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FLORA OF THE INDIAN EPIC PERIOD: ONCE LOST, THE DIVERSITY OF GENE POOLS CANNOT BE RESTORED - OUR EVOLUTIONARY RESPONSIBILITY

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ABSTRACT

The Indian epic flora are a fundamental part of the Indian culture and apart from having medicinal importance they also have religious value. Their present diversity of species is the result of a very long and slow process of genetic change and adaptation. The time necessary for the emergence of new species, and even for the accumulation of genetic variants at individual gene loci within species, greatly exceeds the time since the emergence of Homo sapiens. New techniques of molecular biology combined with recent theories in population genetics allow us to assess the time dimension of genetic change; these suggest that some genetic polymorphisms may have originated over a million generations ago. In other words, once lost, any particular genetic adaptation cannot be regained in any realistic time interval. These plants provide many services that we take for granted. However due to growing population, increasing anthropogenic activities, rapidly eroding natural ecosystem, etc. the natural habitat for a great number of herbs and trees are dwindling. Biotechnological approaches can prove beneficial for the conservation of these important plants. These plants have maintained their existence to date since the epic period and if once lost, they cannot be regained in any realistic time interval. So it is our evolutionary responsibility to conserve these plants for the future generations.

KEY WORDS

Conservation, Flora, Indian epic period

INTRODUCTION

India was one of the foremost developed countries in ancient times. Learned persons of vedic culture were aware regarding unimaginable obligation of plants for the sustenance of life. There are a number of verses in ancient literature depicting this generosity of plant kingdom. No wonder that many such plants species have been revered as God [8]. One of the oldest treaties in the world is Rigveda (4500 BC-1000 BC) where healing properties of some herbs are mentioned in the form of sonnets, which were often recited in religious rituals. Later on a special faculty was developed known as Ayurveda, mostly dealing with human philosophy of health including utilization of medicinal plants [8]. There are records in ancient scripts regarding periodic conferences, seminars and also workshops in selected areas where exchange of knowledge was often manifested. Even it was mentioned that women scholars like Maitrai, Gargi contributed some knowledge about medicinal plants and their maintenance.

We produce here the names of few plants and trees of epic period, in Sanskrit language, their

botanical names, local Hindi or English names and Sargas (Chapters) in which these species have been mentioned (**Table 1, Fig. 1**). (http://en.wikipedia.org/wiki/Flora_of_the_Indian_epic_period)

Table 1. The names of flora of Indian epic period, in Sanskrit language, their botanical names, local Hindi or English names and Sargas (Chapters) in which these species have been mentioned.

S.no	Sanskrit name of plant (Devanagari)	Botanical name	Indian names	Indian epic	Parvaa	Shloka	Location in epics
1.	Agnimukha (अग्निमुख)	*Semecarpus anacardium*	Bhilawa, Bhela, Bhallaataka	Ramayana	Aranya Kanda Sarga 73	3.73.5	Matanga hermitage
2.	Arjuna (अर्जुन)	*Terminalia arjuna*	Arjuna, Arjunasaadaddaa, Sanmadat,	Ramayana	Kishkindha kanda Sarga 1	4.1.81	Pampa Lake
3.	Asoka (अशोक)	*Saraca asoca*	Ashoka	Ramayana Mahabharata	Aranya kanda Sarga 11 Anusasna parva	3.11.74 XIII.54.4	Agastya's hermitage King Kusika country
4.	Ashvakarna (अश्वकर्ण)	*Vateria indica*	Dhupa, Ralla	Ramayana	Bala Kanda Sarga 24	1.24.15	Malada and Karusha provinces
5.	Badari (बदरी)	*Zizyphus mauritiana*	Ber, Bora	Ramayana	Bala Kanda Sarga 24	1.24.16	Malada and Karusha provinces
6.	Bansha (बांस)	*Dendrocalamus strictus*	Bamboo, bansalochana	Ramayana	Aranya kanda Sarga 15	3.15.21	Panchvati
7.	Bhavya (भव्य)	*Dillenia indica*	Bhava, Bhavya, Bhavishya, Bhavan, Vaktrashodhan, Pichchilbeeja	Mahabharata	Anusasana Parva	XIII.54.5	King Kusika country
8.	Bilva (बिल्वा)	*Aegle marmelos*	Bel	Ramayana Mahabharata	Kishkinda kanda Sarga 1 Van Parva	4.1.78 III.174.23	Pampa Lake Dvaita forest kurukshetra Saraswati river
9.	Champaka (चम्पक)	*Michelia champaca*	Champa	Mahabharata	Anusasana parva	XIII.54.5	King kusika country
10.	Chandana (चंदन)	*Santalum album*	Chandana	Ramayana	Kishkindha kanda Sarga 1	4.1.82	Pampa lake

