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An updated conspectus of grasses of Punjab (India)

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Abstract

Poaceae is the fourth largest family of the flowering plants. It includes about 700-800 genera and 11000-13000 species distributed worldwide. The family has unmatched ecological and economic importance. With its origin in the early cretaceous and major diversification in the mid Cenozoic, the family at present covers nearly a fifth of land surface and occurs in nearly all the habitats of the world. With a sub tropical ecology and an agrarian economy of Punjab, grasses comprise the most significant group in the region. Despite an overwhelming significance, taxonomic studies in grasses have not received sufficient attention in the region. It is only in the work of Sharma and Khosla (1989) that grass species have been classified into subfamilies and tribes. However, after the establishment of the Grass Phylogeny Working Group (GPWG) the world has witnessed a renaissance in grass systematics. But, India remains an 'undercollected' country as far as grass diversity is concerned. Our work on the exploration and systematics of the grass flora of the region is an effort to consolidate and update the information on the diversity of grasses of the studied area. The present studies have brought the cumulative species number to 192 including seven new reports. The species representation of subfamilies is: Aristidoideae (5) Arundinoideae (5) Bambusoideae (4), Centothecoideae (1), Chloridoideae (55) Erhartoideae (3), Panicoideae (98) and Pooideae (21).

Key words: Cumulative, India, Poaceae, Punjab, Systematics, Taxonomy, Tropical

Introduction

The grass family Poaceae (R. Br.) Barnh. is the fourth largest family of the flowering plants. It includes about 700-800 genera and 11000-13000 species distributed worldwide (Clayton and Renvoize, 1986; Watson and Dallwitz, 1999). In the classification of grasses proposed by Grass Phylogeny Working Group (GPWG) the genera have been put into forty two tribes and twelve subfamilies besides a group of uncertain affinities, Incertae Sedis. Apart from a high degree of taxonomic diversity, the family has unmatched ecological and economic importance. With its origin in the early cretaceous and major diversification in the mid cenozoic, the family at present covers nearly a fifth of land surface (Arabaci and Yildiz, 2004; Ture and Bell, 2004) and occurs in nearly all the habitats of the world (Clayton and Renvoize, 1986; Ture and Bocuk, 2007). All the cereals and millets are cultivated grasses. Sugarcane, the main source of sugar around the world is also a cultivated grass species. Besides, grasses constitute the main source of forage and fodder for livestock. Apart from food and fodder several grasses are used to extract of aromatic oils

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and scents (Kaul and Vats, 1998; Khanuja *et al*., 2005; Kim *et al*., 2005; Bhuiyan *et al*., 2008; Sujatha, 2010). Grasses also comprise the main source of green cover of our lawns and landscape for tourism and sports. Also, their use in handicraft and cottage industry is well known.

Grasses assume even a greater importance in areas like Punjab which has a tropical/ subtropical ecology and an agrarian economy. But grasses have not been given sufficient attention in the floristic compilations of the region. Some of the earliest works have made no mention of the group (Bamber, 1916; Kashyap, 1936). Others have given only an alphabetic list of species with sketchy descriptions (Stewart, 1869; Sabnis, 1940; Nair, 1978; Sharma and Bir, 1978; Sharma, 1990). It is only in the work of Sharma and Khosla (1989) that grass species have been classified into sub families and tribes. With the establishment of Grass Phylogeny Working Group and their publication of a revised and phylogenetic classification (GPWG, 2001), we have witnessed a great upsurge in research on various aspects of grasses across the globe. Amidst a scenario of renewed interest in various aspect of grasses, India has been identified as a 'seriously under-collected country' as far as inventorization of grass diversity is considered (Kellogg, 2006).

We have initiated work on a systematic inventorization, description and classification of the grass species of Punjab and adjoining hills according to the latest format and classification system proposed by GPWG (2001). In the paper, we present a comparative and updated account of the reports of grasses from the region.

Materials and Methods

Area of study

The entire state of Punjab is located between 29° 30′ to 30°0′ N and 73° 55′ to 76° 50′ E along with the adjoining hills were surveyed and explored for species diversity of grasses in the entire range of habitats occupied by them. According to the classification of forest types proposed by Champion and Seth (1968), the vegetation type of Punjab falls under the subgroup 5B Northern Tropical Dry Deciduous Forests. The average elevation in the plain region is 200-300 AMSL and the annual rainfall ranges from 250mm to 1000 mm at different locations in the regions. In the hilly areas, there are small stretches of Subtropical Pine Forest and Himalayan Moist Forest in which the ground is covered by the stoloniferous grasses. During the extensive exploration and collection surveys, notes were taken on the economic and ethnobotanical significance, distribution range and the flowering and fruiting phenology of the species.

