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Alien Plant Species Recorded in Vedic and Post-Vedic Period of India: An Assessment

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Review Article

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Abstract: Vedic and Post-Vedic Sanskrit literature is heritage of ancient Indian culture and treasure-trove of plant-wealth known to the then Indians. It informs on indigenous plant species as well as few exotics. The latter, however, reflect the human activity related to outside Indian territory. The floral elements included in the various treatises of Vedic and Post-Vedic periods are critically analyzed. Their nativity and purposes are highlighted in this communication. Total 40 species belonging to 21 genera and 23 families of angiosperms as mentioned in the said ancient literature are studied critically. Plant migration as also the activity and human communications with other countries and civilizations are thereby indicated. Maximum species are represented from Asia (13), Europe (8), America (6), Africa and Mediterranean (5 each). It appeared that hard data obtained from archeobotany, archeology, history and religion corroborate information accrued during Vedic and post-Vedic period.
Keywords: Exotic Plants, Vedic and Post-Vedic Literature

INTRODUCTION

Man, right from the beginning, exhibited a selective approach while using the potentials of flora in his ambience. Obviously, this selective process was performed by trial and error method. He enjoyed not only indigenous species but also exotic ones whenever he came across with such species. India, especially to the western mind, appeared encapsulated in the veil of mysticism, right up to the medieval period of the world history. The western scholars, soldiers and traders, as also the Arabian traders, plundered the plant wealth of Indian territory. Travellers from Eastern world also visited India in ancient times. India was thus the centre of human activity. The invaders also ruled India later. This caused exchange of plant materials of India with nearly all human cultures. Ancient Indian Botany reached its pinnacle in Vedic and Post-Vedic eras in North India.

Invasion of aliens in modern period is rather faster but one may be very anxious in knowing this trend of invasion especially during ancient period of a country like India. The present author, therefore, extended literary survey of ancient Sanskrit treatises to pinpoint the status of the exotic taxa of the then India.

METHODOLOGY

The literature cited in the ancient Indian text (Table-2) has been analyzed and the exotic nature of the plant taxa was deciphered using the literary sources as mentioned in the Table-1. The Sanskrit names of plants were studied to find out their Latin equivalent names. Their common classic uses in modern times are given indicating status whether wild or cultivated and for the purposes they are presently in vogue.

