

Indian Pulses Through the Millennia¹

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Abstract

Pulses, the food legumes, have been grown by farmers since millennia, and these have contributed in providing nutritionally balanced food to the people of India. While pigeonpea, black gram, green gram, lablab bean, moth bean, and horse gram have definitely originated and domesticated in the Indian subcontinent, there is a probability that chickpea and lentil (Indian type) were also domesticated in the Indian subcontinent. Pea, grass pea, and cowpea were introduced in India millennia ago. Only faba bean was introduced in medieval times. This paper briefly describes how the pulses constituted an important item of food, how these were cultivated, and how food preparations evolved.

Though substantial progress has been made in evolving techniques to obtain high yields of pulses, their production per hectare has remained the same for the last two centuries. Lessons learned from this review have been listed.

Pulses have been grown since millennia and have been a vital ingredient of the human diet in India. Even “balanced food” – as defined over 1000 years ago – consisted of pulses, besides cereals, vegetables and fruits, and milk products (Ayachit, 2002). Today, nutritionists tell us that pulses are important because they provide the essential proteins.

Mankind began as a carnivorous species (and still is), but people who wanted to avoid killing animals for food, found out the utility of milk and milk products, and thus obtained nourishment with proteins of animal origin. Even today, pulses and milk provide the full complement of proteins to people who avoid eating meat.

Including broad bean or faba bean (*Vicia faba*), which never became popular except in some areas, India has been growing 12 different pulse crops (Fig. 1). The others are: chickpea (*Cicer arietinum*), pigeonpea (*Cajanus cajan*), lentil (*Lens culinaris*), black gram (*Vigna mungo*), green gram or mung bean (*Vigna radiata*), lablab bean (*Lablab purpureus*), moth bean (*Vigna aconitifolia*), horse gram (*Dolichos uniflorus*), pea (*Pisum sativum* var. *arvense*), grass pea or *khesari* (*Lathyrus sativus*), and cowpea (*Vigna unguiculata*).

Any discussion on the history of a crop usually begins with the currently held view about its geographical origin and domestication (Table 1).

Conclusions regarding the origin and domestication of these major pulses have been drawn by plant explorers and botanists on the basis of three main criteria – archaeological findings, presence of wild relatives of a species in a region, and available documentation. All these three criteria suffer from severe limitations. For example, one could ask a simple question, “How extensive have been the archaeological investigations?” Botanists have jumped to conclusions too often, and one extreme example is that of the finding of a single carbonized seed, which looked like pigeonpea, in an Egyptian tomb (2400–2200 BC) leading to the claim that pigeonpea originated in Eastern Africa (van der Maesen, 1990). A similar question can be asked about the findings of wild species, because the exploratory expeditions have been too few, covering some regions more thoroughly than others. Available documentation the world over of course is limited.

1. A part of this paper was presented as an invited lecture at the International Food Legumes Research Conference – IV on 18 October 2005 at Indian Agricultural Research Institute (IARI), New Delhi, India. Since then chronology of Vedic literature has been modified.



Desi chana (Cicer arietinum, chickpea)



Kabuli chana (Cicer arietinum, chickpea)



Masur (Lens culinaris, lentil)



West Asian lentil (Lens culinaris, masur)



Tur (Cajanus cajan, pigeonpea, arhar)



Urd (Vigna mungo, black gram)



Mung (Vigna radiata, green gram)



Sem (Lablab purpureus, lablab bean, vaal)



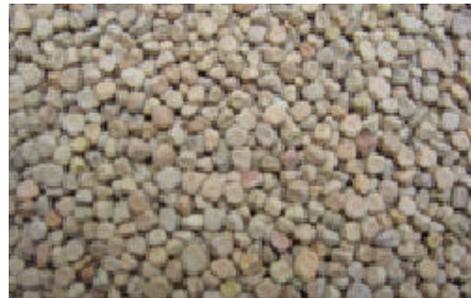
Moth (Vigna aconitifolia, moth bean)



Kulthi (Dolichos uniflorus, horse gram)



Matar (Pisum sativum, pea)



Khesari (Lathyrus sativus, grass pea)



Lobia (Vigna unguiculata, cowpea, chowli)



Baqla (Vicia faba, faba bean) grows wild in Pantnagar area

Figure 1. Various pulses grown and consumed in India (above and facing page).

This paper discusses all the food legumes listed above, which are major crops not only in India, but also in other parts of the world. For each pulse, the origin and domestication are outlined, and the agronomy, yield, markets, and utilization are discussed in the historical perspective.

Table 1. Geographical origin and domestication of various pulses grown in India.

Crop ¹	Geographical origin and domestication
Chickpea (<i>Chana</i>)	Turkey-Syria
Pigeonpea (<i>Tur, arhar</i>)	India
Lentil (<i>Masur</i>)	Southwest Asia (Turkey-Cyprus)
Black gram (<i>Urd</i>)	Indian subcontinent
Green gram (<i>Mung</i>)	Indian subcontinent
Lablab bean (<i>Sem, vaal</i>)	Indian subcontinent
Moth bean (<i>Moth</i>)	Indian subcontinent
Horse gram (<i>Kulthi</i>)	Indian subcontinent
Pea (<i>Matar</i>)	Southern Europe
Grass pea (<i>Khesari</i>)	Southern Europe
Cowpea (<i>Lobhia, chowli</i>)	West Africa
Faba bean (<i>Baqla</i>)	West Asia

1. Names in parentheses are in Hindi.

Chickpea (*Cicer arietinum*)

Origin

As mentioned earlier, it is claimed that chickpea originated in the Turkey-Syria region and then spread eastwards towards South Asia. According to van der Maesen (1987), there are more than 30 wild species (the number now stands at around 40), of which 13 perennial species are found in the Afghanistan-Pakistan-India region. An annual species, *Cicer reticulatum*, which is considered to be the progenitor of the cultivated chickpea, has not yet been found in the Afghanistan-Pakistan-India region; however, one cannot rule out the discovery, in the future, of the presence of *C. reticulatum* or another annual species “close” to the *desi* chickpea.

