REVIEW OF LITERATURE

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The world has realized the prime importance of biodiversity. The biodiversity provides various ecological services of immense value. The world is passing through the age of mass extension especially because of various human activities all over the planet. We have realized an urgent need to explore and document our biodiversity and take appropriate steps for its conservation. Angiosperms form a dominant group of vascular plants playing an important role in providing important ecological services and essential requirements of most of animals. Grasses is one of the most important group of flowering plants providing directly and indirectly food and fodder to animals of terrestrial ecosystem. The group is sometimes referred as green gold of earth for its immense importance to a man and other organisms.

Grasses also form one of the most advanced groups of flowering plants. Significant contributions to the taxonomy and phylogeny of grasses have been made by number of workers [Griffith (1834), Duthie (1883, 1886, and 1888), Symonds (1886), Coldstream (1889), and Lisboa (1896), Gamble (1896), Moulik (1997), Fischer (1934), Bor (1960), Clayton & Renvoize (1986) Karthikeyan *et al.* (1989), Sreekumar & Nair (1991), Watson & Dallwitz (1992), Moulik (1997) etc.]. India is one of the important centers of grass diversity accounting for more than 1200 species (8% of the world's grasses.)

Important floristic work on grasses of India:

Initial work on grasses of India includes that of Griffith (1834), Duthie (1883, 1886, and 1888), Symonds (1886), Coldstream (1889) and Lisboa (1896). The 19th century ended with an account of the Gramineae of India in the Hooker's 'Flora of British India' (Hooker, 1896). An account of grasses along with other families was provided by Cooke (1901-1908) in his 'Flora of the Presidency of Bombay'. Gamble (1896) published 'The Bambuseae of British India'. Fischer (1934) contributed account for the grasses of Madras Presidency. An illustrated account of Bombay grasses was published by Blatter and McCann (1935).

Bor published accounts for grasses of Assam (1940) and Uttar Pradesh (1941). He consolidated concise account of grasses for whole of Indian subcontinent 'The Grasses of Burma, Ceylon, India and Pakistan (1960).

Some important work on grasses include that of Caius (1936), Kapadia (1945), Stewart (1945), Desai and Murty (1950), Tiwari (1954), Majumdar (1956), Raizada *et al.* (1957), Chaudhary (1959, 1960), Raizada and Jain (1964, 1966), Jain *et al.* (1975), Singh *et al.* (1976), Patunkar (1980), Welzen (1981, 1993), Raizada *et al.* (1983), Sharma (1983) and Roy (1984). A synoptic account of uses and phytogeography of grasses of India is provided by Jain (1986) reporting 266 genera and 1200 species for the country. Karthikeyan *et al.* (1989) enumerated grass flora of present India accounting for 1254 species belonging to 260 genera. Sreekumar & Nair (1991) reported 296 species belonging to 103 genera for the state of Kerala. Sharma *et al.* (1996) recorded 373 species belonging to 104 genera for Maharashtra. Salunkhe (1995) reported 283 species belonging to 103 genera for South-Western Maharashtra. The grasses and Bamboos of India by Moulik (1997) is another contribution to grasses of India. Potdar (2006) reported 109 genera, 300 species, 10 varieties and an addition of 16 species of grasses to the grass flora of Maharashtra. Out of these 16 grasses, 3 species are newly discovered.

Several workers have described new taxa to the grass flora of India [Naik(1976), Nair & Nair (1981), Sreekumar *et al.* (1981, 1982, 1983a, 1983b, 1983c, 1983d, 1983e, 1984, 1985a, 1985b), Nair *et al.* (1982a, 1982b, 1983, 1984), Basappa and Muniyamma (1983), Sreekumar & Shetty (1987), Ravi & Anilkumar (1992), Ravi (1995,) Ravi & Mohanan (1997), Kishor Kumar & Muktesh Kumar (1997), Ravi *et al.* (1998), Sajeev *et al.* 1999, Pradeep & Sunil (1999), Janarthanam *et al.* (2000), Velkamp & Salunkhe (2000), Ravi *et al.* (2000a, 2000b), Sunil & Sivdasan (2000), Muktesh Kumar *et al.* (2001), Ravi *et al.* (2001a, 2001b), Sabu & Jayasree (2001), Sunil & Pradeep (2001), Potdar *et al.* (2003a, 2003b), Gawade & Gavade (2004), Potdar *et al.* (2004), Salunkhe & Potdar (2004) and Janarthanam (2007). etc.]

Other important contributions on revision of genera and tribes of grasses include that of Jain (1968 a, 1968 b, 1972 a, 1972 b), Majumdar (1973), Jain and Pal (1975), Ved Prakash and Jain (1979, 1984), Deshpande (1984), Sur (1985a, 1985b, 1988) and Deshpande and Muktesh (1995, 2000).

Endemic grasses:

India is one of the twelve megacentres of biodiversity. About 17000 species of flowering plants are recorded from India of which more than 5000 are endemic to

India. About 141 genera are endemic to India of which 114 are monotypic (Nayar, 1996). Western Ghats is one of the eight hottest hot-spots of the world supporting more than 4500 species of flowering plants of which 1700 are endemic to the region (Ahmedullah and M.P. Nayar 1987). There are about 60 genera endemic to Western Ghats of which 49 are monotypic (Nayar, 1996). Most of them belong to family Acanthaceae and Poaceae. Karthikeyan (1983) reported 43 varieties, 2 sub species, 299 species and 16 genera of grasses to be endemic to India. Jain reported 360 species to be endemic to India (Jain 1986). Majority of endemic species and genera are restricted to Peninsular India. About 225 species and 21 varieties are reported to be endemic to Peninsular India (Ahmedullah and Nayar, 1987; Nayar 1996). Of the 17 genera endemic to India, 3 are found in Himalaya, while rest of the genera are restricted to Peninsular India. Of the 14 grass genera endemic to Western Ghats, 11 are monotypic (Salunkhe 2000; Potdar 2006).

