J. Orchid Soc. India, 34: 45-56, 2020 *ISSN 0971-5371*

MEDICINAL ORCHIDS OF SHIMLA HILLS, HIMACHAL PRADESH (NORTHWESTERN HIMALAYAS), THREATS, AND CONSERVATION MEASURES

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Abstract

Orchids occupy top position amongst all the flowering plants and are valued for cut-flower production as well as potted plants due to their long lasting and bewitchingly beautiful flowers, which fetch a high price in the international market. Shimla, the capital of Himachal Pradesh with diverse climate and the varied environmental conditions supports diverse habitat to the flora and fauna including orchids of high therapeutic values. Ashtavarga (group of eight medicinal plants) is a vital part of Ayurvedic formulations like *Chyavanprash* and includes four orchids namely *Riddhi, Vriddhi, Jeevak,* and *Rishbhak*. These species are known to provide local medicine, food, and fodder thereby contributing to the livelihood and income generation within rural communities. Under existing climatic changes scenario, these orchids face greater risk of extinction and are listed under Appendix II of CITES. Hence, there is a strong need to take steps to conserve these valuable orchids in their natural habitats. Amongst many techniques, plant tissue culture has proved as one of the most promising alternative tools to minimize the pressure on natural population of medicinal as well as floriculturally important orchids and their sustainable utilization.

Introduction

ORCHIDS ARE nature's most charismatic group of flowering plants showing incredible range of floral diversity in shape, size, and colour and comprise of approximately 28,484 species worldwide (Willis, 2017). They account for *ca.* 8% of angiosperm species diversity (Fay, 2018; Willis, 2017). In India, there are about 1256 species of orchids belonging to 155 genera and 388 endemic species (Singh *et al*., 2019a). They are cosmopolitan in distribution and are found almost everywhere except Antarctica and hot deserts. These orchids have adapted themselves to a variety of ecological niches due to their habitat specificity. About 70% of the world's orchids are terrestrial and 5% grow on mixed substrate (lithophytes, epiphytes, and terrestrials) (Arditti, 1992; De and Pathak, 2018). It is a family of considerable economic importance not only in horticulture and floristry (as cut flowers) because of their exotic beauty and long lasting blooming period, but also in the pharmaceutical and fragrance industries. The use of plants and their parts as ethno-medicine for the treatment of various ailments is a common practice among the tribal communities, around the world. Firstly, medicinal properties of orchids were discovered and cultivated by Chinese (Bulpitt, 2005). About 40 *Dendrobium* spp. have been used in traditional Chinese medicine, five of which are listed in the *Chinese Pharmacopoeia* (Chinese Pharmacopoeia Editorial Committee, 2000). Indian orchids have also been used extensively in various indigenous systems of medicine since the Vedic period and in the Vedic scriptures, there is a mention of these plants under the name *Vanda*. In the Ayurvedic system of medicine, *Ashtavarga* a group of eight drugs, is used in the preparation of various rejuvenating formulations and tonic, such as *Chyavanprash* (Chauhan, 1990; Pathak *et al*., 2010; Vasundhra *et al.,* 2019). Out of eight drugs, four come from Orchids mainly Jeevak [*Malaxis muscifera* (Lindl.) Kuntze], Rishbhak [*Crepidium acuminatum* (D.Don) Szlach., *Malaxis acuminata* (D.Don)], Riddhi (*Habenaria intermedia* D.Don), and Vriddhi (*Habenaria edgeworthii* Hook.f.). The various metabolites of different orchid species are useful as anti-rheumatic, anti-inflammatory, anti-viral, anti-bacterial, anti-carcinogenic, anti-convulsive, diuretic, neuro protective, anti-ageing, wound healing, hypo-glycemic, anti-tumor, anti-microbial, and many other human ailments (Barua *et al.,* 2019; Bhandari *et al.,* 2018; Devi *et al.,* 2018; Dhayani *et al*., 2011; Kaushik, 2019; Kumar *et al.,* 2017, 2018, 2019; Ninawe and Swapna, 2017; Pathak *et al*., 2010; Prakash and Pathak, 2019; Prakash *et al.,* 2018; Sharma *et al.,* 2017; Singh *et al.,* 2012*,* 2019b). Due to high demand and anthropogenic pressures on these medicinally and floriculturally important orchids, their number in natural populations are decreasing in many parts of the world. Many orchid species are categorized under endangered, threatened, rare categories in the Red Data Book of International Union for Conservation of Nature (IUCN) due to their habitat destruction and indiscriminate collections. In fact, the entire family is now included in Appendix-II of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2012), where the international trade is strictly prohibited

Received: March 15, 2020; Accepted: June 15, 2020

and monitored. Looking at the commercial as well as medicinal importance of orchids, conservation of orchids has now become a major concern. So, there is a strong need to conserve these medicinally important orchids.

