Taiwania 62(1): 75–92, 2017
DOI: 10.6165/tai.2017.62.75

Poa L. species in Uttarakhand, India and keys for their identification

Dinesh Chandra NAUTIYAL[1,*] and R. D. GAUR[2]

1. Centre for Inter-disciplinary Studies of Mountain and Hill Environment, 3rd Floor, Academic Research Centre Building,University of Delhi, Delhi - 110007, India.
2. Department of Botany, H.N.B. Garhwal University, Srinagar (Garhwal) 246174, Uttarakhand, India.
**Corresponding author's tel.: +01127666163; email:dcnautiyal@cismhe.org*

(Manuscript received 19 July 2016; accepted 7 January 2017; online published 22 February 2017)

ABSTRACT: *Poa* is the largest genus among the grasses of the Himalaya and the species of this genus are mainly distributed in temperate and alpine zones. Uttarakhand state of India lies in the easternmost end of Western Himalaya and a large number of *Poa* species are known here. Plant collections by the authors, study of Indian herbaria and taxonomic literature proves presence of 45 species and 2 subspecies of *Poa* in Uttarakhand. Brief taxonomic accounts and keys for identification of these taxa are provided in this article. In addition, information on habitat, occurrence, approximate elevation range, flowering and fruiting times are also provided. The collected specimens of *Poa* were identified with the help of relevant taxonomic literature and the identity was confirmed by matching them with the authentic specimens housed in DD, BSD, GUH and CAL. Voucher specimens are deposited in GUH. Some taxa which are not collected by the authors are included here based on the specimens housed at Botanical Survey of India, Northern Circle, Dehradun (BSD). *Poa rhadina* Bor is a rare and narrow endemic species of the Western Himalaya and restricted to Tehri Garhwal only.

KEY WORDS: Distribution, Endemic species, Herbarium, Identification, India, Keys, *Poa*, Poaceae.

INTRODUCTION

Poa L. is the largest genus among the grasses of Himalaya and is frequently distributed in temperate to alpine regions (Duthie, 1906; Bor, 1941, 1960; Karthikeyan *et al*., 1989; Rajbhandari, 1991; Uniyal *et al.*, 1994; Gaur and Nautiyal, 1996). The genus has a wide distribution in various regions of the world (Gillespie and Soreng, 2005; Chwedorzewska, 2008). However, the Himalayan *Poa* species have not been successfully distinguished from each other due to insufficient knowledge on variations of morphological characters as well as lack of enough plant materials. Because of its similar and polymorphic taxa and the existence of polyploidy, hybridization and apomixis, the identification of *Poa* species is difficult (Stebbins, 1950; Clausen, 1961; Tzvelev, 1983; Hunziker and Stebbins, 1987; Kavousi *et al.*, 2015). Clayton and Renvoize (1986) claimed that *Poa* is an extremely uniform genus for which there is no satisfactory infrageneric classification and useful morphological characters. The affinities of half of these species are unknown, while the remaining species are considered to belong to several informal species groups (Gillespie *et al.*, 2007; Soreng *et al.*, 2009).

Irrespective of its commonness in the Himalaya, much taxonomic works have not been done on *Poa* genus. Stapf in 1896 studied it for Hooker's Flora of British India. After a long gap, Bor has studied it in 1948 and further revised Indian *Poa* including Himalayan species in 1952. Therefore, our present knowledge on the genus *Poa* in the Himalaya is mostly based on new species or records and summary treatments of all grasses in this subcontinent (Bor, 1960). The grasses from this part of Himalaya are reported by Stapf (1897-1900), Duthie (1833, 1906), Bor (1941, 1960), Stewart (1945), Raizada *et al.* (1983), Babu (1977), Naithani (1985) and others. In addition, some scattered information is also available with the floristic accounts of various workers from different localities by Rau (1961), Semwal and Gaur (1981), Kala and Gaur (1982), Sharma and Gaur (1983), Gaur (1987, 1999), Pangtey *et al.* (1988), Uniyal *et al.* (1994), Gaur and Nautiyal (1995, 1996, 1997), Nautiyal and Gaur (1999a, 1999b) etc.

In a taxonomic revision of the genus *Poa* in the Himalaya, Rajbhandari (1991) listed about 52 species of *Poa* with a key on the basis of morphological characters. Accounts of the revision of *Poa* from other countries are also the results of new species and summary treatment of all grasses. Bor (1970) reported 13 species of the genus *Poa* from Iran; Cope (1982) reported 33 species of the *Poa* from Pakistan; Chen *et al.* (2006) reported 156 species of the *Poa* from China; Press *et al.* (2000) reported 32 species of *Poa* from Nepal; Noltie (2000) reported 29 species of *Poa* in Flora of Bhutan including the plants from Sikkim and Darjeeling. More recently, Soreng *et al.* (2003), Clayton *et al.* (2006), Soreng and Peterson (2012), etc provided a revisionary account of the genus *Poa* in Mexico and included more species based on new discoveries and changes in identification. However, in the context of Uttarakhand, the information available on *Poa* species is scanty and mainly restricted to inventories (Uniyal *et al.*, 1994, 2007). *Poa,* the type genus of Poaceae, is still most interesting one on account of its ambiguity in taxonomic details, as it requires