Potdar (2006) reported that out of 225 species of grasses endemic to Peninsular India, 124 occur in Maharashtra. Genera endemic to Peninsular India include 1) *Bhidea* (3), 2) *Chandrasekharania* (1), 3) *Indopoa* (1), 4) *Danthonidium* (1), 5) *Glyphochloa* (10), 6) *Hubbardia* (1), 7) *Lophopogon* (2), 8) *Pogonachne (1),* 9) *Limnopoa* (1), 10) *Manisuris* (1), 11) *Pseudodichantium* (1), 12) *Silentvalleya* (1), 13) *Trilobachne (1)* and 14) *Triplopogon* (1) .Out of 14 genera endemic to Peninsular India, 10 grow in Maharashtra. Monotypic genus *Pogonachne* is so far known only from Maharashtra. Of the 14 genera, 11 are monotypic while genus *Bhidea* is represented by 3 species, *Glyphochloa* by 10 species and *Lophopogon* by 2 species. There is no work on these genera except for morphology and chromosome counts for some of them. There is need of studies on other aspects such as leaf anatomy, cytology and molecular data etc. to understand their interrelationship and evolutionary aspects.

Anatomical studies on grasses:

In earlier system of classification mainly external morphological characters especially those of flower were used, however, today data from various fields viz., anatomy, cytology, palynology, phytochemistry & more recently molecular biology have been profitably utilized in refining taxonomic classification and understanding phylogeny, evolution and interrelationships of various groups.. The subfamily and tribes of the Gramineae are generally distinguished by morphological character of

the spikelets and inflorescence. The characters of chromosomes, root hairs, stem, apices, the first seedling leaves, embryos, physiology, reserve carbohydrate, nucleoli, leaf anatomy etc. have been presently used in delimiting major taxa within the family. Duval –Jouve (1875) and Pee-laby (1898) studied the leaf anatomy of different grasses and came to conclusion that anatomical characters might be used in taxonomy of grasses. Duval- Jovue (1875) recognized the two basic types of the leaf anatomy subsequently termed "Festucoid" and "Panicoid" by Prat (1936). Stebbins (1956) recognized two more types called "Chloridoid"and "Bambusoid".

Brown (1958) studied 72 genera of grasses and on the basis of their tissue arrangement, recognized six main types. However, these types could not be segregated into two traditional subfamilies, viz., Pooideae and Panicoideae. Metcalfe (1960) provided anatomical account for each group of grasses with illustrations. Anatomical features of leaf in grasses are found to be of considerable taxonomic and phylogenetic value. Tuguo Tateoka (1961) on the basis of leaf structure separated *Eriachne* from Aveneae. Clifford, H.T. (1967) studied the leaf anatomy of *Hubbardia heptanueron* to know the affinities of the genus. Smith (1968) classified several native North American grasses as starch or fructosans accumulators. Renvoize (1982, 1983, 1986 and 1987) studied leaf blade anatomy in grasses of Andropogoneae, Eragrostideae, Centothecoideae and Paniceae respectively and used in characterizing the groups. Amarsinghe and Watson (1990) studied significance of microhairs in taxonomy of genus *Eragrostis*. Peterson (1989) studied the leaf anatomy of *Muhlenbergia* while Papp (1999) made comparative study of morphological and anatomical features of *Poa pratensis* L and *Poa angustifolia* L. and showed the ecotype differing mainly in shape and anatomy of the basal leaves.

Krishnnan *et. al* (2002) studied the phytoliths of Indian grasses and their usefulness in identification. "Bambusoid type" of leaf anatomy was studied in three herbaceous bamboo species by Vieira *et.al.* (2002). Phytoliths preserved in Late Cretaceous coprolites from Deccan traps of India show that at least five taxa from extant grass subclades were present on the Indian subcontinents (Prasad *et.al* 2005). Prasad *et .al's* analysis on the phytoliths of grasses indicates that Titanosaurid sauropods lived in central India about 65-71 million years ago and ate grasses

(Piperno and Sues, 2005). Thus the anatomical features of grasses especially those of leaf are of considerable significance in taxonomy of grasses.

Cytological studies on Grasses:

Avdulov (1931) was the first to use chromosome characters in grass systematics. He studied 232 species and recognized three types of grass karyotypes, based on basic chromosome number (x) and chromosome size. The first type has x = 9, 10 with small chromosome; second has x=12 with small chromosome and third x=7 with large chromosomes.

Stebbins (1956) considered four main lines of evolution in grasses on the basis of cytological characters. The first and second line, namely the Panicoid and the Eragrostoid-Chloridoid lines (x=9, 10) developed in the tropics. The third line was the Festucoideae (x=7) distributed in temperate climate. The fourth line was Bambuseae (x=12) dominant in the moist tropical forest.

Carnahan and Hill (1961) proposed two groups of grasses:1) tropical and subtropical species with small chromosome and x=10 and 2) more temperate species with large chromosome and usually x=7.

Cytological data on endemic grasses is mostly wanting but chromosome number of *Triplopogon* (Joshi, A.B.1959) and *Trilobachne* (Sapre, A.B.1977) is reported. Virendra Kumar and B. Subramaniam. (1986) compiled the cytological data on Indian grasses in his Chromosome Atlas of Flowering Plants of the Indian Subcontinent. They reported chromosome number for about 179 taxa of Indian grasses.