Taxonomic Description

Taxonomic description of the species was done in sufficient details with special emphasis on diagnostic characters for identification and classification. Grasses have a special morphology. They have a fibrous root system and the stem has a horizontal portion below (rhizome) or above (stolon) the soil surface. The erect portion, the culm bears characteristic leaves with a sheath and a blade. The inflorescence is a panicle, a raceme or a spike modified in various ways. The basic unit of the inflorescence is the spikelet which and typically, consists of two glumes enclosing one or more florets. Each bisexual floret consists of a lemma, a palea, 2-3 lodicules, 3 stamens and a pistil with a bifid plumose stigma. Besides, the spikelet may bear male and reduced florets. The description was based on characters of morphology and micromorphology of the vegetative (culm, leaf, blade, ligule, collar etc.) and reproductive (inflorescence, spikelet, floret, caryopsis etc.) parts. Stereoscopic study was followed by drawings which were inked to prepare the plates which were computer scanned

to prepare the final prints.

Identification

Identification of species was done with the help of the floras and compilations mentioned above as well as those of Clayton and Renvoize (1986) and Cope (1982). Specimens were deposited in the Departmental Herbarium.

Results and Discussion

Table 1 presents a comparative statement of grass species reported in some of the important floristic compilations of the region. Irrespective of the schemes of classification followed by these authors, we have annotated the species into the latest system of the GPWG (2001). Compared to just 5-6 subfamilies in the earlier systems of classification (Prat, 1960; Caro, 1982; Clayton and Renvoize, 1986; Watson and Dallwitz, 1992) the GPWG system recognizes 12 subfamilies with the thirteenth group 'Incertae Sedis' of uncertain affinities. Furthermore, the subfamilies have been classified into 42 tribes. Therefore, reclassification into the GPWG system has involved a revision in subfamilial and tribial affiliation of several species listed in Table 1.

A close scrutiny of various columns of Table 1 clearly shows that grasses received scant attention in the earliest floristic compilations and that work on their exploration and inventorization has made a staggered progress.

Stewart (1869) listed only 40 grass species, whereas Kashyap (1936) did not include grasses in his work. Sabnis (1940) prepared an alphabetic list of 74 species taking the cumulative total to 93 which further increased to 133 with Nair (1978) and 147 with Sharma and Bir (1978). However, the compendium by Sharma and Khosla (1989) registered addition of thirty eight new species taking the cumulative total to 185.

However, since the last revision of the grass flora of the region, grass systematics has picked momentum across the globe mainly after the establishment of the Grass Phylogeny Working Group and their system of classification (GPWG, 2001). This has aroused interest and provided invaluable guidance in systematics and evolution of grasses of the world. Several researchers have studied this interesting and promising group of plants. These studies relate to the fundamental questions relating to grass organography and development (Kellogg, 2000), morphological nature of the spikelets and its parts (Ambrose *et al.*, 2000) and origin of C_4 anatomy (Gaut and Doebley, 1997; Kellogg, 2000). Systematic analysis of grasses has also picked momentum (Linder and Rudall, 2005; Soreng *et al.*, 2007). Within subfamilies, large and complex genera have been revised (Salamin *et al.*, 2002; Saarela *et al.*, 2003; Spangler, 2003; Molina and De Agrasar, 2004; Finot *et al.*, 2005; Zuloaga and Morrone, 2005). Owing to their cosmopolitan distribution and occurrence in varied habitats and sharply defined phases in vegetative and reproductive phenology, grasses are being considered as ideal indicator of climate change (Yuan *et al.*, 2007).

Work on Indian grasses has resulted in new species reports (Gopalan and Chandrasekran, 2001; Veldkamp and Salunkhe, 2000; Kiranraj, 2008; Takhar and Katewa, 2008; Sur, 2001; Ravi *et al.*, 2001; Kumar *et al.*, 2008) documentation of intraspecific diversity through molecular and other methods (Chandra *et al.*, 2004; Saxena and Chandra, 2006) and ethanobotanical uses (Sahu *et al.*, 2010). Ecological studies relate to species association (Soodan *et al.*, 2009) habitat preference and dispersion (Bazzaz, 1991; Sharma *et al.*, 2010).

Even though research in grasses around the world and within the country has extended to several aspects, basic exploration and inventorization is far from complete.

Our studies brings the cumulative number of species to 192 with 7 new species reports for the region *Briza minor*, *Cymbopogon citratus*, *Elytrophorus spicatus*, *Pogonatherum crinitum*, *Themeda anathera*, *Tripogon jacquemontii*, *Zoysia matrella* (Table 1).

Among the subfamilies, Panicoideae is the best represented in the region. Within this subfamily 4 tribes with 98 species is the most well represented. It is expectedly so since Panicoid grasses are known to dominate the warmer regions like the area of present investigations. The species representation of subfamilies is: Bambusoideae (4), Erhartoideae (3), Centothecoideae (1), Pooideae (21), Aristidoideae (5), Arundinoideae (5) and Chloridoideae (55).

Table 1. A comparative list of grass species of Punjab

[#] Numbers (1, 2, 3 etc.) refer to authors named in the head row who reported under these synonyms, (+) = Reported; (-) = Not reported; (*) = First reports; [-] = Species not recovered.

