HISTORY OF FOSSIL LEGUMINOSAE IN INDIA

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ABSTRACT

The paper discusses the history and origin of Leguminosae and its early cultivation in India. The pollen grains of family Leguminosae in India are known since Palaeocene time, whereas the oldest records of megafossils are known through the fruit of Hedysareae, leaflets of *Acacia* and *Cassia* and wood of *Aeschynomene* from the Deccan Intertrappean beds.

The domestication of Leguminosae in India seems to be quite recent. The earliest record of legume cultivation comes from Harappa—(2500 B.C.) from where *Pisum arvense* has been reported. The second oldest record of legume cultivation is chick-pea or gram from Atranjikhera in U. P. dated 2000 B.C. and these are followed by many more authentic records of the cultivation of legumes varying in age from Neolithic period to Historic time.

INTRODUCTION

The history of Leguminosae and its early cultivation in the Indian subcontinent is largely derived from the palaeobotanical, archaeobotanical, ethnobotanical, pollen analytical investigations and ancient Indian literature. Until recently a large number of research papers have been published incorporating the data in regard to the occurrence of leguminous plant remains from various parts of the country right from the Palaeocene to the Recent time. Most of the early records of leguminous plant remains are known from megafossils while microfossils are poorly known. The fossil records so far discovered tend to suggest the antiquity of Leguminosae in India since the Palaeocene.

It is, however, not plausible to depend solely upon the pollen evidences while tracing the origin and history of any plant in particular or family in general. Palynologically, the family Leguminosae is eurypalynous and produces a very heterogenous assemblage of pollen grains. The sub-family Mimoseae having characteristic monads, tetrads and polyads, stands unique whereas sub-families Caesalpiniaceae and Papilionaceae produce such common types of pollen grains which are difficult to be differentiated from the pollen types of other families. In view of the above difficulties the megafossils, such as fossil woods, leaves, fruits and seeds have also been taken into consideration to trace the history of Leguminosae in India.

The object of this review is to present an outline picture of the history of Leguminosae in India. However, much attention has been paid to its cultivable forms as to know the food habits of our ancestors. To facilitate the study of the origin and occurrence of Leguminosae in India, the plant remains have been described separately under Pre-Quaternary and Quaternary periods.

Pre-Quaternary Records of Leguminosae

The first report of the occurrence of leguminous plant remains became known as early as 1954 when Carter reported the presence of leaflets and fruits comparable to *Acacia*,

Cassia and Hedysareae respectively from Deccan Intertrappean beds at Bombay. This was followed by the discovery of *Aeschynomene tertiara* from Mahurzari near Nagpur (PRAKASH, 1963).

Megafossil records of the family Leguminosae are quite abundantly preserved in the Cuddalore Series, Pondicherry (RAMANUJAM, 1954, 1960, 1961; RAMANUJAM & RAO, 1966; NAVALE, 1959, 1963; AWASTHI, 1967); Tipam and Dupitila Series of Mizo Ram and Arunachal Pradesh (CHOUDHURY & GHOSH, 1946; PRAKASH, 1965, 1966a, 1966b; PRAKASH & AWASTHI, 1971) which are believed to be Miocene to Pliocene in age. The scattered records of Leguminosae are also known from Siwaliks (RAWAT, 1964-65; LAKHANPAL & DAYAL, 1966). The important genera described from the above series are *Acacia*, *Aeschynomene*, *Afzelia*, *Adenanthera*, *Bauhinia*, *Cassia*, *Caesalpinia*, *Cynometra*, *Dalbergia*, *Millettia*, *Pterocarpus*, *Tamarindus* and Hedysareae. The details of the form genera have been cited in Table 1.