臺灣大學學術期刊資訊網

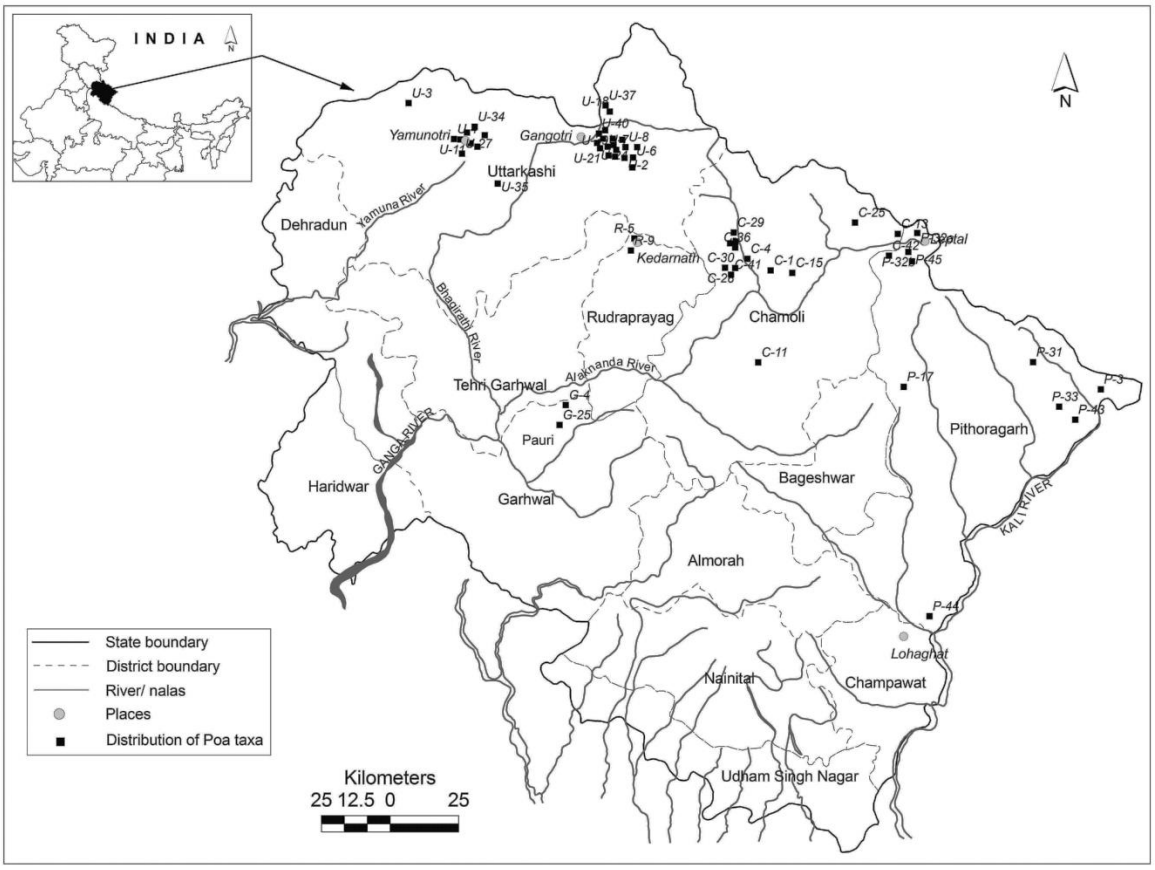


Fig. 1. Distribution map of ***Poa*** taxa in Uttarakhand region. **C**= Chamoli District; **U**=Uttrakashi District; **P**=Pithoragarh District; **G**=Garhwal District; **R**=Rudrapryag District.

critical microscopic observations of callus structure, glumes, lemmas, paleas, stamens and other phenotypic features (Rajbhandari, 1991). Critical study of literature on the genus *Poa* (Hooker, 1896; Duthie, 1906; Bor, 1941, 1960; Rau, 1961; Naithani, 1985; Pangtey *et al.*, 1988; Karthikeyan *et al.*, 1989; Rajbhandari, 1991; Uniyal *et al.*, 1994; Gaur and Nautiyal, 1996, 1997), indicated that some species are new and rare records from this part of the Himalaya, representing extension of their eastward or westward distribution. Due to new records and discoveries, we currently accept 45 species and 2 subspecies of *Poa* in Uttarakhand and provide a key to species occurring in Uttarakhand.

MATERIALS AND METHODS

The authors have been collecting the specimens of *Poa* since 1995 from various parts of Uttarakhand. Field trips were carried out in sub-tropical, temperate and alpine zones in Uttarakhand (Appendix1, Fig. 1). After critical review of literature and consultation of Herbaria at Forest Research Institute (DD), Dehradun and Botanical Survey of India, Northern Regional Centre, Dehradun (BSD), Botanical Survey of India, Sikkim Circle, Gangtok (SHC), Central National Herbarium (CAL), Howrah, these identified specimens of *Poa* were deposited at the Herbarium of H.N.B. Garhwal University, Srinagar-Garhwal (GUH). Usual methods of collection, preservation, and maintenance of specimens in the herbarium (Jain and Rao, 1977) were followed. Besides our own collections, fifteen species were included and described based on their specimens in herbarium of Botanical Survey of India, Northern Regional Centre, Dehradun (BSD), and recent secondary literature on grasses (Uniyal *et al.*, 1994, 2007; Kandwal *et al.*, 2003, Kandwal and Gupta, 2009). Attempts have been made to incorporate latest and valid nomenclature as per International Code of Nomenclature (ICN) (McNeill *et al.*, 2012) as well as in accord with recent floras, monographs and revisions available on the taxa. For the economy of space only currently accepted names and basionyms are given. A dichotomous bracketed keys to species and subspecies are constructed for the identification. In key all measurements were taken from the lowest one floret in the spikelets and ligule length is determined on the upper culm leaf. A key of all known species of *Poa* in Uttarakhand together with flowering and fruiting timing, distribution, ecology (habitat of occurrence, elevation) and collector's herbarium number are given.

