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Conservation of Medicinal and Aromatic Plants

Dr. Gunmala Gugalia

Associate Professor, Department of Botany, Sangam University, Bhilwara(Raj.), India

ABSTRACT: The expanding field of herbal goods industry has a big future for the Indian country's economic progress. Herbs are increasingly being used as a source of food, medicine, perfume, taste, colours, and other products in Ancient medical systems. It is estimated that 95 percent of therapeutic plants utilised in the Ayurvedic industry come from the wild. Despite the fact that India has over 8,000 indigenous species used by various tribes across various environments, only about 10% of them are actively traded. The propagation and cultivation of these plants must be encouraged. The plants are conserved by legislation, *In situ* and *ex situ* conservation.

KEYWORDS: Medicinal Plants, *in situ*, and *ex situ*

I. INTRODUCTION

India has long been regarded as the "wealth home" or "botanical garden" of plant genetic resources due to its unique agro-climatic conditions and geography. As a result, India is considered one of the top 12 megadiversity countries in the world. More than 8,000 species make up India's herbal treasure, accounting for over half of the country's higher blooming plant species; the Western Ghats are home to roughly 70% of the country's medicinal plants. According to current data, 1,800 species are employed in Classical Indian medicinal systems.

Plants are used in various times such as in Ayurveda uses 1,100, Siddha uses 800, Unani uses 700, Amchi uses 500, and Tibetan uses 350. The expanding field of herbal products industry has a lot of potential for the Indian economy. Herbs are increasingly being used in Indian medical systems as a source of food, medicine, fragrance, flavour, colours, and other products. It is believed that 95% of therapeutic plants utilised in the Indian herbal industry are taken from the wild. Per year, approximately half a metric tons of dried herbs are collected in an ad hoc manner using extreme methods and 1.65 lakh hectares of forest are cleared and felled. The fast growth of land under food and staple crops, deforestation, urbanisation, the formation of industries in rural regions, and other factors have resulted in a significant depletion of germplasm, with many of species on the endangered list(1,2)

II. BIODIVERSITY: OVERVIEW

These 880 medicinal plants are well spread across different life forms, with the large percentage relating to the herbaceous category, according to a habit analysis. Herbs (41%) and grasses (26%) are the most common, followed by trees (26%), shrubs (17%), and climbers (17%). (16 percent).It's worth noting that the 880 traded plants are split up into 151 different families. Dicots account for 79%, Monocots 11%, Pteridophytes 5%, Gymnosperms 3%, Fungi 1%, and Lichens 1%. This means that only a small percentage of raw pharmaceuticals are classified as lower plant classes (Table 1).

Table 1. List of medicinal plants

Class	Number of Families
Dicots	119
Monocots	17
Pteridophytes	8
Gymnosperms	5
Fungi	1
Lichens	1



India has ten bio geographic areas, making it one of the world's top 12 mega diverse countries. Two of the world's eight biodiversity hotspots can be found in India alone. The country's climatic and altitudinal variations, combined with its diverse ecological habitats, have resulted in the development of an enormously rich vegetation with a unique diversity of medicinal plants, which serves as a valuable source of medicinal raw materials for traditional medicine systems as well as pharmaceutical industries both domestically and internationally. The WTO has a list of about 21000 plant species that are utilised for therapeutic purposes all around the world. In India, over 2500 species of plants are employed in traditional medicine. The red data book has 427 Indian medicinal plant listings on endangered species, with 28 being extinct, 124 being endangered, 81 being rare, and 34 being unknown (Table 2).

Another point of interest is the natural presence of traded species. These species are reported to be dispersed over a variety of bio-geographic zones, habitats, and landscape features. Around 18% of these species are only found in the Himalayan and Trans Himalayan zones, including North East India, while 4% are only found in the Western Ghats and 0.5 percent are only found in the Desert zone. The remaining species (about 77%) have a wide range of distribution across the country's various bio-geographic zones (Table 3).