11.	Devadaru (देवदारु)	*Cedrus deodara*	Deodar trees	Ramayana	Kishkindha kanda Sarga 43	4-43-13	Himalayas
12.	Dhava (धव)	*Anogeissus latifolia*	Dhavda, Bakli , Dhau , Dhawa, Dhawra, Dhaora	Ramayana	Kishkindha kanda Sarga 1	4.1.81	Pampa lake
13.	Hintala (हिन्ताल)	*Cycus circinalis*	Jangli madan mast ka phool	Ramayana	Kishkinda kanda Sarga 1	4.1.83	Pampa lake
14.	Inguda (इङ्गुद)	*Balanites roxburghii*	Hinganbet, Ingudi, Hingoli, Hingun	Mahabharata	Shalya Parva	IX.36.58	Sarasvati River
15.	Jambu (जंबू)	*Syzygium cumini*	Jamun, Jambul,	Ramayana	Aranya kanda Sarga 73	3.73.3	Matanga hermitage
16.	Kadamba (कदंब)	*Anthocepalus Cadamba*	Kadamba	Ramayana	Aranya kandaSarga 73	3.73.4	Matanga hermitage
17.	Karavira (करवीर)	*Nerium indicum*	Kannhera	Ramayana	Aranya kandaSarga 73	3.73.4	Matanga hermitage
18.	Karira (करीर)	*Capparis deciduas*	kerda, kair, karir, kirir, karril	Mahabharata	Shalya Parva	IX.36.58	Sarasvati River
19.	Karnikara (कर्णिकार)	*Cassia fistula*	Amaltas	Ramayana	Kishkinda kanda Sarga 1	4.1.73	Pampa Lake
20.	Kasha (काश)	*Saccharum spontaneum*	Kans grass	Ramayana	Aranya kanda Sarga 15	3.15.22	Panchvati
21.	Kashmarya (काश्मर्य)	*Berberis vulgaris*	Kashmal	Mahabharata	Shalya Parva	IX.36.58	Sarasvati River
22.	Ketaka (केतक)	*Pandanus tectorius*	Kewada, Ketaki, Keura, Gagandhul	Mahabharata	Anusasana parva	XIII.54.4	King Kusika country
23.	Khadira (खदिर)	*Acacia catechu*	Khair, Khadira	Ramayana	Aranya kanda Sarga 15	3.15.18	Panchvati
24.	Kichaka Venu (कीचक वेणू)	*Bambusa arundinacea*	Kaantaa baans	Mahabharata	Kishkindha kanda Sarga 43	4.43.37	Where River Sailoda flows
25.	Kimshuka (किंशुक)	*Butea monosperma*	Palas, Dhak, Khakara, Kakracha	Ramayana	Kishkindha Kanda Sarga 1	4.1.75	Pampa lake
26.	Kharjura (खर्जूर)	*Phoenix dactylifera*	Pindakhajur	Ramayana	Aranya kanda Sarga 15	3.15.18	Panchvati
27.	Kovidara (कोविदार)	*Bauhinia variegata*	Kachanar	Mahabharata	Drorna parva	VII.153.24	Kurukshetra war
28.	Kurantaka (कुरण्टक)	*Barleria prionitis*	Vajradanti, Koraanti-piwali	Ramayana	Kishkinda kanda Sarga 1	4.1.80	Pampa lake