臺灣大學學術期刊資料庫

TAXONOMIC TREATMENT

In the present investigation 45 taxa of *Poa* have been reported from Uttarakhand out of which 15 taxa are included here based on the specimens housed at Botanical Survey of India, Northern Circle, Dehradun (BSD). *Poa pratensis* L. subsp. *pratensis* Stapf and *P. pratensis* L. subsp. *angustifolia* (L.) Gaud. are treated here as subspecies.

Poa L., Sp. Pl. 1: 67. 1753.

Annuals or perennials, tufted or rhizomatous grasses. Culms terete or compressed, erect or geniculate from base, smooth or scabrid below the inflorescence, with 2–5 nodes. Leaf blades linear or setaceous, flat or folded, smooth or scabrid. Ligule membranous, acute, obtuse or rounded at apex, 0.5–6 mm long. Leaf sheaths round or compressed, glabrous or scabrid, basal sheaths bulbous or not. Inflorescence paniculate, linear, elliptic, ovate or pyramidal in shape; branches ascending, spreading or reflexed, lower branches 1–5, smooth or scabrid; pedicels smooth or scabrid. Spikelets with 2–7 floret, elliptic, ovate or wedge shaped, green or purplish, sometimes viviparous with florets proliferating. Callus at the base of floret glabrous or ciliate with long or short cottony hairs. Glumes lanceolate or subulate, keeled, lower glume shorter or sometimes longer than the lowest lemma, 1 or 3-nerved, upper glume 3-nerved. Lemmas keeled, usually 5-nerevd, sometimes 7-nerved, keel glabrous or ciliate in lower half or rarely smooth, intermediate nerves between keel and marginal nerves distinctly visible or obscure, glabrous, scabrid or ciliate. Paleas membranous, 2-keeled, keels scabrid, ciliate throughout or semipilose. Lodicules 2, hyaline. Stamens 3. Ovary glabrous, styles 2, stigmas plumose.

Key to the species of *Poa*

1a.Basal sheaths with a bulbous thickening at base……2
1b. Basal sheaths without bulbous thickening at base …….. 3
2a.Spikelets not proliferating; lemma keels scabrid……***P. bactriana***
2b. Spikelets proliferating; lemma keels ciliate on lower part ……. ……. ***P. bulbosa***
3a.Palea keels ciliate throughout…… 4
3b. Palea keels scabrid or semipilose …….. 9
4a.Surface of the lower panicle branches smooth……5
4b.Surface of the lower panicle branches scabrid……8
5a.Perennials; anthers more than 1 mm long…….. ***P. supina***
5b. Annuals; anthers up to 0.9 mm long…….. 6
6a. Anthers 0.3–0.4 mm long…… ***P. infirma***
6b.Anthers 0.6–0.9 mm long…… 7
7a.Lower panicle branches 4; intermediate nerves of lemma glabrous; ligules 1.1–1.2 mm long……***P. nephelophila***
7b. Lower panicle branches 1 or 2; intermediate nerves of lemma ciliate on lower part; ligules 1.5–3 mm long…….. ***P. annua***
8a.Lower glumes longer than the lowest lemma; lemma surface hairy……***P. hirtiglumis***
8b. Lower glumes shorter than the lowest lemma; lemma surface glabrous……***P. nepalensis***
9a.Annual, loosely tufted grasses……10
9b. Perennial, densely tufted grasses……14
10a.Lower glume 1-nerved ……11
10b. Lower glume 3-nerved…….. 12
11a Callus glabrous; lemma keel scabrid; palea keels scabrid…….. ……***P. tibeticola***
11b. Callus ciliate; lemma keel ciliate below; palea keels semipilose…… ***P. stewartiana***
12a.Ligules 0.5–1mm long; lemma keel scabrid or glabrous…….. ……***P. pseudamoeana***
12b. Ligules more than 2 mm long; lemma keel ciliate below…….13
13a.Lower glume longer than the lowest lemma; callus ciliate…..… ……***P. rhadina***
13b. Lower glume shorter than the lowest lemma; callus glabrous…. ……***P. hylobates***
14a. Lemma keel scabrid or glabrous ……15
14b. Lemma keel ciliate below ……..18
15a.Surface of lower panicle branches scabrid ……16
15b. Surface of lower panicle branches smooth……17
16a. Ligule 1 mm long; anthers 1.2 mm long……***P. royleana***
16b.Ligule 0.8–1mm long; anthers 1.9–2.2 mm……***P. aitchisonii***
17a. Lowest lemmas keel scabrid, intermediate nerves obscure…..… ……***P. bactriana***
17b. Lowest lemmas keel scabrid on upper part, intermediate nerves distinct……***P. royleana***
18a. Panicle narrow or linear; branches ascending …… ……***P.versicolor*** subsp.***araratica***
18b. Panicle oblong; branches spreading……19
19a. Lower glume equal to or longer than the lowest lemma…..20
19b. Lower glume shorter than the lowest lemma……21
20a.Spikelets 5.5– 6.7 mm long……***P. eleanorae***
20b. Spikelets 3.1– 4.5 mm long…….. ***P. setulosa***
21a. Callus glabrous……22
21b. Callus ciliate……..37
22a. Lemma surface between nerves hairy on lower part……23
22b. Lemma surface between nerves glabrous……..26
23a. Lower glume 1-nerved; anthers 2.7–2.8 mm long…***P. falconeri***
23b. Lower glume 3-nerved; anthers up to 2 mm long……24
24a. Palea keels scabrid……***P. arnoldii***
24b. Palea keels semipilose ……25
25a. Lower panicle branches smooth; spikelets ovate ……. ***P. alpina***
25b. Lower panicle branches scabrid; spikelets elliptic...***P. lahulensis***
26a. Ligules up to 1 mm long; lower glume subulate……27
26b. Ligules more than 1 mm long; lower glume oblong or elliptic.28
27a.Ligules 0.8–1 mm long; lower panicle braches 2...***P. aitchisonii***
27b. Ligules 0.6–0.8 mm long; lower panicle branches 2–5…….. ……***P. polycolea***
28a. Palea keels semipilose……29
28b. Palea keels scabrid……30
29a.Spikelets 3.8–4.7 mm long ……...***P. sikkimensis***
29b. Spikelets 3.4–4.3 mm long ……***P. koelzii***
30a.Lower panicle branches smooth……31
30b. Lower panicle branches scabrid…….. 32
31a. Margin of upper glume ciliate below; anthers 2–2.98 mm long.. ……***P. tibetica***
31b. Margin of upper glume glabrous; anthers 1.2– 1.8 mm long….. ……***P. kanaii***
32a.Lower glume 3 or 1-nerved……***P. harae***
32b. Lower glume 3-nerved……33
33a.Panicle branches spreading……..34
33b. Panicle branches ascending……35
34a. Anthers 1.7–2.2 mm long……***P. sterilis***
34b. Anthers 1.1–1.5 mm long…… ***P. harae***
35a.Culms scabrid……***P. mustangensis***
35b. Culms smooth……36
36a.Lower panicle branches 2–4……***P. poophagorum***
36b. Lower panicle branches 1–2…… ***P. attenuata***
37a.Lemma surface ciliate or scabrid 38
37b. Lemma surface glabrous…… 44
38a. Anthers more than 1.6 mm long…….. 39
38b. Anthers less than 1.5 mm long…… 42
39a. Ligules less than 1.5 mm long……***P. burmanica***

