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

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. Tipitaka, 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 from 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), Vriksha (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 habitual 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 dicotyledons 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 erstwhile 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 Palearctic 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, Malaysia, Indonesia, 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; naturalised and surviving as weeds in waste places or in agricultural lands. Their invasion is obviously

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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 the 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 Tipitaka’ 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], Papal (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).

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| Sr. No. | Plant Species & Family | Pali Name | Wild (W) / Cultivated (C) | Habit | Nativity & References |
|--------|------------------------|-----------|---------------------------|-------|-----------------------|
| 1.     | Achyranthes aspera L.  | 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 Archipelago: Ahuja & Ahuja, 2011; Mukhopadhyay & 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. Caesalpinaceae | 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     | Eastern Europe & China: Spect & Diederichson, 2001. Middle East & Neighboring Region: Prakash, 1980. |
| 13.    | Brassica juncea (L.) Czern & Cors. Brassicaceae | Rajika    | C                         | H     | East Africa: Pullaiah & Rao, 2002. Tropical Asia: Mukhopadhyay & Chakraverty, 2008. |
| 14.    | Calatropis gigantea (L.) R.Br. Asclepiadaceae | 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 & Chakraverty, 2008. |
| 16.    | Cannabis sativa L. Cannabaceae | Bhangna   | 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 argenta 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. |
| No. | Plant Name | Family | Location/Notes |
|-----|------------|--------|----------------|
| 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. | *Clitoria ternatea* L. Papilionaceae | Giri kannika | W,C | C | Tropical America: Purseglove, 1968. |
| 26. | *Coccinia grandis* (L.) Voight (Syn. *Cephalandra indica* Wight & Arn.) Naud Cucurbitaceae | Bimba | W,C | C | Africa, Tittiek 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. Palaeotropical: Singh & Srivastava, 2000. |
| 30. | *Echinochloa frumentacea* 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. | *Glycyrrhiza 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., 1989. |
| 38. | *Luffa acutangula* (L.) Roxb. Cucurbitaceae | Kosataki | C | C | Tropical Asia: John, 1891. |
| 39. | *Macrotyloma uniflorum* (L.) Verde. Papilionaceae | Kalaya, Kulatha | C | H | South-East-Asia: Patil, 2019. |
| 40. | *Manilkara hexandra* (Roxb.) (Syn. *Mimusops hexandra* Roxb.) Sapotaceae | Khirapani | 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. |
| No. | Species Name                          | Tribe/Country                  | Distribution                      |
|-----|--------------------------------------|-------------------------------|-----------------------------------|
| 46  | *Panicum miliaceum* L.              | Cinaka                        | C       | H    | Asia (Excl. India): Kaul, 1986. Transcaucasia & China: Singh & Nigam, 2017. |
| 47  | *Paspalum scrobicalatum* L.          | Kudrusa                       | C       | H    | Tropical Africa, Singh & Nigam, 2017. |
| 48  | *Phoenix dactylifera* L. Areacea    | Khajjur                       | C       | T    | Persian Gulf: Patil, 2019. |
| 49  | *Piper betle* L. Areacea            | Tambula                       | C       | C    | Bali & East Indies: Graf, 1980. |
| 50  | *Pistia stractiotes* L. Aracea      | 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    | Lebanon: Moldenke & Moldenke, 2002. |
| 57  | *Saccharum spontaneum* L. Poaceae   | Kasa                          | W       | H    | Tropical West Asia: Reddy, 2008; Patil, 2017. |
| 58  | *Sesbania scabia* (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: Gaikwad & Garad, 2015. |
| 60  | *Solanum virginianum* L. Solanaceae | Kantakuranda                  | W       | H    | Palotropical: Singh & Srivastava, 2000. |
| 61  | *Spondias mangifera* (L.f.) Kurz. Anacardiaceae | Ambatakaka                  | C       | T    | Tropical Asia: Martin, et al., 1987. |
| 62  | *Tamarindus indica* L. Caesalpiniaeae | Cinca                       | C       | T    | Tropical America: Shetty & Singh, 1987; Patil, 1990. |
| 63  | *Trachyspermum amni* (L.) Sprague (Syn.Carum capticum Bth.) | Muldayanti                  | C       | H    | South America: Yadav & Sardesai, 2002. Africa: Shetty & Singh, 1987; Patil, 1995. |
| 64  | *Trapa natans* L. Trapaceae         | Singhataka                    | C       | C    | Europe: Kak, 1990. Persia To Central Europe: Pulliahw et al., 2007. |
| 65  | *Triticum aestivum* L. Poaceae      | Godhuma                       | C       | H    | Fertile Crescent: Singh & Nigam, 2017. |
| 66  | *Typha angustifolia* L. (Syn.T. angustata Bory & Chauh.) 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. |