Domestication

It is usually a matter of speculation that the presence of wild species of a domesticated species in a geographical area indicates the origin of the latter, as also its domestication. Accordingly, West Asia is claimed to be the region where chickpea was domesticated. Let us look at the documented history of chickpea in India. The Vedas (Rigveda, Yajurveda, Samaveda, Atharvaveda) were compiled between c. 8000 and c. 1000 BC. A commentary on the Rigveda, called *Brahadaranyaka* (c. 5500 BC), mentions a grain called *khalva*. The Yajurveda (c. 7000 BC), which followed the Rigveda, specifies *khalva* as a pulse (Sudarsan Sarma, 1989). There is a large gap in documentation since the time when the Brahmanas, Aranyakas, and Upanishads (c. 6000–1000 BC) were compiled. However, we find that Kautilya (321–296 BC) mentions *kalaya* as a postrainy season crop that is consumed in various ways including the roasted form (Shamasastri, 1961). We should realize that even today chickpea in roasted form is consumed much more commonly than any other pulse. The word *kalaya* has a striking resemblance to *khalva*, and very similar words are used today for chickpea in Karnataka (*kadale*) and Kerala (*kadala*). In the Buddhist literature (c. 400 BC), the word *chanaka* for chickpea gained popularity, and today most Indian languages, except Marathi, have words for chickpea derived from *chanaka*. There existed another old Sanskrit word for chickpea. It was *harimanth* (*hari* = horse; *manth* = agitating/chewing); chickpea grain has been fed to horses since ancient times. Today, the word in Marathi for chickpea is *harbhara*, which closely resembles *harimanth*, and has a similar meaning.

According to van der Maesen (1987), the Greek word *erebinthos* was mentioned in the *Iliad* of Homer (c. 1000–800 BC), but Theophrastus (370–285 BC) specified it for chickpea. Alexander III of Macedon (336–323 BC), who invaded northern India in 326 BC, was a contemporary of Theophrastus. It is easily possible that the Sanskrit word *harimanth* was corrupted, during the Greek-Indian interaction, to the word *erebinthos*. The common Greek word for chickpea is *krios*, meaning ram's head, indicating the resemblance of chickpea to a ram's head.

By the time Theophrastus specified the word *erebinthos* for chickpea, the *desi* chickpeas had become a very common crop in India. I would therefore like to question the claim made in literature that the domestication of chickpea occurred in West Asia.

Agronomy

Kautilya (321–296 BC) mentions the treatment of pulse seeds before sowing (Shamasastri, 1961), which consisted in exposing the seed to the dew for 3–5 nights, while allowing it to dry subsequently in the sun during the day. It is well known that such a treatment should loosen the seed coat and possibly kill the propagules of potential pathogens on or in the seed. Kashyapa (800 AD) states that pulses are grown without irrigation (Ayachit, 2002). Kashyapa also mentions two kinds of varieties – large-seeded and small-seeded – and that the large-seeded varieties are to be sown in lines. Small seeds are moistened and broadcast before sowing. During the Sultanate period (1206–1555 AD) in India's history, seeds were soaked for 24 hours in warm water before sowing (Naqvi, 1984). This procedure was also recorded by a Mughal Prince Dara Shikoh (c. 1650) to produce 'bigger' seeds at harvest (Razia Akbar, 2000). Watt (1889) recorded large (reddish or black), small (light brown), and white ("cabuli") seeds in northern India and Pakistan; the "cabuli" were rare. We find the earliest mention of *cabuli* chickpea in *Ain-i-Akbari*, in c. 1590 AD (Blochmann, 1873). Traders coined the word *desi* to describe non-white seed varieties apparently only in the 20th century.

In the *Kashyapiyakrishisukti*, Kashyapa (800 AD) clearly mentions interculture operations in the pulses of post-rainy season (Ayachit, 2002). According to Kashyapa, weeding should be done about one month after sowing, and, interestingly, manure (obviously cow dung manure) should be mixed with the soil near plant roots. Leaf senescence and pods would be seen three months after sowing. Maturity of seeds depends on varieties and the method of interculture. Kashyapa clearly indicates varietal adaptation; that is what we describe today as genotype × environment interaction.

During Alauddin Khilji's time (1296–1316 AD), an interesting crop rotation was followed in northern India (Lal, 1980) – black gram and moth bean in the rainy season, followed by wheat or barley in the post-rainy season. The land was then left fallow in the rainy season, but followed by chickpea in the post-rainy season. This is a good example of a cereal-legume crop rotation.

Buchanan (1807) recorded (i) considerable chickpea crop mixed with safflower in the Andhra Pradesh-Karnataka border areas, and (ii) chickpea crop followed by a harvest of rice or finger millet. Buchanan also mentions that chickpea grows well on soils endowed with residual moisture, a fact that is common knowledge today.

Watt (1889) recorded sole as well as mixed chickpea (with wheat or barley), or chickpea on fallow lands in Uttar Pradesh, India. Some farmers from Maharashtra (India) and from Pakistan perceived that chickpea enriches the soil and also "kills" weeds. To reduce the possibility of excessive vegetative growth, cattle were allowed to graze on plants in Pakistan, while mechanical 'detopping' was done in Uttar Pradesh for the same purpose. Watt also recorded a perception of Pakistani farmers, which holds true even today, that lightning and thundershowers injure chickpea, a clear reference to the *Ascochyta* blight epidemic that is favored by these weather conditions.