臺灣大學學術期刊資訊庫

39b. Ligules more than 1.5 mm long……..……. 40
40a.Lower glume 3- nerved……..…..……..***P. gammieana***
40b. Lower glume 1-nerved or rarely 3-nerved……... 41
41a.Ligules 1.5–3 mm long; spikelets 4.5–11 mm long…….…. ….……***P. garhwalensis***
41b. Ligules 1.8–3.5 mm long; spikelets 4.3–5.8 mm long……..… ……..……..***P. pagophila***
42a. Panicle branches ascending; intermediate nerves of lemma obscure……..……***P. koelzii***
42b. Panicle branches spreading; intermediate nerves of lemma distinct……..……..……..43
43a. Ligules 2–4 mm long; lower panicle branches smooth……...…. ……..……..***P. stapfiana***
43b. Ligules1.1–1.2 mm long; lower panicle branches scabrid…….. ……..……..……***P. burmanica***
44a. Rhizomatous grasses…….……..…45
44b. Tufted or stoloniferous grasses……..……..…47
45a. Palea keels ciliate ……***P. himalayana***
45b. Palea keels scabrid……46
46a. Ligules 2.5–6 mm long; lowest lemmas 3.7–4.5 mm long…….. ……..……..…..……***P. jaunsarensis***
46b. Ligules 2–2.3 mm long; lowest lemmas 2.5– 4 mm long…… ……..……***P. pratensis***
47a. Ligules 0.5–0.6 mm long……..……..***P. nemoralis***
47b. Ligules more than 0.8 mm long……..……48
48a. Ligules 4–7 mm long……..…….. ***P. trivialis***
48b. Ligules up to 3.5 mm long……..……49
49a. Lower glume 1-nerved……..……..……..…50
49b. Lower glume 3-nerved or rarely 1-nerved……..……..…….. 51
50a. Ligules 0.8–2 mm long; lower glume lanceolate…..***P. khasiana***
50b. Ligules 1.8–3.5 mm long; lower glume elliptic…..***P. pagophila***
51a. Panicle branches ascending; lower panicle branches 2. …… ……..……..……..……***P. versicolor*** subsp.***araratica***
51b. Panicle branches spreading; lower panicle braches 2–5…...…52
52a. Lower panicle branches 2–5; anthers 1.5–1.6 mm long…..…... ……..……..……***P. alpigena***
52b. Lower panicle branches 2–4; anthers 1–1.2 mm long…….……. ……..……..……..***P. palustris***

Brief taxonomic account of *Poa* taxa

1. *Poa aitchisonii* Boiss., Fl. Orient. 5 (2): 602. 1884.

Perennial, tufted. Culms 15–27 cm tall, geniculate below; leaf blades linear; sheaths glabrous; ligules 0.8–1 mm long. Panicles lanceolate or oblong, 3.5–8 cm long, branches spreading, lower branches 2, smooth. Spikelets oblong, 4.5–7.6 mm long, florets 3–5, callus wool glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemma's keel scabrid or ciliate on lower part, intermediate nerves distinct, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 1.5–2 mm long.

