INTRODUCTION

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Black pepper (Piper nigrum L.) is one of the oldest spices known to the world. The black pepper of commerce comprises the dried fruits of this perennial climbing vine, which is indigenous to the forests of Western Ghats region of South India. Wild forms of pepper are still found growing in the rich, moist and humus soils of the sub-mountainous tracts of this region. In ancient days, it was collected as a forest produce and it was highly valued as mentioned in the old Sanskrit literature “Kashyapiyakrishisukti” (Ayachit, 2002). The wild forms of black pepper are unisexual while the cultivated forms are bisexual in nature. Probably the bisexual types might have originated from the wild unisexual ones as a result of domestication and conscious and continuous selection for high yielding types and their maintenance by vegetative propagation by people through the ages (Barber, 1906; Zeven, 1976; Ravindran and Nirmal Babu, 1994a).

Black pepper is the most widely used spice and occupies a proud place in both vegetarian and non-vegetarian cuisines of the West and the East. Black pepper contributes towards flavour, taste, anti-fungal, anti-bacterial and antioxidant properties. It is also used in indigenous medicinal systems of India, China, Indonesia and Japan for making many medicinal preparations. Several black pepper and green pepper based value added products are available in the market nowadays.

Malabar black pepper has been the main item of trade between India and Europe for centuries more than 3,500 years back (Parry, 1969a). A Greek monk Cosmos Indicopleustes, in 548 AD recorded the cultivation of pepper in India for the first time. From time immemorial, trade in spices of Malabar was the monopoly of the Arabs. They were collecting this valuable spice and selling them in the Mediterranean ports from where they were distributed all over European markets. Arabs were keeping the source of these precious commodities as a trade secret. In olden days spices were considered as valuable as gold and precious stones. In England, throughout the medieval period, ‘pepper rent’ was exceedingly common and the tenant was obliged to supply his landlord with a fixed quantity of pepper as rent. Often the ransom demanded included pepper besides gold and silver (Gundert, 1868; Clain, 1961; De Waard and Zeven, 1969). The consumption of black pepper grew astonishingly in the days of Roman Empire and pepper became the most typical spice
in medieval Europe. It was a status symbol of fine cookery and a description of a lavish feast invariably mentioned pepper, if not other spices. Pepper reigned as a paramount spice for several centuries. Though the trade between India and Rome was established as early as 40 AD after the discovery of monsoons by Hippalus, the discovery of America by Columbus was attributed to the demand for pepper in European countries. It is in search of spices the Portuguese captain Vasco da Gama discovered a direct sea route to India, landed in Calicut on 17 May 1498 (Gundert, 1868) and this in turn lead to a series of events of voyages by the Portuguese and Dutch, and finally resulting in colonization of India by the British. Since then pepper trade had become the monopoly of the Portuguese and other European maritime nations until the seventeenth century.

It was thought that the Indian emigrants to Java introduced it sometimes between 100 B.C. and A.D. 600 to Java. Japanese introduced the crop to Brazil after Second World War. Pepper trading between Java and China was recorded in A.D. 1200 and Marco Polo in A.D. 1280 recorded having seen pepper in Malaysia (Parry, 1969b). However, it was the Dutch in the seventeenth and eighteenth centuries that brought pepper cultivation on to Java, Sumatra, Borneo, Sarawak, the Malay Peninsula, Siam, Philippines and later into the West Indies on a plantation scale. Black pepper is believed to be introduced to America during the middle of 18th century (Gentry, 1955a)

India is producing about 64,000 t black pepper from an area of 216,000 ha (Agri. Data Book, ICAR 2005). India accounts for about 26 percent of the world production and about 18 percent of export (Sarma and Kalloo, 2004). In India, black pepper is cultivated mainly in Kerala, Karnataka and Tamil Nadu. Kerala accounts for nearly 90% of our country’s area and production. It is generally grown as an intercrop trailed on various trees in the homesteads of the coastal zones, as a pure crop or mixed crop in the midlands, or slopes and valleys of small hills, whereas in highlands pepper is cultivated as a mixed crop on the shade trees in cardamom, coffee and tea plantations.

_Piper nigrum_ L. belongs to the pepper family Piperaceae of the Series Microembryeae of Monochlamydeae (Bentham and Hooker, 1880). The genus _Piper_ is generally distributed in the tropical and sub tropical regions of the world. The main
centers of distribution are Central and South America and South Asia (Trelease and Yuncker, 1950).