Taxon	1 Stewart (1869)	2 Sabnis (1940)	3 Nair (1978)	4 Sharma and Bir (1978)	5 Sharma and Khosla (1989)	6 Present Work
Subfamily: Bambusoideae						
Tribe: Bambuseae						
Bambusa glaucescens (Willd.) Siebold ex Munro (1868) 89 [Syn. *B. nana* Roxb. (1832) 199 **(2)**][#]	-	+*	-	+	-	+
B. nutans G.C.Wall. ex Munro (1868) 92	-	-	-	+*	+	+
B. vulgaris Schrad. ex J.C. Wendl. (1808) 26 [Syn. *B. arundinacea* (Retz.) Willd. (1799) 245 **(1)**]	+	-	-	+	+	+
Dendrocalamus strictus (Roxb.) Nees (1834) 476-477	+	-	-	-	+	+
Drepanostachyum falcatum (Nees) Keng f. (1983) 16 [Syn. *Arundinaria falcata* Nees (1834) 478 **(1)**]	+	-	-	-	-	+
Subfamily: Ehrhartoideae						
Tribe: Oryzeae						
Leersia hexandra Sw. (1788) 21	-	-	-	-	+*	[-]
Oryza rufipogon Griff. (1851) 5, t. 144	-	-	-	+*	+	+
O. sativa L. (1753) 353	+	+	+	+	+	+
Subfamily: Centothecoideae						
Tribe: Thysanolaeneae						
Thysanolaena maxima (Roxb.) Kuntze (1891) 794	-	-	-	+*	+	+
Subfamily: Pooideae						
Tribe:Triticeae						
Secale cereale L. (1753) 84	+	-	-	-	-	+
Hordeum aegiceras Nees ex Royle (1839-1840) 418	+	-	-	-	-	+
H. vulgare L. (1753) 84-85 [Syn. *H. coeleste* (L.) P. Beauv. (1812) 114 **(1)**] [*H. hexastichum* L. (1753) 85 **(1)**]	+	-	+	+	+	+
Triticum aestivum L. (1753) 85 [Syn. *T. vulgare* Vill. (1787) 153 **(2)**]	+	+	+	+	+	+
T. compactum Host (1809) 4,7	-	-	-	+*	-	+
T. durum Desf. (1798) 114	+	-	-	+	-	+
T. sphaerococcum Percival (1921) 157, 321 f. 202	-	-	-	+*	-	[-]
Tribe: Bromeae						
Bromus tectorum L. (1753) 77	-	+*	-	-	-	+
Tribe: Poeae						
Alopecurus nepalensis Trin. ex Steud. (1854) 148	-	+*	+	-	+	+
Avena fatua L. (1753) 80	+	+	+	+	+	+
A. sativa L. (1753) 79	+	-	+	-	-	+
A. sterilis L. (1762) 118	-	-	+*	-	+	+
Agrostis gigantea Roth (1788) 31 [*A. alba* L. (1753) 63 **(2)**]	-	+*	-	-	-	+

Taxon	1 Stewart (1869)	2 Sabnis (1940)	3 Nair (1978)	4 Sharma and Bir (1978)	5 Sharma and Khosla (1989)	6 Present Work
Briza minor L. (1753) 70	-	-	-	-	-	+*
Lolium temulentum L. (1753) 83	-	+*	+	+	+	+
Phalaris minor Retz. (1783) 8	-	+*	+	-	-	+
Poa annua L. (1753) 68	-	+*	-	+	+	+
Polypogon fugax Nees ex Steud. (1854) 184	-	-	-	-	+*	+
P. monspeliensis (L.) Desf. (1798) 67	-	+*	+	+	+	+
Rostraria cristata (L.) Tzvelev (1970, 1971) 47 [Syn. *Lophochloa phleoides* (Vill.) Rchb. (1830) 42 **(3)**]	-	-	+*	+	+	+
R. pumila (Desf.) Tzvelev (1970) 48 [Syn. *Lophochloa pumila* (Desf.) Bor (1960) 445 **(3)**]	-	-	+*	-	+	+
Tribe: Meliceae						
Melica sp.	+	-	-	-	-	[-]
Tribe: Stipeae						
Stipa orientalis Trin. (1829) 83	-	+*	-	-	-	[-]
Tribe : Nardeae						
Nardus stricta L**.** (1753) 53	+	-	-	-	-	[-]
Subfamily: **Arundinoideae**						
Tribe: Arundineae						
Arundo donax L. (1753) 81	+	+	-	+	+	+
Elytrophorus spicatus Willd A. Camus (1923) 547	-	-	-	-	-	+*
Phragmites australis (Cav.) Trin. ex Steud. (1840) 143 [Syn. *Arundo phragmites* L. (1753) 81 **(1)**] [*P. communis* Trin. (1820,1822) 134 **(2)**]	+	+	-	-	+	+
P. karka (Retz.) Trin. ex Steud. (1841) 324	-	+*	+	+	+	+
Sub family: Danthonoideae						
Tribe: Danthoneae						
Schismus arabicus Nees (1841) 422	-	-	+*	-	-	[-]
Subfamily : Aristidoideae						
Tribe : Aristideae						
Aristida adscensionis L. (1753) 82 [Syn. *A. depressa* Retz. (1786) 22 **(1)**]	+	+	+	+	+	+
A. funiculata Trin. et Rupr. (1842) 159	-	+*	+	-	+	+
A. histricula Edgew. (1862) 208	-	+*	+	-	-	+
A. hystrix L. f. (1781,1782) 113	-	+*	+	-	-	+
A. mutabilis Trin. & Rupr. (1842)150-151	-	-	+*	-	-	+
Stipagrostis hirtigluma (Steud. ex Rupr. & Trin.) De Winter (1963) 134, 136 [Syn. *Aristida hirtigluma* Steud. ex Trin. & Rupr. (1842) 171-172 **(2)**]	-	+*	-	-	-	+
Subfamily: Chloridoideae						
Tribe: Pappophoreae						
Enneapogon cenchroides (Licht. ex Roem. et Schult.) C.E. Hubb (1934) 119	-	-	+*	-	-	+
E. desvauxii P. Beauv. (1812) 82, t. 16, f. 11 [Syn. *Pappophorum brachystachyum* Jaub. & Spach. (1850) 365 **(3)**]	-	-	+*	-	-	+
E. persicus Boiss. (1844) 71 [Syn. *Pappophorum aucheri* Jaub. & Spach. (1851) 32, 323 **(2)**]	-	+*	+	-	-	+
Tribe: Cynodonteae						
Aeluropus lagopoides (L.) Trin. ex Thwaites (1864) 374 [Syn. *A. repens* Trin. (1848) 462 **(1)**] [*A. villosus* Trin. ex C.A. (1896) 334 **(2)**]	+	+	-	-	-	+
Chloris barbata Sw. (1797) 200	-	-	-	-	+*	+
C. dolichostachya Lag. (1816)	-	-	+*	-	+	+
C. gayana Kunth (1830) 293, 58	-	-	-	-	+*	+
C. montana Roxb. (1820) 331	-	-	+*	-	+	+
C. virgata Sw. (1797) 203	-	-	+*	+	+	+
Crypsis schoenoides L. (1791) 166, 42, f. 1	-	-	+*	-	-	-

