure of orchids found in the wet forests. The forests harbor a higher number of epiphytic orchids as compared to the terrestrial ones. Some of the rare species of orchids endemic to Mizoram consist of fine foliage and bright flowers of great interest to garden lovers. The forests house some of the rare varieties of orchids that are found only in this region. Many of the species from this state are economically important. A total of about 244 orchid species belonging to 75 genera are reported from Mizoram.

Manipur has 67% of its total geographical area covered by different types of forests. This accounts for amazing varieties of fauna and flora found in this state at altitudes in the range of 900–2700 m above the sea level. There are wet forests, the temperate forests and pine-forests in different regions of the state which together sustain a host of rare plant and animal species. Many of the most beautiful and precious blooms, orchids and flowers find their natural habitat in Manipur. Manipur is known to be rich in orchid diversity harbouring 61 genera and 251 species and as such occupies the fourth position as far as orchid diversity in Northeast India is concerned. Out of the total orchid species recorded from this state, *Ascocentrum ampullaceum, Paphiopedilum spicerianum, Vanda amesiana and Vanda stangeana* are endemic to this state.

The state of Nagaland is endowed with rich biodiversity and is considered as one of the floristic hotspots in India. Beautiful suitable environmental conditions coupled with varying physiographical features favours the natural habitat for a large number of orchid species. The orchids are found to grow in multiple altitudes ranging from 260 m to 3840 m above sea level. The distribution of orchids is scattered over evergreen and mixed deciduous forests. Terrestrial, epiphytes, lithophytes and saprophytes orchids are found to exist in Nagaland. According to a survey conducted by the Forest Department of Nagaland, there are more than

360 species of orchids belonging to 87 genera and that is about 27.76 percent of the total India's orchid species. The Mount Japfu in Nagaland has the highest number of orchid species found as recorded. *Dendrobium, Bulbophyllum, Calanthe, Coelogyne, Liparis, Eria,Cymbidium,Oberonia, Pholidota,Goodyera,Habenaria and Peristylus* are among the most dominant species. The largest species found is *Dendrobium* which accounts for about 10.52 percent of the total species. Besides these, many rare, endangered and threatened species such as *Arundina graminifolia* (Bamboo orchid), *Renanthera imschootiana* (Red vanda), *Rhynchostylis retusa* (Fox tail orchid), *Paphiopedilum insigne* (Lady's slipper orchid), *Vanda coerulea* (Blue Vanda), *Cymbidium tigrinum, Dendrobium wardianum, Dendrobium thyrsiflorum, Ascocentrum ampullaceum, Bulbophyllum rothschildianum* (Red chimney orchid), *Thunia sp, Phaius sp* and *Pleione sp.* are found in Nagaland.

Sikkim being located in a natural hotspot of the lower Himalayas is one of the three eco-regions of India. The state boasts of a rich variety of plants due to the altitudinal shift and possesses an extensive range of plants and foliage. Sikkim has a wide range of the plant species that grows in sub-tropical to alpine regions. In the lower altitudes, orchids, figs, laurel, bananas, Sal trees and bamboo are traceable enjoying the subtropical climate. Sikkim occupies the second position in terms of orchid diversity from the region. There are about 525 species of orchids of 137 genera known to occur in Sikkim. *Dendrobium nobile*, an orchid of ornamental and medicinal value is most commonly grown species. It is declared as state flower of Sikkim (Pradhan, 2005).

Tripura is located in the bio-geographic zone and is extremely rich in bio-diversity, which is getting increasingly threatened. However, the State has the lowest number of orchids i.e. around 33 genera with nearly 48 species. The genus *Dendrobium* has the highest species diversity (14 species). Both Red Vanda *(Renanthera imschootiana)* and Blue Vanda *(Vanda caerulea)* are reported from the state.