The other economically important species of *Piper* are Indian long pepper (*Piper longum* L.), betel vine (*P. betle* L.), Java long pepper (*P. chaba* Hunter), tailed pepper (*P. cubeba* L.), Kawa pepper (*P. methysticum* Forster), West African pepper (*P. clusi* C.DC.), Benin pepper (*P. guineense* Schum. & Thonn.) and Japanese pepper (*P. kadzura* (Choisy) Ohwi.). In India, black pepper, long pepper and betel vine are the three economically important *Piper* species grown.

The genus *Piper* was established by Linnaeus (1753) in his *Species Plantarum*, where he recognized seventeen species of *Piper*. This genus in general is characterized by very small, highly reduced flowers closely packed to form spikes. The female flower is represented by the naked ovary and the male flower is represented by 2-3 anthers subtended by a bract. The International Plant Name Index (IPNI, 2006) records more than 6000 *Piper* binomials of which 115 are from the Indian subcontinent. About 18 species are found in sub mountainous tracts of Western Ghats and adjacent peninsular and coastal region (Hooker, 1886; de Candolle, 1912; Rama Rao, 1914; Gamble 1925; Ravindran et al., 1987; Velayudhan and Amalraj, 1992, Nirmal Babu et al., 1993 and Tyagi et al., 2004).

*Piper* species occurring in India are unisexual, but the Central and South American species are generally bisexual types. However, the cultivated black pepper is bisexual. It seems more than 100 cultivars of black pepper are known to India. Of these about 20 of them are widely cultivated in the major pepper growing tracts.

Though black pepper is a much sought after and economically important crop, little is known about its exact distribution pattern, botany, taxonomy and evolution. The important earlier works in this regard are those of Rheede (1688), Miquel (1843), de Candolle (1869), Hooker (1886), Rama Rao (1914), Gamble (1925), Fyson (1932), and Kanjilal et al. (1940). Some of the recent taxonomic studies of South Indian *Piper* are those of Manilal (1988), Rahman (1981) Ravindran (1991) and Mathew (1998). No reports are available on the diversity and variability existing in the wild species and local cultivated types except in the case of Karimunda. The major bottleneck is the unavailability of the live specimens for the study. Hooker (1886) wrote about the genus *Piper* – Thus: -
A most difficult genus, herbarium materials for the analysis of which have never been intelligently collected, whilst the descriptions of the published species are quite inadequate for their accurate determination......

In the process of (with little success, I fear) to discriminate the Indian species for this work, and to unravel their intricate synonymy......, I have been much impressed by the correctness of Miquel's views as to the ordination of the species, and the skill with which he has grouped them.... When he undertook to monograph the Order, the materials were very bad, were in a chaotic state of confusion, and were so scattered in the ..... herbaria, that he could bring no two large collections under his eye at one time. Yet he traced the outlines of a good system, gave characters to a large proportion of well defined species and founded genera. ....... In the discrimination and elucidation of species he was too hasty by far.

For the rest I must have the further study of the Order to local botanist in the four great centers of its Indian distribution, namely its transgangetic provinces, the South Deccan, the Malayan Peninsula and Ceylon: in each of which the species should be examined on the spot, with a view to matching the sexes, and flowering with fruiting specimens, and to observing the transition from young to old foliage, and the effects of locality and climate on the characters of each species. (Hooker 1886, The Flora of British India. Vol. V. p-79)

Rahiman (1981) recently carried out studies on the biosystematics of Piper species occurring in Karnataka State based on morphological, biometrical, palynological, cytological and biochemical aspects to fix norms for classification of the genus. His studies provided the supporting evidence for the conclusions arrived at by classical taxonomists based on morphological classification. Ravindran (1991) studied the inter specific relationship of Piper species using taxonomic, morphologic, numeric and chemotaxonomic characterization and concluded that P. nigrum would have originated as a natural hybrid between P. wightii and P. galeatum. Mathew (1998) conducted morphological, cytological and palynological studies of Piper species.

The present study is aimed at characterizing the South Indian Piper spp. and 33 most important cultivars representing the diversity in cultivated black pepper (P. nigrum) with more detailed taxonomic and morphological characterization and distribution patterns based on Geographic Information System. This is supplemented with more recent molecular taxonomy data for a clear understanding of the species inter relationships of Piper including the co-existence of P. nigrum and the other species of this family.