Table-1: Alien Plant Species in Ancient Sanskrit Scriptures

Sr. No	Exotic species & Family	Nativity	Sanskrit Name & Ancient Scripture	Status & Remark
1.	*Albizia lebbeck* (Linn.) Benth. Mimosaceae	NorthAustralia & Tropical Asia. Kshirsagar & Patil[30]	Bhandi Shiris, Shirsparni. Brahmanas, Kalpasutras, Panini's Astadhyayi & Vartik, Patanjal's Mahabhasya	Planted for shade along roads
2.	*Allium cepa* Linn. Liliaceae	Western Asia, Persian and adjacent regions. Bailey, [31]	Palandu. Kalpasutras, Patanjal's Mahabhasya	Cultivated as spice.
3.	*Allium sativum* Linn. Liliaceae	Western Temperate Asia & Europe. Bailey, [32]	Lasun. Kalpasutras	Cultivated as spice
4.	*Aloe barbadensis* Mill. Liliaceae	Cape Verde Islands. Backer & Brink, 1968; Mediteranean Region. Bailey, 1949 [33,32]	Bala, Kumari. Kalpasutras	Cultivated as ornamental and medicinal
5.	*Amaranthus paniculatus* Linn. Amaranthaceae	Africa, East & West Asia. Cooke, 1958 [34]	Jivant. Atharv Veda	Cultivated for seeds as food.
6.	*Amaranthus spinosus* Linn. Amaranthaceae	America. Patil, 1995 [35]	Tanduliyak, Bhandi. Kalpasutras	Weed on waste places
7.	*Ananas comosus* (L.) Merr. Bromeliaceae	South America. Sharma & Pandey, 1984 [6]	Parayati. Rig Veda	Cultivated for edible fruit.
8.	*Azadirachta indica* A.Juss. Meliaceae	Persia & Asia minor. Maheshwari & Paul, 1975; Burma. Benthall, 1946; Rajgopal & Panigrahi, 1965 [36,37,38]	Nimb, Pichmund. Kalpasutras	Planted for shade
9.	*Benincasa hispida* (Thunb.) cong. Cucurbitaceae	Java and Japan. Patil, 1995; Cooke, 1958 [35,34]	Apaskambha, Krimuk. Kusmanda. Atharv Veda, Kalpasutras	Cultivated for fruit as vegetable, sweetmeat and medicine
10.	*Cannabis sativa* Linn. Cannabaceae	Central Asia. Cooke, 1958; Capsian Sea Region & Caucasus mountains. Watt, 1908 [34,39]	Bhang, Bhonga. Rig Veda, Brahmanas, Kalpasutra, Panini's Astadyayi and Vartik	Wild inHimalayan region and northern India, also cultivatedinKumaon region.
11.	*Carthamus tinctorius* Linn. Asteraceae	Native of South-West Asia. Patil, 2003 [40]	Kusumbh, Maharajan. Upnisadas, Kalpasutras Panini's Astadhyayi and Vartik	Cultivated for seeds and oil
12.	*Cassia tora* L. Caesalpiniaceae	America. Backer & Brink, 1963, 1968 [41,33]	Chakramardak. Kalpasutras	Weed on waste lands
13.	*Cicer arientinum* Linn. Fabaceae	South Europe. Patil, 1990 [42]	Chanak. Yajur Veda, Kalpasutras	Cultivated for seeds as pulse.
14.	*Cleome gynandra* Linn. Brassicaceae	Africa. Cleome gynandra Wikipedia Flora of Zimbabwe	Ajashringi, Arataki, Kabru, Tikshnashringi. Atharv Veda, Kalpasutras	Weed on waste places
15.	*Clitoria ternatea*	Tropical America.	Ajita, Aparka,	Naturalised on hedges