Table 1—Distribution of Leguminosae in India

TAXA	HORIZON	LOCALITY	REFERENCE	REMARKS
Hedysareae	Deccan Intertrappeans	Bombay	Carter, 1854	Fruit
Acacia	Deccan Intertrappeans	Bombay	Carter, 1854	Leaflet
Acacioxylon indicum	Cuddalore Series	Pondicherry	Ramanujam, 1954	Wood
A. bharadwaji	Cuddalore Series	Pondicherry	Navale, 1963	Wood
Cassia	Deccan Intertrappeans	Bombay	Carter, 1854	Leaflet
Cassioxylon barooahii	Tipam Series	Assam	Prakash, 1966a	Wood
C. variegatum	Cuddalore Series	Pondicherry	Ramanujam, 1960	Wood
Peltophoroxylon cassioides	Tipam Series	Assam	Prakash & Awasthi, 1970	Wood
Aeschynomene tertiara	Deccan Intertrappeans	Mahurzari, Nagpur	Prakash, 1963	Wood
Cynometroxylon indicum	Tipam Series; Cuddalore Series	Assam; Pondicherry	Chowdhury & Ghosh, 1946; Prakash, 1966a; Ramanujam & Rao, 1966	Wood
C. dakshinense	Cuddalore Series	Pondicherry	Navale, 1959	Wood
Adenantheroxylon pavoninum	Tipam Series	Assam	Prakash & Tripathi, 1969	Wood
Millettioxylon indicum	Cuddalore Series	Pondicherry	Awasthi, 1967	Wood
Albizzioxylon sahni	Cuddalore Series	Pondicherry	Ramanujam, 1960	Wood
Tamarindoxylon antiquum	Cuddalore Series	South Arcot, Madras	Ramanujam, 1961	Wood
Pterocarpoxylon arcotense	Cuddalore Series	Pondicherry	Ramanujam, 1960	Wood
Caesalpinioxylon sitholeyi	Cuddalore Series	Pondicherry	Ramanujam, 1954	Wood

Table 1—Contd.

C. feistmantali	Cuddalore Series	Pondicherry	Ramanujam, 1960	Wood
C. felixi	Cuddalore Series	Pondicherry	Navale, 1963	Wood
Pahudioxylon deomaliense	Tipam Series	Assam	Prakash, 1965	Wood
P. sahnii	Tipam Series	Assam	Prakash, 1966b	Wood
P. bankurensis		W. Bengal	Chowdhury, Ghosh & Kazmi, 1960	Wood
P. arcotense	Cuddalore Series	Pondicherry	Navale, 1963	Wood
Dalbergia sissoo	Siwaliks	Jwalamukhi, Himachal Pradesh	Lakhanpal & Dayal, 1966	Fruit
Dalbergioxylon antiquum	Cuddalore Series	Pondicherry	Ramanujam, 1960	Wood
Bauhinioxylon indicum	Siwaliks	Mohand, near Saharanpur, U. P.	Rawat, 1964-65	Wood
Leguminosae	Palaeocene	Shillong Plateau	Dutta & Sah, 1971	Pollen
Leguminosae	Miocene, Warkalli Lignites	Trawancore	Vimal, 1953; Banerjee, 1964; Ramanujam, 1966	Pollen
Acacia sp.	Tuffaceous limestones	Udaipur	Trivedi, 1959	Pollen
Acacia catechu	Pleistocene	Bombay	La Touche, 1910	Tree trunk
Desmodium sp.	Karewas	Kashmir	Puri, 1951	Leaf impression
Indigofera sp.	Karewas	Kashmir	Puri, 1951	Leaf impression
Indigofera sp.	Postglacial	Kashmir	Vishnu-Mittre & Sharma 1966; Sharma & Vishnu-Mittre, 1968	Pollen
Leguminosae	Pleistocene and Holocene	Kumaon Hills; Bengal; Himachal Pradesh and Assam	Gupta, 1966; Vishnu-Mittre *et al.*, 1967; Chanda & Mukherjee, 1969; Sharma, 1971 and Gupta, 1971	Pollen
Acacia	400 B.C.—300 A.D.	Sisulpalgarh, Bhubneshwar; Maski, Rangpur, Gujarat; Navdatoli-Maheshwar, M P.	Chowdhury & Ghosh, 1957; Ghosh & Chowdhury, 1957; Ghosh & Lal, 1962-63; Prakash & Awasthi, 1971.	Wood
Dalbergia latifolia	2300 B.C.	Harappa	Vats, 1940; Chowdhury & Ghosh, 1951	Wood
D. sissoo	1000 B.C.	Hastinapur	Chowdhury & Ghosh, 1954-55	Wood
Albizzia sp.		Rangpur, Gujarat	Vats, 1940; Ghosh & Lal, 1962-63	Wood
Pisum arvense L.	4000—3000 B.C. 1500—1000 B.C. 2500—1700 B.C. Historic pd.	Chirand, Bihar; Navdatoli Maheshwar; Harappa; Kundinyapur, M. P.	Vishnu-Mittre, 1972; Vishnu-Mittre, 1962; Vats, 1940; Vishnu-Mittre, 1966	Seeds

Table 1—Contd.

