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REVIEW ARTICLE

Scientific History of Some Alien Plants in India: Origin, Implications and Culture

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ABSTRACT

Indian subcontinent has a rich heritage of biodiversity because of its variable geo-climatic conditions. Several exotic plant species survived since ancient period and became an integral part of Indian flora. They now seem to be iconic plants and are being generated. They are valued by the Indians for their esteem, culture and welfare. Selected 20 exotic notable species are studied from the standpoint of their origin, distribution, culture and ancient Sanskrit literature. Diverse information about them is adduced from architecture, art, archaeological sites, etymology (philology), anthropology, ancient Sanskrit and religious scriptures. Some of them were once thought introduced by western rulers in the then India few centuries ago. This belief can be easily negated based on the present investigation. They appeared to have been brought in India during pre-Columbian period. They also appear to be indicators of Indian contacts with various parts of the Old World and interestingly even New World.

Keywords: Exotic plants, Origin, Culture, India

INTRODUCTION

Carefulness while collating researches

History deals with the life and not the dead. Archaeology demands very gradual removal of soil around the objects and is a time-consuming endeavour. Genesis of languages is also a slow process. During revisionary studies and assessing revelations from these fields, one has to be very careful. The reviewer has to go back in such exercises in the then environment and societal status understanding their every *pros* and *cons*. Indians, in past, accepted useful alien plant species and appropriated them for their own welfare.

Current as well as ancient Indian philosophy developed by expert Jivak in Buddhist period state that 'all plants have medicinal virtues' (Charak Samhita, 1949). Vedic texts also inform that no root (plant) is useless. All that is good is culturally welcomed and absorbed by Indian civilization. This has been also Vedic doctrine since ancient times. Moreover, Indian subcontinent has been the host to some of the oldest ancient civilizations. All these philosophies and histories indicate a fact that useful (intentional) as well as unusual (unintentional) alien plant species invaded India in past.

PRESENT STUDY

Their history, probable period of introduction and familiarization by Indians can be investigated from diverse sources such as archaeology, archaeobotany, anthropology, ancient literary scriptures and such other sources of empirical information. This paper is an attempt in investigate some popular alien plants and limelight their existence in Indian Territory and culture based on their all-pervasive examination. Relevant literature based on aforesaid sources has been consulted critically and assessed in the Indian perspective.

ENUMERATION

Allium cepa L. (Liliaceae)

It is a native of Western Asia (Backer and Brink, 1968), Persia and adjacent regions (Bailey, 1949). It is mentioned in ancient Sanskrit scripts *viz*., Charak Samhita, Bhava prkasham, Dhanvantari-Nighantu, Harit Samhita, Kaiyadeva Nighantu, Nighantu-sangraham, Rajavallabham and Sushrut Samhita. It is called (in Sanskrit) as 'Palanduh', 'Durgandha', 'Mukhdushak', 'Sukada' and 'Yavaneshta'. Archaeological remains in Middle Gangetic Plains revealed its cultivation during 800-1600 BC. (Saraswat, 2005). Emperor Ashok (ca. 268-232 BC.) was cured using juice on onion bulbs. It is so reported in Divyavadan (200 AD) (Vaidya, 1959). In Indian languages, it is called 'Pyaz' (Hindi), 'Kanda' (Marathi). All these historical facts are indicative of its ancient cultivation.

Allium sativum L. (Liliaceae)

De Candolle (1882) considered Western Temperate Asia as its nativity, while Bailey (1949) mentioned it a native of Europe. Recent technique isozyme and RAPD markers used by Maab and Klaas (1995) pointed out West to the Middle Asia to be the primary centre of origin and the Mediterranean region as the secondary centre of origin. It is thought that introduction of garlic into India during Mohenjo-Daro period (nearly 3000 BC.) out of trade relationships between India, Egypt and Mesopotamia. Carbonized cloves of garlic at Harappan site Balu, district Kaithal (Haryana) have been also recorded (Saraswat and Pokharia, 2002). This confirms evidence of its cultivation in ancient period. It is mentioned in ancient Sanskrit scripts *viz*., Ashtanga hridayam, Bhava Prakasam, Charak Samhita, Dhanvantari Nighantu, Kaiyadeva Nighantu, Raja nighantu, Rajavallabham, etc. In Sanskrit, it is called 'Ransonah', 'Ugragandha', 'Yavanishta', 'Malechakanda', 'Lasunaha', 'Granjanaba', 'Mahakandaba', etc. In Indian subcontinent it is/was widely used as spice and medicine since ancient times.

