

RESEARCH ARTICLE

INFRAGENERIC CLASSIFICATION OF FESTUCA L. IN INDIA

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ABSTRACT

Festuca L. is one of the largest genera in the grass-family Poaceae accounting for about 640 species distributed in all continents. In India most of the species are found in the higher altitude areas of Eastern and Western Himalayas, North-East India, very often in the inaccessible areas and mostly grows in the moist hill slopes and rock crevices, alpine grasslands. Clayton and Renvoize (1986) had classified the genus *Festuca* L. into 9 subgenera namely- Drymanthele, Helleria, Hesperochloa, Obtusae, Schedonorus, Subulatae, Festuca, Subuliflorae and Xanthochloa. An Infra-generic classification of the genus *Festuca* L. in India has been represented here. The following subgenera Drymanthele, Hesperochloa, Schedonorus, Subulatae, Festuca had their representatives in India, of them most of the species (24 species + 2 varieties + 1 subspecies) belongs to the Subgenus: Festuca, others (13 species) are included within subgenera: Drymanthele, Hesperochloa, Schedonorus, Subulatae.

KEYWORDS: Poaceae, grasses, infra-generic, *Festuca*.

Introduction

Festuca L. is one of the largest genera in the grass-family Poaceae (subfamily *Pooideae*, tribe *Poeae*), accounting for about 640 species distributed in all continents (Kerguelen and Plonka, 1989; Watson and Dallwitz, 1992). The genus shows a great diversity and is widely distributed across the northern hemisphere and in grassland communities of the southern hemisphere, but restricted to higher altitudes in subtropical and tropical regions (Clayton and Renvoize, 1986; Watson and Dallwitz, 1992). In India most of the species are found in the higher altitude areas of Eastern and Western Himalayas, North-East India, very often in the inaccessible areas and mostly grows in the moist hill slopes and rock crevices, alpine grasslands. *Festuca* L. generally comprises of tufted grasses and being cosmopolitan in

distribution forms an important component of grass ecosystems of the temperate zone as well as alpine grasslands of the tropical zone (Stančík and Peterson, 2007).

Festuca L. is characterized by typical features of the tribe such as by its caespitose or rhizomatous perennial habit with plicate, involute or flat leaves, paniculate inflorescences, possession of a pooid-type, 4–5-flowered spikelet with subequal glumes and a sterile terminal floret, lower glume is usually 1-nerved, the upper one is wider, usually 3-nerved, several florets, and 5-nerved lemmas with or without a terminal or sub-terminal awn and other specific attributes such as an overall dorsally rounded lemma and linear hilum running to the length of caryopsis (Clayton and Renvoize, 1986, Hackel, 1882; Macfarlane and Watson, 1982;

Received 16 December 2018 | Accepted 20 February 2019 | Published online 9 March 2019

Citation: Kar, S., N.D. Paria & P. Singh. 2019. Infrageneric classification of *Festuca* L. in India. NeBIO 10(1): 1-4

Acknowledgements

The first author wishes to express her deep sense of gratitude to the Director cum Supervisor, Dr. Paramjit Singh, Botanical Survey of India, Kolkata for his guidance, valuable suggestions and providing facilities for research and also grateful to Dr. Subir Bandyopadhyay, Scientist, Central National Herbarium, Botanical Survey of India, Kolkata for his valuable suggestions.

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NeBIO, *An International Journal of Environment and Biodiversity*

Official publication of North East Centre for Environmental Education (NECEER), Imphal | ISSN 2278-2281 (Online), 0976-3597 (Print) | www.nebio.in

Markgraf-Dannenber, 1980; Tzvelev, 1982). These species are highly variable in both vegetative and reproductive traits that have traditionally been used to separate them into the broad-leaved fescues, and the fine-leaved fescues (Hackel, 1882; Saint-Yves, 1927; Kerguelen and Plonka, 1989).

Taxonomic treatment

Festuca L. is the main genus of subtribe Loliinae Dumort. (= Festucinae C. Presl) (cf. Sorong & Davis, 2000), a monophyletic lineage that also encompasses *Lolium* L., *Vulpia* C.C. Gmel. and related genera, and shows a broad range of variation in morphological traits and life-cycles. Classification of the almost cosmopolitan genus *Festuca* has varied through the last two centuries. Hackel (1882) recognized six sections for the European fescues (*Oviniae* Fr., *Bovinae* Fr., *Subbulbosae* Nyman ex Hack., *Variae* Hack., *Scariosae* Hack., *Montanae* Hack.) based on vegetative and floral characters. Within *Festuca* sect. *Oviniae* and *F.* sect. *Variae*, subgroups were characterized by intravaginal versus extravaginal innovation. Saint-Yves (1922, 1925, 1927, 1928, 1929) largely adopted this system for his worldwide revisions of the genus. However, Tzvelev (1971, 1976) and Alexeev (1975, 1977, 1978, 1980, 1981, 1985, 1986) proposed a substantially new system containing ultimately 11 subgenera, many of which were further divided into sections.