29.	Kurvaka (कुरवक)	*Lawsonia inermis*	Mehandi, Mendee English:Henna, Hina,	Ramayana	Kishkindha kanda Sarga 1	4.1.82	Pampa lake
30.	Kuṭasalmali (कूटशाल्मली)	*Ceiba pentandra*	Kapok tree	Ramayana	Kishkindha kanda Sarga 40	4.40.39	Eastern side of the Jambudvipa
31.	Madhavi (माधवी)	*Gaertnera racemosa*	Vasanti, Madhumalati, Haladvel, Madahavilataa	Ramayana	Kishkindha Kanda Sarga 1	4.1.77	Pampa Lake
32.	Madhuka (मधूका)	*Madhuka indica*	Mahuwa, Mahuli	Ramayana	Aranya kanda Sarga 11	3.11.74	Agastya hermitage
33.	Malati (मालती)	*Jasminum sambac*	Bel/Beli, Mogra, Mallika, Kampupot, Melati	Ramayana	Kishkindha kanda Sarga 1	4.1.76	Pampa lake
34.	Malati (मालती)	*Jasminum grandiflorum*	Chameli, Jati	Ramayana	Kishkindha Kanda Sarga 1	4.1.76	Pampa lake
35.	Naga (नाग)	*Messua ferrea*	Nagachampa, Naagakeshara, Naagachaafaa,	Ramayana	Kishkinda kanda Sarga 1	4.1.78	Pampa lake
36.	Naktamala (नक्तमाल)	*Pongamia pinnata*	Karanja, kiramal, Kidamar	Ramayana	Kishkinda kanda Sarga 1	4.1.82	Pampa lake
37.	Narikela (नारिकेल)	*Cocos nucifera*	Coconut Palm	Ramayana	Kishkinda kanda Sarga 42	4.42.11	Cities Murachi, Jatapura, Avanti and Angalepa
38.	Nila (नील) Nyagrodha (न्यग्रोध)	*Ficus bengalensis*	Plaksha, Bengal fig, Indian fig, East Indian fig, Indian Banyan or simply Banyan, also borh, nyagrodha and wad or Vad/Vat	Ramayana Mahabharata	Kishkinda kanda Sarga 1 Drorna parva	4.1.79 VII.153.24	Pampa Lake Kurukshetra war
39.	Padma (पद्म)	*Nelumbo nucifera*	Hindi:Kamal, English:Indian lotus, sacred lotus, bean of India, or simply lotus	Ramayana	Kishkinda Sarga 1	4.1.76	Pampa lake
40.	Padmaka (पद्मक)	*Prunus cerasoides*	Himalayan wild cherry	Ramayana	Kishkindha kanda Sarga 43	4.43.13	Himalayas
41.	Panasa (पनस)	*Artocarpus heterophyllus*	Kat-hal	Mahabharata	Shalya parva	IX.36.58	Sarasvati river
42.	Parnasa (पर्णास)	*Ocimum sanctum*	Tulasi	Ramayana	Aranya kanda Sarga 15	3.15.18	Panchvati
43.	Paribhadraka (परिभद्रक)	*Erythrina indica*	Pangara, Dadap, Mandar, Ferrud, Panara	Ramayana	Aranya kanda Sarga 73	3.73.5	Matanga hermitage