Anacardium occidentale Linn. (Anacardiaceae)

It is a native of tropical America (Patil, 1995) especially Brazil and Venezuela. It is reported introduced in India in 16th Century AD by the Portuguese (Sauer, 1993). Rheede (1682) mentioned its medicinal (ethnomedicinal) properties, information obtained from Malabar region of India, in his Vol.3 of 'Horti Indici Malabarici' (Amsterdam) with a common or vernacular local name in Malayalam 'Kapa-mava'. Local uses and local name indicate that the species was introduced much earlier in Malabar region of India. and was deeply integrated with native culture. Interestingly, its Malayam name 'kapa-mava' is also incorporated by Linnaeus (1753) in his Species Plantarum. Cunningham (1879) suggested its ancient cultivation in India. He noted sculptured depiction of fruit of this species at the Bharhut Stupa dated ca.200 BC. Gupta (1996) also observed depiction of entire plant of cashew-nut with flowers and fruits at the Jambukeshwara temple in Tiruchirapalli, Tamil Nadu (India), which was constructed 2500 years back. Sorenson (2005) pointed out cashew-nut as one of the plant species as decisive evidence of transoceanic carriage from America to India. He provides sketch of cashew-nuts on the balustrade of the Bharhut Stupa in Madhya Pradesh (India) ca. 2nd Century BC. Sanskrit names for it are cited as 'Kajutaka' (Pullaiah, 2002), 'Shoephahara' (Nadkarni, 1914) and 'Bijara Sala or Sula' (Balfour, 1871-1873). Other ancient Sanskrit treatises *viz*., Rajavallabham and Sushruta Samhita Uttarasthanam include names such as 'Vrkkabijah',

'Vrkkphalah' and 'Venamrah'. All these lend supports for its ancient cultivation in India. The Sanskrit appropriately describe curved shape of fruits or seeds.

***Ananas comosus* (L.) Merr. (Bromeliaceae)**

Commonly called 'Ananas' in most states of India and in Sanskrit, called 'Ananasam' (Pullaiah, 2002). In South American Tupi Indian language, it is called 'Nanas' (meaning pineapple) (Patil, 2007). Thus common names in India are derived originally from American continent. Origin of the species is thus revealed.

***Annona squamosa* (Annonaceae)**

Cunningham (1879) opined that the Hindi name 'Ata' or 'At' is derived from Sanskrit word 'Atripya'. Phonetic variants are found in various Indian states (languages) e.g. Ata (Bengal, Malarar), Ath (Konkan), Ato (Orissa) and Atta (Tamil Nadu). Interestingly similar variants are also noticed in other countries e.g. Attier, Hattier (France). At, Atte (Philippines), Ata (Brazil) and Ahate (Mexico) (Annonymous, 1985). Geographical distribution of the species and etymological affinities suggest diffusion in Asian and American countries. The botanical name *Annona* is also thought originated from Haitian name 'Anon' for it (Patil, 2007). However, Manilal (1980) thought it derived from Malaylam name 'Anona Maram' in India. Few others derive it from 'Menona', Indian vernacular name (Patil, 2007). In India, it is also mentioned in the great epic, the Ramayana (ca. 2000-1000 BC.) (Singh and Nigam, 2017). It is called commonly 'Sitaphal' in India and 'Sitaphalam' (Torkelson, 1999), besides other three names in Sanskrit. All these names also indicate antiquity of species in each country. All three obviously contradict its introduction in India by the Portuguese in the 16th Century as thought by De Candolle (1882). Representation of custard apple on a bas-relief in the Stupa of the Bharhut and Sanchi in India help trace it in 1-3 century BC. (Pokharia and Saraswat, 1998-1999; Brown, 1949; Gupta, 1996; Watt, 1889-1893; Cunnigham, 1879).

Johannesen and Siming (1998) reported first *A.squamosa* depicted in the hands of goddess Durga at Aihole (Karnataka) in India from the 10th Century CE. Its occurrence prior to Europian invasion in India is corroborated by sculptures of the fruit in the hands of deities e.g. Vishnu from Bengal (9th-10th Century CE), Kartikeya in Madhukesvara temple (Mukhalingam) Andhra Pradesh (8th Century CE) Shiva in a Katatiya (12th Century CE) and Kubera at the Hoyasaleshvara temple from Karnataka (12th Century CE) (Nandita Krishna and Amirthalingam, 2014). The Indian evidences are sometimes misunderstood for its Indian origin.