Table 2 Botanical representations of traded medicinal plants (Family wise)

Family	Species
<i>Fabaceae</i>	67
<i>Asteraceae</i>	54
<i>Euphorbiaceae</i>	48
<i>Caesalpinaceae</i>	41
<i>Apiaceae</i>	37
<i>Lamiaceae</i>	37
<i>Solanaceae</i>	35
<i>Cucurbitaceae</i>	32
<i>Rubiaceae</i>	29
<i>Malvaceae</i>	28

Plant parts such as leaves, bark, roots, fruits, seeds, and even the entire plant are gathered illegally from wild sources without regard for the plants' survival. Due to over-exploitation and habitat loss, many vital valuable species are on the edge of extinction. More than 95% of medicinal plants are harvested from the wild, and many have become endangered in their native habitat. It is necessary to promote their expansion and development of plants. Collection of the following species from wild sources should be prohibited.

Aconitum sp. (Monk's Hood, Bachang), *Acorus* spp. (Sweet Flag, Vekhand), *Anchusa strigosa* (Gaozaban), *Aristolochia bracteata* (Kiramar), *Artemisia annua* (Worm wood), *Atropa acuminata* (Indian belladonna), *Berberis aristata* (Indian Berbery, Daru Haridra), *Brunium persicum* (Kala Zeera), *Chlorophytum* spp (Safed Musli), *Colchicum luteum* (Tara-Tutiya, Suranjan-1- Talah, Golden Collyrium), *Commiphora wightii* (Guggul), *Concinum fariestatum* (Jeevanti), *Coptis teeta* (Halad-Vachnag, Gold Thread, Mamira), *Curculigo orchioides* (Kali Musli), *Didymocarpus pedicellata* (Shila- Pushpa), *Dorsera* sp. (Sundew), *Ephedra gerardiana* (Somlata), *Eulophia campestris* (Saleb Misri), *Ferula jaeskaena* (Indian Hing), *Gentiana kurroa* (Indian Gentian Pashanbheda), *Gloriosa superba* (Glory Lily, Agnisikha), *Gynocardia odorata* (Kadu Bonsha), *Holostemma annualare* (Peet Chandan, Kasturi Mazil), *Hydrocarpus* sp., *Hyoscyamus niger* (Henbane), *Inula racemosa* (Pshkar Mool), *Iphigenia indica* (Nirpani), *Lilium polyphyllum* (Kshira Kankoli), *Microstylis nicifera* (Jeevaka), *Microstylis wallichii* (Rishvake), *Nardostachys grandiflora* (Jata mansi), *Onosma bracteatum* (Ratnajyot), *Orchis latifolia* (Salam Panja), *Panax pseudo-ginseng* var. *himalicus* (Indian Ginseng), *Physochlaena praelta* (Scholar, Lalthang), *Picrorhiza kurroa* (Kutki), *Piper cubeba* (Kababchini), *Podophyllum hexandrum* (Bankari), *Rauwolfia serpentina* (sarpagandha), *Rheum astrata* (Rewadchhini), *Rheum emodi* (Indian Rhubarb, Gandhini), *Saussurea sacra* (Yogispada), *Swertia chirayata* (Chirayata), *Taxus baccata* (Talispatra), *Taxus wallichiana* (Indian Yew).



Geographic distribution of Indian endangered plants

Trans Himalayan

Approximately 700 recognised medicinal plants are thought to be present in this region. *Ephedra gerardiana* Wall., *Hippophae rhamnoides* L., and *Arnebia euchroma* (Royle) John are some of the well-known species that thrive in the region's harsh, desert-like conditions.

Central and Eastern Himalayas

Overall, the bio provinces are thought to include over 1,200 recognised medicinal plant species. *Nardostachys grandiflora* DC., *Taxus wallichiana* Zucc. (CITES listed), *Rhododendron anthopogon* D.Don, and *Panax pseudoginseng* Wall are only a few of the well-known plants (only found in the Eastern Himalayas).