	Linn. Fabaceae	Purseglove, 1968 [43]	Aprajita, Shveta. Atharv Veda, Kalpasutras	along roads or on shrubs or trees.
16.	*Coriandrum sativum* Linn. Apiaceae	South Europe. Bailey, 1949 [32]	Kustumburu. Panini's Astadhyayi and Vartik	Cultivated for leaves and fruits as spice
17.	*Crocus sativus* Linn. Iridaceae	South-East Europe, Western & Central Asia. Fernandez , 2009 [44]	Balhika. Atharv Veda Kumkum. Kalpasutras Harichandan. Panini's Astadhyayi and Vartik	Stigmas as spice, food colorant and perfume
18.	*Datura stramonium* Linn. Solanaceae	America. Haegi, 1976 [45]	Kankkanak. Atharv Veda	Weed on waste places
19.	*Eclipta prostrata* (Linn.) Linn. Asteraceae	South America. Ridley, 1930; Rajagopal & Panigrahi, 1965 [46,38]	Alaka, Bhringraj, Rama, Shyama Swarupkarni. Atharv Veda, Kalpasutras	Weed on wet waste places
20.	*Foeniculum vulgare* Mill. Apiaceae	Europe. Coats, 1956; Mediterranean Region. Purseglove, 1968 [47,43]	Shatpuspa. Kalpasutras Panini's Astadhyayi and Vartik	Cultivated for fruits as spice
21.	*Glycyrrhiza glabra* Linn. Fabaceae	Mediterranean and Europe. Katya *et al*., 2014 [48]	Jyesthi madhu, Madhuk, Madhula, Ritavari, Klitak. Rig Veda, Yajur Veda, Kalpasutras, Atharv Veda, Brahmanas, Patanjalis Mahabhasya	Roots sold for medicine.
22.	*Gossypium herbaceum* Linn. Malvaceae	Arabia & Asia Minor. Bailey, 1949; Africa & Asia. Purseglove, 1968 [32,43]	Karpas. Kalpasutras, Paninin's Astadhyayi and Vartik, Patanjal's Mahabhasya	Cultivated for fibres from seeds.
23.	*Hibiscus rosa-sinensis* Linn. Malvaceae	China. Pal & Krishnamurthi, 1967 [49]	Japa. Kalpasutras	Planted as ornamental flowers and foliage
24.	*Lawsonia inermis* Lythraceae	North America & Australia. Patil, 1990 [42]	Nakharanjani. Pannini's Astadhyayi and Vartik,	Planted for dye-yielding leaves
25.	*Lens culinaris* Medicus Fabaceae	Western Temperate Asia. De Candolle, 1886 [50]	Mangalya, Masur Yajur Veda, Upanishada, Kalpasutras	Cultivated for seeds as pulse
26.	*Linum usitatissimum* Linn.	Mediterranean Region. De Candolle, 1886 [50]	Atasi, Uma. Rig Veda, Atharv Veda, Upanishadas, Kalpasutras, Panini's Astadhyayi and Vartik, Patanjal's Mahabhasya	Cultivated for seeds as oil and stem fibre
27.	*Mimosa pudica* Linn. Mimosaceae	South America. Ridley, 1930 [46]	Shamipatrika. Kalpasutras	As botanical curiosity planted in gardens
28.	*Nerium oleander* Linn. Apocynaceae	China & Cochin-China. Voight, 1845 Mediterranean Region. Purseglove, 1968 [51,43]	Karvir, Srekparn. Yajur Veda, Brahmanas, Panini's Astadhyayi and Vartik Patanjal's Mahabhasya	Planted as ornamental in gardens
29.	*Phyllanthus acidus* (Linn.)	Malay Isalands & Madagascar.	Lavani. Panini's Astadhyayi and Vartik	Planted for acidic fruits

	Skeals Euphorbiaceae	Patil, 1995 [35]		
30.	*Pisum sativum* Linn. Fabaceae	West Asia. Patil, 1995 [35]	Kalanj, Kalaya Kalpasutras Patanjal's Mahabhasya	Cultivated for seeds as pulse or vegetable
31.	*Plumeria acutifolia* Poir. Apocynaceae	West Indies. Bailey, 1949 Srivastava, 1964 Mexico to Ecuador. Maheshwari & Paul, 1975 [32,52,36]	Ksiri. Harita Samhita	Planted in garden for flowers and foliage as ornamental
32.	*Punica granatum* Linn. Punicaceae	Afganistan, Baluchistan & Persia. De Candolle, 1959 [53]	Dadim. Kalpasutras, Panini's Astadhyayi and Vartik, Patanjal's Mahabhasya	Cultivated for edible fruit (seeds)
33.	*Raphanus sativus* Linn. Brassicaceae	Western Asia. Purseglove, 1968; China. Chauhan, 1972; China, Japan & W.Asia. Voight, 1845 [43,54,51]	Mulak. Kalpasutras, Patanjal's Mahabhasya	Cultivated for edible roots
34.	*Ricinus communis* Linn. Euphorbiaceae	Africa. Bailey, 1949; Backer & Brink, 1963-1968; Purseglove, 1968 [32,55,43]	Erand, Tajadbhang Atharv Veda, Brahmanas Kalpasutras	Cultivated for seeds as oil
35.	*Spinacea oleracea* linn. Chenopodiaceae	Persia. De Candole, 1886 Arabia. Vight, 1845 [50,51]	Palakya. Kalpasutras	Cultivated for leafy vegetable
36.	*Tamarindus indica* Linn. Caesalpiniaceae	Tropical Africa. Benthall, 1946; Purseglove, 1968 [37,43]	Amlak, Amlika, Tintidok. Upanishadas, Kalpasutras, Pannini's Astadhyayi and Vartik, Patanjal's Mahabhasya	Planted for sour fruits
37.	*Trigonella foenum-graecum* Linn. Fabaceae	South Europe. Patil, 1995 [35]	Metika. Kalpasutra	Cultivated for leafy vegetable and spicy seeds.
38.	*Triticum aestivum* Linn. Poaceae	Fertile crescent, Middle East. Simmons, 1987 [56]	Godhum. Yajur Veda, Atharv Veda, Brahmanas Upanishadas, Kalpasutras	Cultivated for grains as staple food
39.	*Vigna unguiculata* (Linn.) L. (Syn. V. cylindrical Skeels) Fabaceae	Africa. Xiong *et al*., 2016 [57]	Rajmas. Kalpasutras Patanjal's Mahabhasya	Cultivated for pods and seeds as vegetable and pulses.
40.	*Vitis vinifera* Linn. Vitacee	South-East Europe. Ugemuge, 1986 [58]	Draksha, Mridvika. Kalpasutras, Pannini's Astadhyayi and Vartik, Patanjal's Mahabhasya	Cultivated for edible fruits