44.	Parijata (पारिजात)	*Nyctanthus arbortristis*	Paarijaat, Praajakt, Harsinghar, Seoli, Khurasli	Mahabharata	Shailya parva	IX.36.60	Sarasvati river
45.	Pilu (पीलु)	*Salvadora oleoides*	Jaal, Pilu	Mahabharata	Shailya parva	IX.36.59	Sarasvati river
46.	Plaksha (प्लक्ष)	*Ficus religiosa*	Pipal, Pimpalla, Bodhi	Mahabharata Ramayana	Shailya parva Aranya Kanda sarga 73	IX.36.58 3.73.3	Sarasvati river Matanga Hermitage
47.	Priyala (प्रियाल)	*Buchanania lanzan*	Chironji, Chanhar, Piyal, Achar	Ramayana	Aranya kanda Sarga 73	3.73.3	Matanga hermitage
48.	Punnaga (पुन्नाग)	*Calophyllum inophyllum*	Undi, Undala, Unang, Surangi, Surpunka, Sultan champa,	Ramayana	Aranya Kanda Sarga 15	3.15.16	Panchvati
49.	Rakta (रक्ता)	*Rubia cordifolia*	Indian Madder	Ramayana	Kishkindha kanda Sarga 1	4.1.82	Pampa Lake
50.	Rohitaka (रौहीतक)	*Tecomella undulata*	Rohida, Desert teak	Mahabharata	Vana parva	III.174.23, III. 241.67)	Dvaita forest Kurukshetra Sarasvati river
51.	Sahakaras	*Mangifera indica*	Mango, Indian: Aamba, Aamra, Aam, Amb	Mahabharata	Anusasana Parva	XIII.54.4	King Kusikas's Country
52.	Sanjivani (संजीवनी)	*Sellaginella byropteris*	Sanjivani	Ramayana	Yuddha kanda Sarga 89	6.89.16	Mt. Dronagiri Himalayas
53.	Shalmali (शाल्मली)	*Bombax ceiba*	Semal, Shaalmali, laala-saanwar, Deokapaas, Shimal, Savari, Shembal	Ramayana	Kishkindha kanda Sarga 1	4.1.82	Pampa lake
54.	Shami (शमी)	*Prosopis cineraria*	Khejdi, sami, Jant/Janti, Sangri	Ramayana Mahabharata	Sarga 15 Sabha parva	3.15.22 II.47.4	Panchvati Kamboja country
55.	Shirisha (शिरीष)	*Albizzia lebbeck*	Siras, Shirisha, Kala-siris, Chichola, Chichwa	Mahabharata	Van Parva	III.174.23	Dvaita Forest, Kurukshetra, Sarasvati River
56.	Shyama (शयाम)	*Salvadora persica*	Khaankann, mirajollee, khakhin, miraj, jhak, pilva, kharjal, rhakhan, thorapilu	Mahabharata	Anusasana Parva	XIII.54.6	King Kusika Country
57.	Simsupa (शिंशुप)	*Dalbergia latifolia*	Simsipa, Sinsipa, Krishnasara, Gurusara, Krishnasimsapa	Ramayana	Kishkindha Kanda Sarga 1	4.1.81	Pampa Lake