Yields and markets

Unfortunately, ancient documents give very little information on yields per unit area. This is due to many reasons, such as (i) the measurement of land varied in different periods and in different regions; (ii) weight measurements were rarely done; (iii) volumetric measurements, such as number of bags per unit area, were common, but lacked

uniformity; and (iv) commercial commodity farming was rarely the goal; the produce was consumed by the farming families and fed to the domestic animals, and only the surplus was marketed. In addition to these reasons, a millennium of political turmoil in India, after 900 AD, discouraged farmers from making any effort to increase the productivity of land. It is only after the British gained political control of the Indian subcontinent, and aimed at exploiting the resources of the region to strengthen the empire, that we begin to see definite data on yields. Watt (1889) recorded the following information:

1. Uttar Pradesh: Non-irrigated, 460–750 kg ha⁻¹ (sole), 550–830 kg ha⁻¹ (mixed);
Irrigated, 1100 kg ha⁻¹ (sole), 1300 kg ha⁻¹ (mixed)
2. Central India: 1000 kg ha⁻¹
3. Gujarat: 1120 kg ha⁻¹
4. Maharashtra: 740 kg ha⁻¹

It is interesting to note that in Uttar Pradesh, yields of chickpea from a mixed crop were higher than the sole crop yields. One reason could be that chickpea used to be mixed usually with a cereal crop such as wheat that had received manure, which in turn could have benefited chickpea. On the other hand, yields of the sole crop were low because these were rarely manured.

The *Ain-i-Akbari*, which was written around 1590 AD, gives interesting and useful information on market prices of chickpea (Blochmann, 1873). The *kabuli* chickpea cost twice as much as the *desi*, and it was 33% more costly than wheat. The *kabuli* chickpea and the green gram dhal were sold at the same price, thereby showing a high demand for the green gram dhal. Chickpea flour, because of value addition, was sold at par with wheat. I have not given actual prices, since the units of both weight and money were very different in those times.

Storage

We find the same descriptions for all pulses. These were stored in large pots, their borders and inner walls were smeared with oil, and ash was spread all around the pots (Risala-Dar-Falahat c. 1400 AD; Majumdar, 1984). Apparently, ash and oil were commonly used by the Romans (Orlob, 1973), and the technique must have spread to India through West Asia, because I have so far not come across the use of oil and ash to protect stored grain in any of the ancient Indian texts. During the Sultan period (1206–1555 AD), grain was stored by mixing with pounded bones of elephants and also by placing leaves of pomegranate and *Lactuca* sp. with the grain, in a ratio of 1 part leaves to 100 parts grain (Naqvi, 1984). Again, I must point out that I have not read about the practice of placing leaves (e.g., neem) so far in any of the ancient Indian texts.

Food

Chickpea serves as food in many ways. The cooked dhal, called *soopah* (soup) in Sanskrit, constituted a common food item. We find it mentioned by Charaka (c. 700 BC), who states that chickpea soup has good food value and that it helps in the recovery from spleen and liver disorders (Vidyalankar, 1994). Susruta (400 BC) mentions the cooking of chickpea in various forms: leaves (as vegetable), green seeds, dry whole seed, and flour (Krishnamurthy, 1991). A common food since the time of the Rigveda (c. 8000 BC) was the 'instant' food *sattoo*, made by preparing flour from roasted chickpea and barley or wheat, and mixing it in milk or water with some cane jaggery. Roasted chickpea enabled hungry people to survive under adverse conditions such as wars (Khan, 1982). The collection of acids from chickpea leaves for medicinal use (digestion; cooling effect) was mentioned by Vagbhatta II around 800 AD (Gode, 1961). The practice of collecting acids from leaves is unique to the Indian subcontinent.

Feed

As pointed out before, chickpea grain has been fed to horses since ancient times. Likewise, seed hulls were fed to cattle, a practice that continues to this day. Elephants were also given chickpea grain

(Gode, 1961). The Manasollasa (1131 AD) mentions chickpea flour as fish feed, and the grain as feed for buffaloes (used in fights) and boars (Gode, 1961; Sadhale and Nene, 2005).

Pigeonpea (*Cajanus cajan*)

Origin

After some debate about its origin in Africa or India, it is now generally agreed that the most likely region where pigeonpea originated is the Eastern Ghats in the Indian subcontinent. The most probable progenitor of pigeonpea, *Cajanus cajanifolia*, is found in India in addition to about 17 *Cajanus* species. Some 13 wild species are found in Australia and one in Africa (van der Maesen, 1990).

The Latin name *Cajanus cajan* came from the Malay word *cachang*, which in turn was a corrupt form of the Telugu word *kandi*. The Telugu word has its origin in the Sanskrit word *kaand* (a stem), a reference to the long stem of the pigeonpea plant.

Domestication

The oldest Sanskrit word for pigeonpea seems to be *adhaki*; both Charaka (c. 700 BC) and Susruta (c. 400 BC) have used the term *adhaki* (Krishnamurthy, 1991; Vidyalankar, 1994). We find the same name *adhaki* in the Buddhist and Jain literature (200 BC–300 AD), and in subsequent writings until the 16th century. Kautilya (Shamasastri, 1961) does not mention *adhaki*; however, in the Arthashastra, there is a word *udaara*, which means a sort of grain with long stalks, and *daara* means to split. I would like to suggest that Kautilya used the word *udaaraka* for pigeonpea (Kangle, 1982). Amarsimha (c. 200 BC), in his lexicon *Amarkosa*, mentions *adhaki*, *kakshi*, and *tuvarika* as names of pigeonpea (Jha, 1999). Bhavamisra (16th century) adds yet another word *shanapushika*, probably because the yellow flowers of pigeonpea resemble those of the sunn hemp (Chunekar and Pandey, 1998).

The word *adhaki* originated most likely from the word *ardha*, meaning ‘one-half’ or ‘split into two parts’. Dry whole pigeonpea seed is rarely consumed; only the dhal is commonly eaten. One of the two common names used for pigeonpea in the Indian subcontinent is *arhar*. It is logical to assume that *arhar* is a corrupt form of *adhaki*. The second common name for pigeonpea is *tuvara*. In Sanskrit, *tuvara* or *tubara* means astringent. The green seed, which has been consumed in Gujarat for centuries, has an astringent taste. This, therefore, might have led to the word *tuvara* and its variants, *tuvarika*, *turri*, *tur*, etc. It is interesting to note that the word *arhar* is common in northern India, and *tuvara* (with variants) in southern India. The Sangam literature of the Tamil people (100 BC–300 AD) does not mention pigeonpea, indicating that it found a place in Tamil kitchens in the later centuries (Achaya, 1998). The Ain-i-Akbari (1590) does not mention pigeonpea (Blochmann, 1873). Akbar was essentially a “Punjabi” and pigeonpea even today does not figure in the common man’s diet, either in the Indian or in the Pakistani Punjab.