Himachal Pradesh (NorthWestern Himalayas) is situated between the latitudes 30° 22' to 33° 12'N and longitudes 75° 4' to 79° 4'E, covering area of 55,673 sq.km. and called *Land of Snowy Mountains* (Fig. 1). It is bordered by Jammu and Kashmir on the North, Punjab on the West, Haryana on the SouthWest, Uttarakhand on the SouthEast and Tibet on the East. The name Himachal was coined from Sanskrit *Him- Snow* and *Achal-Mountain*, due to extreme variation in elevation, great deviation occurs in the climatic conditions of Himachal Pradesh. The climate varies from hot and sub humid tropical in the Southern tracts, to with more elevation, cold alpine and glacial in the Northern and Eastern mountain ranges. The capital Shimla being endowed with a rich biodiversity has a tremendous potential of harbouring several important orchids of high therapeutic values. The average total annual precipitation is 1575 mm and snowfall in the months of January and February in the high altitudinal ranges, but low lying areas experience only rains during that time. The climate is subtropical to warm temperate. According to Vij *et al.* (2013), a total of 85 species in 44 genera are recorded in Himachal Pradesh. Climatic conditions of Shimla favour the growth of orchids. Only terrestrial orchids are found during the monsoon season. Factors like light, temperature, moisture, and rhizosphere (mycorrhizal) act together to determine the character of an orchid habitat. They are found in open and grassy slopes, moist humus rich and more in shady forest floors and distributed localities along forest and embankments. These terrestrial orchids also exhibit a complimentary relationship with the surrounding vegetations such as ferns (either compete with orchids and aid in their germination), grasses (protective cover against strong winds), bryophytes and lichens (better water absorption potential helps in withstand excessive evapo-transpiration). According to Vij *et al.* (1982), absence of epiphytes in Shimla hills are due to low rainfall, severe winters, and due to preponderance of the gymnospermic trees which in general are poor hosts for orchids in these hills. They serve as poor hosts due to their rough resinous bark. Some of the medicinal orchids found in various regions are enlisted (Figs. 2A-I, Table 1).

Threats

The orchid seeds are microscopic, dust like in appearance, produced in large numbers and lack sufficient reserve food material *i.e.* endosperm to support the growth of embryo. They are also considered as smallest seeds in the plant kingdom (Rasmussen, 1995). The number of seeds produced per capsule varies from thousands to millions (Arditti, 1967). These plants require symbiotic relationship with an appropriate fungal endophyte for the germination of their seeds, in nature. Seeds disperse like spores or dust particles, however, less than 1% of them germinate in nature in association with mycorrhizal fungus (Pathak *et al.,* 2001). Many achlorophyllous species (*Aphyllorchis*, *Gastrodia etc.*) remain fully myco-heterotrophic. The orchid-fungus relationship may be specific or non-specific (Stewart and Kane, 2006; Vij *et al.*, 2002). Any imbalance in the habitat can disturb the germination and development of these orchids because of this peculiar habit of dependence on mycorrhiza for germination and nutrition. Due to natural and anthropogenic threats, most of the orchids have been categorized as critically endangered, rare and listed

