Plantae Scientia – An International Research Journal in Botany Publishing Bimonthly Open Access Journal

Plantae Scientia : Volume 04, Issue 04 & 05,
September, 2021

ISSN 2581-589X

RESEARCH ARTICLE

Pali Tipitaka in the Perspective of Plant Invasion in India

D. A. Patil

Post-Graduate Department of Botany,
S.S.V.P. Sanstha's L.K.Dr.P.R. Ghogrey Science College, Dhule-424005 (M.S.), India.
(*Former Professor & Principal)

*Corresponding Author: dapatil_10aug@yahoo.com

Manuscript Details

Manuscript Submitted : 14/06/2021
Manuscript Revised : 18/07/2021
Manuscript Accepted : 25/08/2021
Manuscript Published : 16/09/2021

Available On

https://plantaescientia.com/ojs

Cite This Article As

Patil D. A., (2021). Pali Tipitaka in the perspective of plant invasion in India. *Pla. Sci.* 2021; Vol. 04 Iss. 04 & 05:243-249.

Indexed In

CrossRef, Scientific Indexing Services (SIS), Google Scholar, Index Copernicus International (ICI), Directory of Research Journal Indexing (DRJI), CiteFactor, Scientific Journal Impact Factor (SJIF), General Impact Factor, Journal Factor, Cosmos Impact Factor, PKP Index, AJIFACTOR Indexing, etc.

ABSTRACT

This communication is an effort to decipher phytogeographic alterations particularly due to exotic plants associated with the teachings and disclosures of Lord Buddha. The various exotic taxa on Indian landmass in Lord Buddha's time had an important role to play in human sustenance and civilization. The present author, therefore, analysed plant species as contained in 'Pali Tipitaka' in view of plant invasion in ancient period in Indian territory. It was possible to identify total 70 exotic plant species pertaining to 66 genera and 41 angiospermic families. Majority of them (47 species) are introduced for cultivation in India to sustain human life, while 19 species exhibit wildness and integral to Indian biodiversity in present time. Their native geographical regions are deciphered consulting relevant literature. They belong to both Old and New Worlds. Importance of ancient religious scriptures is brought under clearer focus from standpoint of phytogeography and plant invasion.

Keywords: Tipitaka, Exotic plants, Plant Invasion, India.

INTRODUCTION

The Lord Buddha was born in Majhima-Desha, the broad fertile plains surrounding the rivers Ganga and Yamuna in India. He spent his whole life in this environment. His teachings were committed to memory but compiled later on in 'Pali Tipitaka'. It is the sacred scripture belonging to Theravada school of Buddhism. Tpitaka, in Pali, means: ti-three, pitaka-basket. There are three divisions of Tipitaka *viz.* (i) Vinaya Pitaka (Rules of conduct of daily affairs within community, (ii) Sutta Pitaka (Discourses attributed to Lord Buddha and Buddhism) and (iii) Abhidhamma Pitaka (Underlying doctrinal principles presented in Sutta Pitaka recognised systematically). The core material is found in Sutta Pitaka which probably dates 5th to 3rd centuries BCE. The said Tipitaka contains information relating to economic, social, cultural and political life of Lord Buddha's time. It informs the then ancient natural environment particularly soils, habitats, topography, seasons, forests, etc. in northern India. Pali Tipitaka is replete with references to various plant species, crop plants, forests, useful botanicals, etc. Some information about biodiversity from it find place in some literary works by various authors (Robert, 1876; Rhys and Stede, 1921-1925; Monier-William, 1899; Horner, 1938-1966). Pali Tipitaka reflects floral elements of northern India of ancient period. It, therefore, appeared worth to study it especially froom the viewpoint of phytogeography and plant invasion in the erstwhile India. Present account focussed the exotic plant species gleaned from the said scripture and dilated the subject matter pertinently.

METHODOLOGY

The information concerning floral elements has been borrowed from different literary works (Robert, 1876; Rhys and Stede (1921-1925; Monier-William, 1859; Horner, 1938-1966; Dhammika, 2015). Their exotic status and geographic sources have been confirmed by consulting relevant taxonomic literature as noted against each plant species. Their status regarding native geographical region, plank habit, cultivation or wildness is also tabulated in Table-I. The information adduced in discussed from the viewpoint of plant invasion and nativity in the erstwhile Indian subcontinent.