Agronomy

Kautilya (321–296 BC) mentions the sowing of *udaaraka* with the onset of the rains (Shamasastri, 1961). Kashyapa (800 AD) states that ‘the science recognizes large and small varieties’; the large-seeded types are sown in lines, both in irrigated and rainfed lands (Ayachit, 2002). He also mentions that excess rain after the sowing damages the sown seed. We find a reference to a black-seeded pigeonpea (*krishnadhaki*) in the *Sivatatvaratnakara* by Raja Keladi Basavaraja (17th century) of Shimoga, Karnataka (Achaya, 1998). Buchanan (1807), who traveled extensively in southern India, mentions line sowing as well as broadcast sowing. For line sowing, a seed drill called *curigay* was used. In Karnataka, pigeonpea was intercropped with *Panicum miliare* (*kutki*; *samai*). Watt (1889) mentions two varieties – normal and early by two months – in Raipur (now in Chhattisgarh state), as well as large- and small-seeded varieties in the Mysore region (Karnataka). Kashyapa (800 AD) mentions a 3-month crop, information similar to that given for chickpea (Ayachit, 2002). This indicates the availability of short-duration landraces, at least during the time when pigeonpea was grown at latitudes 18–22° N in eastern India. Watt (1889) repeatedly states that pigeonpea was

cultivated not only as a subordinate crop with sorghum, pearl millet, cotton, etc., but also as a sole crop in some parts of Uttar Pradesh. In Central India (Maharashtra and Madhya Pradesh), one row of pigeonpea was grown with 5 rows of cotton; a practice that continues even today with some variations. Watt describes frost to be the chief ‘enemy’ of the crop in northern India, but also mentions that the manured crop withstands frost. Watt further mentions a 4-month crop in Thane (near Mumbai) and that the pod borer was controlled manually. Early morning, when the caterpillars are rather quiet, the plants were shaken, worms collected in baskets, and then destroyed by burying.

Yields and markets

Again, only limited information is available. Watt (1889) mentions an average of 645 kg ha⁻¹ in Uttar Pradesh, with a range from 100 kg to 1480 kg ha⁻¹. This clearly points to the crop management as the key factor that holds well even today. CSIR (1950) mentions an average yield of 767 kg ha⁻¹ in Bihar in 1935–36. Methods of storage were similar to those described for chickpea, i.e., use of leaves, ash, and oil.

Food and feed

Since the ancient times, pigeonpea seed was split and decorticated for preparing soup or dhal; dilute dhal was cooked to go with rice, and thick dhal to go with flat bread (*chapati*) made from cereal flour. Pigeonpea has been used in preparing very few dishes in contrast to chickpea. The dehulled material leftover after obtaining dhal has all along been fed to cattle. It is a valued feed. Ayurvedic treatises since the time of Charaka (c. 700 BC) mention that pigeonpea dhal has properties of purifying the blood and improving the complexion (Vidyalankar, 1994). Its flatulence-causing property has also been documented.

Lentil (*Lens culinaris*)

Origin

It is generally stated that the lentil originated in the Turkey-Cyprus region (Southwest Asia) and that South Asia is a center of diversity (Cubero, 1981). It is claimed that the archaeobotanical remains of lentil were found in the excavations covering the period of the so-called Harappan civilization (3300–1300 BC) (It was in reality a period in the Indus-Saraswati civilization). The truth is that these claims are based on very few studies.

The Latin name of lentil is *Lens culinaris*, the genus name *Lens* meaning ‘lens’ in English, suggestive of the lens-like shape of the lentil seed. *Lens orientalis* is considered to be the progenitor (Zohary, 1973). Most of the West Asian lentils have a flattened lens-like appearance. On the other hand, both sides of most South Asian lentils have a convex shape. Thus the Sanskrit word *masura* for lentil seems most appropriate – the word *masura* means a pillow in Sanskrit. It is interesting to note that the Turkic word for lentil is *mercimek*, and an Old Persian word was *marjunak*, both phonetically close to *masura*. Today, *adas* is the word for lentil in both Arabic and Persian. Another interesting fact is that all languages of India have derivatives of the name *masura* for lentil. Another Sanskrit word for lentil was *mangalya*, which connotes resemblance to the planet Mars or *Mangal* in Sanskrit.

Domestication

Archaeological investigations have revealed the presence of lentil as far back as 8500–6000 BC in the Turkey-Syria-Iraq region. It is speculated that the lentil spread from the Turkey-Iraq region to the Nile, Greece, central Europe and eastwards to South Asia. A speculation made by the Swiss botanist Alphonse de Candolle in 1882 makes interesting reading. He states, “It may be supposed that lentil was not known in this country (India) before the invasion of the Sanskrit-speaking race” (Cubero, 1981). Recent studies have convincingly proved that the so-called Aryan invasion of India had never

occurred. We need to have a fresh look at the subject of ‘domestication of crops’, at least those crops that have been grown in the subcontinent for millennia. *Masura* has been mentioned in the *Brahadaranyaka* (c. 5500 BC), a commentary on the Rigveda (c. 8000 BC) and also in the Yajurveda (c. 7000 BC). We find the same word *masura* for lentil written by Charaka (c. 700 BC), Susruta (c. 400 BC), Kautilya (c. 321–296 BC), and by later authors.

Agronomy

Documents written during the Sultan period (1206–1555) describe seed dressing with cow dung to ensure faster plant growth and high yields. This is clearly an influence of the ancient Indian practice (Nene, 1999). Another seed treatment mentioned was soaking seeds in bird droppings before sowing (Naqvi, 1984). The time for sowing has been indicated as the postrainy season in most documents, starting with that of Kautilya (c. 321–296 BC). The lentil crop was sown mixed most often with wheat, barley, horse gram, or chickpea. The other agronomic practices mentioned are similar to those prescribed for chickpeas.