11.3 ORCHIDS AND THEIR UTILIZATION IN THE REGION

The orchids of the region are extensively used by the people for various socio and economic activities of the states. The people of Arunachal Pradesh and Assam use the different orchid species like *Aerides odoratum, Rhynchostylis retusa, Papilionanthe teres, Vanda roxburghii,* and many dendrobes in their cultural and religious festivals. *Rhynchostylis retusa* also known as 'bihu' orchid is closely linked with the spring festival- *Rongali Bihu* in Assam. The girls and women decorate their hair with the inflorescences of *Rhynchostylis retusa.* This orchid species is also regarded as symbol of love. Even the flowers of *Coelogyne nitida, Vanda coerulea* and *Vanda roxburghii* are used to adorn the girls of Northeast India during festivals. The species of *Liparis* has been ornamentally used by the tribes of Manipur. *Papilionanthe teres* is used as an offering flower to Lord Buddha by the tribals of Assam and Arunachal Pradesh, whereas in Arunachal Pradesh, the flowers of *Cymbidium grandiflorum* are used in religious functions (Jain, 1987). Many of the orchids e.g. *Dendrobium hookerianum, Dendrobium nobile, Dendrobium gibsonii,* etc. are considered as the symbol of purity and sanctity by the local people.

The orchid species have been also used by the local people of Northeastern region as tradition food (Kirtikar and Basu, 1935). The leaves of many *Cymbidium* species are used as food. Many orchids, for e.g. *Cephalanthera ensifolia, Habenaria* spp., *Orchis latifolia, Microstylis wallachii, Pholidata articulate, Satyrium species* form an important part of the nutritious diet of the people of this region. In some regions, orchids are used as fodder for domestic animals. The cattle are allowed to graze on the pastures with terrestrial orchids. Some of the dendrobes are mixed with the fodder of the cows so as to enhance the yield of milk. Also, in certain cases, the cymbidiums are fed to the cattle for good health.

The use of traditional knowledge of the plants for medical treatment by indigenous local communities of the region has been there for time immemorial. Many of the locals of Northeastern region use orchids for the cure of various ailments as orchids are rich sources of alkaloids, flavonoids, glycosides, carbohydrates and other phytochemical contents. Some of the orchid species which are used as medicine by the people of northeastern region are listed in the Table 11.1.

11.4 DEPLETION OF ORCHIDS OF THE REGION FROM NATURAL HABITATS

The beautiful and mysterious orchids present in the Northeast India and the country as a whole are being threatened for various reasons such as the increased biotic influences, socio-economic development and uncontrolled commercial exploitation of forest wealth. Almost all

Table 11.1 Orchids used as medicines by the tribals of Northeast India

Name of the Orchid	Parts used	Therapeutic uses
Cymbidium giganteum	leaf juice	Clotting of blood in wound
Cymbidium aloifolium	seeds	Healing wounds
Dendrobium fimbriatum	whole plant	Liver upsets and nervous debility
Dendrobium moschatum	leaf juice	Earache
Dendrobium nobile	powdery seeds	Fresh wounds for quick healing
Cleisostoma williamsonii	leaves and stem	Healing fractured bones
Eria muscicola	whole plant	For disorders of chest, lungs, eyes, ears and nervous system
Eulophia camprestris	rhizome	As tonic; effective in curing stomach ailments
Liparis odorata	leaf juice	In burns, cancerous ulcers and gangrene
Orchis latifolia	tubers and roots	Nerve tonic and aphrodisiac
Papilionanthe teres (Vanda teres)	leaf paste stem	High fever To protect from cold and cough
Phaius tankervilliae	Pseudobulbs	Bone fractures and dysentery
Satyrium nepalense	pseudobulb	As tonic; to cure dysentery and malaria
Vanda coerulea	leaf juice	In diarrhoea, dysentery and external skin diseases
Vanda cristata	leaves	As tonic and expectorant
Vanda roxburghii (Vanda tessellata)	leaf paste	High fever
	leaf juice	Treatment of otitis; rheumatic and similar kind of pain; diseases of nervous system and syphilis
	powdered Roots	An antidote for poisoning
Vanda spathulata	crushed leaves and stem	Skin diseases and diarrhoea
	Powdered flowers	Asthma, tuberculosis and madness