***Arachis hypogaea* L. (Fabaceae)**

In South American languages, it is called 'Mandobi', 'Manobi', 'Mandowi', 'Munduki' and 'Munui' (in Tupi), 'Mandovi' (in Pilaga), 'Manduvi' (in Chiriguano) and 'Manuki' (Kirtikar and Basu, 1987). These are similar to those of Indian languages e.g. 'Mandavi' (In Gujarathi), 'Munghali' (Hindi) and 'Andapi' (in Sanskrit). The species was first domesticated in interior of South America. Comparative similar vernacular names are shown by Michael Black (*cf.* Sorenson, 2005) for it which are prevalent in India. This indicates that the species was introduced in India in ancient time soon after South Americans did so.

***Cannabis sativa* L. (Cannabinaceae)**

It is native of Capsian sea region and Caucasus Mountains (Watt, 1908). In India, especially in Rigveda (1400-900 BC.), it is mentioned as 'Bhang' and other ancient Sanskrit texts *viz*., Kalpsutra, Brahmanas and Paninin's Astadhyayi and Vartik (6th- 5th Century). It is also called 'Vijaya' or Siddapatri (Nadkarni, 1914) and by few other names. It is deeply rooted in Indian mythology. After churning of the sea (Samudramanthan), demons attempted to gain control of 'Amrita', but the gods seized giving *Cannabis* the name Vijaya (Victory) to commemorate their success. It is hold sacred to Lord Shiva. Since ancient times, it is used for rituals and Tantrik practices. All Indian names are distinctive and based on its narcotic virtues. Its medicinal virtue to cure leprosy is mentioned in Susruta Samhita (200 BC.). The Bhava prakasha (1600 AD.) fairly documented its medicinal utility. Archaeological remains of Kunal (Haryana) contained flattened seeds as far back as, 100 AD. (Saraswat and Pokharia, 2003). It was domesticated in India 200 years before the nominal invention of papermaking by Cai Lun in China about 2000 years ago. It was used for narcotics, fibre and oil (Sudhir Chandra, 2017). It is one of the plant species which found place in food economy in the Pre-Harappan period. It was found in archaeological site in the Pre-Narhan Phase (Pre 1800-1400 BC.) (Vishnu-Mittre and Savithri, 1993). Interestingly, Singh and Sardesai (2016) recorded its use as sustainable construction material as an organic additive in the clay plaster of the 6th Century AD Buddhist caves of Ellora (M.S., India). Authors revealed valuable property of hemp known to the ancient Indians. Its ancient cultivation is thus corroborated also by empirical evidence.

***Capsicum annuum* Linn. (Solanaceae)**

It is a native Chile (Bailey, 1928) and South America (Voight, 1845). Roxburgh (1814) mentioned its first introduction in the Indian Botanical Garden, Calcutta (India) before 1798. Rheede (1682) mentioned Malayam name for it as 'Capo-molago' in his Hortus Malabaricus. He also gave local medicinal utility of fruits against tooth-ache and opening

bails. The local name and utility indicates its more familiarity of the people of Malayalam although its introduction in India in thought by the Portuguese in 16th century AD. Its Sanskrit name 'Katuvirah' and 'Raktamaricuh' are mentioned in Sanskrit scripts *viz*., Ayurvedavijnam, Gunapatham, Sivadatta nighantu and Sushruta Samhita Uttarsthanam. Torkelson (1999) cited its Sanskrit name as 'Marich-phalam'. Chillies find place in Vamana Purana and Siva Purana dated ca 6th-8th century AD. and mention its application in pulmonary tuberculosis. This again lends support its cultivation in ancient period in India. Interestingly, developing and mature fruits along with leaves and flowers are depicted in honour of Hindu God Lord Shiva, at Jambukeshvara Shiva temple, Tiruchirapalli in Tamil Nadu (Gupta, 1996) dating 6th-8th century AD.

Cicer arientinum L. (Fabaceae)