Yields and markets

Watt (1889) mentions an average yield of 740 kg ha⁻¹, when grown on residual moisture, and 1110 kg ha⁻¹, when grown with irrigation. The lentil crop was grown all over India, but much more in Central India and Bengal (India and Bangladesh). The Ain-i-Akbari (1590) mentions that lentil was as costly as wheat, and that lentil dhal was priced 33% higher than wheat (Blochmann, 1873).

Food

Lentil seeds, with or without hulls, are cooked as dhal and this has been the main dish for millennia in the South Asian region. Ayurvedic treatises consider lentil to be a highly nutritious pulse, second only to the green gram or mung bean. It is also claimed to be a blood purifier. One of the common usages has been to get rid of old skin marks by the application of lentil paste. There are sects in India who do not include lentils in their food, probably because of the red color resembling flesh. For example, Kashyapa (800 AD) does not mention lentil in his treatise (Ayachit, 2002).

Black gram (*Vigna mungo*) and green gram (*Vigna radiata*)

Origin and domestication

India has been universally accepted as the original home of these two pulse crops. While green gram spread to many countries, especially in tropical and subtropical Asia, the black gram has remained more or less confined to South Asia. Currently, the green gram is being grown in USA. The progenitor of both black and green grams is believed to be *Vigna trilobata*, which grows wild in India. It has a Sanskrit name *mudgaparni* (literally meaning plant having leaves like those of mung bean or green gram). Another Sanskrit name, *mashparni* (leaves similar to those of *mash* or black gram) exists in the literature for *Vigna dalzelliana*.

The Latin names for green gram and black gram are *Vigna radiata* and *Vigna mungo*, respectively. It is unfortunate that green gram, which is widely known as mung bean, was not named *Vigna mungo*, thereby creating an avoidable confusion for which William Roxburgh, the botanist is responsible (Watt, 1889). It is difficult for me to understand why present-day plant taxonomists, who so frequently change names of species, continue with the current confusion. I wish Indian plant taxonomists today picked up enough courage to rename mung bean (green gram) as *Vigna mungo* and propose another name for black gram, and use these names. This historical taxonomic nonsense must end.

Since ancient times, the Sanskrit name for green gram has been *mudga* from which *mung* has been derived, and all North Indian languages have derivations of the word *mung*. In most South Indian languages, names for green gram relate to the Tamil name, *pasipayir*. However, it is called *hesaru* in Karnataka.

For black gram, the ancient Sanskrit name is *masha*. Even today in Punjab, black gram is called *mash* and in West Bengal, it is called *mash kalaya*. In all other Indian languages, the name *urad* is used, which seems to have originated from the Tamil word *ulundu*.

Masha (black gram) has been mentioned in the *Brahadaranyaka* (c. 5500 BC), in the Mahabharata (c. 2000 BC), in the *Krishni-Parashara* (400 BC; Sadhale, 1999), and in the later literature. The *mudga* (green gram) has been mentioned in the Yajurveda (c. 7000 BC).

Seed and sowing

Kautilya's Arthashastra (321–296 BC) mentions preservation of seed for sowing in the next season. As pointed out earlier, the seed for sowing was to be exposed to dew and sunlight for 3–5 days (Shamasastri, 1961; Nene, 1999; 2002). In the medieval Sultanate/Mughal period (1206–1650 AD), it was specified that seed should be mixed with cow dung for faster seedling growth and ultimately for higher yield (Naqvi, 1984). Majumdar (1984) reported a 14th century practice of soaking black gram seeds in bird droppings before sowing to ensure faster growth. In the 16th century text *Bhavaprakash Nighantu* (Chunekar and Pandey, 1998), and also in Watt (1889), it is mentioned that there were green, yellow, red, or black-seeded “varieties” of green gram; and black (large), brown, or green (small)-seeded “varieties” of black gram. It is also mentioned that many “varieties” had an intermediate color range.

Crops in field

Kashyapa mentioned line sowing as early as in 800 AD (Ayachit, 2002). Kashyapa also recommended weeding to be done a month after sowing, to be followed by a top dressing with manure. He reported leaf senescence after about three months, indicating that the crop was approaching harvest. Additional information given under pigeonpea earlier applies to both green gram and black gram. Watt (1889) recorded a few interesting practices and observations of farmers. Broadcasting was the common method of sowing these as intercrops in the Punjab. These were grown extensively as “subordinate” crops to millets or cotton. These crops do not impoverish the soil “in any case to the extent cereals do”. A variety of black gram called *mugi* was most frequently grown as a mixed crop with pearl millet in the Punjab. These crops were intercropped with finger millet in Andhra Pradesh and Tamil Nadu. Three varieties were grown in Bengal (*Sona*, *Krishna*, and *Ghora*, possibly referring to the golden, dark, and whitish seed color, respectively). These crops were grown in the post-rainy season in southern India. Black gram thrived better than green gram in heavier soils. Black gram suffered from mildew (*Cercospora* leaf spot?) under damp weather conditions, and an insect pest attacked pods in the Punjab. Sheep manure was used for black gram in Andhra Pradesh and Tamil Nadu.

Yields, markets, and storage

It is only in a 19th century document (Watt, 1889) that we find precise yield data on these two crops. Yields of black gram in Andhra Pradesh and Tamil Nadu were around 800 kg ha⁻¹. Yields of green gram were 500 kg ha⁻¹ in the Central Provinces (Madhya Pradesh and Maharashtra) and 550 kg ha⁻¹ in Andhra Pradesh and Tamil Nadu.

The Ain-i-Akbari of 1590 AD (Blochmann, 1873) mentions black gram price to be 50% of that of wheat. The green gram dhal was costlier than chickpea and lentil dhals, indicating higher demand or less supply. Black gram dhal was not mentioned.

Storage practices were the same as those mentioned for chickpea during the Sultanate period, i.e., 1206–1555 AD (Naqvi, 1984). In the Risala-Dar-Falahat (c. 1450 AD), it is mentioned that these pulses were stored in large pots with their borders smeared with oil, and ash “applied” on all sides (Majumdar, 1984).