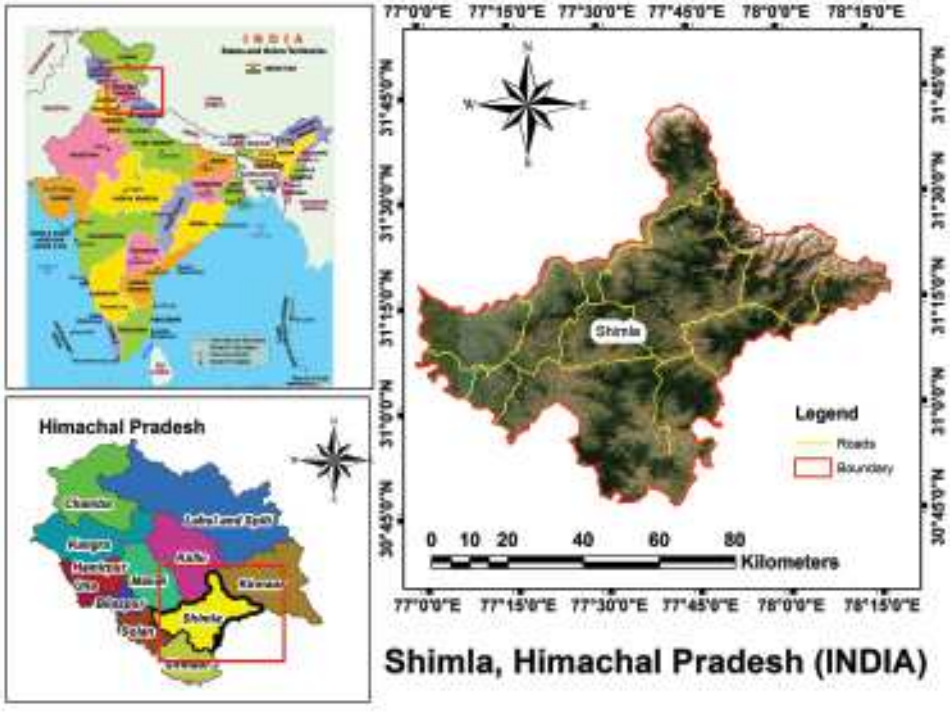

Fig. 1. Map of study area in Shimla District of Himachal Pradesh.

under Appendix II of CITES. According to IUCN (2017), 56.5% of orchids were found to be threatened with extinction [VU (vulnerable), EN (endangered), or CR (critically endangered)]. Cypripedioideae, the only subfamily of orchids which has been shown to be at particularly high risk, with *ca*. 90% of species assessed

Fig. 2. A-L. Some medicinal orchids of Shimla hills, Himachal Pradesh: A, *Calanthe tricarinata*; B, *Cephalanthera longifolia*; C, *Crepidium acuminatum*; D, *Cyprepidium cordigerum*; E, *Epipactis helleborine*; F, *Goodyera repens*; G, *Habenaria intermedia*; H, *Herminium lanceum;* I, *Satyrium nepalense;* J-L, Habitat destruction.

Table 1. Some medicinal orchids of Shimla hills, Himachal Pradesh.

Species	Locality	Altitude range (m)	Habitat	Associated vegetation	Part(s) used	Uses
Calanthe plantaginea Lindl.	Shimla hills	1500-2800	Forest floors	Grasses, ferns, mosses	Root	Powdered root with milk is consumed as tonic and aphrodisiac.
C. tricarinata Lindl.	Narkanda, Choupal, Fagu	2000-3000	Shady, humus rich	Arisaemas, grasses, ferns mosses, liverworts	Leaf, Pseudobulb	Leaf paste applied on sores and eczema. Leaves and pseudobulbs are aphrodisiac.
Cephalanthera longifolia (L.) Fritsch.	Kufri, Mashobra, Water Catchment Wildlife Sanctuary, Charabra	1800-2500	Semi-shaded, humus rich	Arisaemas, grasses, ferns, orchid (*Oreorchis indica*)	Root	Used as tonic, appetizer, and to heal wounds.
Crepidium acuminatum (D.Don) Szlach	Summerhill, Tara Devi, Water Catchment Wildlife Sanctuary	1750-2300	Semi-shaded, humus rich, grassy slopes, forest borders	Orchids (*Herminium lanceum, Liparis rostrata*) grasses, mosses, and liverworts	Stem , Rhizome, Root, Pseudobulb	Root powder is used to cure burns. One of the ingredients of *Ashtavarga* of Ayurveda. Bulbs are used to treat bronchitis, fever, tuberculosis and weakness. Also given as a tonic.
Cypripedium cordigerum D.Don	Kufri, Charabra, Fagu	2500-3000	Shady, humus rich forest floors mosses	Arisaemas, composits, labiates, grasses, ferns	Root	Used as tonic and edible as a vegetable.
C. himalaicum Rolfe	Choupal	3000-4300	Shady, humus rich forest floors	Tall grasses and shrubs	Whole plant	Used to cure urine blockage, stone disease, heart disease, chest disorder, and cough.
Dienia cylidrostachya Lindl.	Tara Devi, Fagu	1850-3500	Shady forest floors	Grasses, ferns, herbs, orchids (*Goodyera biflora, Habenaria intermedia, Liparis rostrata*)	Tuber	Decoction of tuber used to strengthen kidneys.
Epipactis gigantea Douglas ex Hook.	Tara Devi, Summerhill	2000-4000	Semi-shaded and exposed humus rich, grassy slopes	Arisaemas, composits, grasses, ferns, mosses, liverworts	Root	Used to combat mania and used for treating insanity.
E. helleborine (L.) Crantz	Tara Devi, Hattu Peak, Narkanda, Water Catchment Wildlife Sanctuary, Kufri	1500-4000	Exposed and humus rich grassy slopes	Arisaemas, composits, umbellifers, orchids (*Goodyera repens*), gentians, sedums, grasses, legumes, ferns mosses, liverworts	Root, Leaves	Roots of this plant are medicinal which cure insanity. Infusion of leaves given in intermittent fever.
Eulophia dabia (D.Don) Hochr.	Kaithlighat	350-500	Exposed, humus rich grassy slopes	Potentillas, scrophs, composits, orchids (*Habenaria edgeworhtii, Herminium monophyllum)*	Tuber	Used as appetizer, tonic and aphrodisiac. Used in purulent cough and heart trouble. Tubers are given to infants in cough and cold.
Goodyera biflora (Lindl.) Hook.f.	Tara Devi	1500-2500	Shady, humus rich, moist forest floor	Ferns, mosses, liverworts	Leaves	Used to treat sores and ulcers.