RESULTS AND DISCUSSION

The Lord Buddha is said to have classified life forms as 'tasa' (moving) and 'thavara' (still). He also classified animals and plants. The latter were recognised by him as Osadhi (medicinal herbs), Vanaspati (forest-type trees), Vriksa (fruits and flowers-bearing trees), Gumba (shrubs), Tina (grasses), Patana (plants learning tendrils) and Valli (Vines). He was also aware about methods of plant propagation by Mula (Roots), Khandha (Stem), Phulla (Joints), Agga (Cuttings) or Bija (Seeds). He was fascinated by diversity of the natural world in his ambience. Tipitaka was compiled after his passing away.

Information as disclosed from 'Pali Tipitaka' is enumerated mentioning habital category, status regarding cultivated and wildness, source regions of the exotic plant species, besides their recent botanical name, family and Pali common names. On its close scrutiny, total 70 species of angiosperms are pointed out belonging to 66 genera and 41 families. Out of total 70 species, majority of them (55 species) are dicotyledons, whereas the monocotyledons share is relatively lesser (15 species). Their generic split up indicated 53 dicotyledonous and 13 monocotyledonous ones. As far as families concerned, there are 35 dicotyledonous and 06 monocotyledonous ones. Herbaceous exotic species have major share (35 species), whereas trees (18), climbers (10) and shrubs (07) are other habital categories. The figures in parenthesis denote number of species. It appears worth to note that majority of them (47 species) are cultivated ones, whereas some species (19) are wild and an integral part of Indian biodiversity. There are four exotic species which are found naturalised and under cultivation as well.

The plant species have been critically examined for their alien status on the earstwhile Indian territory. They belong to different continents, geographical regions, gulf regions, islands and countries pertaining to both Old and New Worlds. Hardly there is any compartment of the 'Blue Planet' which is not represented as native for the taxa presented in this communication. Various parts of America and Africa shared 16 exotic species each. The Asian continent (excluding India) has obviously fair representation (19 species) invading in India. Likewise, Europe also share considerably (14 species). There are some countries or geographical areas which contributed some exotic species. They are, in descending order, as such: China (08), East Indies and Persia (04 each) Mediterranean and Paletropical species (03 each) and Afghanistan (02). There are countries or regions which shared just a single species *viz.*, Cochin China, Japan, Persian Gulf, Fertile crescent, Transcaucasia, Bali, Baluchistan, Mongolia, Indonesian Archipelago, Malaysia, Pakistan, Arabia, Middle East, Mexico, Lebanon, Italy; tropical, subtropical and temperate regions, etc. Several exotic species have been introduced in the ancient period intentionally and they are even being cultivated in modern period in India. They helped the Indian community for their routine sustenance for food grains, medicine and other miscellaneous human requirements. Some taxa (19 species) invaded Indian landmass; naturaised and surviving as weeds in waste places or in agricultural lands. Their invasion is obviously

unintentional. Probably, they were brought with cultigens negligently. It is also possible that they would have dispersed naturally by biotic or abiotic mechanisms of dispersal.

Siddhartha Gautama Buddha is known to us popularly as the 'Buddha'. He is founder of the world religion of Buddhism. He lived in ancient India and travelled throughout the Ganges plain, taught for 45 years and built a large following. His teaching is compiled into a 'Pali Tipitak' after his 'Nirvana'. It is written by some close disciples and based on his disclosures. It is explained earlier how he attempted classification of plants. His indepth observations attempted classification of plants. His observations especially in Gangetic plain have obviously crystalized in this treatise. Apart from these exotic plant species, Lord Buddha has symbolic identity also with the indigenous Indian plants such as Asoka [*Saraca asoca* (Roxb.) de Wilde], Pipal (*Ficus religiosa* L.), Sala (*Shorea robusta* Gaertn.). Some forests are directly associated with Lord Buddha e.g. Jetavana, Mahavana, Nyagodhra Vana, Lumbini Vana, Venuvana, Amra Vana, etc. Many tree species are also depicted on historical monuments in India (Basanta Bidari, 1999).