Lens culinaris Medik	4000—3000 B.C. 1500—1000 B.C.	Chirand, Bihar; Navdatoli-Maheshwar, M. P.	Vishnu-Mittre, 1972; Vishnu-Mittre, 1962;	Seeds
	E. Historic pd.	Ter, Maharashtra	Vishnu-Mittre, Prakash & Awasthi, 1972	
Lathyrus sativus L.	Neolithic 1500—1000 B.C.	Chirand, Bihar; Navdatoli-Maheshwar, M.P.,	Vishnu-Mittre, 1972; Vishnu-Mittre, 1962;	Seeds
	E. Historic pd.	Ter, Maharashtra	Vishnu-Mittre, Prakash & Awasthi, 1972;	
	Historic pd.	Kaundinyapur, M.P.	Vishnu-Mittre, 1966	
L. sphaericus Retz.	1500—1000 B.C.	Navdatoli-Maheshwar;	Vishnu-Mittre, 1962;	Seeds
	Historic pd.	Kaundinyapur, M. P.	Vishnu-Mittre, 1966	
Lathyrus sp.	1500—1000 B.C.	Navdatoli-Maheshwar	Vishnu-Mittre, 1962	Seeds
Phaseolus mungo L.	1500—1000 B.C.	,,	,,	Seeds
Phaseolus radiatus L.	1500—1000 B.C.	,,	,,	Seeds
Phaseolus sp.	E. Historic pd.	Ter, Maharashtra	Vishnu-Mittre, Prakash & Awasthi, 1972.	Seeds
Vicia sativa	1500 –1000 B.C.	Navdatoli-Maheshwar	Vishnu-Mittre, 1962	Seeds
Vicia tetrasperma	1500—1000 B.C.	,,	,,	Seeds
Dolichos biflorus L.	Neolithic; E. Historic pd.	Raichur-Bellary Doab; Ter, Maharashtra	Vishnu-Mittre, MS; Vishnu-Mittre, Prakash & Awasthi, 1972	Seeds
Medico denticulata	,,	Burzahom, Kashmir	Vishnu-Mittre, MS ..	Seeds
M. fulcata	,,	,,	,,	Seeds
Lotus corniculatus	,,	,,	,,	Seeds
Cicer arietinum L.	Neolithic; E. Historic pd;	Atranjikhera, U. P. Bhatkuli, Amaroati	Chowdhury, Sarswat, Hasan & Gaur, 1971; Vishnu-Mittre & Gupta, 1968;	Seeds
	Historic pd.	Ter, Maharashtra	Vishnu-Mittre, Prakash & Awasthi, 1972.	Seeds

The palynological evidence of the family Leguminosae is as old as Palaeocene. DUTTA AND SAH (1971) have recorded the presence of leguminous pollen from south Shillong plateau, Assam.

The Miocene record of leguminous pollen in India is largely incorporated from the publications of VIMAL (1953), BANERJEE (1964) and RAMANUJAM (1966). The pollen of *Acacia* have been reported from tuffaceous limestones near Udaipur (TRIVEDI, 1959) of which the age is quite disputable but based on the Gastropods the minimum age assigned is Tertiary (MURTY, 1955).

Quaternary Records of Leguminosae

The best known records of Early Quaternary Leguminosae are preserved in Karewas of Kashmir found at altitudes ranging from 2700—3500 m at Ningal Nullah, Laredura, Liddarmarg, Botapathri and other sites.

The repeated occurrence of leguminous woods such as *Dalbergia*, *Acacia* and *Albizzia* from archaeological sites all over the country indicates that besides fuel, *Dalbergia*, *Acacia* and *Albizzia* were considered as important commercial timbers.

As early as the beginning of the 19th century the tree trunks of *Acacia catechu* have been found in the excavations of the Prince's Dock, E. Bombay by La Touche (1910) and described by Pascoe (1964). Later on leguminous woods are reported from a good many archaeological sites (vide Table 1).

The palynological records of the family Leguminosae in the Pleistocene deposits of India are well preserved but hitherto not much work has been carried out except for Kashmir which has received considerable attention from time to time. These deposits in Kashmir largely comprise Karewas and vary in age from first Interglacial to Holocene period. The pollen grains of *Indigofera* are encountered from the Post-glacial deposits in Kashmir at Haigam Lake (Vishnu-Mittre & Sharma, 1966); Baba Rishi and Yush Maidan (Sharma & Vishnu-Mittre, 1968).

The leguminous pollen from other parts of the Indian sub-continent have been reported from Naukuchiya Tal and Bhim Tal in Kumaon Hills, (Gupta, 1966; Vishnu-Mittre, *et al.* 1967); from Bengal (Chanda & Mukhrjee, 1969), from Himachal Pradesh (Sharma, 1971) and from Assam (Gupta, 1971).

Agricultural Records of Legumes

Domestication of animals, pit dwelling and cultivation of food grains was probably conceived in the Early Neolithic Period. The earliest records of food habits of the ancient people come from Chirand, Bihar; Mohenjo-Daro and Harappan excavations from where besides other food grains *Lens culinaris* and *Pisum arvense* have been recovered. The carbonized food grains of Leguminosae are also known from a good many archaeological sites (vide Table 1).