The north-east

A further biodiversity - rich location of the country is the region with an estimated 2000 medicinal plant species. This zone is one of 18 hot places with high levels of endemism. It is divided into two bioregions: the Brahmaputra Valley and the Assam Hills. Some of the well-known medicinal plants found here include *Aquilaria malaccensis* Lam. (CITES-listed), *Smilax glabra* Roxb., *Ambroma augusta* (L.) L.f., and *Hydnocarpus kurzii* (King) Warb.

Desert

The biodiversity zone encompassing the biotic regions of Kutch and Thar is home to around 500 recognised medicinal plant species. *Convolvulus microphyllus* Seib ex Spreng (Syn *C. pluricaulis* Chois), *Tecomella undulata* (Sm.) Seem, *Citrullus colocynthis* (L.) Schrader, and *Cressa cretica* L. are some of the plants gathered in this area.

Plain of Ganges

The biotic regions of the Upper Gangetic Plain and Lower Gangetic Plain are believed to have over 1000 medicinal plant species. *Holarrhena pubescens* (Buch-Ham.) Wallich ex A.DC., *Mallotus philippensis* (Lam.) Muell.-Arg., *Pluchea lanceolata* C. B. Clarke, and *Peganum harmala* L. are a few of the well-known species present in the area.

Zone of semi-arid

It is made up of the biological punjab region and Gujarat-Rajwar and is home to over 1,000 medicinal plant species. *Tribulus rajasthanensis*, *Commiphora wightii* (A.) Bhandari, *Caesalpinia bonduc* (L.) Roxb., *Caesalpinia bonduc* (L.) Roxb., *Caesalpinia bonduc* (L.) Roxb., *Caesalpinia bonduc* (L.) Roxb., *Caesalpinia bonduc* (L.) Roxb.

The West Coast and the East Coast

Around 500 plant species of known medicinal plants are thought to exist in the seaside biogeographic zone. *Rhizophora mucronata* Lam., *Acanthus ilicifolius* L., *Avicennia marina* (forsk.) Vierh, and *Sonneratia caseolaris* (L.) Engl. are a few well-known ones.

Andaman, Nicobar, and Lakshadweep

Calophyllum inophyllum L., *Adenanthera pavonina* L., *Barringtonia asiatica* (L.) Kurz, and *Aesandra butyracea* (Roxb.) Baehni are some of the significant medicinal plants of this island biogeographic zone, which is estimated to have approximately 1000 species.

Calophyllum inophyllum L., *Adenanthera pavonina* L., *Barringtonia asiatica* (L.) Kurz, and *Aesandra butyracea* (Roxb.) Baehni are some of the most important medicinal plants of this island biogeographic zone, which is estimated to have over 1000 species.

Western Ghat

The Malabar Coast and Ghats biogeographic zone is also one of the world's 18 biodiversity hot areas, featuring almost 2000 medicinal plants. *Myristica malabarica* Lam., *Garcinia indica* (Dup.) Choisy, *Uleria salicifolia* Bedd. ex.Hook.f., and *Vateria indica* L. are all endemic to this region. These species are classified as vulnerable (VU) in the case of *Vateria indica* L. and critically endangered (CR) in the case of *Uleria salicifolia* Bedd. ex.Hook.f(3).

Loss of biodiversity of medicinal plants.

A. Physical factors

Rainfall: Annual rainfall has decreased in recent years, resulting in a decline in the health of many herbaceous species throughout the summer months.

Deforestation: Deforestation has been documented throughout the last two decades. Agriculture, logging, firewood collecting, heavy wood collection, extensive grazing, and other factors are all contributing to the loss of precious forest



land. Every year, deforestation causes the extinction or reduction of many significant wild medicinal plant species.

Siltation of water bodies: Siltation of water bodies in forests has resulted in a decline in water holding capacity, resulting in subsurface water depletion. Honey bee colonies have fallen by 50-60% in woods and other locations due to a lack of pollinators. Pollinator loss has resulted in decreased seed set and distribution.