Clayton and Renvoize (1986) had classified the genus *Festuca* L. into 9 subgenera namely- Drymanthele, Hellaeria, Hesperochloa, Obtusae, Schedonorous, Subulatae, Festuca, Subuliflorae and Xanthochloa. The following subgenera Drymanthele, Hesperochloa, Schedonorous, Subulatae, Festuca had their representatives in India of them most of the species (24 species + 2 varieties + 1 subspecies) belongs to the Subgenus: Festuca, others (13 species) are included within subgenera: Drymanthele, Hesperochloa, Schedonorous, Subulatae. Most of the revisionary work on *Festuca* L. followed this system of classification worldwide.

The **Indian representatives** of the respective above mentioned subgenera are mentioned below:

Subgenus 1: Drymanthele: *Festuca asthenica* Hook.f; *Festuca modesta* Steud.

Subgenus 2: Hesperochloa.

Section 1: Leucopoa: *Festuca lucida* Stapf; *Festuca nepalica* E.B.Alexeev; *Festuca olgae* (Regel) Krivot.; *Festuca sibirica* Hack. Ex Boiss.

Section 2: Breviaristatae: *Festuca alatavica* (St.-Yves) Roshev.; *Festuca altaica* Trin.

Subgenus 3: Schedonorous.

Section 1: Plantynia: *Festuca gigantea* (L.) Vill.

Section 2: Schedonorous: *Festuca arundinacea* Schreb.; *Festuca pratensis* Huds.

Subgenus 4: Subulatae: *Festuca leptopogon* Stapf; *Festuca nandadevica* Hajra

Subgenus 5: Festuca.

Section 1: Aulaxyper: *Festuca rubra* L. subsp. *clarkii* (Stapf) St.-Yves; *Festuca rubra* L. var. *rubra* L., *Festuca rubra* L. var. *villosa* Mert. ex Koch

Section 2: Festuca: *Festuca alaica* Drobow; *Festuca bhutanica* E.B.Alexeev; *Festuca boriata* E.B.Alexeev; *Festuca chumbiensis* E.B.Alexeev; *Festuca coelestis* (St.-Yves) V.I.Krecz. & Bobr.; *Festuca cumminsii* Stapf; *Festuca debilis* (Stapf) E.B.Alexeev; *Festuca hartmannii* (Markgr.-Dann.) E.B.Alexeev; *Festuca kashmiriana* Stapf; *Festuca levingei* Stapf; *Festuca nitidula* Stapf; *Festuca ovina* L.; *Festuca pamirica* Tzvelev; *Festuca parvigluma* Steud.; *Festuca poluninii* E.B.Alexeev; *Festuca polycolea* Stapf; *Festuca sikkimensis* E.B. Alexeev; *Festuca simlensis* (Stapf) E.B.Alexeev; *Festuca stapfii* E.B.Alexeev; *Festuca tibetica* (Stapf) E.B.Alexeev; *Festuca undata* Stapf; *Festuca valesiaca* Schleich. ex Gaudin; *Festuca wallichiana* E.B.Alexeev.

Subgenus 1.

Drymanthele Krecz. and Bobr. In Komarov, Fl. URSS 2: 532. 1934.

Type: *Festuca drymeja* Mert. & W.D.J. Koch in Deutschl.

Fl. (Mertens & W.D.J. Koch), ed. 3, 1: 670. 1823. Austria, in waldungenunweit Wien, 17 Jun 1806, *sin. loc., s. col.* (Iso.- LE, n. v).

Annual plants, 50–150 cm high. Basal innovations extravaginal. Leaf-blades flat, 5–15 mm wide; margin convolute, many nerved, mid-rib raised adaxially; ligule 2.6–6 mm; leaf-sheaths without auricles. Glumes membranous only along margins. Lemma chartaceous, apex muticous, awnless. Ovary densely hairy at apex. Lodicules obliquely ovoid. Caryopsis fruits are linear-oblong.

Subgenus 2.

Hesperochloa Piper in North American species of *Festuca*. Contributions from the United States National Herbarium, 10: 40. 1906.

Type: *Festuca kingii* (Watson) Cassidy in Bull. Agric. Exper. Sta., Colorado, 12: 36. 1890. USA, Nevada, East Humoldt Mts., 7,500–10,000 ft., Jul-Sep, *S. Watson* 1317 (US-556202, Image!).

Leaf-sheath without auricles. Caryopsis fruits are oblong.