58.	Sindhuvara (सिन्धुवार)	*Vitex negundo*	Nirgundi, Nirguddi, Sambhalu, Shivari, Nisida, Nigudi	Ramayana	Kishkindha Kanda Sarga 1	4.1.81	Pampa Lake
59.	Surakta (सुरक्त)	*Pterocarpus santalinus*	Rakta chandana, Laal chandan	Ramayana	Aranya kanda Sarga 73	3.73.5	Matanga hermitage
60.	Supuṣpi (सुपुष्पी)	*Clitoria ternatea*	Aparajita, saukarnika, ardrakarni, girikarnika, Sankhupushpam	Ramayana	Kishkinda Sarga 1	4.1.77	Pampa lake
61.	Tala (ताल)	*Borassus flabellifer*	Tari (Hindi), Tal (Bengali), Nungu (Tamil), Thaati/Munjalu (Telugu), Munjal (Urdu)	Ramayana	Aranya Kanda Sarga 15	3.15.16	Panchvati
62.	Tilaka (तिलक)	*Cinnamomum iners*	Daalachini, Tejpat, Tamaal saala	Ramayana	Kishkindha Kanda Sarga 1	4.1.78	Pampa Lake
63.	Tinduka (तिन्दुक)	*Diospyros melanoxylon*	Tendu	Ramayana	Bala Kanda Sarga 24	1.24.15	Malada and Karusha
64.	Tinisa (तिनिश)	*Lagerstroemia speciosa*	Taaman, Jarul, Mota-bondara	Ramayana	Aranya Kanda Sarga 15	3.15.16	Panchvati
65.	Uddalaka (उद्दालक)	*Cordia myxa*	Lasora, Bhokara	Ramayana	Kishkindha Kanda Sarga 1	4.1.81	Pampa Lake
66.	Vakula (वकुल)	*Mimusops elengi*	Vakula, Bakulla, Maulsari, Ovalli	Ramayana	Kishkindha Kanda Sarga 1	4.1.78	Pampa Lake
67.	Varanapushpa (वारणपुष्प)	*Calophyllum inoplyllum*	Sanskrit- Punnaga Indian:Undi, Undala, Unang, Surangi, Surpunka, Sultan champa	Mahabharata	Anusasana parva	XIII.54.6	King Kusika country
68.	Vasanti (वासन्ती)	*Hiptage benghalensis*	Vasanti, Madhumalati, Haladvel, Madahavilataai	Ramayana	Kishkindha Kanda Sarga 1	4.1.77	Pampa Lake
69.	Vetas (वेतस)	*Calamus rotang*	Rattan Palm	Mahabharata	Van Parva	III.174.23	Dvaita Forest, Kurukshetra, Sarasvati River
70.	Vibhitaka (विभीतक)	*Terminalia bellirica*	Baheraa, Behaddaa, Bibheeta	Mahabharata	Shalya Parva	IX.36.58	Sarasvati river

Figure 1. Some of the flora of Indian epic period

Kashmarya (Kashmal)

Berberis vulgaris

[Berberidaceae]

Ketaka (Kewada)

Pandanus tectorius

[Fabaceae]

Kimshuka (Palas)

Butea monosperma

[Fabaceae]

Kovidara (Kachanar]

Bauhinia variegata

[Fabaceae]

Kurantaka (vajradanti)

Barleria prionitis

[Acanthaceae]

Kurvaka (Mehendi)

Lawsonia inermis

[Lythraceae]

Kutasalmali (Kapok tree)

Ceiba pentandra

[Malvaceae]

Naga (Naagakeshara)

Messua ferrea

[Calophyllaceae]

Nila (Indian fig)

Ficus bengalensis

[Moraceae]

Padma (Kamal)

Nelumbo nucifera

[Nelumbonaceae]

Paribhadraka (Pangara)

Erythrina indica

[Fabaceae]

Parijata (Harsinghar)

Nyctanthus arbortristis

[Oleaceae]

Rohitaka (Rohida)

Tecomella undulate

[Bignoniaceae]

Sanjivani (Sanjivani)

Selaginella bryopteris

[Selaginellaceae]

Shalmali (Semal)

Bombax ceiba

[Malvaceae]

Shami (khejdi)

Prosopis cineraria

[Fabaceae]

Sindhuvara (Nirgundi)

Vitex negundo

[Lamiaceae]

Supuspi (Aparajita)

Clitoria ternatea

[Fabaceae]

Tinisa (Jarul)

Lagerstroemia speciosa

[Lythraceae]

Vakula (Maulsari)

Mimusops elengi

[Sapotaceae]

NEED FOR CONSERVATION

Homo sapiens arose and became the dominant species on earth in the last 1 / 20,000 of the time elapsed since the origin of life. In this relatively short time, humans have altered both the physical and the biological worlds in profound ways. The changes that we are making in our environment are detrimental to biological diversity and ultimately to ourselves. The biodiversity of plants that surrounds us provides us with food, fiber, medicine and energy [12].