It is a native of southern Turkey (Lardizinsky, 1975). It is variously named in India as: Chan, Chana (Hindi), Kariikadale (Kannada), Harbhara (Marathi), Channia (Gujarati), Chanaka, Harimantha, Khalva, Vajimantha, Saleapriya (Sanskrit), Kadalaii (Tamil), Harimandakma (Telugu). It was spread westwards by the Western Aryans (the Pelasgians and Hellenes) to the Mediterranean and eastwards to India (De Candolle, 1882). According to Allchin (1969), it was introduced in India (relatively) recently. It was found in Nevasa (Maharashtra) in a layer dating from 300-100 BC. (Sankalia *et al*., 1960; Allchin, *loc.cit*.). In the Puranas and literature of the Aryans, it is mentioned in the 4th Century AD. Apart from the northern side, it could also have been introduced via south Indian harbours. The Dravidian use the names 'But', 'Buta', 'Kadalia' for chichpea. These names are quite different form the Sanskrit names 'Chennuka', 'Chanak', etc. Sanskrit names eventually became 'Chana', in Hindi and other Indian languages. Its 'Kabuli' from a variety logically points to Kabul (Afghanistan) on the ancient 'Silk Road' from Europe via Samarkand to India. Indians thought this variety hailed from Kabul and hence the name. It is called Horse gram. Watt (1908) opined that the name 'gram' originated from the Portuguese 'grao' (i.e. grain). The name 'Bengal Gram', however, should not be conceived as Bengali origin. It is a special appropriation in India. According to De Candolle (1882), the fact that it has Sanskrit names would indicate that the crop has been under cultivation in India longer than in any other country. Sanskrit name 'Khalva' is mentioned in 'Brahadaranyak', a commentary on Rigveda and in Yajurved (Sharma, 1989). Kautilya also cited this name in his 'Athashastra' (Sharmashastry, 1961). Charak Samhita (700 BC.) states that chicken soup provided health to the populace. Sushruta Samhita (400 BC.) states that cooked chickpea and their leaves were nutritious items (Krishna Murthy, 1991). There is a striking similarity of chickpea in Karnataka (called Kadale) and Kerala (called Kalala). Sanskrit name 'Harimantha' (Hari-horse, mantha-agitating, chewing) indicates feeding of chickpea grains to horses from ancient times. Marathi name 'Harabara' (Har, Hari-horse; bhara, bharane-to feed) closely resembles Sanskrit name 'Harimantha'. The Greek word 'evebinthos' is mentioned in the Illiad of Homer (ca 1000-800 BC.) for Chickpea. Sanskrit word 'Harimantha' was possibly corrupted the Greek word 'erebinthos' especially during the Greek-Indian interaction [We know, Alexander III of Macedon (336-326 BC.) attempted to invade northern India in 326 BC.]

Gossypium species (Malvaceae)

The species of the genus *Gossypium* are distributed in both the Old and New Worlds. They are also broadly Asiatic or American species. Synonyms of various species and forms and their history is rather complicated. Their common names appear rather informative. Varieties other than proper of *G. herbaceum* Linn. are found in India e.g. (i) *G. herbaceum* Linn. var. *wightianum* Woodrow is locally called 'Hinganghat' cotton. It is the principal source of Indian cotton. (ii) *G. herbaceum* Linn. var. *religiosum* Mast. is named as 'Khaki' or 'Nankin' cotton. Roxburgh (1832) opined that this variety come to India from China. (iii) *G. herbaceum* Linn. var. *hirsutum* Mast. is called 'Upland Georgian' and suggests its exotic nature. *G. herbaceum* Linn. is also called 'Asiatic' or 'Levent Cotton (Bailey, 1999; Purse glove, 1968). Bailey (*loc.cit.*) cite its nativity as Asia Minor and Arabia, whereas Purseglove (*loc.cit*.) considered it native of Asia and Africa. Another species *G. barbadense* Linn. is introduced one (Dalzell and Gibson, 1861). Its variety *viz*., *G. barbadense* Linn. var. *brasiliense* is called 'Brazilian' cotton and thought introduced from Brazil or Peru by the Portuguese (Dalzell and Gibson, *loc.cit*.). *Gossypium arboretum* Linn. is referred under local the name Devakapas (Deva-god; kapas-cotton) as it is usually grown near temple and also used as sacred thread during 'Munj' ceremony in Hindus. *G. arboreum* Linn. var. *neglectum* is cultivated in Bengal and hence called (commercially) 'Bengals' (Watt, 1889-1893). Rheede (1678) included *G. arboreum* L. under Malabar local name 'Cudu-pariti' in his 'Hortus Malabaricus'. Sorenson (2005) considered it to be Asian in origin. Herodotus (440 BC.) mentioned in his 'Histories, Book 3, Chapter 106' that in India tree grew in the wild producing wool. This can be assumed to be an arborescent species of *Gossypium*, probably *G. aroboreum*. *Gossypium herbaceum* Linn. in ancient Sanskrit scriptures is mentioned as 'Karpash' *viz*., Abhidhan Manjari, Bhava Prakasam, Charak Samhita, Chikitsa Stanum, Kaideva Nighantu, Nighantu Sangraham and Rajavallabham. Likewise, *G. arboretum* Linn. is called 'Karpus' in the ancient Sanskrit texts *viz*., Kalpasutras, Panini's Astadhyayi and Vartik, and Patanjali's Mahabhasya. *Gossypium barbadense* L., although American in origin, is named as in Sanskrit as

'Maghani' (Torkelson, 1999) and thought cultivated at least before 1000 AD. Pokharia and Saraswat (1998-1999) reported seeds of *G.arboreum* L. / *G.herbaceum* L. from the ancient archaeological site Sanghal, Punjab (India) dated 100-300 AD. Kirit (2012) recorded a coarse cotton sash slung across chest of Lord Buddha sculpted in Rani-Ki-Vav, Patan, Gujarat (India) dated most likely in the 11th Century AD. Region of Harappan extends in the state of Gujarat. For example, Lothal (Gujarat) was a Harappan port town from where trade between then India and overseas depended. This Harappan town dates back ca. 2500-1900 BC. (Rao, 2008).