Table 1. Some medicinal orchids of Shimla hills, Himachal Pradesh (contd.).

Species	Locality	Altitude range (m)	Habitat	Associated vegetation	Part(s) used	Uses
G. repens (L.) R.Br.	Fagu, Kufri, Charabra, Hattu peak, Narkanda, Jakhu	1800-3700	Shady, humus rich, moist forest floor, road embarkments and forest borders	Labiates, legumes, gentians, sedum, grasses, orchids (*E. helleborine*) ferns, mosses, and liverworts	Whole plant	Plant paste externally applied in syphilis, extract is taken as a blood purifier.
Gymnadenia orchidis Lindl.	Chansil pass	3500-4500	Open, slopes and other herbs	Grasses, ferns	Tuber	Used to treat wounds, liver and urinary disorders.
Habenaria edgeworhtii Hook.f. ex Collett	Narkanda, Tara Devi, Summerhill, Water Catchment Wildlife Sanctuary	1500-3000	Exposed, humus rich grassy slopes	Composits, labiates, grasses, ferns, mosses	Root, Leaves	As an ingredient of *Ashtavarga* in *Chyavanprash*, blood purifier and rejuvenator.
H. intermedia D.Don	Tara Devi, Chail, Fagu, Summerhill, Water Catchment Wildlife Sanctuary	1500-2800	Semi-shaded, grassy slopes, road embarkments and forest borders	Orchids (*Habenaria pectinata*) composits, gentians, labiates, ferns, mosses	Tuber	Tubers are one of the ingredient of *Ashtavarga* of Ayurveda, used as tonic. Tuber paste is used to cure various diseases such as hyperdipsia, fever cough, asthma, leprosy, skin diseases.
H. latilabris (Lindl.) Hook.f.	Summerhill, Tara Devi, Water Catchment Wildlife Sanctuary	1500-3000	Shady-moist forest floors	Grasses, ferns, *Pinus roxburghii, Rhododendron arboreum*	Pseudobulb	Used as a blood purifier.
H. pectinata D.Don	Tara Devi, Kaihtlighat	1500-3500	Semi shades, grassy slopes, road embarkments and forest borders	Orchids (*Habenaria pectinata*) composits, gentians, labiates, ferns, mosses	Leaves, Tuber	Tubers along with leaf juice applied to snake bites. Tuber are used against arthritis.
Hemipilia cordifolia Lindl.	Elysium hill, Mashobra	1500-2200	Semi-shady and moist forest floors.	Grasses, ferns, *Pinus wallichiana, Cedrus deodara,* orchid (*Cymbidium macrorhizon*)	Root	Used as diuretic and to treat hernia and kidney diseases.
Herminium lanceum (Thunb. ex Sw.) Vuijk	Tara Devi, Water Catchment Wildlife Sanctuary, Summerhill, Kaihtlighat	1250-3000	Exposed, humus rich grassy slops	Potentillas, scrops, composits, orchids (*Habenaria edgeworthii, Liparis rostrata*) grasses, mosses	Whole plant	Extract of plant given in suppressed urination.
Liparis rostrata Rchb.f.	Tara Devi, Summerhill, Kufri, Water Catchment Wildlife Sanctuary	1500-2500	Semi-shaded, humus rich, grassy slopes	Grasses, mosses, liverworts, orchids (*Herminium lanceum, Malaxis acuminata*)	Tuber	Treatment of cancerous ulcers and gangrene. Stem is used to cure throat cancer.
Malaxis muscifera (Lindl.) Kuntze	Kaihtlighat, Kufri	1000-2000	Semi-shaded, humus rich, grassy slopes, road embarkments and forest borders	Labiates, legumes, grasses, mosses, and liverworts	Swollen Stem Base	It is also an ingredient of *Ashtavarga* and used as rejuvenating agent. Swollen stem base useful in sterility, seminal weakness, dysentery, fever, and general debility as a tonic.
Oreorchis foliosa var. *indica* (Lindl.) N. Pearce & P.J. Cribb	Kufri, Charabra, Water Catchment Wildlife Sanctuary	1800-3650	Moist, shady humus rich forest floor	Grasses, ferns, herbs, orchids (*Oreorchis micrantha, Epipactis helleborine*)	Stem	Used as antidote for snake bite and to treat tuberculosis, sores, and ulcers.