B. Developmental Activities

Submersion: Submersion has resulted in the extinction of numerous medicinal plant species in forests, such as the Maradavally forest, which is the catchment area of the Linganamakki Dam, Karnataka's largest reservoir for irrigation and power generation. During monsoons, roughly 10 square kilometres of forest land are submerged, resulting in the extinction of valuable medicinal plant species.

Infrastructure: Road expansion, electricity line installation, and building development have all resulted in considerable destruction to forests and medicinal plants, such as the Devanarayandurga forest in Karnataka.

C. Agriculture and forestry methods

Monoculture: In the forest, monoculture plantations of commercially valuable indigenous and foreign species have been steadily increasing. Monoculture plantations have a significant impact on organic productivity and impair natural stability and complexity, resulting in the extinction of medicinal plants in many woods, for example, Eucalyptus and Acacia species.

Depredation: Forest depredation has reached frightening proportions. Apart from tree felling and vegetation clearance, the agriculture tactics used on high sloppy lands have resulted in soil erosion and a decrease in medicinal plant diversity.

Over-harvesting: The harvesting of medicinal plants from forests is widespread. The commodity was collected by unorganised forest collectors, who then sold it to a developer at a price set by the latter. Unauthorized gathering has been regulated to some extent thanks to the awareness raised by members of the 'Local Traditional Medicinal Practitioners Association.'

Conservation of medicinal and aromatic plants

According to IUCN, UNEP, and WWF, 1980 defines conservation as "the management of human use of biodiversity to provide the maximum sustainable benefit to current generations while maintaining its ability to meet the needs and desires of upcoming generations."

Biodiversity's key goals, strategies, and priorities

The World Conservation Strategy's conservation goals can be described as follows:

- i. The preservation of critical ecological processes and life support systems that are necessary for human survival and economic activity.
- ii. Species and genetic diversity preservation, as well as the sustainable use of species and ecosystems that support millions of rural populations and big enterprises.
 - i. Forest Act, 1927
 - ii. Wildlife (Protection) Act 1972 and Wildlife (Protection) Amendment Act 1991
 - iii. Forest (Conservation) Act, 1980
 - iv. Environment Protection Act, 1986
 - v. National forest policy, 1988
 - vi. National biodiversity act, 2002

The scheduled tribes and other traditional forest dwellers act, 2006

In-situ conservation

In-situ conservation refers to the preservation of a species in its natural habitat or the place where it grows naturally.

- ii. It comprises Biosphere reserves, national parks, sacred sites, and Sacred Grooves, among other things.
- iii. Plant diversity at the genetic, species, and eco-system level can only be protected in nature through time.
- iv. Inter and intra-specific genetic variation must be conserved in distinct, representative biogeographic zones.

The 'in-situ' or on-site conservation, in which a wild species or stock of a biological community is protected and conserved in its natural habitat, is the most cost-effective approach of maintaining existing biological and genetic diversity. The advantage of a "ecocentric" strategy over a "species-centered" approach is that it prevents species from becoming endangered as a result of human activities and reduces the need for human interference to avoid premature extinction. Biosphere reserves, national parks, wildlife sanctuaries, holy groves, and other protected sites are examples of 'in-situ' conservation. conservation techniques At the national, international, and global levels, the idea of constructing a protected area network has taken centre stage in all policy decision-making processes linked to biodiversity conservation.

The following are the most often used in situ conservation techniques:

Biosphere Reserve: Based on survey data, the Ministry of Environment and Forest of the Government of India selected 14 biosphere reserves, with seven of them now functioning (Table 2).