***Helianthus annuus* L. (Asteraceae)**

It is a native of Central America and Peru (Coats, 1956). In Sanskrit, it is called Suryamukhi and Adityabhakta (Torkelson, 1999; Nadkarni, 1914) and so mentioned in ancient Sanskrit scripts *viz.*, Bhava prakasham, Dhanvantari Nighantu, Kaiyadeva Nighantu, Raja nighantu, etc. It is mentioned in Charaka Samhita, prior to 4th Century AD. which decisively suggests its ancient introduction or cultivation in India (Aiyer and Narayan, 1956). Gupta (1996) highlighted its depiction in Ram Gumpha cave at Udaigiri (Orissa, India) dated 2nd Century BC. It is also depicted in temples of Hoysala Empire in Karnataka in the 12th-13th Century (Sorenson, 2005). It is also sculpted between ear and horn of Nandi, a mythological bull always associated with Lord Shiva (a Hindu God), at a temple of Halebid (Karnataka) (Johannesen, 1998) indicating its antiquity. It is commonly called 'Sunflower' worldwide. Interestingly, it is a emblem of the Sun God in Peru and carved as such in the walls of Inca temple (Patil, 2007). It is rightly incorporated while coining scientific or botanical name *Helianthus* (Gk. Helios-the sun; anthos-a flower) simulating the Sun (Patil, *loc.cit.*). The Incas believed that the sunflower was the physical manifestation of the Sun God on Earth.

***Lagenaria siceraria* (Mol.) Standly (Cucurbitaceae)**

It is a native of Africa (Decker-Walters *et al.* 2004). It is called by many different names in India but 'Tumba' and its variations are commonly noted in some languages (e.g. Marathi, Gujarati, Bengali) apart from the ancient Sanskrit and national language Hindi. Tumba is the name of an African-derived rhythm (as are 'seu' and 'tambu'). Dried fruit is used to make musical instrument and played while dancing. Tumba (a resonator) in India used in music and called 'pungi', 'sitar', 'veena', 'vichita-veena', etc. *Lagenaria sicearia* is mentioned as 'Alabu' in Yajurveda (1200-1000 BC.) Atharveda (900 BC.) and other ancient scripts e.g. Kalpasutras, Panini's Astadhyayi and Vartik and Patanjali's Mahabhasya and as 'Pindaphala' in Panini's Astadhyayi and Vartik (Singh, 2008). These sources are certainly indicative of empirical evidence of its cultivation in ancient India especially during Vedic Period. Rheede (1688) mentioned it as 'Bela-schora' in his 'Hortus Malabaricus' (Vol.III) published in 1688 and gave local medicinal uses from Malabar region of Indi. This is inactive of a fact that it was introduced much earlier and integrated as local medicine in this region.

***Lawsonia inermis* Linn. (Lythraceae)**

It is a native of Northern Africa (Rama Krishna et al., 2017). Its application as dye (Mehandi) inVedas, Charak (700 BC.) and Susruta (200 BC.) Samhitas, apart from later Sanskrit scripts such as Dravyaguvijnan, Nighantu Sangraham and Rajavallabham, besides Panini's Astadhyayi and Vartik. In these Sanskrit scripts, it is called 'Medhini', 'Nakharanjani', 'Madayantika', 'Mendika', 'Ragangi', 'Raktagarbha', etc. All these scriptures and Sanskrit names are indicative of its use as dye for hair and human body parts since long time. This is also evidenced from the paintings of world-fame Ajanta Caves in Maharashtra (India). *Lawsonia inermis* (called Mehandi or Henna in India) is a biocolorant, chemically it is quinonoid used for dying or to draw certain artistic patterns on body parts. The earliest artefacts are available in the Ajanta Caves (District Aurangabad, Maharashtra) from about 400 CE. Dyed hands and feet in the Ajanta paintings are observed on men, women, deities and demons (*cf.* www.newsfinder.org/site/more/the_art_of_mehandi).
Rheede (1678) in his 'Hortus Malabaricus' Vol.I named it as 'Mail-anschi' published in 1678 and gave local medicinal uses from Malabar region of India.Pokharia and Saraswat (1998-1999) reported a large number of carbonized seeds somewhat triangular to pyramidal in shape with papillated surface resembling the seeds of *Lawsonia inermis*.