Table 1. Some medicinal orchids of Shimla hills, Himachal Pradesh (contd.).

Species	Locality	Altitude range (m)	Habitat	Associated vegetation	Part(s) used	Uses
O. micrantha Lindl.	Kufri, Charabra, Hattu Peak, Fagu, Charabra	2000-2500	Moist, shady humus rich forest floor	Tall grasses, orchids (*Oreorchis micrantha*, *Epipactis helleborine*)	Bulb	The powder of the bulb is mixed with milk and mixture is used as aphrodisiac.
Pecteilis gigantea (Sm.) Raf.	Kufri, Mashobra, Narkanda, Fagu, Charabra, Kaihtlighat	2400-3300	Open or shady localities	Tall grasses	Tuber	Used to cure watery blisters particularly on hand palm.
Platanthera clavigera Lindl.	Tara Devi, Summerhill	1800-4000	Grassy slopes	Grasses, ferns, liverworts, *Pinus roxburghii, P. wallichiana, Rumex hastatus, Cedrus deodara*, orchids (*Crepidium acuminatum, Habenaria edgeworthii, H. intermedia*)	Whole plant	Used to strengthen the kidneys, impotence, sexual dysfunction, and hernia.
Satyrium nepalense D.Don	Tara Devi, Water Catchment Wildlife Sanctuary, Hatu Peak	1500-3000	Exposed, semi-shaded, humus rich, grassy slopes, road embarkments and forest borders	Labiates, pine seedlings, grasses, mosses, and liverworts	Tuber	Tubers used as a tonic and also used in diarrhea, malaria, cut and wounds.
Spiranthes sinensis (Pers.) Ames	Summer hill	500-2500	Shady forest floors	Grasses, mosses, liverworts	Whole plant	Decoction of plant is given in intermittent fever. Tuber is powdered and used to prepare energy tonic.

Source: (cf. Jalal *et al*., 2008; Pathak *et al*., 2010; Singh and Duggal, 2009; Vij *et al*., 2013).

falling in one of the categories of threat (Fay and Rankou, 2016).