Table-2: Plants In Ancient Sanskrit Treatises

Sr.No.	Name of text	No. of Plants	Period
	Vedic Texts (Vedic Period 1500-500 BCE Late Bronze Age & Iron Age)		
1	Rig Veda	67	1400 BCE-900 BCE
2	Yajur Veda	82	1200 BCE-1000 BCE
3	Atharv Veda	288	900 BCE
4	Brahmanas (All combined)	129	900 BCE-700 BCE
5	Upnisadas (All combined)	31	800 BCE-300 BCE
6	Kalpasutras (All combined)	519	500 BCE-300 BCE
	Post-Vedic Texts		
7	Astadhyayi and Vartika by Panini	152	6^{th}-5^{th} Century
8	Mahabhasya by Patanjal	109	Mid-2^{nd} Century
9	Nirutta by Yaska	26	4^{th} Century BC.
*	Source: Sharma, P.V. [59]		

DISCUSSION

Exotic species are alternatively known as alien, introduced, non-indigenous, foreign, invasive species or as bioinvaders. As the names imply, these species do not belong to ecosystems in which they either intentionally or unintentionally placed. Introduction of plant species to places outside their areas of natural distribution has been a common practice throughout human history [1]. As a part of human civilization and human migration from the time immemorial, useful exotic plant species are cultivated in different parts of India and also elsewhere. These helped the economy of a region or nation. They have boosted the economy and helped providing additional plant resources for food and non-food purposes. But some of the exotic or aliens may be invasive in their new environment. Invasions of alien taxa in foreign land are linked to historical and current human activities [2] and are a serious but underestimated problem in biodiversity conservation [3]. Such invasions sometimes led to extinction of native species. They adversely upset ecological balance and modification of ecosystem functions. They have created health hazards and also to reduction of agricultural production [4,5]. In India, the exotics form quite a good percentage of our flora today. There are, however, a few serious publications available on this subject matter. Workers in biodiversity studies normally do not pay adequate attention to the plants of Agri-horticultural importance [6].