***Linum usitatissimum* L. (Linaceae)**

It is a native of Mediterranean region (De Candolle, 1882) and was first domesticated in the 'Fertile Crescent' region. It is mentioned in Bible as a fibre useful for making cloth and was also known to Egyptians in pre-Biblical period. In India, its cultivation is known before 5000 years. It is mentioned in Rigveda 1400-900 BCE, Charka Samhita (700 BC.) and other ancient Sanskrit Scripts *viz.*, Ashtanga hridayam, Bhava Prakasam, Dhanvantari Nighantu, Kaiyadeva Nighantu, Rajanighantu, Nighantusangraham, Susruta Samhita, Cikitsanam, Upanishadas, Kalpsutras, Panini's Astadhyayi and Vartik, Patanjali Mahabhasya, etc. In Sanskrit scripts, it is named as 'Atasi', 'Uma', 'Nil-Pushpin', 'Picchla', 'Kshuma', etc. It is mentioned as 'Khauma' in the 'Neelatantram' a Sanskrit script as old as the 'Vedas' (Sensarma, 1994; Winternitz, 1927). Seeds of this species have been reported at Harappa and other archaeological sites in northern India (Saraswat, 2005; Saraswat and Pokharia, 2003; Kajale, 1996; Saraswat *et al.*,1994) during 600-1300 BC. (Singh and Nigam, 2017).

***Nicotiana tabacum* L. (Solanaceae)**

It is a native of America (Bailey, 1949; Purseglove, 1968). In India, in most languages, it is called 'Tambaku' or 'Tambhakhu'. In Sanskrit, it is called 'Tamakhu' (Torkelson, 1999) or mentioned as 'Tamakhuh' in ancient Sanskrit scripts viz., Nighantusamgradam, Rajavallabham, Sushruta Samhita, Uttarasthanam, etc. It specific name is derived from 'Taobasco', a Mexican name (Patil, 2007). It is generally thought introduced in India in 1665 AD. Some opine that, after introduction is Europe, it was cultivated in India (Ashraf, 1985). It is was/is still enjoyed using Hooka, a water-cooled device. This device is evidenced archaeologically on a temple in Himachal Pradesh (India) dated 1422-1424 AD. (Singh, 2016). It means it was introduced and very familiar to Indians prior to discovery of America by Columbus (1492 AD.).

***Papaver somniferum* L. (Papaveraceae)**

It is native of Mediterranean countries and the Middle East (Coats, 1956; Anonymous, 1966). Morton (1977) thought especially Western Mediterranean region of Europe as the centre of origin. He further stated its spread through Balkan Peninsula to Asia Minor. The name 'Soma' is applied to it in Rigveda dating back to 1500 BC or even more, although this name is used to denote many other narcotic species in Indian ancient Sanskrit scriptures. It is mentioned as 'Aphiphenam' and 'Aphukam' in ancient Sanskrit texts viz., Bhava Prakasam. Dhanvantari Nighantu, Nighant Adars and Susruta Samhita Uttarashanam. Its carbonized seeds have found at archaeological site Sanghal (ca. 1900-1400 BC.) in Punjab (India) (Saraswat, 1997).

***Phoenix dactylifera* L. (Arecaceae):** It is a native of North Arabian Peninsula, Africa and Middle East (Chao and Krueger, 2001). It is commonly called Date Palm. In India, it fruit is known as 'Khajur'. Most Indian flora do not make reference to it. Before Indian independence Blatter (1909) listed it from Kutch (Possibly under rare cultivation). Earlier, it has been reported by Brandis (1874) from North-West and Central India under cultivation. The dates hail from Persian Gulf. In ancient times, it was cultivated in the desert belt of North Africa and the Middle East and its cultivation is traced back to Neolithic times. In the subcontinent, samples of stones (seeds) dated 7000 8500 BC are recorded at Mehrgarh (Kach Plains) in Baluchistan, adjacent to present Indian territory. Ceilings resembling date stones are recovered from Harappa (Vats, 1941) (presently adjacent locality to Punjab and Gujarat states of India). Its extension is recently reported, although somewhat doubtfully, from pre-Harappan levels at Rohira, Sangrur district of Punjab, dating 2300-2200 BC. (Saraswat, 1988). Singh (2008) reports still further distribution from Chalolithic-Narhan (ca. 1000 BC.) in Gorakhpur district of Uttar Pradesh (India). It is called 'Khajur' in various Indian languages. In Sanskrit, it is called 'Bhumikhajurika' and 'Duraroha' (Singh and Nigam, 2017). Although Sanskrit is not used in present times, dates or date-palm has several meaningful names in Sanskrit: (i) Kharjura (leaves and fruits appear a top the tree), (ii) Pindi (fruits rounded or oval in shape), (iii) Skanda phala (fruits appear top part of stem), (iv) Swadu Mastaka or Swadu Phala (frutis being sweet), (vi) Duraroha (difficult to climb tall tree). Sanskrit was used in ancient period in India. The ancient scripts were/are written in it. Conclusively, we can say that date-palm were introduced in ancient times in India.