Himalayas are prone to landslides, floods *etc*., therefore, affecting natural populations of many terrestrial orchids which are growing near the river (Fig. 2J-L). Changes in climate conditions such as delay in rainfall are also affecting their life cycle and pollination mechanisms. Forest fire is another cause of destruction. Various anthropogenic activities in the area lead to the loss of their natural habitats. According to Sylvain and Wall (2011), the anthropogenic factors contribute variously to climate change and are affecting temperature, precipitation, and soil moisture which have varying effects on the diversity, distribution, and abundance of soil flora and fauna. Dependency of local people on forest products like fodder, fuel, and timber are the main cause of habitat destruction. Due to lack of awareness amongst the locals, these plants are being over exploited for food, medicine, and sale. Collection and sale of wild orchids from the orchid rich area especially by the rural community is the routine activity, uprooting the whole plants causes the extinction of many species and providing the huge amount of such orchids to the local and international traders. Grazing is also a big threat with multitude effects both on sexual (flower, fruit, and seed production) as well as asexual (vegetative increment through rhizomes) reproduction. Introduction of invasive species to the indigenous flora also causes drastic change. There are some species such as *Liparis olivacea*, which have already got extinct from the wild (Subedi *et al*., 2013). Due to such varying levels of disturbances, destruction of number of economically important plants in alpine meadows has continued like reduction of *Dactylorhiza hatagirea* populations, a highly valued medicinal orchid of the Himalayas which has been categorized as critically endangered listed under Appendix I of CITES (Giri *et al*., 2008). Due to the recent trend of using traditional medicine in Western countries, its demand is increasing. Many orchid species are still being collected and transported across international borders, for use as medicine or food in addition to the horticultural trade, without the permits required under CITES (Fay, 2015; Hinsley *et al*., 2018); such rapid depletion from the wild requires urgent conservation measures.

Conservation Measures

Demand for medicinal plants is increasing at such a high rate that the natural stocks in the world are being

destroyed. Hundreds of species are over-harvested, and may face extinction throughout all geographical regions, if they are not protected or cultivated. There is an urgent need to create awareness amongst local people about the importance of conserving these medicinally and floriculturally important species. An integrated conservation approach needs to be adopted for saving their natural populations from further depletion. Tourists should strictly be instructed not to encourage littering in natural habitats with non-biodegradable plastic objects. Overgrazing should be checked. Their conservation can be addressed by both government and private sectors with research institutions, non-government organization, community growers, international collaboration as well as in association with participation of local people. Many orchid societies could promote orchid conservation education via public orchid shows, motivating policy makers, donors and civil society groups to engage with previously unrecognized conservation issues. This will ensure proper co-ordination in the management, sustainable utilization of medicinal resources, and germplasm conservation of especially those that make a direct contribution to human livelihoods and human or animal health. Government of India has initiated conservation measures by adopting the IUCN resolutions under Wildlife Conservation Laws. India has strengthened its hold on biodiversity conservation by implementing the Indian Forest Act, 1927; the Wildlife (Protection) Act, 1972; the Forest (Conservation) Act, 1980; the Environment (Protection) Act, 1986; the Biodiversity Act, 2002; the Biodiversity Rule, 2004, *etc.* All orchid species are protected under Scheduled-VI of Wildlife Protection Act 1972 of Government of India and simultaneously under CITES Appendix-I and II. Assam government (1936) prohibited unauthorized collection of *Vanda coerulea* (blue vanda) and *Renanthera imschootiana* (red vanda) which are now included under, Schedule-VI of wildlife Protection Act, 1972 (amended in 1992). The International Union of Conservation of Nature (IUCN) has a Species Survival Commission (SSC) with a well-defined preservation programme for the Convention on International trade in Endangered Species of Wild Flora and Fauna (CITES).

Himachal Pradesh is a store house of high value medicinal plants including orchids which are used in the Indian system of medicine. The continuous natural habitat destruction due to various anthropogenic pressures (clearing of forests, development of dam, tunnels, power houses *etc.*), grazing, and illegal over-exploitaion of these medicinally important orchids from wild, in Shimla hills, has caused increased pressure towards the extinction of these species. Efforts has also been made to conserve the species by designating a notified protected area (Water Catchment Wildlife Sanctuary), in the region. Hence, there is an urgent need to device suitable strategies for conservation of these species. Cultivation of these medicinally important species in the surrounding area of villages may reduce extinction pressures to some extent on the natural wild habitats. Further, there is a need to identify the regions for the establishment of nurseries/ areas for *in situ* conservation of the species which are facing threat of immediate extinction in the region. Restrictions should be imposed on the entry of tourists and grazing activity particularly in alpine and sub-alpine regions *etc*. Success of such practices may give enough time for these species to regenerate in the natural conditions.