Taxon	1	2	3	4	5	6
	Stewart (1869)	Sabnis (1940)	Nair (1978)	Sharma and Bir (1978)	Sharma and Khosla (1989)	Present Work
Cynodon barberi Rang. & Tadul. (1916) 846	-	-	-	-	+*	+
C. dactylon (L.) Pers. (1805) 85	+	+	+	+	+	+
Melanocenchris abyssinica (R. Br. ex Fresen.) Hochst. (1855) 274	-	-	+	-	+	+
M. jacquemontii Jaub. et Spach. (1851) 36, t.325 [Syn. *Gracilea royleana* Hook. f. (1896,1897) 284 **(2)**]	-	+*	+	-	-	+
Ochthochloa compressa (Forssk.) Hilu (1981) 560 [*Eleusine flagellifera* Nees (1842) 220 **(2)**] [Syn. *E. compressa* (Forssk.) Asch. & Schweinf. ex C. Chr. (1922) 12 **(3)**]	-	+*	+	-	+	+
Oropetium biflorus Stapf (1820) 98	-	+*	-	-	-	[-]
O. thomaeum (L. f.) Trin. (1820) 98 pl. 3	-	+*	+	-	+	+
Perotis hordeiformis Nees (1838, 1841) 247- 248	-	-	-	+*	+	+
P. indica (L.) Kuntze (1891) 787	-	-	+*	-	-	+
Tetrapogon tenellus (J. König ex Roxb.) Chiov. (1908)352 [Syn. *Chloris tenella* J. König ex Roxb. (1820) 330 **(2)**]	-	+*	+	-	-	+
T. villosus Desf.(1799) 389, pl. 255 [Syn. *Chloris villosa* (Desf.) Pers. (1805) 87 **(2)**]	-	+*	-	-	-	+
Tragus racemosus (L.) All. (1785) 241 [Syn. *T. roxburghii* Panigrahi (1974) 496 **(3)**] [*T. biflorus* Schult. (1824) 205 **(4)**]	-	+*	+	+	+	+
Tripogon jacquemontii Nees ex Steud. (1892) 85	-	-	-	-	-	+*
Zoysia matrella (L.) Merr. (1912) 20, 230	-	-	-	-	-	+*
Tribe: Eragrostideae						
Acrachne racemosa (Heyne. ex Roem. & Schult.) Ohwi (1947) 1 [Syn. *Eleusine verticillata* (Roxb.) (1820) 346 **(2)**]	-	+*	-	-	+	+
Cleistogenes gatacrei (Stapf) Bor (1960) 487	-	-	-	-	+*	+
Dactyloctenium aegyptium (L.) Willd. (1809) 1029 [Syn. *Eleusine aegyptia* (L.) Desf. (1798) 85 **(2)**]	+	+	+	+	+	+
D. aristatum Link (1827) 59	-	-	-	-	+*	+
D. sindicum Boiss. (1859) 131	-	-	+*	-	+	+
Desmostachya bipinnata (L.) Stapf (1900) 632 [Syn. *Erogrostis cynosuroides* (Retz.) P. Beauv. (1812) 71, 162, 174 **(1)**]	+	-	+	+	+	+
Dinebra retroflexa (Vahl) Panz. (1813) 59-60	-	-	-	+*	+	+
Eleusine coracana (L.) Gaertn. (1788) 8	+	-	-	+	+	+
E. indica (L.) Gaertn. (1788) 8	-	-	-	-	+*	+
Eragrostiella nardoides (Trin.) Bor (1940) 270	-	-	-	-	+*	+
Eragrostis atrovirens (Desf.) Trin. ex Steud. (1840) 562	-	-	-	+*	+	[-]
E. cilianensis (Bellardi) Vignolo ex Janch. (1907) 110 [Syn. *E. major* L. (1809) 14,24 **(2)**]	-	-	+*	-	+	[-]
E. ciliaris (L.) R.Br. (1818) 478	-	-	+	+	+	+
E. coarctata Stapf 313 (1897).	-	-	+*	-	-	+
E. diarrhena (Schult. & Schult f.) Steud. (1854) 266	-	-	+*	+	+	+
E. diplachnoides Steud. (1854) 268	-	-	-	-	+*	+
E. gangetica (Roxb.) Steud. (1854) 266	-	-	+*	-	+	+
E. japonica (Thunb.) Trin. (1830) 405 [Syn. *E. interrupta* (Thunb.) Trin. (1812) 71, 162,175 **(2)**]	-	+*	+	+	+	+
E. minor Host (1809) 15 [Syn. *E. poaeoides* P. Beauv. (1812) 162 **(3)**]	-	+*	+	+	+	+
E. nutans (Retz.) Nees ex Steud. (1840) 563	-	-	+*	-	-	+
E. pilosa (L.) P. Beauv. (1812) 71, 162, 175	-	+*	+	+	+	+
E. tenella (L.) P. Beauv. Roem. & Schult. (1817) 576	-	-	+*	+	+	+
E. tremula Hochst. ex Steud. (1854) 269	-	+*	+	+	+	+
Leptochloa chinensis (L.) Nees (1824) 4	-	-	-	-	+*	+
L. paniceae (Retz.) Ohwi (1941) 311 [Syn. *L. filiformis* (Pers.) P Beauv. (1812) 163,166 **(2)**]	-	+*	+	+	+	+
Neyraudia arundinacea (L.) Henrard (1929) 8	-	-	-	-	+*	+