Table 2 Biosphere reserves in India

S.No.	Biosphere reserve	Area (sq.	State
1.	Nokrek	80	Meghalaya
2.	Nilgiri	5520	Karnataka, Kerala,Tamil Nadu
3.	Namdapha	4500	Arunachal Pradesh
4.	Nanda Devi	1560	Uttar Pradesh
5.	Sunderbans	9630	West Bengals
6.	Great Nicobar	885	Andaman & Nicobar Islands
7.	Gulf of Manner	555	Tamil Nadu
8.	Manas	2837	Assam
9.	Valley of Flowers	2000	Uttaranchal
10.	Kaziranga	760	Assam
11.	Thar Desert	760	Rajasthan
12.	Kanha	760	Madhya Pradesh
13.	Rann of Kutch	2000	Gujarat

National parks: Out of a total of 91 National Parks in the country, Pin Valley National Park and Great Himalayan Park, located in the regions of Lahaul-Spiti and Kulu, respectively.

There are also World Heritage sites (5), Wetlands (19, including 6 Ramsagar sites), Mangroves (15), Coral Reefs (4), and other locations like as holy groves, natural monuments, ethno-biological reserves, and so on, in addition to the 448 wildlife sanctuaries listed above.

These will undoubtedly aid in the conservation of biodiversity in their particular areas. However, history has shown that declaring protected areas in a highly populated developing country like India, where a large population lives in close proximity to forests, will not be sufficient to assure the protection of rapidly deteriorating biological diversity. The competent management of protected areas is the sole determinant of the success of any conservation initiative. The need of involving local communities in conservation efforts is becoming increasingly apparent. As a result, a people-centered, nature-oriented approach becomes critical. This will aid in instilling a sense of responsibility among the local population on the importance of biodiversity and the need to use it sustainability for their own well-being and ecosystem resilience.

Sacred groves

Sacred groves are tiny or large patches of vegetation that are protected on the basis of cultural and traditional religious traditions (Table 3).

Table- 3 Sacred groves in India

States	Number of documented
Andhra Pradesh	750
Arunachal Pradesh	58
Assam	40
Chhattisgarh	600
Gujarat	29
Haryana	248
Himachal Pradesh	5000
Jharkhand	21



Karnataka	1424
Kerala	2000
Maharashtra	1600
Manipur	365
Meghalaya	79
Orissa	322
Rajasthan	9
Sikkim	56
Tamil Nadu	448
Uttaranchal	1
West Bengal	670
Total	13720

The following are some other in-situ conservation methods:

- i. Conservation on the farm: On-Farm Within the traditional agricultural system, conservation refers to farmers maintaining traditional crop cultivars (land races) or farming practises. Land races, produced by the farmer and well adapted to the local environment, are used by traditional farmers. Though farmers have employed this method of conservation for millennia, it has recently gained popularity. When it comes to agrobiodiversity, the consequences of producers' activities are critical. Farmers' knowledge of diversity and uses must be documented in a systematic way.
- ii. Home gardens: Conservation in a home garden is quite related to conservation on a farm, although the scale is considerably lower. Home gardens in rural areas typically feature a diverse range of species, including vegetables, fruits, medicinal, and spice plants.
- iii. A paraforest conservation idea based on zero input energy in the Himalayan region that is still covered in snow.

In-situ management guidelines

- A. The Forest Service should develop a national policy on medicinal plant conservation and utilisation in conservation areas.
- B. The strategy should include the following:
- C. Determining which conserved areas are most beneficial to medicinal plants;
- D. Medicinal plant recording and monitoring targets and methodologies in protected areas;
- E. Medicinal plant collection techniques and processes in protected areas.
- F. The Parks Department should analyse the extent to which the country's medicinal plants are covered by the protected areas system. It should next establish new protected areas and expand existing ones in order to ensure that all of the country's medicinal plants are preserved. The Parks Department should come up with financial and social incentives to encourage the preservation of natural areas and wild animals.
- G. Park administrators should guarantee that indigenous medicinal conservation and exploitation are included in site management plans.
- H. Species that have been severely diminished as a result of over-collection should be reintroduced into places where they once flourished.