Flowering and Fruiting: May─August.

Habitat and Ecology: Rare, in shaded or moist alpine slopes, at an elevation of 3300 m.

Distribution: Northwest India, Afghanistana, Iran, Pakistan.

Specimen examined: **INDIA**: Uttarakhand, Chamoli District, Dalisera, 3300 m, 10 June 1991, *D.C. Nautiyal 14001* (GUH!).

Note: Earlier *Poa aitchisonii* has been collected from the westernmost part of the Himalaya, Kuram valley. Lemmas of this species do not have ciliate hairs, but sometimes ciliate hairs are found on the lower part. This species resembles *P. polycolea* Stapf, but differs in being tufted habit, leaf blades more flattened and 2 lower panicle branches. Whereas, *Poa polycolea* has stoloniferous habit, leaf blades linear or setaceous and 2–5 lower panicle branches.

2. *Poa alpigena* (Blytt) Lindm., Svensk. Fanerogamfl. 91.1918.

Poa pratensis var. *alpigena* Blytt, Fl. Norges 1: 130. 1861.

Perennial, rhizomatous. Culms 6–22 cm tall, with curved underground stem; leaf blades linear; sheaths glabrous; ligules 1.1–1.5 mm long. Panicles ovate or pyramidal, 3–6 cm long, branches ascending, lower branches 2–5, smooth. Spikelets elliptic, 3.2–5.2 mm long, florets 2–4, callus with long ciliate hairs. Lower glume 1 or 3-nerved; upper glume 3-nerved. Lowest lemma's keel ciliate on lower half to two-thirds, intermediate nerves obscure, marginal nerves ciliate on lower half. Paleas keels scabrid; anthers 1.5–1.6 mm long.

Flowering and Fruiting: May─August.

Habitat and Ecology: Rare, in sandy alpine meadows and glacial moraines frequently exposed to the sun, at an elevation of 5000 m.

Distribution: Arctic, N Scandinavia to the mountains of Asia, Himalaya, Tibet.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Tapovan, 5000 m, 27 Aug. 1995, *D.C. Nautiyal 14913* (GUH!).

Note: *Poa alpigena* is a perennial rhizomatous species with culms bent at the base. This species resembles *Poa pratensis* L. in long ciliate hairs on the callus, but clearly differs in having ligules 1.1–1.5 mm long (versus 2–2.3 mm long in *P. pratensis*), intermediate nerves obscure on lemmas (versus intermediate nerves distinct in *P. pratensis*) and anthers 1.5–1.6 mm long (versus 1.5–2 mm long in *P. pratensis*).

3. *Poa alpina* L., Sp. Pl. 1: 67. 1753.

Perennial, tufted. Culms 3–30 cm tall, erect or geniculate below; leaf blades mostly crowded at the base of stem, flat or folded; sheaths glabrous; ligules1.5–3 mm long. Panicles ovate or triangular, 2–7 cm long, branches spreading, lower branches 2, smooth. Spikelets ovate, 4–7 mm long, florets 3–6, callus wool glabrous; Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, intermediate nerves obscure, surface hairy on lower half, marginal nerves ciliate. Palea's keels semipilose; anthers 1.2–1.5 mm long.

Flowering and Fruiting: June–October.

Habitat and Ecology : Uncommon, in the partly moist alpine grazing meadows, between 3800–4500 m elevation.

Distribution: Europe, Asia North America, Himalaya.

Specimen examined: **INDIA**: Uttarakhand, Pithoragarh District, Parvatikund, 4500 m, 15 August 2005, *M. K. Kandwal 111664* (BSD!)

Note: *Poa alpina* is a widely distributed species of the Northern Hemisphere. In the western Himalaya, it is commonly found in the alpine zone and there is no record of collection from the eastern Himalaya. In Nepal, there is only one collection from the northwestern part (Rajbhandari, 1991). This species is

臺灣大學學術期刊資料庫

distinct from other species of Himalayan *Poa* in having ovate spikelets, glabrous callus, lemmas with hairy surfaces and paleas with semipilose keels.

4. *Poa annua* L., Sp. Pl. 1. 68. 1753.

Annual, tufted. Culms 4–20 cm tall, erect or geniculate; leaf blades linear; sheaths glabrous; ligules 1.5–3 mm long. Panicles ovate or pyramidal, 1.5–5 cm long, branches spreading or deflexed, lower branches 1 or 2, smooth.Spikelets elliptic-oblong, 3.4–7.2 mm long, florets 3–5, callus glabrous. Lower glume 1-nereved; upper glume 3-nerved. Lowest lemma's keel ciliate for half to three quarters of its length, intermediate nerves distinct and ciliate on lower part, marginal nerves ciliate on lower part. Paleas keels ciliate; anthers 0.7–0.9 mm long.

Flowering and Fruiting: June–November.

Habitat and Ecology: Common, in moist fields, playgrounds and high altitude forest slopes, between 600–3500 m elevation.

Distribution: Cosmopolitan.

Specimen examined: **INDIA**: Uttarakhand, Rudraprayag District, Kedarnath, 3500 m, 1 June 1994, *D.C. Nautiyal 13604* (GUH!); Garhwal District, Srinagar old campus garden area, 600 m, 14 July 1994, *D.C. Nautiyal 13605* (GUH!).