***Psidium guajava* L. (Myrtaceae)**

It is a native of tropical America, especially Supe Valley of Peru which yielded its remains dating ca 2627 and 2020 BC. Nadkarni (1914) cited Sanskrit name 'Perala', while Chopra *et al*., (1956) and Pullaiah (2002) mentioned it as 'Perukah'. It is called simply 'Peru' in Marathi language in India. All these appear named after the country Peru, its nativity. It also finds place in ancient script Charak Samhita. It means guava is not introduced in India at least, not later than 4th Century. All these evidences certainly refute its introduction in India by Portuguese in 17th Century.

***Vitis vinifera* L. (Vitaceae)**

It is thought a native of South-East Europe (Naik, 1898; Ugemuge, 1986). Some others cite it as a native of Eurasia. Prior to 2000 BC., it was brought under cultivation especially from Iran and Baluchistan (Singh and Nigam, 2017). Thence onwards, it gradually introduced in India during beginning period of Christian era. It does not find place in Vedic texts. In late period, various Sanskrit scripts included it e.g. Bhava Prakasam, Kaiyadeva Nighantu, Charak Samhita, Susruta Samhita, Gunapatham, Nighantu sangraham and Yogratnasamuccayam, Kalpsutras, Panini's and Vartik and Patanjali's Mahabhasya.

In Sanskrit scripts, it is mentioned as 'Draksha', 'Rasa', 'Mridvika', 'Madhurasa', 'Swadhuphala', etc. Even Kautilya in his 'Arthashastra' mentioned it as 'Mridvika' (*cf*.Shamasastry, 1915). These scriptures and Sanskrit names are evidences of cultivation and utility in India. Carbonized seeds of grapes have been unearthed at archaeological sites *viz*., Balu and Kunal, Haryana (India) from mature Harappan stage (Saraswat and Pokharia, 2002, 2003) or 2000 BC. (Singh and Nigam, 2017). Pokharia and Saraswat (1998-1999) reported its seeds from ancient Sanghal site in Punjab during Kushana period (100-300 AD). Saraswat (1988, 1992) explained evidence of grape-pips and vine charcoals from archaeological site Rohira, Punjab (India) that Harappans used to practice viticulture. Prior to this fact of viticulture in the then India, grapevine was known based on literature and

sculptural evidence. Eastern gateway of Sanchi Stupa is sculpted with a parrot with a bunch of grapes. The grapevine is found as ornamental design at Sanchi and Bharut on pillar in Madhya Pradesh dating 2nd -3rd Century AD (Sitholey, 1976). A sculpture shows a lady with a wine pod and also holding a bunch of grapes in her hand at Mathura (2nd Century CE). A sculpture from Bharut depicts a king with a grape twig, a leaf and bunch of grapes in his right hand. Another sculpture at Sanchi shows three parrots holding a bunch of grapes. Still another sculpture at Mount Abu (Rajasthan) and Andal temple of Srivilliputtur (Tamil Nadu) shows Rati holding a bunch of grapes (Gupta, 1996; Nandita and Amirthalingam, 2014). All these evidence its occurrence in ancient period in India.

Zea mays Linn. (Poaceae)

Maize is thought introduced in India by the Arabs and not by the Portuguese (Jefferys, 1965). He lent support to this by citing Indian names used such as 'Makka Jouri', 'Makka Jola', 'Makkai', 'Mukka Cholam'. Ashraf (1990) negated this view and instead cited mention of maize as 'Markataka' in ancient Sanskrit scripts *viz*., Vishnu Purana and Apasthamba Saruta Sutra. He further opined that, subsequent derived 'Mak' or 'Maka' terms are convincing. Depiction of maize ears at Hoysala temple (Near Mysore). Karnataka (India) built in 12th and 13th Century AD. supports antiquity of maize introduction (Vishnu-Mittre, 1968) or cultivation in India. Watt (1889) also noted Sanskrit names for maize e.g. 'Sasyam', 'Stambakari', 'Sasyavisesha' and 'Yavanala' by Torkelson (1999).