The tribal people living in the remote hilly areas possess a vast treasure of knowledge regarding the herbal cure but they do not disclose it to others particularly to outsiders as there is a general belief that if the information about the use of herbs is revealed/shared, the herbs will loose their healing power. The traditional knowledge about plant biodiversity and cultural practices of these tribal people are also facing high risk of decline due to fast urbanization in these areas. The number of traditional herbal healers in the state is declining because less young individuals are coming forward to learn this tradition folklore knowledge. Moreover, migration of youth from hills to towns and metro cities is also playing a major role in the decline of the traditional knowledge. Therefore, compilation of such valuable information is extremely necessary to keep alive the traditional knowledge for the use of future generations. Scientific validation of this traditional knowledge by isolation and purification of the phyto-constituents is also necessary for large scale use of the plants or their decoctions for future drug development. The database so developed may prove as a key tool in designing and developing programmes for sustainable use of medicinal plants for value addition to fetch higher economic returns to the state. Database would also be useful in identifying the areas where population of threatened species is available.

The State Medicinal Plant Board and Forest Department may play a important role in conserving the medicinally important orchid species. State Biodiversity Board (SBB), Biodiversity Management Committee (BMC), People's Biodiversity Register (PBR) are being formed in states for the purpose of promoting conservation, sustainable use, and documentation of biological diversity. In 2005, Himachal Pradesh Biodiversity Board has been constituted by Government of Himachal Pradesh under Biological Diversity Act, 2002 for conservation of Biological

diversity and its sustainable use. Biodiversity strategies, action plans, and policy guidelines are made. Comprehensive database of these medicinally important orchids including other medicinal plants could be developed and utilized in identification of conservation areas and further to establish sustainable management practices. Awareness for the implementation of Biological Diversity Act, 2002 amongst the stakeholders of biodiversity and environmental friendly farm practices through demonstration techniques is being carried out. To promote the conservation of medicinal plants, a comprehensive Medicinal Plants Policy was adopted during the year 2006 and dialogue amongst various stakeholders was initiated towards conservation and management of medicinal plant resources of the state and various National Medicinal Plant Board Projects (Government of India funded) being implemented by Himachal Pradesh Forest Department. Conservation and Propagation of Medicinal Plants in Kullu and Kangra districts had been formulated. Conservation, Development and Sustainable Management of Priority Wild Medicinal Plant Species Project was implemented in Himachal Pradesh keeping in view, *in situ* conservation of medicinal plants, resource augmentation, community organization and local value addition, strengthening marketing facilities, capacity building, educational and awareness activities, and net working with the research organizations. The project (Strengthening of High Altitude Medicinal Plant Resources in Trans-Himalayan Districts of Lahaul & Spiti and Kinnaur in state) has been formulated to be implemented in jurisdiction of Rampur Forest Circle (Kinnaur Forest Division), Kullu Forest Circle (Lahaul Forest Division), Wildlife Circle(s), Shimla (Spiti & Sarahan Wildlife Divisions). The main objective of the project was to multiply superior stock of selected medicinal plants for *in situ* and *ex situ* conservation and propagation, and to build capacity of front line forestry staff in techniques of raising priority medicinal plants and their management in the wild. *In situ* and *ex situ* measures are being adopted. The conservation of species in their natural habitats (national parks, sacred groves, gene sanctuary, biosphere reserves) is known as *in situ* conservation and considered as the most appropriate way of conserving biodiversity. There are Wildlife Sanctuaries (29), National Parks (05), Conservation Reserves (03), and Biosphere Reserve (01) in the state. Anthropogenic interferences are very low and the species are saved on community basis rather than targeting a single specific one. However, there is still, illegal collection of species from their natural habitats due to which natural populations of many species are on decline. However, this continues in many parts of the world due to poor enforcement and regulation of law (Dixon *et al*., 2003). Moreover, *in situ* conservation is not always a viable option because of the modification of habitat and migration or absence of the pollinators due to unfavorable modifications environment (Swarts and Dixon, 2009).