Flora of a region is the natural consequence of its geographical conditions. Indian subcontinent is a vast landmass with diverse climatic conditions. It was exposed to the action of ever-changing external factors, of which the climate and human activities have been major elements. While studying biodiversity, the indigenous floral elements have been and are being rightly assessed. A large number of exotic taxa found entry to this land and became part of its flora. The period and places of their, and human activity are hardly paid attention. Ancient evidence of plant sciences can be learnt obviously from ancient Sanskrit treatises. The present author, therefore, studied the literature stated in the Table-1 with a view to find out the status of exotic species. Out of 40 species, maximum 13 exotic species represented in India belong to parts of Asia. This is naturally so, India being part of the continent. In the descending order, the exotic species represented are: Europe (08), America (06), Africa and Mediterranean region (05 each). Other countries *viz*., Java, Japan, China, Burma and Australia, etc. are represented by just one or two species each. The Table-1 indicates that nearly all regions of the world, inclusive of very isolated Australia, were in contact, directly or indirectly, with the then India.Table-2 suggests the number of plant species, whether indigenous or exotic, in the period when these ancient treatises have been compiled. The Table-1 also suggests the purposes for which probably the said exotic taxa have been brought intentionally. There are also few taxa invaded but without any purpose, for example, *A.spinosus*, *C.tora*, *C.gynandra*, *D.stramonium*, and *E.prostrata*. These aliens take over the areas with abundant sunlight and use up nutrients essential for other plants. They are often able to survive better than native species, which results in increased competition among native species. They have naturalized rapidly. These also, in later period, have been searched out for their medicinal potential as indicated by other literature sources. Modern humans (*Homo sapiens*), since their emergence, have played an ever-increasing role in species invasions. With the rise of civilization, several exotic plants were brought from distant lands to broaden the palettes of consumers or serve as curiosities. Their written records are hardly available. Ancient Indian culture is but proud of their traditional records especially written in Sanskrit as those thought for the present account.

Apart from ancient scripts of Vedic and Post-Vedic period, evidence from archeology, archaeobotany, literary or historical records also reveal information about antiquity of some aliens with certainty. For example: (i) *Allium cepa*: Archaeobotanical remains of onion seeds are recorded in Middle Gangetic Plains-Waina, Ballia and Raja-Nala-Ka-Tila in Uttar Pradesh during 800-1600 BC [7,8]. Medicinal utility of onion is also documented by Emperor Ashok (ca. 268-232 BC. in Divyavadan [9]. (ii) *Allium sativum*: It was introduced in India as a part of trade relationship between Mesopotamja, Egypt and India especially during Mohenjo-Daro period about 300 BC. Sanskrit names, Lashunaha, Granjanaha, Aristah, Mahakandaha and Rasonakha are published in Amar Kosh by Amarsingh in 600 AD during the rule of Vikramaditya [10]. Also, its carbonized cloves are found at Harappa site Balu in Haryana state (India) [11]. (iii) *Ananas comosus*: Archaeological evidence of sculpture of pineapple fruit as "Vanamala" of Lord Vishnu, a Hindu god, in his 'Varah Avatara' in the Udayagiri cave temple, at Madhya Pradesh (India) supports its antiquity ca. 5th century AD. Also, more than 1000 years old depiction at Moti-Shahka-Tuk, Shatrunjaya, Hill complex, Palitana, Gujarat (India) confirms its occurrence in those days [12]. Sorenson [13] supports