the epiphytes because of their habitat specificity and slow growing nature fail to withstand habitat destruction pressure and all of them figure prominently in the list of endangered plants (Rajeevan and Shobhana, 1993). Deforestation and other unplanned human activities have led to the destruction of the habitats of orchids in nature which has resulted in a considerable depletion of orchids at an alarming rate. The non sustainable and destructive methods of collection of orchids by the people from the wild have also resulted in their depletion from nature. Orchids are also important ecological indicators. The disappearance of the orchids from their natural habitats indicates a change in the quality of soil and air of the region. Reports indicate that the disappearing populations of "Blue Vanda" from Cheerapunjee in Meghalaya could be attributed not only to indiscriminate collections but also to the degrading environment of the region. All the orchid species are protected under the Convention of International Trade for Endangered Species (CITES) with most of the species listed under Appendix II. Therefore, it has become necessary to create awareness for conservation, propagation and commercialization of orchids of the region for their sustainable utilization.

11.5 CONSERVATION OF ORCHIDS

Conservation of wild orchids has become a matter of universal concern. There is urgent need to conserve the valuable orchid resources in their natural habitat as orchids are very sensitive to the disturbances in nature. The conservation of orchids in Northeastern India can be closely related to the socio - economic culture of the people of this region. Many of the wild orchids are protected in their natural habitats in sacred groves by the people of the region. Any human interference in these sacred groves is completely prohibited. Also, the orchids in this region are not only conserved in the protected forest areas but are also cultivated by the local people in their homes for their cultural, religious and medicinal uses. The natural phenomenon of regeneration is low and moreover, the seeds of orchids need a specific mycorrhizal association for germination. In this regard therefore the modern tools of Biotechnology can be utilized for propagation and conservation of orchids (Tandon and Kumaria, 2005). To accomplish this both *in situ* and *ex situ* methods of conservation can be used. The *in situ* conservation of orchids involves the protection of the natural habitats itself thereby allowing the orchids to interact and co-evolve (Tandon, 2004). Conserving the orchids in their natural environment ensures their natural growth, proliferation and perpetuation. In this aspect, many areas in North-Eastern India have been declared as National Parks, Wildlife Sanctuaries and Biosphere Reserves by the Government so as to promote the cause of *in situ* conservation. But, *in situ* conservation is costly to maintain and is highly susceptible to natural calamities. This problem can be overcome through *ex situ* conservation methods which are suitable for acclimatization, rehabilitation, multiplication and judicious exploitation of the orchids. In general, it has been observed that the Biotechnological approaches of conservation are complementary to conventional methods (Tandon and Kumaria, 1998). The declining populations of orchids can be protected and conserved through *in vitro* asymbiotic seed germination (Kumaria and Tandon, 2007). Orchid seeds being very minute are difficult to germinate in nature because they posses no endosperm and the embryo is immature (Zeigler et al., 1967). Because of their particular fungal requirement, less than 1% of the orchid seeds germinate in nature. A large number of orchid species that have become rare and/or are at the verge of extinction could be propagated through *in vitro* asymbiotic seed germination using different media and nutrients (Arditti and Ernst, 1984). On the other hand, mericloning of orchids which was pioneered by Morel (1960,1964) has been since used for commercial multiplication of orchids. A number of micropropagation protocols for propagation, conservation and commercialization of orchids using suitable explants in order to

maintain identical genotypes are available (Arditti and Ernst, 1993; Kumaria and Tandon, 2001; Kumaria et al., 2005).

CONCLUSION

In spite of the rich orchid diversity in the region, many species are yet to be discovered because of the difficult terrain. As the loss of habitat of orchids has added significantly to their declining populations in nature, public awareness and promotion of conservation strategies is essential. The orchid resources of the Northeast India are valuable tools for the socio-economic activities of the region. However, due to over-exploitation and unmindful collections of these resources from their natural habitats, there is an increasing decline of the orchid populations in the region. This rapid depletion of the orchids calls for immediate and concerted efforts to be taken up for their conservation. Both the *ex situ* and *in situ* methods of conservation combined with the traditional knowledge of the people on conservation of orchids would further facilitate proper management and utilization of orchid resources of the region which is of paramount concern.

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