Taxon	1 Stewart (1869)	2 Sabnis (1940)	3 Nair (1978)	4 Sharma and Bir (1978)	5 Sharma and Khosla (1989)	6 Present Work
Sporobolus coromendelianus (Retz.) Kunth ((1829) 68	-	+*	-	+	+	+
S. diandrus (Retz.) P. Beauv. (1812) 26, 147, 178	-	+*	+	+	+	+
S. fertilis Steud. (1965) 291 [Syn. *S. indicus* (L.) R. Br. (1810) 170 **(2)**]	-	+*	-	-	+	+
S. helvolus (Trin.) T. Durand. & Schinz (1895) 820 [Syn. *S. glaucifolius* (Hochst. ex Steud.) Hochst. ex T. Durand & Schinz (1854) 154 **(2**)]	-	+*	+	-	+	+
S. ioclados(Nees ex Trin.) Nees (1841) 161 [Syn. *S. marginatus* Hochst. ex A. Rich. (1850) 397 **(3)**]	-	-	+*	+	+	+
S. tenuissimum (Mart. ex Schrank) Kuntze (1898) 369 [Syn. *S. minutiflorus* (Trin.) Link (1827) 88 **(2)**]	-	+	+	-	-	+
Subfamily : Panicoideae						
Tribe: Isachneae						
Isachne albens Trin. (1828) 8, 85	-	-	+*	-	-	[-]
I. himalaica Hook. f. 1897(1896) 23 [Syn. *I. australis* R. Br. (1810) 196 **(2)**]	-	+*	-	-	-	+
Tribe: **Paniceae**						
Alloteropsis cimicina (L.) Stapf (1919) 487	-	-	-	-	+*	+
Brachiaria brizantha (Hochst. ex A. Rich.) Stapf (1919) 531	-	-	-	-	+*	+
B. distachya (L.) Stapf (1919) 565	-	-	-	-	+*	+
B. mutica (Forssk.) Stapf (1919) 526	-	-	-	-	+*	+
B. ramosa (L.) Stapf (1919) 542-544 [Syn. *Panicum ramosum* L. (1767) 29-30 **(2)**]	-	+*	+	+	+*	+
B. reptans (L.) C. Gardner & C.E. Hubb. (1938) pl 3363, f. 3 [Syn. *Panicum prostratum* Lam. (1791) 171 **(2)**]	-	+*	+	-	+	+
Cenchrus biflorus Roxb. (1820) 238 [Syn. *C. catharticus* Delile. (1839) 4 **(2)**]	-	+*	+	+	+	+
C. ciliaris L. (1771) 302 [Syn. *Pennisetum cenchroides* Rich. ex pers. (1805) 72 **(1)**]	+	+	+	+	+	+
C. echinatus L. (1753) 1050	+	-	-	-	-	+
C. pennisetiformis (Hoscht. & Steud.) (1854) 109	-	-	-	+*	+	+
C. prieurii (Kunth) Maire (1931)523	-	-	+*	-	-	+
C. setigerus Vahl (1805) 395	-	-	+*	+	+	+
Digitaria abludens (Roem. & Schult.) Veldkamp (1973) 53-55	-	-	-	-	+*	+
D. bicornis (Lam.) Roem. & Schult. (1817) 470	-	-	-	-	+*	+
D. ciliaris (Retz.) Koeler (1802) 27 [Syn. *D. biformis* Willd. (1809) 92 **(3)**] [Syn. *D. adscendens* (Kunth) Henrard (1934) 92 **(4)**]	-	-	+*	+	+	+
D. longiflora (Retz.) Pers. (1805) 85	-	-	-	-	+*	+
D. nodosa Parl. (1842) 39	-	-	+*	-	-	+
D. radicosa (J. Presl.) Miq. (1857) 437	-	-	-	-	+	+
D. sanguinalis Pers. (1771) 52	+	-	-	-	-	+
D. setigera Roth (1817) 474	-	-	-	-	+*	+
D. stricta Roth ex Roem. & Schult. (1817) 474	-	-	+*	+	+	+
Echinochloa colonum (L.) Link. ((1833) 209 [Syn. *Panicum colonum* L. (1759) 870 **(2)**]	-	+*	+	+	+	+
E. crusgalli (L.) P. Beauv. (1812) 161 [Syn. *Panicum crusgalli* L. (1753) 56 **(2)]**	-	+*	+	-	+	+
E. stagnina (Retz.) P. Beauv. (1812) 171	-	-	-	-	+*	+
Eriochloa fatmensis (Hoscht.) W. D. Clayton (1975) 108 [Syn. *E. nubica* (Steud.) Hack. & Stapf ex Thell. (1919) 697 **(4)**]	-	-	-	+*	+	+
E. procera (Retz.) C.E. Hubb. (1930) 256	-	-	+*	-	-	+
Oplismenus burmanii (Retz.) P. Beauv. (1812) 168,169	-	-	-	+*	+	+
O. compositus (L.) P. Beauv. (1812) 168,169	-	-	+*	+	+	+
Panicum antidotale Retz. (1786) 17 [Syn. *P. miliare* Tam. (1791) 173 **(1)**]	+	+	+	+	+	+
P. atrosanguineum Hochst. ex A. Rich. (1851) 375 [Syn. *P. hydaspicum* Edgew. (1862) 207 **(1)**]	+	+	+	-	-	+