Section 1: Leucopoa (Griseb.) Krivot. in Bot. Mat. (Leningrad) 20: 48. 1960.

Type: *Festuca sibirica* Hack. ex Boiss. In Fl. Orient. 5: 626. 1884. Ex herbario horti Petropolitini, *sin. loc., s. col.* 'Poa albidia' (Lecto.- W, W19610004621, Image!).

Leaf-blade 1.2–2.5 cm wide, flat, convolute, 7-many nerved; ligule 3–9 mm; leaf-sheath open for most of their length. Panicle 0.6–1.5 cm wide. Spikelet 2–4.5 mm wide, rachilla scaberulous. Lower glume chartaceous, hyaline. Upper glume chartaceous, hyaline, apex acute. Lemma awnless, sometimes muticous. Palea oblong-lanceolate, keels scabrous.

Section 2: Breviaristatae Krivot. in Bot. Mat. (Leningrad) 20: 57. 1960, excl. *F. venusta* St.-Yves.

Type: *Festuca altaica* Trin. In Ledeb. *Fl. Altaic. 1: 109. 1829*. Hab. in summa alpeadfontem fl. Acjulacrissima. (Holo.- LE, LE01010145, Image!).

Leaf-blades 0.1–0.3 cm wide, linear-setaceous, conduplicate, 4–5-nerved; ligule 0.5–0.8 mm; leaf-sheath tubular for much of their length. Panicle 3–6 cm wide. Spikelet 0.4–0.7 mm wide, rachilla scabrous. Lower glume membranous. Upper glume membranous, apex acuminate. Lemma awned, sometimes mucicous. Palea ovate-lanceolate, keels scaberulous.

Subgenus 3.

Schedonorus (P. Beauv.) Peterm. in *Deutschl. Fl.* 643, s. str. 1849.

Type: *Festuca arundinacea* Schreb. in *Spic. Fl. Lips.* 57. 1771. Scheuchzer (1719: tab. V, fig. 18). (Lecto.- designated by Reveal & al. in *Taxon* 40(1): 136. 1991); Africa, South Morocco, Greater Atlas, Amsmiz, 3,000–6,000 ft., May 1871, *Dr. Hooker s. n.* (Epitype- K, K000345320, designated by Sutrishna Kar, SangitaDey and P. Singh in *Phytotaxa* 195(1): 090–093. 2015).

Annual plants, 30–150 cm high. Basal innovations extravaginal. Leaf-blades flat, margin convolute, many nerved, mid-rib not raised adaxially; ligule 0.5–2.5 mm; leaf-sheaths with lanceolate, falcate auricles. Panicle ovate-lanceolate, often pyramidal; 3–10 floret per spikelet. Lower glume narrowly lanceolate-broadly lanceolate, membranous, both abaxial and adaxial surface scabrous. Upper glume apex acute-acuminate, abaxial surface scabrous. Lemma 1.4–2.7 mm wide, chartaceous, apex awned, rarely awnless (*F. pratensis*). Palea lanceolate-oblong, inter-keel region membranous hyaline. Anther 2.1–4.2 mm. Pistil 3.2–4 mm × 0.5–0.8 mm. Ovary 0.8–1.7 mm, glabrous at apex. Lodicules truncate-obovate, sometimes bi-fid. Hilum 1/2-same as the length of the caryopsis.

Section 1: Schedonorus (P. Beauv.) Koch in *Syn. Fl. Germ. Helv.* 810. 1837.

Type: *Festuca arundinacea* Schreb. in *Spic. Fl. Lips.* 57. 1771. Scheuchzer (1719: tab. V, fig. 18). (Lecto.- designated by Reveal & al. in *Taxon* 40(1): 136. 1991); Africa, South Morocco, Greater Atlas, Amsmiz, 3,000–6,000 ft., May 1871, *Dr. Hooker s. n.* (Epitype- K, K000345320, designated by Sutrishna Kar, SangitaDey and P. Singh in *Phytotaxa* 195(1): 090–093. 2015).

Leaves adaxial surface glabrous-scaberulous, margin glabrous-scabrous. Panicle 2–5 cm wide, open-contracted, lanceolate-ovate. Spikelet 4–5.2 mm wide, elliptic-ovate. Lower glume narrowly lanceolate, apex acute, margin scabrous. Upper glume oblong-lanceolate, apex acute, adaxial surface scabrous, margin scabrous. Lemma apex acuminate, adaxial surface glabrous, margin scabrous towards apex. Palea 0.8–1.2 mm wide, lanceolate, inter-keel region scabrous. Caryopsis fruits are 2.5–4 mm, hilum 1/2 the length of the caryopsis.

Section 2: Plantynia(Dum.) Tzvel. in *Poaceae*, USSR 1: 394. 1976.