Literary Records

The radio-carbon assay has proved that the Neolithic culture took place in different times in various parts of the world. The earliest reference of agriculture comes from the old world in N. Syria about 8000 B.C. (Van Zeist & Casparie, 1968). To about 6000 B.C. the Neolithic culture reached its maximum in Western Asia comprising W. Iran, Anatolia, Iraq, Palestine and Mesopotamia and this belt is considered to be a fertile crescent and perhaps India was lying at its periphery.

The Neolithic culture in India persisted between *C* 2300—900 B.C. and most of the information has been gathered from Sanskrit treatises.

During the period of Upanisads and Sutras (800 B.C. to 300 B.C.), besides other food articles the cultivation of legumes and their various uses were quite known to the early people.

The economic and medicinal uses of some leguminous trees such as *Acacia catechu* and Kachnar (*Bauhinia variegata*) is referred to in the *Ramayana* and the literature written subsequent to *Ramayana*, the *Arthasastra*, the *Brihatsamhita*, the *Silappadikaram* and the *Pathupadikam*. *Dolichos lablab* and *D. biflorus* are repeatedly mentioned in the above mentioned

literature. About 1550 A.D. mercury in the form of catechu was frequently administered to patients suffering from a disease described to become leanness and weakness, sinking down of nose and, loss of appetite, dry and crooked bones (BHAVA MISRA). Between 1300—1500 A.D., the acids for medico-chemical purposes were mainly derived from *Cicer arietinum* (JAGGI, 1966).

About 6th Century A.D., KHANNA an ancient agriculturist has mentioned that if rain occurred in Phalgoon (February-March) gram grows very abundantly. As regards sowing and planting KHANNA says "By sowing *Phaseolus radiatus* (Kalai) in last four days of Bhadra (August-September) and first four days of Aswin (September-October) one gets full harvest. Pea is suggested to be sown after the first 19 days of Aswin (September-October) and within the 19 days of Kartik (October-November).

GODE (1945, 1946) has traced the history of *Canaka* (gram) as food for horses between A. D. 800 and 1870. A comparative account of the use of *Canaka* (gram) as horse food vouched by five Sanskrit treatises on the *Asvasastra* is also presented by GODE (1946).

Asvayrveda of Vagbhata, son of Vikrama before A. D. 1000 mentions *Yava* and gram as food for horses in the Himalayas and south of the mountains respectively.

Asvacikitsa of Nakul (before A. D. 1000) while referring to the Arabian and Khorasan as best horses also mentions *Yava* and gram as best and second best food for horses. Between 800—900 A.D. *Agripurana* refers gram as food for horses.

Atvavaidyaka of Jayadatta mentions Arabian and Persian horses as the best and gram as their food. *Rajanighantu* of Narahari (A. D. 1450) mentions gram as food for horses.