Taxon	1 Stewart (1869)	2 Sabnis (1940)	3 Nair (1978)	4 Sharma and Bir (1978)	5 Sharma and Khosla (1989)	6 Present Work
P. maximum Jacq. (1781) 2, 13	-	-	+*	+	+	+
P. miliaceum L. (1753) 58	+	-	+	-	+	+
P. paludosum Roxb. (1820) 310	-	-	-	-	+	+
P. virgatum Roxb. ex Steud. (1841) 262 [Syn. *P. psilopodium* Trin. (1826) 217 **(5)**]	-	-	+*	-	+	+
P. repens L. (1762) 86	-	-	-	-	+*	+
P. tenellum Roxb. (1854) 21 [Syn. *P. trypheron* Schult. (1824) 244 **(3)**]	-	-	+*	-	+	+
Paspalidium flavidum (Retz.) A. Camus (1922) 419	-	-	+*	+	+	+
Paspalum dilatatum Poir. (1804) 35	-	-	-	-	+*	+
P. longifolium Roxb. (1820) 283 [Syn. *P. longiflorum* Retz. (1786) 15 **(2)**]	-	+*	+	-	-	+
P. notatum Fluegge. (1810) 106	-	-	-	-	+*	+
P. scrobiculatum L. (1767) 29	+	-	+	-	+	+
P. vaginatum Sw. (1788) 21 [Syn. *P. sanguinale* L. (1896)15 **(2)**] [*P. paspaloides* (Michx.) Scribn. (1894)29 **(4)**]	-	+*	+	+	+	+
Pennisetum glaucum (L.) R. Br. (1810) 195 [Syn. *Penicillaria spicata* Willd. (1809) 1037 **(1)**] [*P. typhoides* (Burm.) Stapf et C.E. Hubb. (1933) 271 **(2)**]	+	+	+	+	+	+
P. orientale (L.) C. Rich. (1805) 72	-	+ *	+	-	+	+
P. polystachyon (L.) Schult. (1824) 146	-	-	-	-	+*	+
P. purpureum Schumach. (1827) 44	-	-	-	+*	+	+
Setaria intermedia Roem. & Schultz. (1817) 489 [Syn. *S. tomentosa* (Roxb.) Kunth (1829) 47 **(4)**]	-	-	-	+*	+	+
S. italica (L.) P. Beauv. (1812) 170, 178 [Syn. *Panicum italicum* R.Br. (1753) 56 **(2)**]	-	-	-	-	+	+
S. pumila (Poir.) Roem. & Schult. (1817) 891 [Syn. *S. glauca* (L.) P. Beauv (1812) 168,169.(3)]	-	+*	+	-	+	+
S. sphacelata (Schumach.) Stapf et C.E. Hubb. (1929) 195	-	-	-	-	+	+
S. verticillata (L.) P. Beauv. (1812) 178 [Syn. *Panicum verticillatum* L. (1762) **(3)**]	-	-	+*	+	+	+
Urochloa panicoides P. Beauv. (1812) 53	-	-	+*	+	+	+
Tribe: Arundinelleae						
Arundinella nepalensis Trin. (1826) 62	-	-	-	-	+*	+
Tribe: Andropogoneae						
Andropogon glomeratus (Walter) Britton (1888) 67 [Syn. *Chrysopogon glaucoptis* Stend (1934) 139 **(1)**]	+	-	-	-	-	+
A. pumilus Roxb. (1894) 496	-	-	+*	-	-	+
Apluda mutica L. (1753) 82 [Syn. *A. varia* Hack. Subspecies *aristata* Hack. (1889 (199) **(2)**] [*A. aristata* L. (1756) 303 **(5)**]	-	-	+*	-	+	+
Arthraxon lancifolius (Trin.) Hochst. (1856) 188 [Syn. *Andropogon monticola* Schult. (1827) 665 **(2)**]	-	+*	-	-	+	+
A. prionoides Steud. (1956) 399	-	-	-	-	+*	+
Bothriochloa insculpta (Hochst.) A. Camus (1931) 165	-	-	-	-	+*	+
B. bladhii (Retz.) S.T. Blake. (1969) 62 [*B. odorata* (Lisboa) A. Camus (1931) 165 **(5)**]	-	-	-	-	+*	+
B. ischaemum L. (1936)201	-	-	+*	-	-	+
B. pertusa (L.) A. Camus (1931) 164	-	-	+*	+	+	+
Capillipedium huegelii (Hack.) A. Camus (1921) 308	-	-	-	-	+*	+
C. parviflorum (R.Br.) Stapf (1917) 169	-	-	-	-	+*	+
Chrysopogon serrulatus Trin. (1832) 318 [Syn. *Andropogon monticola* Schult. (1896) 193 **(2)**] [*C. fulvus* (Spreng.) Chiov. (1929) 327 **(3)**]	-	+*	+	-	+	+
Coix lacryma-jobi L. ((1753) 972	-	-	-	-	+*	+
Cymbopogon commutatus (Steud.) Stapf (1907) 211 [Syn. *C. parkeri* Stapf. (1929) 10 **(3)**]	-	-	+*	-	+	+