Note: *Poa annua* has a wide distribution in the Himalaya from 600–3500 m. This species is very similar to *P. infirma* Kunth, European origin. Both of them are annuals, having smooth panicle branches, glabrous callus and ciliate palea keels, but *P. annua* can easily be separated from *P. infirma* by the size of anthers, lemmas and paleas.

5. *Poa arnoldii* Melderis, Enum. Fl. Pl. Nepal 1:142. 1978.

Perennial, tufted. Culms 18–21 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 2.2–3 mm long. Panicles oblong or ovate, 3.5–6.5 cm long, branches spreading, lower branches 2, scabrid. Spikelets elliptic-oblong, 4–7 mm long, florets 2–3, callus glabrous. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas short ciliate on lower part, keel ciliate on lower part, intermediate nerves distinct, marginal nerves ciliate. Paleas keels scabrid; anthers 1.5–1.7 mm long.

Flowering and Fruiting: July─September.

Habitat and Ecology: Rare, in partly dried alpine slopes and glacial moraines, between 5000–5600 m elevation.

Distribution: W. Himalaya (Nepal to Uttarkhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Gangotri National Park, on way to Kedar-tal, 5000-5600 m, 6 August 2003, *P.K. Pusalkar 103898* (BSD!).

Note: Earlier *Poa arnoldii* has been collected from the west Nepal. It is characterized by perennial tufted habit with ligules 2.2–3 mm long, glabrous calluses and lemmas with short hairy surfaces on lower part and anthers 1.5–1.7 mm long.

6. *Poa attenuata* Trin., Mem. Acad. Sci. Petersb. Sav. Etrang. 2: 327. 1835.

Perennial, tufted. Culms 1.5–30 cm tall, erect; leaf blades folded; sheaths glabrous; ligules 1.5–3 mm long. Panicles oblong 1.5–6 cm long, branches ascending, lower branches 1 or 2, scabrid. Spikelets elliptic, 4–5.5 mm long, florets 2–4, callus glabrous. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, intermediate nerves obscure, marginal nerves ciliate. Palea keels scabrid; anthers 1–1.2 mm long.

Flowering and Fruiting: August─October.

Habitat and Ecology: Rare, in sandy dried alpine meadows and glacial moraines, between 4000–5000 m elevation.

Distribution: Central Asia, Siberia, Mongolia, W. Himalaya (Pakistan to Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarakashi District, Tapovan, 4000 m, 26 June 1995, *D.C. Nautiyal 14911* (GUH!).

Note: Earlier this species was collected from far Western Himalaya, Baltistan, Karakoram in Kashmir and Lahul in Himachal Pradesh. It is a perennial tufted plant varies from 1.5–30 cm with ligules 1.5–3 mm long, anthers 1–1.2 mm and lemmas with glabrous surfaces and intermediate nerves obscure.

7. *Poa bactriana* Roshev., Bot. Matter. Gerb. Glavn. Bot. Sada R.S.F.S. R.4: 93. 1923.

Perennial, tufted. Culms 20–48 cm tall, terete; leaf blades linear, flat or folded; sheaths glabrous, bulbous at base; ligules1.5–3 mm long. Panicles pyramidal, 2.5–10 cm long, branches ascending, lower branches 1–3, smooth. Spikelets ovate-oblong, 4–5 mm long, florets 3–4, callus glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel scabrid, intermediate nerves obscure, marginal nerves glabrous. Paleas keels scabrid; anthers 1.5–1.7 mm long.

Flowering and Fruiting: June–October.

Habitat and Ecology: Rare, in sandy sun exposing alpine meadows and glacial moraines, between 4000–5000 m elevation.

Distribution: Russia, W. Himalaya.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, above Gaumukh, 4000 m, 25 June 1995, *D.C. Nautiyal 14903* (GUH!).

Note: Earlier *Poa bactriana* has been collected from the western drier parts of Lahul. It can easily be recognised by its bulbous based sheaths, glabrous calluses and lemmas without ciliate hairs.

8. *Poa bulbosa* L., Sp. Pl. 1: 70. 1753.

Perennial, tufted. Culms 18–40 cm tall, erect; leaf blades flat or folded; sheaths glabrous, bulbous at base; ligules 1.2–3 mm long. Panicles oblong-ovoid, 2–9 cm long, branches ascending or spreading, lower branches 2–4, scabrid. Spikelets mostly proliferating; normal spikelets ovate-oblong, 4–6 mm long, florets 3–6,

臺灣大學學術期刊資料庫

callus with ciliate hairs or glabrous in proliferating spikelets. Lower glume 1 or 3-nerved; upper glume 3-nereved. Lowest lemmas keel ciliate on lower part, intermediate nerves obscure, marginal nerves ciliate below. Palea's keels scabrid; anthers 1–1.3 mm long.

Flowering and Fruiting: June–September.

Habitat and Ecology: Rare, in sandy, dried glacial moraines and between stone boulders, at an elevation of 5000 m.

Distribution: Widespread in the northern hemisphere.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, above Gaumukh, 5000 m, 24 June 1995, *D.C. Nautiyal 14904* (GUH!).

Note: Earlier *Poa bulbosa* was collected from far northwestern part of Himalaya in Chitral and Kashmir. *Poa bulbosa* resembles only with *P. bactriana* Roshev. having similar bulbous based sheaths in both species, but it differs in having ciliate keel on lemmas, calluses ciliate and proliferating spikelets.