Ex Situ conservation refers to the germplasm preservation outside the natural habitats. Gene banks, botanical and herbal gardens, orchid seed gene bank, *in vitro* conservation, and cryopreservation are main *ex situ* conservation measures. Orchids are highly heterozygous and their vegetative propagation through division of clumps of rhizomes, bulbs or by the rooting of shoots also takes a long time and it is difficult to obtain desired number of orchids and also as their seeds are minute and non endospermic, and require fungal association, drives the many orchids including medicinal orchids to be threatened and some are reached to extinction. It is therefore important to take initiative for their mass propagation and re-establish them in nature. Orchid rescue from degraded habitats and their rehabilitation in newly created ones is an important conservation strategy. Therefore, one of the important steps for orchid conservation is to reintroduce the micropropagated seedlings/plantlets back to their natural or natural-like artificial habitats with desired soil characteristics. A networking of institutions engaged in conservation of orchids coupled with strong orchid breeding programme would enhance judicious utilization of orchids. Using Satellite Remote Sensing and Geographic Information System by the Indian Institute of Remote Sensing and Department of Space, Government of India, priority sites have been identified in all the states of the region and accordingly, actions and strategies have been taken up. Efforts to conserve different medicinally important orchid species by growing through plant tissue culture techniques have provided a new dimension for efficient conservation and commercialization of medicinally as well as floriculturally important orchids. Knudson (1946) established methodology for asymbiotic seed germination on suitable artificial nutrient medium under controlled conditions; nutrient medium provided all the required factors necessary for seed germination and seedling growth. Some attempts have been made to conserve a few medicinally important plants through *in vitro* mass propagation using seeds (Anuprabha and Pathak, 2012, 2019; Anuprabha *et al.,* 2017; Bembemcha *et al*., 2016; Bhattacharjee *et al*., 2015; Bhatti *et al.,* 2017; Chen *et al.,* 2015; Decruse and Gangaprasad, 2018; Godo *et al*., 2020; Gurudeva, 2019; Hossain *et al.,* 2008; 2010, 2012; Kaur *et al.,* 2017; Lekshmi and Decruse, 2018; Madhavi and Shankar, 2019; Mohanty and Salam, 2017; Pathak and Vij, 2007; Pathak *et al.,* 2001, 2011, 2016, 2017;

Romero *et al.,* 2018; Santos *et al*., 2016; Vij *et al.,* 1988; Yeung, 2017) and other explants such as leaves, roots, tubers pseudobulbs *etc.* (Balilashaki *et al*., 2015; Bhowmik *et al*., 2020; Chen *et al.,* 2004; Meilasari and Iriawati, 2016; Park *et al*., 2018; Pathak and Vij, 2001; Pathak *et al*., 2012; Pradhan *et al*., 2013; Regmi *et al*., 2017; Sembi *et al*., 2007; Sheelavantmath *et al*., 2000; Udomele *et al*., 2012; Utami *et al*., 2019; Vasundhra *et al.,* 2019; Vij and Sood, 1982; Vij and Pathak, 1988, 1989, 2006; Vij *et al.,*1997, 1983, 2000, 2002, 2004). Extensive research work is being carried out for *in vitro* mass propagation and conservation of medicinally important orchid species of Shimla hills, Himachal Pradesh (NorthWestern Himalayas) at Orchid Laboratory, Department of Botany, Panjab University, Chandigarh. The rapid and dynamic progress in molecular biology and biotechnology (transformation methods, molecular markers, bioreactors *etc*.) may also help to conserve orchid germplasm by producing new varieties with novel characteristics by genetic engineering, such as multi-coloured flowers, disease and pest resistance, improved flower quality, resistance to biotic and abiotic stresses, rapid mass propagation *etc*. The significant advanced biotechnological approaches have led the scientists to study and understand biological, physiological, molecular, genetic mechanisms, proteomics, and metabolomics of orchids.

Conclusion

There is a strong need to create awareness amongst people of the region to conserve these medicinally and floriculturally important plants. Private sectors, NGOs, research institutions, schools, colleges, stakeholders, and government agencies may play a very important role by educating and spreading awareness about their importance through short communications, presentations, lectures, painting competitions, and workshops *etc*. The Orchid Society of India is creating awareness amongst the masses by organizing National Conferences cum Workshops and Orchid Exhibitions in different regions and involving school and college students so as to highlight their importance at the grass root level. Plant tissue culture techniques could be one of the major and most suitable alternative tools to minimize the pressure on natural populations of medicinal orchids and to maintain the gene pool of such unique and valuable group of plants for future generation. Cost effective protocols for mass propagation of these endangered, threatened, and rare medicinal orchids need to be developed in order to conserve them. Proper utilization and management of medicinal orchids might be a better alternative of synthetic medicine.

Acknowledgement

The author is thankful to Ministry of Tribal Affairs, Government of India, New Delhi for providing fellowship in the form of National Fellowship for Higher Education for ST Students during the present investigation.

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