The accumulation of this biodiversity has been a very slow process when measured in human timescales. Biodiversity is the product of a vast history of evolutionary change - about 3.5 billion years. The colonization of the terrestrial environment by life forms began approximately 500 to 600 million years ago, and during this most recent 10% of evolutionary history all of the diverse forms of terrestrial life that comprise our environment appeared. We cannot repopulate our world with species that have been lost, nor can we expect to regain the use of lost genetic variants within the timescale of human existence [12].

To gain perspective on our biological resources and to formulate wise strategies for managing our world, we must consider the following questions: What do we know about the processes that have produced the biological diversity of our world? And how have we attempted to place a value on

biological diversity through our conservation activities.

a. Timescales and diversity

How long does it take to acquire the unique genetic attributes that mark distinct species? The temporal thread that binds generations is the transmission of the hereditary information encoded in DNA (deoxyribonucleic acid). The preservation of form and function depends on a highly efficient system for the replication of DNA, so that the information transfer from one generation to the next is nearly error free. Paradoxically, some errors are essential to provide evolutionary flexibility. The ultimate source of biological diversity derives from mutational change in DNA molecules [12].

Owing to the powerful tools of molecular biology, our understanding of the genetic dimension of evolutionary change has advanced enormously over the past decade. These tools have provided us with a direct means of studying the pattern of mutational changes in DNA molecules among diverse life forms. Based on comparative studies, we now know that the error rate for DNA replication is very low (approximately 5×10^{-9} base substitutions per nucleotide per year) [13]. We have also learned that a number of mechanisms cause mutational change, including the insertion and deletion of DNA sequences and the transposition of DNA sequences (e.g., with respect to the chloroplast genome [2].

If we can determine the number of mutations that separate different species and if the mutation rate is constant, we can calculate the time it took to accumulate the observed level of mutational divergence. This notion of a molecular clock has been widely employed in evolutionary biology. To cite but one example of a molecular clock argument, it is estimated from the accumulation of mutational change in molecules that the monocotyledonous class of flowering plants (e.g., grasses, palms, orchids) separated from within the dicotyledonous class (eg, cotton, sunflowers, apple trees and so on) approximately 200 million years ago [17] .

Let us move from these ancient events in terrestrial evolution to the accumulation of genetic diversity within species. A commonly accepted definition of species is a group of individuals that are able to breed with each other [9]. As a consequence, the members of a species share a common gene pool. As the populations that compose a species diverge from one another through time, evolution barriers to reproduction begin to emerge. These include chromosomal rearrangements, behavioral divergence and changes in flowering time. New daughter species are born. The essential characteristic of a species is that the members share a common evolutionary future [12].

How extensive is the genetic diversity contained within species' gene pools? What factors control diversity levels and how long does it take to reach a given degree of diversity within a species' gene pool? According to biochemical assays of genetic diversity conducted over the past 25 years, most of the 470-plus tested plant species have extensive levels of genetic diversity [5] and plant breeders exploit genetic diversity to improve domesticated species. Similarly, natural selection depends absolutely on genetic diversity to produce adaptive responses to environmental changes [12].

Levels of genetic diversity within species are controlled by mutation rates, the size of the breeding population (effective population size), and the pattern and strength of natural selection. (Effective population size is calculated as the

harmonic mean of population sizes taken over time.) While mutation rates are reasonably constant across most life forms, patterns of effective population size and selection are highly specific and depend on the unique history of the species in question. For example, species that have expanded from glacial refugia may have much larger current numbers but their effective population size is still dominated by the bottleneck imposed by the glacial era. (Refugia are areas of relatively unaltered climate inhabited by plants and animals during a period of continental climatic change.) Hence the time it took to achieve a given degree of genetic diversity depends on the species. The age of genetic variants within a species can be estimated by coalescence theory [6]. Coalescence theory is a recent development in population genetics that relates mutational diversity for a particular gene to past episodes of selection and to the effective population size can, in turn, be related to the age of genetic variants. To apply coalescence theory, researchers obtain DNA from a sample of individuals. For each individual, DNA sequence data are determined for a specific gene. According to the theory, the present-day sequences all trace back to a common ancestral sequence called the coalescent. The age of the coalescent depends on mutation rate and effective population size. Gene genealogies can also be used to detect natural selection.