9. *Poa burmanica* Bor, Kew Bull. 3 (1): 141. 1948.

Perennial**,** tufted. Culms 10–32 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 1.1–1.2 mm long. Panicles oblong or pyramidal, 6–10 cm long, branches spreading, lower branches 2, scabrid. Spikelets elliptic-oblong, 3.6–5.3 mm long, florets 2–3, callus ciliate. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas surface scabrid, keel ciliate on lower two-thirds, intermediate nerves distinct, marginal nerves shortly ciliate. Paleas keels semipilose; anthers 0.6–0.9 mm long.

Flowering and Fruiting: May–January.

Habitat and Ecology: Rare, in semi dense temperate forest floor or semi open sub-alpine forest slopes, at an elevation of 3000 m.

Distribution: Himalaya (Uttrakhand to Arunachal Pradesh, Bhutan), Yunnan and Myanmar.

Specimen examined: **INDIA**: Uttarakhand, Rudrapryag District, Rambara, 3000 m, 1 June, 1994, *D.C. Nautiyal 13602* (GUH!).

Note: *Poa burmanica* is a rare species of the Himalaya. Earlier collected from Myanmar (Bor, 1960). Later reported from the Eastern Himalaya (Sikkim/Bhutan, Arunachal Pradesh) by Noltie (2000) and from NW Yunnan (Myanmar) by Guanghua *et al.* (2006). The gross appearance of this species resembles that of *P. himalayana* Nees ex Steudel, but differs from it in having lemmas with scabrid surfaces and a semipilose palea keels.

10. *Poa eleanorae* Bor, Kew Bull. 3 (1): 142.1948.

Perennial, tufted. Culms 11–40 cm tall, erect, geniculate at base; leaf blades linear; sheaths glabrous; ligules 0.5–2 mm long. Panicles oblong, 8–24 cm long, branches spreading, lower branches 2, smooth. Spikelets wedge shaped, 5.5–6.5 mm long, florets 2–3, callus glabrous. Lower glume longer or equal to lowest lemmas, 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower third, intermediate nerves obscure, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 0.8–1 mm long.

Flowering and Fruiting: July–September.

Habitat and Ecology: Uncommon, in moist alpine meadows, between 3000–3300 m elevation.

Distribution: Himalaya (Nepal to Sikkim).

Specimen examined: **INDIA**: Uttarakhand, Chamoli District, Badrinath area, 3300 m, 2 August 1995, *D.C. Nautiyal 14926* (GUH!).

Note: *Poa eleanorae* is an endemic species in the Himalaya and occurs in alpine zone of Uttarakhand, Nepal, Sikkim and Bhutan. It is characterized by the lower glumes usually longer or equal to lowest lemmas and length of variable ligules.

11. *Poa falconeri* Hook, f., Fl. Brit. India 7 (22): 342. 1896.

Perennial, loosely tufted. Culms 20–80 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 1.5–3.5 mm long. Panicles oblong, 6–20 cm long, branches spreading, reflexed, lower branches 1–2, smooth. Spikelets elliptic-oblong, 5–7.5 mm long, florets 2–3, callus glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel short ciliate on lower half, scabrid on upper half, intermediate nerves obscure, marginal nerves ciliate at base. Paleas keels scabrid; anthers 2.7–2.8 mm long.

Flowering and Fruiting: August–November.

Habitat and Ecology: Rare, in shaded and damp sub-alpine forest floor or moist alpine slopes, between 3000–3500 m elevation.

Distribution: W. Himalaya (Pakistan to Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Yamnotri, 3500 m, 12 September, 1995, *D.C. Nautiyal 14948* (GUH!).

Note: *Poa falconeri* is an endemic species of the W. Himalaya. Earlier reported from Tehri Garhwal (Duthie, 1883), Kashmir and Kulu (Bor, 1960). This species can be distinguished from other species of Himalayan *Poa* by its loosely tufted or short stoloniferous habit, lemmas keel short ciliate on lower part and anthers 2.7–2.8 mm long.

12. *Poa gammieana* Hook. f., Fl. Brit. India 7 (22): 345. 1896.

Perennial, tufted. Culms 53–60 cm tall, stout, leafy; leaf blades linear; sheaths keeled; ligules 3.5–4 mm long. Panicles linear or triangular, 10–12 cm long, branches spreading, lower branches 2, smooth. Spikelets oblong-lanceolate, 5.5–9.2 mm long, florets 3–4, callus wool with short ciliate hairs. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower two thirds, intermediate nerves distinct, marginal nerves ciliate more than half. Paleas keels semipilose or rarely scabrid; anthers 1.1–2 mm long.

Flowering and Fruiting: August–October.

Habitat and Ecology: Rare, in moist alpine meadows, between 3600–4000 m elevation.

Distribution: Himalaya (Uttarakhand to Sikkim, Bhutan).

臺灣大學學術期刊資料庫

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, above Gangotri, 4000 m, *M.K. Kandwal*, Not traced in BSD; Sikkim, Tankra mountain, 4000 m, 28 August 1892, *Gammie641* (SHC!).

Note: *Poa gammieana* is rare and endemic species in the Himalaya. This species can be distinguished from other species of Himalayan *Poa* in having tufted habit, ligules 3.5–4 mm long, 3-nerved lower glumes, ciliate callus and semipilose palea keels.

13. ***Poa garhwalensis*** D. C. Nautiyal and R. D. Gaur, J. Bomb. Nat. Hist. Soc. 96 (2): 285–287. 1999.