DISCUSSION

Sources of investigation

Agriculture was/is a way of life, nay a philosophy and culture of its own in India. Thus history of agriculture is wedded with the history of civilization in India. Domestication of crops and animals is essential for agricultural activity. Kautilya's 'Athasastra' (4th CCE) explains agriculture in India, besides ancient Indian Sanskrit scripts *viz*., Vedas, especially Rigveda. Glimpses of introduction, domestication and cultivation of crops are available in many Indian ancients' scripts, archaeological sites, arts, architecture, paintings, ancient literary records, etc. However, the evidences of these activities related especially to useful plants are scattered. Experts in these fields of knowledge have hardly any contacts or exchange of thoughts and thus each field of knowledge has largely remained air-tight compartment. Multidisciplinary approach is a modern trend which gives justice fully in a domain like agriculture and human civilization. It is now a high time to collate evidences from various domains. The present author could find fine time (after his retirement) to study especially exotic plants found in India.

Alien species

In this communication, 20 useful but exotic plant species are projected based on studies in various disciplines. Apart from literary and historical evidences, an emphasis has been also laid upon on hard data, an empirical approach. Apart from indigenous crop species, ancient Indians also opted and appropriated foreign plants in Indian environment. The select 20 species of the present account reflect selection and adaptation of the exotic crop species meant for various purposes, probably for better yields or an alternative to indigenous crop species. They appropriated plant as spices (*Allium cepa*, *A. sativum*, *Capsicum annuum*), Cereals (*Zea mays*), Pulses (*Cicer arientinum*), oil-yielders (*Arachis hypogaea*, *Helianthus annuus*, *Linum usitatissimum*), fibers (*Gossypium species*, *Linum usitatissimum*), edible nuts and fruits (*Anacardium occidentale*, *Ananas comosus*, *Phoenix dactylifera*, *Annona squamosal*, *Vitis vinifera*) and vegetables (*Lagenaria siceraria*). All these were/are essential crops for their sustenance. Apart from sustaining crop species, ancient Indians also loved mind-altering or psychoactive plants e.g. *Cannabis sativa*, *Papaver somnifera* and *Nicotiana tabacum*. Interestingly, for dyeing purpose, they also cultivated dye-yielders e.g. *Lawsonia inermis*. All these alien crop species reflect the then Indian economy.

Indian Culture

Besides economic importance, the exotic species even found place in Indian culture: (i) Custard Apple (*Annona squamosa*): It is carved on the bas-reliefs at Sanchi and Bharut (Madhya Pradesh) by the end of 2nd Century BC. (Marshall *et al*., 1940; Brown, 1949), on the sculptures dug up in Mathura (Uttar Pradesh), and at the Ajanta Caves (Watt, 1889-1893). Its fruits are depicted in the hands of a sculpted goddess from 10th Century AD., at Durga temple, Aihole (Karnataka) (Pokharia *et al*., 2009). (ii) Maize (*Zea mays*) : Ears of maize are carved at Hoysala stone block temples, near Mysore (Karnataka) dated 12th and 13th Century AD, (Johannessen and Parker, 1989). Ears are also recovered in left hand of 8-armed dancing Vishnu in his female form Mohini at Lakshmi Narasimha temple, Nuggehalli (Karnataka) 12th-13th Century AD. (Gupta, 1996). (iii) Sunflower (*Helianthus annus*): Flowering heads are recovered in Rani Gumpha cave, Udaigiri (Madhya Pradesh) 2nd Century BC (Johannessen, 1988). (iv) Pine Apple (*Ananas comosus*): It is depicted in Bharut Stupa balustrade relief (Madhya Pradesh) 2nd Century BC. (Gupta, 1998). It is similarly depicted in Udaigiri temple (Madhya Pradesh) 5th Century BC. (Gupta, 1998). (v) Chillies (*Capsicum annuum*): It is mentioned in Siva Purana and Vamana Purana, 6th-8th Century AD (Gupta,

1998). (vi) Tobacco (*Nicotiana tabacum*): 'Hooka' (a water-cooled smoking device using tobacco) is depicted in a temple in Himachal Pradesh dated 1422-1424 AD (Singh, 2016). (vii) Cashewnut (*Anacardium occidentale*): A flowering and fruiting tree is depicted at Jambukeshwara temple, Tiruchirapalli (Tamil Nadu) built 2500 years ago (Gupta, 1998). Its nuts (fruits) are also depicted at Bharut Stupa dated ca. 200 BC. (Cunningham, 1879).

CONCLUSIONS

All these species were probably commonly cultivated in India and after well familiarization they have been appropriated and thought sacred to these deities since then. Some plant species were thought introduced by the European invaders during last few centuries ago. However, the present review clearly explained their introduction and domestication during pre-Columbian period in India.

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