its antiquity decisively as far back as 600 BC in India. (iv) *Cannabis sativa*: Sorenson [13] stated for its decisive evidence of introduction in India by 100 AD. Flattened seeds have been recovered from archaeological remains of Kunal, Haryana State (India) [14] and wood charcoal at Senuwar, Middle Gangetic Plain [15]. This evidence lend support for its ancient cultivation. (v) *Carthamus tinctorius*: Cysella of safflower have been recovered from the remains at Imlidih-Khurd, Uttar Pradesh and Middle Gangetic Plains [7]. Its grain were also recorded at Savalda dating as back as ca.2300-2000 BC in western Maharashtra State (India) [16] (VI) *Cicer arientinum*: According Vishnu-Mittre [17], it was introduced as early as 2000 BC. Its grains were found at Savalda (ca 2300-2000 BC.) in Maharashtra, at Imlidih-Khurd in Uttar Pradesh, at Balu, Kunal in Haryana and Middle Gangetic Plains [7,11,14,16]. (vii) *Pisum sativum*: Its archaeological remains have been recovered from Harappa dating back to 2250-1750 BC. and in Middle Gangetic Plains [16]. It appeared in the 2nd half of the 2nd millennium BC in Gangetic basin and Southern India [18]. (ix) *Ricinus communis*: It is recorded at earliest between 1800 and 1300 BC. in Harappan site of Hulas [19]. Later, it is also found in Indus Valley and Gangetic Plains [20,21,7]. (x) *Trigonella foenum-graecum*: Seeds were found in early and mature Harappan phases at Kunal and Banawali in Hariyana and Rohiro in Punjab state [22,14,23]. (xi) *Triticum aestivum*: Carbonised grains were recovered at Mohenjo-Daro dated to 1755 BC. It then spread in Indus Valley and Gangetic Plains. This is evidenced by post-Harappan record at Atranjikherain Etah, Uttar Pradesh State (ca. 2000-50 BC [24]. It was also found from post-Harappa Chalcolithic sites at Nevadatoli-Maheshwar (1600-1450 BC [25,26]. It is also recorded from Kayatha culture (ca. 1900 BC.) at Ujjain in Madhya Prdesh State; at Sonegaon (1340-1290 BC.), Inamgaon (1370-1025 BC). and Ter (ca.200 BC.) in the state of Maharashtra [17]. (xii) *Vitis vinifera*: Carbonised pyriform seeds were found at Balu and Kunal from mature Harappa stage as far back as 2000 BC [11,14]. (xiii) *Amaranthus paniculatus*: Its archaeological remains have been reported dating to before 800 BC [16,21]. Sorenson [13] also lent supports for its introduction in India before Christian era. (xiv) *Lens culinaris*: Its seeds were recovered from archaeological remains at Malhar in Uttar Pradesh, from Balu, Kunal in Haryana and Middle Gangetic Plains (2500 BC.) [21,7,11,14,16]. (xv) *Linum usitatissimum*: Its cultivation is mentioned in Bhav Mishra (ca. 1600 AD) [27]. Archaeobotanical remains of seeds were found at Harappa and in other sites in north India (600-1300 BC.) [7,14,28]. The agrobiodiversity of India was thus enriched in the long past by our ancestors. In this communication, hard data belonging to evolution of trade, economics, human societies and agriculture corroborate with certainty the information drawn from Vedic and post-Vedic period. Based on evidence from archeological (architectural) remains, archaeobotanical and ancient literature, we can deduct origin, history and evolution of intentionally introduced or domesticated plant species. However, there are many more exotic species brought negligently or unintentionally in past. These may or may not find evidence of the aforesaid mentioned type as they have lesser importance or recognitions by mankind. Some of these are still deep-rooted in ancient Indian societies. For example, flowers of *Datura* are offered to Hindu god, Lord Shiva and depicted on temples on his as head-dress [29]. Hindu offer (red) flowers of *Hibiscus rose-sinensis* to Lord Ganesha. Many other aliens are invasive out compete the native species. Apart from the species highlighted above, rest others await for hard data.