Food, feed, medicine, and manure

According to Achaya (1998), fermented black gram grits were used to make *vatakas* (the *vadas* of today) during the Sutra period (800–300 BC). Buddha (6th century BC) recommended green gram

soup to his disciples. Kashyapa (800 AD) mentioned soup (dhal) prepared from both the pulses (Ayachit, 2002). However, Kalhana (1200 AD) of Kashmir, who authored the famous *Rajatarangini*, surprisingly rated green gram as inferior food (Achaya, 1998). Travelers such as Ibn Batuta (1325–1354 AD), Tavernier (1640–1667 AD), and Abdur Razzak (1443) have mentioned green gram as the most widely used constituent of *khichari* (rice or other cereals and pulse cooked together) (Achaya, 1994). The most popular side dish in India, the *papad*, was called *parpata* during the Buddhist and Jain periods (c. 400 BC). The popularity of *papad* led to professional *papad* makers called *Kagal Kutas*, who have been mentioned in 14th century documents as part of kings' armies in Rajasthan (Achaya, 1998). Also according to Achaya (1994), black gram and rice were fermented together to produce liquor in ancient times. Both black gram and green gram were fed to cattle and horses (Watt, 1889).

Susruta (c. 400 BC) considered green gram to be better than other pulses in terms of food quality. Green gram soup was recommended during convalescence (Krishnamurthy, 1991). The Bhavaprakash (16th century AD) mentions black gram as sticky, tasty, and nutritious. Also, it enhances sperms, is good for lactating mothers, and is useful to patients of facial paralysis and arthritis (Chunekar and Pandey, 1998). Watt (1889) specifies a *svalpa masha taila* (oil prepared with black gram) for massage in the treatment of rheumatism and joint pains. Watt (1889) also mentions that green gram flour is an excellent substitute for soap and that it leaves the skin soft and smooth.

Surapala (c. 1000 AD) found use of black gram in enriching *kunapa* (liquid manure based on animal flesh), especially for application to coconut trees (Sadhale, 1996).

Horse gram (*Dolichos uniflorus*)

Horse gram is indigenous to the Indian subcontinent. Archaeological investigations have revealed the use of horse gram as food around 2000 BC (Mehra, 2000). The *Brahadaranyaka* (c. 5500 BC), a commentary on the Rigveda (c. 8000 BC) mentions *khatakula*, which is the original Sanskrit name for horse gram. The Yajurveda (c. 7000 BC) mentions the Sanskrit *kulattha* (Achaya, 1998) as the name for horse gram. Subsequently, Buddhist and Jain literature, and Kautilya's Arthashastra, all mention *kulattha*. Susruta (c. 400 BC) mentioned *vanyakulattha*, obviously a wild species. *Kulattha* is mentioned in the Sangam literature of the Tamils (100 BC–300 AD) as *kollu*, which seems to be a derivative of *kulattha*. The original Latin name for horse gram was *Dolichos biflorus*, which was later changed to *D. uniflorus*.

Watt (1889) mentions two varieties of seeds, red and white. Kautilya (321–296 BC) mentions its sowing time as the postrainy season, while, according to Watt (1889), the seed could be sown in any season. Kashyapa (800 AD) mentions broadcast sowing after moistening the seed (Ayachit, 2002). The crop is drought tolerant. It requires one weeding (Kashyapa, 800 AD; Ayachit, 2002), but no manuring is mentioned. The Sangam literature of the Tamils mentions intercropping horse gram with *Paspalum scrobiculatum* (Achaya, 1998). In Satara (Maharashtra), horse gram was sown in June with pearl millet in separate rows (Watt, 1889). Horse gram fodder has been fed to horses for centuries and is a good cattle fodder as well (Watt, 1889).

Horse gram has been used as a food item for millennia. The soup extract from *kulattha*, called *yusa*, was consumed commonly during the Sutra period (c. 1500–800 BC). These soups are the *rasams* of today (Achaya, 1998). The *vadas* (cakes) made from horse gram were listed in the *Varanaka Samuchaya* (1520 AD) in the Gujarati language (Achaya, 1998). Horse gram was used as medicine to treat calculus afflictions, corpulence, hiccups, and worms (Chunekar and Pandey, 1998). Surapala's Vrikshayurveda (Sadhale, 1996) mentions interesting uses of horse gram in horticulture. Horse gram decoction was used for flower and fruit drop. The Ain-i-Akbari (1590 AD) does not mention horse gram as an item sold in the markets (Blochmann, 1873).

Moth bean (*Vigna aconitifolia*)

Moth bean too is indigenous to the Indian subcontinent. Its earliest mention is in the *Taitriya Brahmana*, a commentary on the Yajurveda (c. 7000 BC). There are two Sanskrit names – *makushta* or *makushtaka*, and *vanamudga* (literally meaning ‘wild green gram’). Names in most Indian languages today are derived from these two Sanskrit names, except the distinct Tamil name, *narippayir*. The name “moth bean” is coined from the Hindi name *moth*.

Kautilya (321–296 BC) mentions moth bean as a rainy season crop. Watt (1889) describes it as a drought-resistant crop of the entire Indian subcontinent, including the mountains up to 1200 m. The most common sowing practice was by seed broadcast. In Punjab, it was grown mixed with black and green grams, more often in poor soils. Sometimes it was grown in good soils and intercropped with pearl millet. It was grown as a sole crop in Uttar Pradesh, with some crop being irrigated if necessary, and it was widely grown in the Meerut region. The Dholpur region of Rajasthan had a very large area under moth bean.

Moth bean was a market commodity during Akbar’s time (1590 AD) and it cost the same as wheat. This meant moth bean was costlier than black gram, a common pulse at that time.

As food, moth bean was used for preparing soup. No old text mentions cooking of sprouted moth bean as a food item, although this dish is widely prepared nowadays in Western India.

Watt (1889) mentions moth bean grain as a feed for fattening oxen and horses. Moth bean was not given to cattle as it prevented the flow of milk. Lawrence (1996) mentioned moth bean as a feed for sheep in Kashmir.

The Bhavaprakash mentions the medical uses of moth bean, especially in reducing fever, as well as the narcotic property of its roots (Chunekar and Pandey, 1998). Watt (1889) also documented the narcotic property of moth bean roots.