Taxon	1	2	3	4	5	6
	Stewart (1869)	Sabnis (1940)	Nair (1978)	Sharma and Bir (1978)	Sharma and Khosla (1989)	Present Work
C. citratus (DC.) Stapf. (1906) 357	-	-	-	-	-	+*
C. jwarancusa (Jones) Schult. (1824) 458 [Syn. *Andropogon schoenanthus* (L.) Spreng. (1896) 204. **(2)**]	+	+	+	-	+	+
C. martinii (Roxb.) Watson (1882) 392	-	-	+*	-	+	+
C. nardus (L.) Rendle (1899) 155	-	-	-	-	+*	+
Dichanthium annulatum (Forssk.) Stapf (1917) 178 [Syn. *Andropogon annulatus* Forssk. (1775) 173 **(1)**]	+	+	+	+	+	+
D. caricosum L. A. Camus (1921) 459	-	-	-	-	+*	+
D. foveolatum (Delile) Roberty (1960) 170 [Syn. *Andropogon foveolatus* Delile (1812) 16 t. 82. **(2)**]	-	+*	-	-	+	+
Eulaliopsis binata (Retz.) C. E. Hubb. (1935) 3262 [Syn. *Ischaemum angustifolium* Hook. (1889) 241 **(2)**]	-	+*	-	-	+	+
Hackelochloa granularis (L.) O. kuntze. (1891) 776	-	-	-	-	+*	+
Hemarthria compressa (L. f.) R. Br. (1810) 207 [Syn. *Rottboellia compressa* L. (1781) 114 **(2)**]	-	+*	+	+	+	+
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult. (1817) 836 [Syn. *Andropogon contortus* L. (1753) 1045 **(2)**]	+	+	+	+	+	+
Imperata cylindrica (L.) P. Beauv. (1812) 165 [Syn. *I. arundinacea* Cyprill.. (1792) 27, t. 11 **(2)**]	-	+*	+	+	+	+
Ischaemum rugosum Salisb. (1791) 1	-	-	-	-	+*	+
Iseilema prostratum (L.) Andersson (1856) 251 [Syn. *I. wightii* Andresson (1856) 251 **(2)**] [*Andropogon prostratus* L. (1856)251 **(3)**]	-	+*	+	-	+	+
Lasiurus sindicus (Boiss.) Henr. (1941) 414 [Syn. *Elionurus hirsutus* auct. (1881) 68 **(2)**]	-	+*	+	-	+	+
Pogonatherum crinitum (Thunb.) Kunth. (1906) 178	-	-	-	-	-	+*
P. Paniceum (Lam.) Hack. (1906) 178 [Syn. *P. saccharoideum* P. Beauv. (1812) 176, 177 **(2)**]	-	+*	+	-	+	+
Rottboellia cochinchinensis (Lour.) Clayton (1981) 817 [*R. exaltata* L. f. (1779) 40 **(5)**]	-	-	-	-	+*	+
Mnesithea laevis (Retz.) Kunth (1829)154 [Syn. *Rottboellia perforata* Roxb. **(2)**]	-	+*	-	-	-	[-]
Saccharum bengalense Retz. (1789) 16 [Syn. *S. sara* Roxb. (1820**)** 249 **(1)**] [*S. arundinaceum* Hook. f. (1786 -1787) 14 **(2)**]	+	+	+	+	+	+
S. officinarum L. (1753) 54	+	-	+	+	+	+
S. ravennae L. (1774) 88 [Syn. *Erianthus ravennae* Beauv. (1812) 162, 177 **(2)**]	-	+*	+	+	+	+
S. spontaneum L.(1771) 183	+	+	+	+	+	+
Sorghum bicolor (L.) Moench (1794) 207 [Syn. *S. vulgare* Pers. (1805) 101 **(1)**] [*S. cernuum* (Ard.) Host (1809) 2 **(3)**]	+	-	+	+	+	+
S. halepense (L.) Pers. (1805) 101 [*Andropogon halpensis* Brot. (1804) 89 **(2)**]	+	+	+	+	+	+
Themeda anathera (Nees ex Steud.) Hack. (1889) 669	-	-	-	-	-	+*
T. quadrivalvis (L.) O. Kuntze. (1891) 794 [Syn. *Anthistiria ciliata* L. (1781-1782) 113 **(1)**]	-	-	-	+*	+	+
Vetiveria zizanioides (L.) Nash (1903) 67 [Syn. *Anatherum muricatum* Beauv. (1812) 150 **(1)**] [*Andropogon squarrosus* of Hook. f. (1896) 186 (**2**)]	+	+	+	+	+	+
Zea mays L. (1753) 971	+	-	+	+	+	+
Species Number (Cumulative)	**40**	**74 (93)**	**105 (133)**	**73 (147)**	**146 (185)**	**187 (192)**