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REFERENCES

1. Villaseñor JL, J Espinosa-Garcia F. The alien flowering plants of Mexico. Diversity and distributions. 2004 Mar 1;10(2):113-23.
2. Dehnen-Schmutz K. Alien species reflecting history: medieval castles in Germany. Diversity and Distributions. 2004 Mar 1;10(2):147-51.
3. Cronk QC, Fuller JL. Plant Invaders–Chapman & Hall.1995.

4. Vitousek PM, Walker LR, Whiteaker LD, Mueller-Dombois D, Matson PA. Biological invasion by Myrica faya alters ecosystem development in Hawaii. Science. 1987 Nov 6;238(4828):802-4.
5. Holt JS, Boose AB. Potential for spread of Abutilon theophrasti in California. Weed Science. 2000 Jan;48(1):43-52.
6. Sharma BD, Pandey DS. Exotic flora of Allahabad district.1984.
7. Saraswat KS. Agricultural background of the early farming communities in the Middle Ganga Plain. Pragdhara. 2005;15:145-77.
8. Singh AK, Nigam SN. Ancient Alien Crop Introductions Integral to Indian Agriculture: An Overview. Proceedings of the Indian National Science Academy. 2017 Sep 20;83(3):549-68.
9. Majmudar MR, from Shāmaláji Š, Vidyā B. Hence when during the course of exploration in hilly region of eastern part of North Gujarat this Torana at Shāmalāji came to present writer's notice it was considered worthy of detailed archaeological study. Journal of the Maharaja Sayajirao University of Baroda. 1959;8:39.
10. Singh AK, Nigam SN. Ancient Alien Crop Introductions Integral to Indian Agriculture: An Overview. Proceedings of the Indian National Science Academy. 2017 Sep 20;83(3):549-68.
11. Saraswat KS, Pokharia AK. Harappan plant economy at ancient Balu, Haryana. Pragdhara. 2002;12:153-72.
12. Gupta SM. Plants in Indian temple art. Delhi: BR Publishing Corporation; 1996.
13. Sorenson JL. Ancient Voyages Across the Ocean to America: From “Impossible” to “Certain”. Journal of Book of Mormon Studies. 2005;14(1):3.
14. Saraswat KS, Pokharia AK. Palaeoethnobotanical investigations at Early Harappan Kunal. Pragdhara. 2003;13:105-40.
15. Saraswat KS. Plant economy in ancient Malhar. Pragdhara. 2004;4:137-71.
16. Saraswat KS, Sharma NK, Saini DC. Plant economy at ancient Narhan (ca. 1,300 BC-300/400 AD). Excavations at Narhan (1984–1989). Varanasi: Banaras Hindu University. 1994:255-346.
17. Vishnu-Mittre B. Palaeobotanical evidence in India. Evolutionary Studies in World Crops: Diversity and Change in the Indian Sub-continent. 1974:3-0.
18. Zohary D, Hopf M, Weiss E. Cereals. Domestication of plants in the old world, 3rd edn. Oxford University Press, New York, USA. 2000:70-1.
19. Saraswat KS. Plant economy of late Harappans at Hulas. Purattatva. 1993;23:1-2.
20. Saraswat KS. Ancient Crop-economy of Harappans from Rohira, Punjab (c. 2000-1700 BC), The Palaeobotanist. 1992; 35: 32-8.
21. Saraswat KS. Plant economy of early farming communities. Early farming communities of the Kaimur (excavations at Senuwar). Jaipur: Publication Scheme. 2004;416535.
22. Saraswat KS. Ancient crop economy of Harappans from Rohira, Punjab (C. 2,000-1,700 BC). Palaeobotanist. 1986.
23. Saraswat KS, Chanchala S, Pokharia AK. Palaeobotanical and pollen analytical investigations. Indian Archaeology 1989–1990–A Review. 1994:132-3.
24. Chowdhury KA, Saraswat KS, Buth GM. Ancient agriculture and forestry in north India. Asia Pub. House; 1977.
25. Sankalia HD, Subbarao B, Deo SB. The excavations at Maheshwar and Navdatoli, 1952-53. Maharaja Sayahirao University; 1958.
26. Singh AK, Nigam SN. Ancient Alien Crop Introductions Integral to Indian Agriculture: An Overview. Proceedings of the Indian National Science Academy. 2017 Sep 20;83(3):549-68.
27. Pandey A, Shao H, Marks RM, Polverini PJ, Dixit VM. Role of B61, the ligand for the Eck receptor tyrosine kinase, in TNF-alpha-induced angiogensis. Science. 1995 Apr 28;268(5210):567.
28. Kajale MD. Palaeobotanical investigations at Balathal: preliminary results. Man and Environment. 1996;21(1):98-102.
29. Geeta R, Gharaibeh W. Historical evidence for a pre-Columbian presence of Datura in the Old World and implications for a first millennium transfer from the New World. Journal of biosciences. 2007 Dec 1;32:1227-44.
30. Kshirsagar SR, Patil DA. Exotic floral elements in the Flora of Jalgaon district (Maharashtra). Journal Of Economic And Taxonomic Botany. 2002;26(3):529-32.
31. Bailey P, Cushing H. A classification of the tumors of the glioma group on a histogenic basis with a correlated study of prognosis.
32. Bailey LH. Manual of cultivated plants. Manual of Cultivated Plants. 1949(Rev. Edn.).
33. Backer CA, Van Den Brink RB. Flora of Java Vol. III. Noordhoff, Groningen. 1968.
34. Cooke T. Flora of Presidency of Bombay Vol, I–III Bot. Surv. India, Culcutta. 1958.
35. Patil DA. Exotic elements in the flora of Dhule District (Maharashtra). J. Econ. Taxon. Bot. 1990;14(3):721-4.
36. Maheshwari JK, Paul SR. The exotic flora of Ranchi. J. Bombay Nat. Hist. Soc. 1975;72(1):158-88.
37. Benthall AP. The trees of Clacutta: and its neighbourhood. Thacker Spink and Co. Ltd.; Calcutta; 1946.
38. Rajagopal T. New records of species for Flora of Allahabad. Proceedings of the national academy of