b. Space needed for evolution

Species are composed of systems of populations called metapopulations [7] that are spread across an environment or landscape. A given environment is spatially heterogeneous [15], that is, local environments differ from each other. In each local environment, particular genetic variants of a species are more likely to survive and reproduce successfully, and natural selection favors those variants. Over time a given population adapts to its local environment. While genetically different, these locally adapted populations remain part of the same species because genetic migration among populations maintains a common evolutionary trajectory for the species as a whole. Species cannot exist as dynamic evolutionary entities without sufficient habitat. One of the most fundamental generalizations of ecology is the relation between the size of a habitat and the number of species that can live there [11]. Reducing the size of a habitat means reducing the number of species that live there. In addition, habitat loss can ultimately reduce the ecosystem services required to sustain human activities.

The enormous expansion of the global human population has engendered an unavoidable conflict between biological diversity and the activities necessary to accommodate population growth. The battle field is habitat. To expand our agricultural, urban, industrial and other needs, we must convert habitat that supported a variety of biological activities into space for human use. How do we manage the environment to sustain human life in the long term while still meeting the needs of present populations? The obvious answer is that we adopt societal rules to conserve habitat and thereby to conserve the biological heritage upon which we depend.

c. Saving our ultimate resources

The loss of species and valuable gene pools is proceeding at an accelerating pace. Once gone, this lost genetic diversity will not be regained for a long time - vastly longer than the total history of human existence. Man depends on the biological world for survival. Other species are the ultimate source of the energy, food, fiber and many of the medicines that we consume. While we have managed to convert the biological and physical resources of the earth to human use with increasing efficiency, we have simultaneously degraded the resource base for future human

generations. This, coupled with a vastly expanding human population, threatens our ability to sustain our current standard of living into the future [12].

BIOTECHNOLOGICAL METHODS FOR CONSERVATION OF INDIAN EPIC FLORA

Most of the medicinal plants either do not produce seeds or seeds are too small and do not germinate in soils. Thus mass multiplication of disease free planting material is a general problem. In this regard biotechnology is a boon for conservation of these important plants.

1. Micropropagation (Invitro regeneration)

Micropropagation is the technique of in vitro multiplication of large number of plants from its part, whether it is leaves, seeds, nodes and tubers etc. In the recent years, tissue culture has emerged as a promising technique to obtain genetically pure elite populations under in vitro conditions. It a fast and dependable method for production of a large number of uniform plantlets in a short time. Moreover, the plant multiplication can continue throughout the year irrespective of season and the stocks of germplasm can be maintained for many years [9].

2. Mycorrhization

Plant production by micro propagation technology is limited by the acclimatization stage, one of the most critical stages of this process. A high percentage of micro propagated plantlets are lost or damaged during transfer from test tube conditions to in vivo environment. It would be useful to acclimatize plantlets during the in vitro period to reduce the stress during transfer ex vitro. For this reason, mycorrhizal technology can be applied. Inoculation of arbuscular mycorrhizal fungi (AMF) into the roots of micropropagated plantlets plays a advantageous role [16, 1]. As a result, the mycorrhizal technology can be applied for the conservation of rare and endangered medicinal plants, by inoculation of growth-promoting fungi.