ACKNOWLEDGEMENT

I am thankful to the authority of S.S.V.P. Sanstha, Dhule, for library facilities.

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Table-I: Exotic Plant SpeciesIn Tiptaka.					
Sr. No.	Plant Species & Family	Pali Name	Wild (W) /Cultivated (C)	Habit	Nativity & References
1.	*Achyranthes aspera* L. Amaranthaceae	Moragu	W	H	Tropics: Medakkar & Sharma, 2016a.
2.	*Allium cepa* L. Liliaceae	Palanduka	C	H	West Asia: Gaikwad & Garad, 2015. Persia: Bailey, 1928. Western Temperate Asia: De Candolle, 1959.
3.	*Allium sativum* L. Liliaceae	Lasuna	C	H	Europe: Yadav & Sardesai, 2002; Bailey, 1949; Patil, 2003.
4.	*Anethum graveolens* L. (Syn.*A.sowa* Roxb. *et* Flem) Apiaceae	Satapupha	C	H	Europe: Yadav & Sardesai, 2002; Patil, 2003.
5.	*Areca catechu* L. Arecaceae	Puga	C	T	Tropical Asia: Gaikwad & Garad, 2015. Indonesian Arrhipelago: Ahuja & Ahuja, 2011; Mukhopdhyay & Chakraverty, 2008.
6.	*Averrhoa bilimbi* L. Averrhoaceae	Vallibha	C	T	Tropical America: Singh *et al*., 2008; Yadav & Sardesai, 2002.
7.	*Barleria cristata* L. Acanthaceae	Kuravaka, Sereyyaka	C	S	Paleotropical: Singh & Srivastava, 2000.
8.	*Barleria prionitis* L. Acanthaceae	Korandaka	C	S	Tropical Africa: Medakkar & Sharma, 2016b.
9.	*Bauhinia variegata* L. Caesalpiniaceae	Kovidara	C	T	China; Debnath & Debnath, 2017; Pullaiah & Ramamurthy, 2001.
10.	*Benincasa hispida* (Thunb.) Cogn. Cucurbitaceae	Kakkaru	C	C	Java: Patil, 1995.
11.	*Borassus flabellifer* L. Arecaceae	Tala	C	T	Tropical Africa: Reddy, 2008; Chandra Sekar, 2012.
12.	*Brassica campestris* L. Brassicaceae	Siddhatthaka	C	H	Europe: Naqshi & Javeid, 1987.
13.	*Brassica juncea* (L.) Czern & Cors. Brassicaceae	Rajika	C	H	Eastern Europe & China: Spect & Diederichson, 2001. Middle East & Neighboring Region: Prakash, 1980.
14.	*Calatropis gigantea* (L.) R.Br. Asclapiadaceae	Akka	W	S	Tropical Africa: Reddy, 2008; Patil, 2017.
15.	*Calophyllum inophyllum* L. Clusiaceae	Punnanga	W	T	East Africa: Pullaiah & Rao, 2002. Tropical Asia: Mukhopadhyay & Chakravarty, 2008.
16.	*Cannabis sativa* L. Cannabaceae	Bhanga	W	H	Central Asia: Chandra Sekar, 2012. Asia (Excl. India): Kaul, 1986.
17.	*Cardiospermum halicacabum* L. Sapindaceae	Sibala	W	C	South America: Patil, 1990, 2003.
18.	*Carissa carandas* L. Apocynaceae	Karamadda	W	S	South Africa: Sainkhediya, 2016.
19.	*Carthamus tinctorius* L. Asteraceae	Kusumbha	C	H	South-West Asia: Cooke, 1958; Singh *et al*., 2001.
20.	*Celba pantandra* (L.) Gaertn. (Syn. *B. malabaricum* DC.) Bombacaceae	Simbali	C	T	Tropical America: Pullaiah & Rao, 2002; Singh *et al*., 2000.
21.	*Celosia argentia* L. Amaranthaceae	Isimugga	W	H	Tropical Africa: Reddy, 2008; Chandra Sekar, 2012.
22.	*Cinnamomum camphora* (L.) Nees & Eberm. Lauraceae	Kappura	W	T	China & Japan: Benthal, 1946; Voight, 1845.