Conservation in situ

Ex-situ (outside of natural habitat) conservation of medicinal plants can be achieved by cultivating plants in botanic



gardens, parks, and other suitable locations, as well as long-term restoration of plant inoculum in gene banks (seed banks, pollen banks, DNA libraries, etc.) and plant tissue culture repositories, as well as cryopreservation.

A field gene bank (also known as a field repository or clonal repository) is a collection of genes found in the field.

i. Gene Bank: Seed storage (base collection at -20°C ; active collection at $+4^{\circ}\text{C}$ to 10°C .) In India, three national gene banks have been established to preserve medicinal and aromatic plants *ex situ*.

ii. The National Bureau of Plant Genetic Resources (NBPGR), which is part of the Indian Council of Agricultural Research (ICAR), is based in New Delhi.

iii. The Central Institute of Medicinal and Aromatic Plants (CIMAP) in Lucknow, Uttar Pradesh, is part of the Council of Scientific and Industrial Research (CSIR), which is part of the Ministry of Science and Technology of India.

iv. TBGRI (Tropical Botanical Gardens Research Institute), Palode, Thiruvananthapuram (Kerala).

v. The National Bureau of Plant Genetic Resources (NBPGR), which is part of the Indian Council of Agricultural Research (ICAR), Department of Agricultural Research and Education, is solely responsible for the conservation of genetic variety in cultivated plants and their wild counterparts (DARE).

Gene bank for seeds

Seed Gene Bank's germplasm conservation is more cost-effective. The National Gene Bank (NGB) is housed at the NBPGR in New Delhi, and it is primarily responsible for the conservation of germplasm of agri-horticultural crops and their wild relatives for long-term seed preservation. These are known as the "Base Collection," and they are kept in -20°C modules. The seeds are dried to a moisture content of 4-6 percent before being packed in moisture-proof aluminium foil packages.

These seeds can be preserved for 50 to 100 years. Only seeds samples with more than 85% seed viability are treated in most crops. The seeds in the gene bank are stored optimally according to the FAO/IPGRI gene bank criteria.

Sites of active germplasm across the country

The network's core component is the national active germplasm sites (NAGS). ICAR institutes (crop-based institutes for a certain crop or group of crops) and SAUs are home to 40 NAGS at the moment. These are an important part of the national network for plant biodiversity protection. The NAGS is in charge of multiplying, evaluating, maintaining, and conserving active collections, as well as their distribution to legitimate users at both the national and international levels.

These active/working collections are kept in modules with a temperature of $+4^{\circ}\text{C}$ and a relative humidity of 35-40% (RH). Seeds are projected to be viable for 15 to 50 years at these temperatures. The moisture content of the seeds is reduced to 8 to 10% for medium-term preservation. To assist the active germplasm conservation operations of the regions, the NBPGR has a network of 11 regional stations placed in various agroclimatic zones around the country.

Cryopreservation (at -165°C to -196°C in liquid nitrogen)

Cryopreservation, often known as liquid nitrogen freezing, is a method of preserving items.

i. Seed preservation: The seeds were divided into two groups based on how they responded to dehydration(4). The bulk of them, known as 'Orthodox,' are desiccation tolerant and hence may be stored for longer periods of time. The second group of plant species is known as 'Recalcitrant,' meaning that their seeds are damaged during drying and hence cannot be stored at subzero temperatures.

ii. Pollen preservation: Pollen storage was primarily developed as a method for controlling pollination of synchronised flowering in plants, particularly in fruit tree species. Pollen freezing has also been touted as a promising new approach for genetic preservation(5-7). Pollen may be harvested in vast numbers and cryopreserved in a minimal amount of space.

iii. Plant quarantine concerns are reduced when germplasm is exchanged by pollen. Cryo-preservation strategies for



pollen from a wide range of taxa have been developed in recent years. Several countries have built pollen cryobanks for fruit-tree species(8,9)

In vitro Conservation (PTC)

The establishment of particular facilities (culture rooms with regulated environments, artificial lights, laminar airflow cabinets, autoclave, etc.) and skilled scientists and personnel are required for an in vitro conservation effort. It would also be useful to get information on those plant species' in vitro multiplication and/or conservation techniques. There are two steps to any in vitro conservation programme:

- i. in vitro multiplication to produce a huge number of plants;
- ii. in vitro storage Meristems, shoot tips, axillary buds, embryos, and even callus and cell suspension are examples of material maintained in vitro. If effective storage techniques are established, in vitro gene banks are simple to maintain and generally affordable.