Conclusion

The reclassification of grasses of the region proposed in the present paper shall provide new direction to future studies in the group. This is in consonance with a world wide renewal of interest in systematics and evolution of this group. Apart from their conventional uses, grasses have emerged as model plant species for events in plant development and as indicators of environmental changes. Intensive explorations need to be carried out to identify candidate grass species for these areas in the modern biology. The usefulness of intensive explorations is indicated by the fact that the seven new species have been identified in the present study.

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گزارش به‌روز شده‌ای از گندمیان پنجاب (هندوستان)

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چکیده
تیره Poaceae چهارمین تیره بزرگ گیاهان گل‌دار است. این تیره دربردارنده ۷۰۰–۸۰۰ جنس و ۱۱۰۰۰–۱۳۰۰۰ گونه با پراکنش جهانی است. این خانواده، از اهمیت بوم‌شناختی و اقتصادی بی‌نظیری برخوردار است. پیدایش این تیره به دوره کرتاسه نخستین و گونه‌گونی عمده آن به دوره سنوزوئیک میانی باز می‌گردد. در حال حاضر، این تیره نزدیک به یک پنجم سطح خشکی‌ها را پوشش می‌دهد و تقریباً در تمامی زیستگاه‌ها در سطح جهان وجود دارد. با وجود شرایط بوم‌شناختی نیمه گرمسیری و موقعیت اقتصادی منطقه پنجاب، گندمیان بخش قابل ملاحظه‌ای را در منطقه تشکیل می‌دهند. با وجود اهمیت قریب به اتفاق، مطالعات تاکسونومیک در مورد گندمیان در این منطقه از توجه کافی برخوردار نبوده است. تنها در مطالعات Sharma و Khosla (۱۹۸۹) است که گونه‌های گندمیان به زیرتیره‌ها و طایفه‌ها طبقه‌بندی شده‌اند. با این حال، پس از تأسیس کارگروه تبارشناسی گندمیان (GPWG) جهان تحولی نوین در زمینه طبقه‌بندی گندمیان داشته است. اما کشور هند تا آنجا که به تنوع گندمیان مربوط می‌شود هنوز به طور کامل مورد توجه قرار نگرفته است. تحقیقات ما برای اکتشاف و رده‌بندی فلور تیره گندمیان منطقه، تلاشی برای تقویت و به روزرسانی اطلاعات درباره تنوع آن در منطقه مورد مطالعه است. مطالعات حاضر، جمع‌بندی ۱۹۲ مجموعه گونه از جمله ۷ گزارش جدید را ارائه کرده است. نمونه‌های گونه‌ای از زیرتیره‌ها عبارتند از: Aristidoideae (۵)، Arundinoideae (۵)، Bambusoideae (۴)، Chloridoideae (۵۵)، Centothecoideae (۱)، Erhartoideae (۳)، Panicoideae (۹۸) و Pooideae (۲۱).

واژه‌های کلیدی: هندوستان، تیره گندمیان، پنجاب، رده‌بندی، تاکسونومی، گرمسیری

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