23.	*Citrullus calocynthis* (L.) Schrad. Cucurbitaceae	Inidravarani-karukkha	W	C	West Africa: Sainkhediya, 2016.
24.	*Citrus aurantium* Linn. Rutaceae	Matulunga	C	T	South China: Pullaiah & Rao, 2002.
25.	*Clitorea ternatea* L. Papilionaceae	Girikannika	W,C	C	Tropical America: Purseglove, 1968.
26.	*Coccinia grandis* (L.) Voight (Syn.*Cephalandra indica* Wight & Arn.) Naud Cucurbitaceae	Bimba	W,C	C	Africa, Titiek *et al*., 2015. Medakkar & Sharma, 2016a.
27.	*Corchorus olitorius* L. Tiliaceae	Kottha	W	H	Tropical Africa: Patil, 2017; Chandra Sekar, 2012.
28.	*Cyperus rotundus* L. Cyperaceae	Bhaddamuttaka	W	H	Tropical Africa: Debnath & Debnath, 2017. Europe: Panda *et al*., 2018; Kaul, 1986.
29.	*Datura stramonium* L. Solanaceae	Dhanutakkari	W	S	Tropical America: Chandra Sekar, 2012. Paleotropical: Singh & Srivastava, 2000.
30.	*Echinochloa frumantacea* Link. Poaceae	Sayana, Samak	C	H	Tropical, Subtropical & Temperate Areas of Old World: Patil, 2019.
31.	*Ferula assafoetida* L. Apiaceae	Hingu	W	H	Central Asia, Europe & North America: Patil & Dhale, 2013.
32.	*Flacourtia jangomas* (Lour.) Raeusch. (Syn.*F.catraphracta* Roxb.) Flacourtiaceae	Talisa, Tilak	C	T	Tropical Asia: Martin *et al*., 1987.
33.	*Glycirrhiza glabra* Linn. Papilionaceae	Madhulatthika	W	H	Pakistan & Afghanistan: Negi & Hajra, 2007.
34.	*Hordeum vulgare* L. Poaceae	Yava	C	H	Europe & North America: Dar *et al*., 2002.
35.	*Ixora coccinea* L. Rubiaceae	Bandhuka	W,C	S	China: Debnath & Dabnath, 2017. East Indies: Graf, 1980.
36.	*Lagenaria siceraria* (Mol.) Standl. (Syn. *L.vulgaris*) Cucurbitaceae	Labu	C	C	Tropical Central America: Reddy, 2008; Patil, 2017. Tropical America, Sri Lanka, Malaysia & Mexico: Pulliah *et al*., 2007.
37.	*Linum usitatissimum* L. Linaceae	Khoma	C	H	Mediterranean Region: De Candolle, 1959. Europe: Dar *et al*., 2002.
38.	*Luffa acutangula* (L.) Roxb. Cucurbitaceae	Kosataki	C	C	Tropical Asia: John, 1891.
39.	*Macrotyloma uniflorum* (L.) Verdc. Papilionaceae	Kalaya, Kulatha	C	H	South-East-Asia: Patil, 2019.
40.	*Manilkara hexandra* (Roxb.) (Syn. *Mimusops hexandra* Roxb.) Sapotaceae	Khirapanni	C	T	South America: Sainkhediya, 2016.
41.	*Moringa oleifera* Lam. Moringaceae	Sobhanjanaka	C	T	America: Singh & Srivastava, 2000.
42.	*Murraya koenigii* (L.) Spreng. Rutaceae	Kara	C	T	Tropical Asia: Martin *et al*., 1987.
43.	*Nerium indicum* Mill. Apocynaceae	Kanvira, Karavira	C	S	Mediterranean Region: Singh *et al*., 1991. China, Cochin China: Voight, 1845.
44.	*Nigella sativa* L. Ranunculaceae	Jiraka	W,C	H	Eastern Mediterranean Region (Levant): Deb, 1983. Europe: Khuroo *et al*., 2007.
45.	*Ocimum americanum* L. (Syn.*O.canum* Sims.) Lamiaceae	Ajjaka	W	H	Tropical America: Reddy, 2008; Panda *et al*., 2018. Tropical Africa: Debnath & Debnath, 2017.