Pea (*Pisum sativum*)

It is generally believed that the pea is indigenous to Southern Europe. We find one of the earliest references to pea in the dictionary (*Amarsikha*) of Amarsikha (c. 200 BC), who names pea as *satina*, *khandika*, or *harenu* in Sanskrit. In the later literature, the word *kalaya* (chickpea) was also used for pea, possibly from the Arabic *khalaj* for pea, since medieval India borrowed many words from Persian and Arabic. In the *Brhat Samhita* (6th century AD), Varahamihira used the name *vatala* (Bhat, 1981), which might connote the flatulence (*vata*) causing property of pea. The Bhavaprakash (16th century AD) used names such as *vartula*, *satina*, and *hareneku*. In Marathi, Kannada, and Telugu, pea is called *vatana* or *vatani*, which is similar to *vatala* of Varahamihira. *Patani* in Tamil could be a corrupt form of *vatani*. In North India, the pea is known as *matar*, which might be related to the Sanskrit word *matachi* or *matati* meaning hail.

It is not easy to trace how pea was introduced into India. The Arabs or Persians did not introduce it, as the names for pea in the respective languages bear no resemblance to the Sanskrit names. Also, peas did not find a niche in Kashmir, which has a temperate climate (Lawrence, 1996).

Pea has been a postrainy season crop. Descriptions of crop cultivation are missing in old literature. Watt (1889) gives yield data such as 1100 kg ha⁻¹ in Oudh (eastern Uttar Pradesh) and 925 kg ha⁻¹ in the rest of Uttar Pradesh, both under irrigation. The non-irrigated crop gave 650 kg ha⁻¹.

We find a description of possibly an endemic soilborne disease of pea in Kashmir in the memoirs of Jahangir (1605–1622) (Rogers and Beveridge, 1909; 1914). Watt (1889) mentions substantial damage due to a pod borer as also due to bruchid in storage.

Lablab bean (*Lablab purpureus*)

The lablab bean originated in India and grows in the wild in Bengal and Assam. Excavations in the Harappan region revealed consumption of the lablab bean as food as far back as 3200–2000 BC

(Mehra, 2002). By the time Charaka (c. 700 BC) wrote his Ayurvedic treatise, the word *shimbi* in Sanskrit was used for pods, and most of the pulses were classified as *shimbidhanya* (grain produced in pods). The Sanskrit names for lablab bean are *nishpava*, *shimbi*, *rajshimbi*, and *vallaka*. In the Jain literature (c. 200 BC–300 AD), we find names such as *nippava* and *valla*, both of which originated from the Sanskrit words. The current names for lablab bean in some of the Indian languages have originated from the Sanskrit names; for example, *sem* in Hindi from *shimbi*, *pavate* in Marathi from *nishpava*, and *val papdi* in Gujarati from *vallaka*. The origin of the Tamil word *mochai* and *avare* of Malayalam and Kannada could not be traced.

Kautilya (321–296 BC) mentions the sowing time to be the middle of the rainy season (Shamasastri, 1961). The botanist William Roxburgh (1759–1815), who worked at Chennai and Kolkata, described 13 different kinds of lablab bean (Watt, 1889). In the Chennai area, lablab bean was grown as a 6-month crop (June–July/February–March) and was drilled with other pulses. Seed color was described as white, red, or black (Watt, 1889). In Thane in Maharashtra, the lablab bean, like black gram, was sown in standing rice in small holes made between the rice plants, two seeds in a hole. The green pods were consumed as vegetable and the stalks as fodder (Watt, 1889). Nowadays, the dry seed is soaked, sprouted, dehulled, and then cooked as an alternative to dhal in Western India.

The Bhavaprakash (16th century) considers it to be a semen reducer (Chunekar and Pandey, 1998). In Assam, the salted juice of the lablab plant is used for treating ear and throat infections (Watt, 1889).

Cowpea **(*Vigna unguiculata*)**

It is now accepted that cowpea originated in Africa since the wild types are found there. Ng and Marechal (1985) suggested that cowpea reached India more than 2000 years ago. These authors further suggested that two “cultigroups”, Biflora and Sesquipedalis evolved from Unguiculata in India and Southeast Asia, respectively, under intensive human selection. Thus, it seems India has been a center of cowpea diversity. Excavations at Harappa (Indus-Saraswati civilization; 3200–2000 BC) have revealed that cowpea was one of the grain legumes grown (Mehra, 2002). Charaka (c. 700 BC) documents cowpea with its Sanskrit name *rajmash* (not to be confused with ‘*rajmah*’, the name currently used for *Phaseolus vulgaris*), and since then *rajmash* is the name that has been used for cowpea in all Ayurvedic texts (Vidyalankar, 1994). Other Sanskrit names are *mahamash* and *chapala*. The Jain literature (200 BC–300 AD) mentions cowpea as *chavala* (Jain, 1984). The Ain-i-Akbari (1590 AD) mentions the Persian word *lobhia* for cowpea as a grain legume sold in the markets (Blochmann, 1873).

Currently, the popular names for cowpea are *lobia* and *chaura*. In other languages, the names are *chola* or *chorap* (Gujarati), *chavalya* (Marathi), *alсандулу* (Telugu), *alсанде* (Kannada), and *karamani* (Tamil). *Lobia* can be traced to Persian, and not to the Sanskrit word *lobhya* (meaning ‘alluring’) as Achaya (1998) has suggested. *Chola*, *chorap*, and *chavalya* can be traced to *chavala* in the Jain literature as also to *chapala* in Old Sanskrit. The origin of *karamani* in Tamil is not clear. Achaya (1998) suggests that the Kannada name *alсанде* could be because cowpea was brought to the west coast of India from Alexandria. However, I would like to suggest that either the name *alсанде* is derived from the Sanskrit *alасaka* meaning flatulence, or to Alasanda, a city founded by Alexander near Kabul. Maybe the cowpeas were marketed from Alasanda. Watt (1889) has given information on how cowpea was grown by farmers in the 19th century. In Northwest India, cowpea was mostly intercropped with cotton or pearl millet. In the Rohilkhand region of Uttar Pradesh, Watt (1889) recorded about 2000 ha of sole crop of cowpea. The cowpea grain was less valued than green and black grams as it is “difficult to digest”. In Andhra Pradesh and Tamil Nadu, cowpea was fairly important; about 16000 ha were under the crop. In Maharashtra and Gujarat, cowpea was not an important crop; it was grown mixed with sorghum or pearl millet. In the Burdwan region of West Bengal, two types called *barbate* and *rambha* were sown in September; the white seed was preferred. Bhavamisra mentions three kinds of cowpea, white, red, and black. He describes cowpea as tasty and nutritious, and capable of increasing milk production, and that the larger grain is better for food purposes (Chunekar and Pandey, 1998).