DISCUSSION

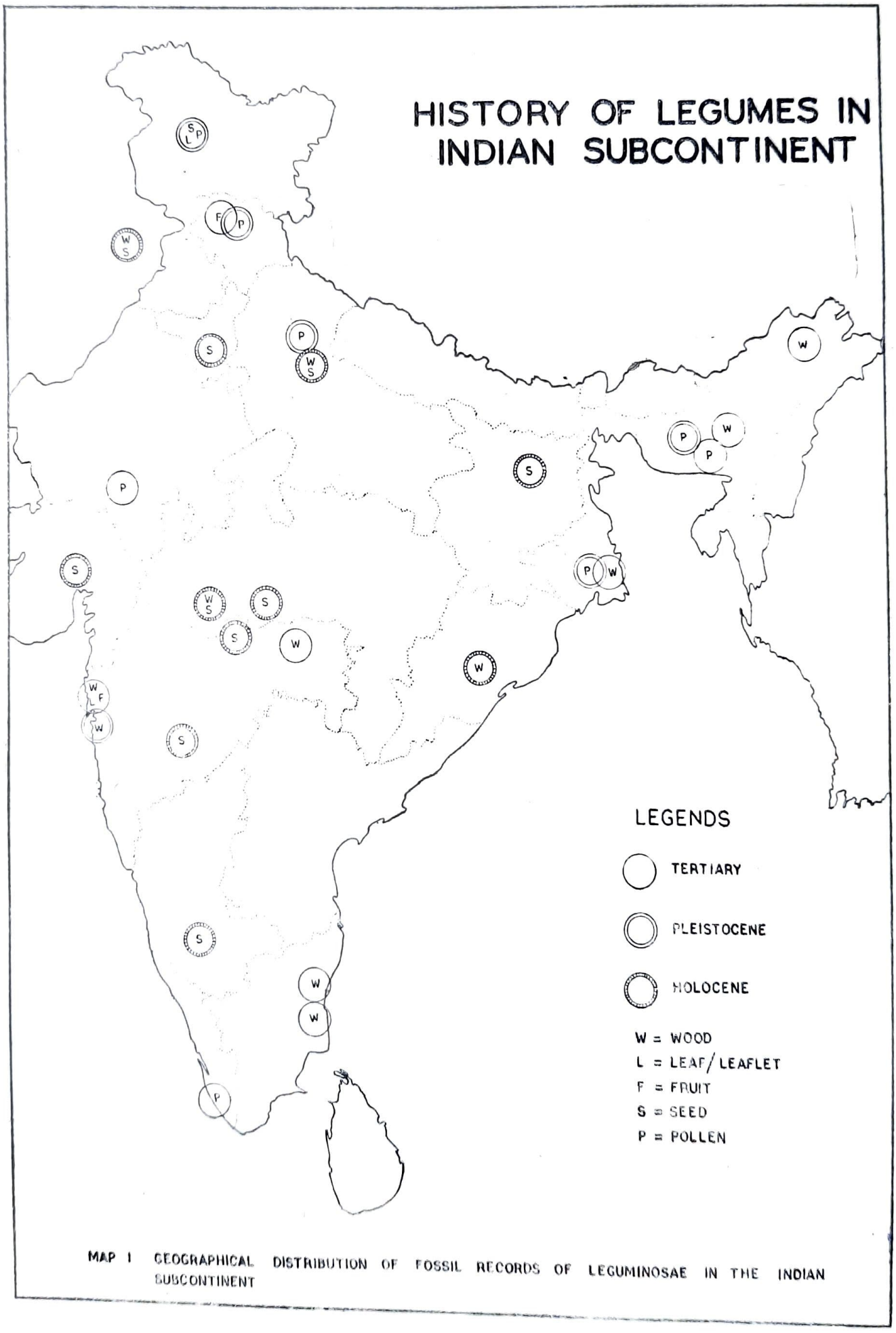
The Palaeobotanical and palynological records so far unearthed from the Indian sub-continent give a glimpse of the origin of Leguminosae during Early Tertiary Period and more particularly during the Eocene epoch.

Hedysareae, *Acacia*, *Cassia* and *Aeschynomene* are the oldest legumes to have been known in India and belong to Early Eocene. The Tertiary records of Leguminosae are mostly distributed in south-east and west of India (Map 1).

Fossil records of Leguminosae are chiefly known from Tippam and Dupitila Series of Mizo Ram and Arunachal Pradesh and the Cuddalore Series in South India. The Eocene records of Leguminosae are very meagre. Either the Eocene of India is devoid of complexity of Leguminosae or it has not been worked out thoroughly. However, from the information so far available it is assumed that the Miocene Period had the most suitable environment particularly conducive to the luxuriant growth of the members of family Leguminosae.

The cultivation of legumes perhaps started during Neolithic Period. *Pisum arvense* is the oldest legume to have been cultivated during 2500 B. C. in Harappa and thereafter it is known from Chirand, Bihar; Navdatoli-Maheshwar, M. P.; Khokhrakot, Rohtak and Ter, Maharashtra. The chick-pea or gram is the next oldest legume dating from about 2000 B. C. in Atranjikhera, U. P. The early historic records ranging from 150 B. C. to 200 A. D. are from Maharashtra. *Dolichos biflorus* has been in use since 1780 B. C. *Phaseolus mungo*, *Ph. aureus*, *Lens culinaris* and *Lathyrus sativus* have been in use between 1660 B. C.—1440 B. C.

Seeds of leguminous weeds such as *Medicago denticulata*, *M. falcata* and *Lotus corniculata*



MAP 1 GEOGRAPHICAL DISTRIBUTION OF FOSSIL RECORDS OF LEGUMINOSAE IN THE INDIAN SUBCONTINENT

are known from Burzahom, Kashmir and dated to 2300—1500 B. C. *Lathyrus sphaericus*, *Vicia sativa*, *V. tetrasperma* are known since 1660 B. C. in Madhya Pradesh.

From a perusal of Indian literature it seems that agriculture was perhaps initiated during 4000 B.C. but the cultivation of leguminous plants is very recent. In the absence of any reference of Leguminosae in ancient Indian literature and in the lack of wild leguminous progenitors growing in India, one can visualize that either they are introduced in India or their wild progenitors have been naturalized.

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