Type: *Festuca gigantea* (L.) Vill. in *Hist. Pl. Dauphine* 2: 110. 1787. Type of Basionym: *Bromus giganteus* L. in *Hist. Pl. Dauphiné* 2: 118. 1787. Herb. A. van Royen (Lecto.- L, L-913. 62–78, *n. v.*,

designated by Darbyshire in Cafferty & al., *Taxon* 49(2): 248. 2000).

Leaves adaxial surface scabrous, margin scaberulous. Panicle 1–1.8 cm wide, open, pyramidal-ovate. Spikelet 1.5–3 mm wide, linear-lanceolate. Lower glume broadly lanceolate, apex acuminate, margin glabrous. Upper glume broadly lanceolate, apex acuminate, adaxial surface glabrous, margin glabrous. Lemma apex acute, adaxial surface scaberulous, margin glabrous. Palea 1.8–2.7 mm wide, oblong-lanceolate, inter-keel region scaberulous. Caryopsis fruits are 5.5–6.4 mm, hilum same as the length of the caryopsis.

Subgenus 4.

Subulata (Tzvelev) E.B. Alexeev in *Byull. Moskovsk. Obshch. Isp. Prirodoz.* 82 (3): 96. 1977.

Type: *Festuca subulata* Trin. *Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math.* 2(2): 173. 1832. USA, Ile de Sitcha, Alaska, *Mertens s. n.* (LE, *n. v.*).

Basal innovations extravaginal; leaves flat, margin convolute, many nerved, mid-rib not raised adaxially; ligule 0.5–2.5 mm. Panicle ovate; 1–3 floret per spikelet. Lower glume subulate-lanceolate, chartaceous, both abaxial and adaxial surface glabrous-scaberulous. Upper glume apex obtuse-attenuate, abaxial surface glabrous-scaberulous. Lemma 0.8–1 mm wide, chartaceous, apex awned, rarely awnless. Palea linear-oblong, inter-keel region membranous tough. Anther 1.1–2 mm. Pistil 4.2–5.2 mm × 1.3–1.7 mm. Ovary 2.4–4.5 mm, pubescent at apex. Lodicules bi-fid. Hilum 1/3rd of the length of the caryopsis.

Subgenus 5.

Festuca L. in *Sp. Pl.* 1: 73. 1753.

Type: *Festuca ovina* L. in *Sp. Pl.* 1: 73–74. 1753. (Lecto.- designated by Nash, III. *Fl. U. S. Canad.*, ed. 2, 1: 269. 1913; also Jarvis & al., *Watsonia* 16: 300. 1987).

Basal innovations intravaginal, both intra and extravaginal, sometimes extravaginal. Culm 5–100 cm; slender, erect-geniculately ascending. Leaf-blades setaceous, sometimes flat on fertile culms; conduplicate, margin involute, glabrous-scabrous; auricle absent. Lemma membranous-chartaceous, sometimes membranous tough; lemmas awned, less often awnless. Palea lanceolate. Ovary apex glabrous-sparsely hairy. Lodicules membranous, hyaline, obliquely ovoid. Caryopsis fruits are linear-oblong; hilum linear, similar the length of caryopsis.

Section 1: Aulaxyper Dumort in *Observ. Gramin. Belg.*: 104. 1824.

Type: In *paludosis pratiregii*, Upsalia, a Linne P (ater), ex herb. C. Alstroemerii (Lecto.- GB, GB0048954, Image!, designated by Jarvis & al., *Watsonia* 16: 302. 1987).

Perennial, caespitose, moderately tufted, 15–90 cm high. Basal innovations extravaginal. Leaf-blades setaceous; margin involute, glabrous, 5–7-nerved; ligule 0.2–0.5 mm, membranous, narrow, truncate, eciliate; auricle absent. Lemma membranous

tough, awned, principal lemma awn 0.5–3 mm, stiff. Ovary apex glabrous-sparsely hairy. Caryopsis fruits are linear-oblong.

Section 2: *Festuca* L. in Sp. Pl. 1: 73. 1753.

Type: *Festuca ovina* L. in Sp. Pl. 1: 73–74. 1753. (Lectotype designated by Nash, III. Fl. U. S. Canad., ed. 2, 1: 269. 1913; also Jarvis & al., *Watsonia* 16: 300. 1987).

Monococious plants, 5–100 cm high. Basal innovations intravaginal, both intra and extravaginal. Leaf-blades setaceous, sometimes flat on fertile culms, up to 2.5 mm wide; margin conduplicate, involute, 3–9-nerved; leaf-sheaths without auricles. Lemma membranous-chartaceous, lemmas awned, less often awnless. Ovary usually glabrous, less often pubescent at apex. Caryopsis fruits are linear-oblong.

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