Grass pea (*Lathyrus sativus*)

The grass pea apparently originated in Southern Europe. Archaeological studies have revealed the existence of grass pea seeds in Bihar around 2000 BC (Mehra, 2000).

In Sanskrit, the grass pea is called *triputa* or *khandika*. It is called *khesari* in Hindi, Bengali, and Oriya, *lakh* in Marathi, *khesari parippu* in Tamil, and *lanka pappu* in Telugu. The fact that the Sanskrit names have not been used in Indian languages confirms that the origin of grass pea is outside the Indian subcontinent. It seems the name *khesari* comes from the saffron-colored seed.

The Ain-i-Akbari (1590 AD) mentions *kisari* as a pulse resembling the pea (vegetative growth?), which is eaten by the poor but is “unwholesome” (Blochmann, 1873). The Bhavaprakash, written around the same time as the Ain-i-Akbari, specifically mentions “lameness and paralysis” due to grass pea grain consumption (Chunekar and Pandey, 1998). Thus, what we call lathyrism today was known in India at least 400 years ago.

Faba bean (*Vicia faba*)

This crop apparently originated in West Asia, where its consumption as a food item is common, unlike in India where it never became popular. Most likely, it was introduced into India during the Sultan period (1206–1555), during which its cultivation has been mentioned (Naqvi, 1984). Faba bean is called *baqla* in Persian and that is the name in Hindi today. Interestingly, while Dara Shikoh (c. 1650) mentions the word *baqla* in the Nuskha Dar Fanni-Falahat (Razia Akbar, 2000), the Ain-i-Akbari (c. 1590) calls it *rajmaan*, probably from *rajmash*, which is cowpea. Europeans living in India grew it as a garden crop (Watt, 1889).

The soil fertility enhancing property of faba bean has been mentioned in the Nuskha Dar Fanni-Falahat (Razia Akbar, 2000). Since no Sanskrit text that I have come across so far refers to the soil fertility enhancing property of pulses, I believe this knowledge came to us from West Asia.

Additional points

The Ayurveda experts of the past had studied how a very large number of food plants influenced human health. In addition to the facts I have mentioned earlier, Ayurvedic treatises consider green gram to be the best pulse for humans, being the least flatulent of all pulses. Green gram also helps in improving eyesight; we know today that sprouted green gram is rich in β -carotene (Duke, 1981). Like lentil paste, green gram paste, when applied to the skin, improves complexion (Chunekar and Pandey, 1998).

The role of legumes in enriching the soil with nutrients such as nitrogen is well known. The “oldest record” so far that I have come across is from the Nuskha Dar Fanni-Falahat, compiled by Dara Shikoh (c. 1650) (Razia Akbar, 2000). The statement reads, “Because its (*Vicia faba*; *baqla*) roots, branches, and leaves have the qualities of manure, it is grown among plants.” It seems the knowledge that pulses enhance soil fertility spread to India from West Asia, because no Indian text that I have read so far mentions any similar observation.

I should also point out that the adverse effect of *Lathyrus* (*khesari*) on human health has been known at least since the 16th century. Bhavamisra (16th century AD) mentions that the consumption of *khesari* can bring in lameness and paralysis (Chunekar and Pandey, 1998).

The role of pulses in balanced nutrition was encapsulated by Kashyapa (800 AD) in Section II, verses 12–15 of the Kashyapiyakraishisukti (Ayachit, 2002):

“Varieties of rice are first in the priority list, the pulses for preparation of soup are second, vegetables (and fruits) come third, and ghee, milk, etc., the fourth. These four together are stated to make a

complete meal. This food brings stability to human life by providing nourishment and health. It sharpens the intellect and enhances the span of life.”

One can read cereals in the place of rice. Pulses were second to cereals in human nutrition.

Lessons for the future

The historical review of important pulses reveals several key messages that I list below. These could serve as valuable indices for planning future research and development programs.

1. Pulses have been and will continue to be an important ingredient in the daily food and nutrition of the people of the Indian subcontinent.
2. In terms of the quantity needed, pulses have always been second to cereals.
3. Pulses have not been normally grown in rich soils or with irrigation.
4. Pulses have almost always been grown as subordinate crops in cropping systems.
5. Yield levels of pulses reported since the 18th century have not been different from the yield levels being obtained today.
6. The “Green” Revolution in cereals and some other crops, characterized by a quantum jump resulting from high levels of management with purchased inputs and irrigation, is not required for pulses. This is because pulses will always remain a ‘secondary’ food item. Export opportunities being limited, an excess production could result in a market glut and loss to farmers. It is much more sensible to talk about increasing the average yields of pulses to 1275 kg ha⁻¹ to meet the needs of the Indian population by 2050 (Nene, 2000).
7. Improvement in management with regionally adapted and preferred varieties is the key.
8. The major research focus on pulses should be to obtain better yields with limited or no purchased inputs. The focus should be primarily on rainfed pulses.
9. Biotechnology tools could be the answer to long-standing problems such as Ascochyta blight, pod borers, and sensitivity to salinity.
10. Eleven different pulses are grown and eaten in South Asia. In addition, 10 grain legume species were consumed during the past famines (Nene, 2004). These 10 species should be researched as additional crops.
11. Most plant explorers today seem to be obsessed with the idea that the Fertile Crescent (semicircle of fertile land stretching from the southeastern coast of the Mediterranean around the Syrian Desert north of Arabia to the Persian Gulf) is the only place in the world where agriculture and many crops originated. This attitude needs a change.

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