46.	*Panicum milliaceum* L. Poaceae	Cinaka	C	H	Asia (Excl. India): Kaul, 1986. Transcaucasia & China: Singh & Nigam, 2017.
47.	*Paspalum scrobiculatum* L. Poaceae	Kudrusa	C	H	Tropical Africa, Singh & Nigam, 2017.
48.	*Phoenix dactylifera* L. Arecaeae	Khajjur	C	T	Persian Gulf: Patil, 2019.
49.	*Piper bettle* L. Piperaceae	Tambula	C	C	Bali & East Indies: Graf, 1980.
50.	*Pistia stractiotes* L. Araceae	Hata	W,C	H	Tropical America: Graf, 1980.
51.	*Pisum arvense* L. Papilionaceae	Harenuka	C	H	Italy: Shetty & Singh, 1987.
52.	*Punica granatum* L. Punicaceae	Dalika	C	T	South Asia: Gaikwad & Garad, 2015. Afghanistan, Baluchistan & Persia: Patil, 2003; Shetty & Singh, 1987.
53.	*Raphanus sativus* l. Brassicaceae	Mulakakanda	C	H	Western Asia: Purseglove, 1968. Europe & Temperate Asia: Patil, 1995. Europe: John, 1891.
54.	*Ricinus communis* L. Euphorbiaceae	Eranda	C	T	Tropical Africa: Yadav & Sardesai, 2002. Africa: Singh, *et al*., 1991.
55.	*Rubia cordifolia* L. Rubiaceae	Manjetthi	W	C	Asia (Excl. India) & Africa: Kaul, 1986.
56.	*Saccharum sara* Roxb. Poaceae	Sara	W	H	Lebnan: Moldenke & Moldenke, 2002.
57.	*Saccharum spontaneum* L. Poaceae	Kasa	W	H	Tropical West Asia: Reddy, 2008; Patil, 2017.
58.	*Sesbania sesban* (L.) Merr. (Syn.*S.aegyptica* Baker) Papilionaceae	Takkari	C	T	South America: Rajagopal & Panigrahi, 1965. Tropical Africa: Martin *et al*., 1987.
59.	*Solanum melongena* L. Solanaceae	Vatingana	C	S	East Indies: Singh *et al*., 2001. America: Gaikwd & Garad, 2015.
60.	*Solanum virginianum* L. Solanaceae	Kantakuranda	W	H	Paleotropical : Singh & Srivastava, 2000.
61.	*Spondias mangifera* (L.*f*.) Kurz. Anacardiaceae	Ambataka	C	T	Tropical Asia: Martin *et al*., 1987.
62.	*Tamarindus indica* L. Caesalpiniaceae	Cinca	C	T	Tropical America: Shetty & Singh, 1987; Patil, 1990.
63.	*Trachyspermum ammi* (L.) Sprague (Syn.*Carum capticum* Bth.)	Muddayanti	C	H	South Europe: Yadav & Sardesai, 2002. Africa: Shetty & Singh, 1987; Patil, 1995.
64.	*Trapa natans* L. Trapaceae	Singhataka	C	C	Europe: Kak, 1990. Persia To Central Europe: Pullaiah *et al*., 2007.
65.	*Triticum aestivum* L. Poaceae	Godhuma	C	H	Fertile Crescent: Singh & Nigam, 2017.
66.	*Typha angustifolia* L. (Syn.*T. angustata* Bory & Chaub.) Typhaceae	Bilali	W	H	Tropical America: Reddy, 2008; Chandra Sekar, 2012. Europe & North America: Kak, 1990.
67.	*Vitex negundo* Linn. Verbenaceae	Niggundi	W	S	North China & Mongolia: Bailey, 1949.
68.	*Vitis vinifera* L. Vitaceae	Muddika	C	C	South-East Europe To West Indies; Singh *et al*., 2000. West Asia: Gaikwad & Garad, 2015.
69.	*Ziziphus jujuba* Mill. Rhamnaceae	Badara	C	T	Subtropics & Warm Temperate Zone: Martin *et al*., 1987.