sciences india section b-biological sciences. 1965 Jan 1;35:25.
39. Watt G. The commercial products of India. London; 1908.
40. Patil DA. Flora of Dhule and Nandurbar Districts (Maharashtra). M/S Bishen Singh Mahendra Pal Singh; 2003.
41. Backer CA. Bakhuizen van den Brink RC. Flora of Java. 1963;1:305-6.
42. Patil DA. Exotic elements in the flora of Dhule District (Maharashtra). J. Econ. Taxon. Bot. 1990;14(3):721-4.
43. Purseglove JW. Tropical crops. Dicotyledons 1 and 2. Tropical crops. Dicotyledons 1 and 2.. 1968.
44. Fernández JA. Saffron, a Sustainable Crop with Potential Medicinal and Industrial Applications. InInternational Symposium on Underutilized Plants for Food Security, Nutrition, Income and Sustainable Development 806 2008 Mar 3 (pp. 315-322).
45. Haegi L. Taxonomic account of Datura L.(Solanaceae) in Australia with a note on Brugmansia Pers. Australian Journal of Botany. 1976;24(3):415-35.
46. Ridley H. The dispersal of plants throughout the world. The Dispersal of Plants throughout the World. 1930.
47. Coats AM. Flowers and their histories. Hulton Press Limited.; London; 1956.
48. Uzundzhalieva K, Ruseva R, Kachakova S. Ex Situ and In Vitro Conservation of Glicyrrhiza glabra L.– Crop Wild Relative from Fabaceae. Ecologia Balkanica. 2013 Jan 1;5(1):9-13.
49. Pal BP, Krishnamurthi S. Flowering Shrubs. Flowering Shrubs. 1967.
50. Candolle AD. Origin of cultivated plants. Reprint of second edition. 1959.
51. Voigt JO. catalogue of the plants which have been cultivated in the Hon. East India Company's Botanical Garden, Calcutta, and in the Serampore Botanical Garden, generally known as Dr. Carey's Garden, from the beginning of both establishments (1786 and 1800) to the end of August 1841.
52. Srivastava JG. Some tropical American and African weeds that have invaded the state of Bihar. J Indian Bot Soc. 1964;43:102-12.
53. Candolle AD. Origin of cultivated plants. Reprint of second edition. 1959.
54. Chauhan DV. Vegetable Production in India,(1972). Ram Prasad and Sons (Agra).
55. Backer CA, van den Brink Jr B. RC, 1963-1968. Flora of Java. 3 volumes.
56. Simmons SR. Growth, development, and physiology. Wheat and wheat improvement. 1987 Jan(wheat and wheatim):77-113.
57. Xiong H, Shi A, Mou B, Qin J, Motes D, Lu W, Ma J, Weng Y, Yang W, Wu D. Genetic diversity and population structure of cowpea (Vigna unguiculata L. Walp). PloS one. 2016 Aug 10;11(8):e0160941.
58. Ugemuge NR. Flora of Nagpur District, Maharashtra. Shree Prakashan, Shankarnagar, Nagpur, India. 1986.
59. Sharma PV, Mehta PM. Dravyaguna Vigyan. Re edition. 1993;2:162.