3. Genetic Transformation

Genetic transformations improve yield and quality of medicinal plants, which involve the alteration or introduction of genes which improve the secondary metabolite synthesis in plant, which are mainly responsible for their medicinal properties. Genome manipulation is the general aim of the genetic transformation with medicinal plants by developing techniques for desired gene transfer into the plant genome in order to improve the biosynthetic rate of the compounds of interest. An essential strategy in this regard is the choice of the correct marker genes for genetic transformation, as it assists to analyze the transformed cell. Many researchers are mainly focusing on the mechanism of transfer and integration of the marker and reporter genes. Agrobacterium tumefaciens and A. rhizogenes are virulent for plants. They contain a large megaplasmid (more than 200 kb), which plays a key role in tumor induction. During infection the T-DNA, a mobile segment of Ti or Ri plasmid, is transferred to the plant cell nucleus and integrated into the plant chromosome and transcribed. Genetic transformation facilitates the growth of medicinal plants with multiple durable resistances to pests and diseases. There are more than 120 species belonging to 35 families in which transformation has been carried out successfully by using Agrobacterium and other transformations techniques [3].

4. Establishment of DNA banks

The establishment of DNA banks is one of the ex situ conservation method which is planned activity. The extraction of genetic material, and storage should be made readily available for molecular applications. DNA resources can be maintained at -20ºC for short- and midterm storage (i.e. up to 2 years), and at -70ºC or in

liquid nitrogen for longer periods. Other objectives of the creation of DNA banks may be related to training or distribution to scientists with an interest in different areas of biology. DNA banks assembled as a means to replace traditional methods of conserving genetic resources. For many species that are difficult to conserve by conventional means (either as seeds or vegetatively) or that are highly threatened in the wild, DNA storage may provide the ultimate way to conserve the genetic diversity of these genetic diversity of these species and their populations in the short term, until effective methods can be developed [4].

5. Cryopreservation

Cryopreservation is an important technique for long term storage of tissues/plants. This requires liquid nitrogen (-196°C). Some important DNA banks are as below: (i) The Royal Botanic Garden, Kew, UK, which contains PGR DNA specimens, and presently the world's largest and the most comprehensive PGR DNA bank, consisting of over 20,000 DNA specimens representative of all plant families. (ii) The US Missouri Botanical Garden has collection of more than 20,000 plant tissue samples, and provide raw material for the extraction of DNA for its subsequent use in conservation research. (iii) The Australian Plant DNA Bank of Southern Cross University, which was established in June 2002. It contains representative genetic information from the entire Australian flora. (iv) DNA bank of Leslie Hill Molecular Systematics Laboratory of the National Botanical Institute (NBI) in Kirstenbosch, South Africa, in collaboration with the Royal Botanic Garden, Kew, which preserves genetic material of the South African flora [14].

CONCLUSION

The Indian epic flora are a fundamental part of the Indian culture. In view of the tremendously growing world population, increasing anthropogenic activities, rapidly eroding natural ecosystem, etc the natural habitat for a great number of herbs and trees are dwindling. Many of them are facing extinction. To cope up with alarming situation, the recent exciting developments in biotechnology are proving to be beneficial. India has a long history of conservation policy aimed at preserving useful genetic variants for agriculture, animals as well as ecosystems that are crucial to the quality of human life. Today, population pressures are intensifying the conflict between the need to preserve biological resources and the need of an expanding population to use land and raw materials. A major challenge will be to develop approaches to conservation that meet our obligations to both present and future generations. Certainly, a concerted effort involving collaborations of field biologists familiar with the status of threatened and endangered species with reproductive scientists, geneticists, and others with expertise and resource banking should be undertaken to match conservation and technological opportunities. Identification of the taxa at risk and the systematic collection of samples as opportunities arise, consistent with the conservation management of threatened and endangered species, offer increased opportunities for preventing extinction and for the preservation of gene pools. The plants of the Indian epic period are a part of our cultural heritage and religious beliefs, these plants have maintained their existence to date since the epic period and if once lost, they cannot be regained in any realistic time interval. So it is our evolutionary responsibility to conserve these plants for the future generations.

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