DNA storage (Conservation at -20°C)

DNA storage is, in theory, simple to implement and extensively applicable. DNA storage appears to be simple and inexpensive. In recent years, genetic engineering has enabled the transfer of genes across species and genus boundaries. Genes from viruses, bacteria, fungus, and even mice have been used to create transgenic plants. As a result of these efforts, DNA Libraries have been established. The necessary techniques and procedures for using the material contained in the form of DNA must be created.

Arboreta/botanical gardens

A botanical garden is a place where you can find a documented collection of living plants for scientific research, conservation, display, and education.(10) They are germplasm repositories, especially for rare and endangered indigenous and exotic germplasm collections(11) Botanic Garden Conservation International (BGCI), a non-profit organisation based in London, UK, was founded in 1987 to promote global cooperation and monitoring of botanical garden conservation programmes.

The Botanical Garden Conservation International (BGCI) has 500 member botanical gardens in three nations across the world (10). According to the BGCI database, there are around 1,846 botanical gardens around the world. In India, there are around 140 botanical gardens, including 33 botanical gardens affiliated with 33 university botany departments. However, just about 30 botanical gardens have a conservation programme in place. The Tropical Botanical Gardens & Research Institute (TGBRI) in Kerala, which is located in a degraded forest zone of the Western Ghat Mountains, is an exceptional example of ex-situ plant variety conservation in India.

REFERENCES

1. Vijayalatha SJ. An Ornamental garden with medicinal plants an indirect approach for conservation of medicinal plants. *Indian J Arecanut Spices and Medicinal Plants*. 2004;6(3):98–107.
2. Singh S. Medicinal plants –A Natural gift to mankind. *Agriculture Today*. 2005;3(3):58–60.
3. <https://geographyandyou.com/distribution-of-indian-medicinal-plants-northwest-and-west-himalaya/>
4. Roberts EH. *Viability of Seeds*. London: Chapman and Hall; 1972.
5. Harrington JF. 'Seed and pollen storage for conservation of plant genetic resources'. In: *Genetic Resources in Plants. Their Exploration and Conservation*. Frankel OH, et al. editors. UK: Blackwell; 1970. p. 501– 521.
6. Roberts EH. Problems of long-term storage and seed and pollen of genetic resources conservation'. In: *Crop Genetic Resources for Today and Tomorrow*. Frankel OH, et al. editors. Cambridge, UK: Cambridge University Press; 1975. p. 226–296.
7. Withers LA. Biotechnology and plant genetic resources conservation. In: *Plant Genetic Resources Conservation and Management*. Paroda RS, et al. editors. New Delhi: IBPGR Regional Office; 1991. p. 273–297.
8. Towill LE. Low temperature and freeze/vacuum-drying preservation of pollen. In: *Cryopreservation of Plant Cells and Organs*. Kartha KK, et al. editors. Florida, USA: CRC Press; 1985. p. 171–198.
9. Alexander MP, Ganeshan S. 'Pollen storage'. In: *Advances in Horticulture. Fruit Crops-part I*. Chadha KL, et al.



editors. New Delhi: Malhotra Publishing House; 1993. p. 481–496.

11. Jackson WP. 'Plenary address, BGCI. 4th International Congress on Education in Botanic Gardens held in Thiruvanthapuram. Kerala, India; 1999.

12. Sharma SC, Goel AK. Role of botanic gardens in modern times. *Indian J Forestry*. 1994;17:230–238.



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