Perennial, tufted. Culms 45–60 cm tall, erect; leaf blades linear, scabrid; sheaths keeled; ligules 1.5–3 mm long. Panicles lax, 4–10 cm long, branches spreading, lower branches 3–5, scabrid. Spikelets elliptic, 5–11 mm long, florets 3–8, callus with ciliate hairs. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower two-thirds, scabrid above, intermediate nerves distinct, marginal nerves ciliate. Palea keels scabrid; anthers 2–2.5 mm long.

Flowering and Fruiting: July–October.

Habitat and Ecology: Rare, in marshy and damp alpine meadows, at an elevation of 4000 m.

Distribution: W. Himalaya (Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Chamoli District, Leptal, 4000 m, 28 August 1995, *D.C. Nautiyal 13501* (GUH!).

Note: *Poa garhwalensis* resembles *P. gammieana* Hook.f. in gross appearance of tall tufted habit, but differs in length of ligules 1.5–3 mm long (versus 3.5–4 mm long in *P. gammieana*), lower panicle branches 3–5, scabrid (versus 2, smooth in *P. gammieana*), spikelets 5–11 mm long (versus 5.5–9.2 in *P. gammieana*) and palea keels scabrid (versus palea keels semipilose in *P. gammieana*).

14. ***Poa harae*** Rajbh., Acta Phytotax. Geobot. 39 (1-3) : 55.1988.

Perennial, tufted. Culms 20–40cm tall, with short stolons; leaf blades linear; sheaths glabrous; ligules 2.6–3 mm long. Panicles oblong, 5–10 cm long, branches spreading, lower branches 2–5, scabrid. Spikelets mostly proliferating; normal spikelets elliptic, 4–6 mm long, florets 2–3, callus glabrous or with few ciliate hairs. Lower glume 3 or rarely 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower part, intermediate nerves distinct, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 1.1–1.5 mm long.

Flowering and Fruiting: August–November.

Habitat and Ecology: Rare, in sandy glacial moraines and in stone crevices, between 4600–4800 m elevation.

Distribution: Himalaya (E. Nepal, Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Nandanvan, 4800 m, 12 August 1997, *D.C. Nautiyal13504* (GUH!).

Note: *Poa harae* is an endemic species of the Himalaya. Earlier reported from E. Nepal by Rajbhandari (1991). This species can be confused with other species of *Poa* having proliferating spikelets viz., *P. bulbosa* L. and *P. kanaii* Rajbh., but it differs from *P. bulbosa* in lacking the bulbous base and from *P. kanaii* it differs in its tufted habit.

15. ***Poa himalayana*** Nees ex Steud., Syn. Pl. Glumac.1 (3): 256.1854.

Perennial, tufted or sometimes stoloniferous. Culms 25–35 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 0.6–1.6 mm long. Panicles linear, 13–16 cm long, branches spreading, lower branches 2, scabrid. Spikelets oblong, 3.8–6 mm long, florets 2–3, callus with long ciliate hairs. Lower glume subulate, 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, intermediate nerves distinct, marginal nerves ciliate on lower part. Paleas keels ciliate; anthers 0.7–1 mm long.

Flowering and Fruiting: June–October.

Habitat and Ecology: Common, in shaded and damp sub-alpine forest floor or forest edges between 3000–3500 m elevation.

Distribution: Himalaya (Nepal to Sikkim), Tibet, Yunnan.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Yamnotri, 3500 m, 11 September 1995, *D.C. Nautiyal14006* (GUH!).

Note: *Poa himalayana* Nees ex Steud. has been a subject of much discussion and to some extent ambiguous too, in its determination, mainly due to some misunderstanding for nomenclature type, distribution and characterisation etc. For this species nomenclature type was ticked from the Wallich collection 8885 from Nepal. Whereas collection from North West Himalaya by Royle also determined for *P. himalayana* but in the later stage Bor (1951) established a separate species *P. stewartiana* (annual grass and palea keels semipilose or ciliate in the lower half). The *P. himalayana* is widely distributed species in the Himalaya (Nepal to Sikkim) whereas the later restricted to the N.W. Himalaya only (Bor, 1960). Noltie (2000) considered *P. stewartiana* is a superfluous one for *P. himalayana* and also established *Poa rajbhandarii* and included the variants *Poa himalayana* sensu Bor and sensu F.B.I. (Wallich and Hooker specimens), non Nees ex Steudel. Furthermore, as *P. rajbhandarii* Noltie in the Sikkim Himalaya is almost similar to *P. khasiana*, but differs in the shape and size of lower glumes. Flora Yunnan in FRPS described *P. himalayana*, *P stewartiana*, along with Poa allied species like *P. gracilior*, *P khasiana*, but suggested to convert these into subspecies level, for the complex *Poa himalayana* (Guanghua *et al.*, 2006).

Based on the recent available nomenclature i.e. Plant List, 2013 which provides the accepted Latin names for most of Poa species, with link to all synonyms, we preferred to adopt both the species *Poa himalayana* and *P. stewartiana*as valid one, due to perennial habit and ciliate palea keels in the former and annual habit and semipilose keels of palea in the later.

臺灣大學學術期刊資訊網

16. ***Poa hirtiglumis*** Hook. f., Fl. Brit. India 7 (22): 343. 1896.

Perennial, tufted. Culms 10–40 cm tall, erect or geniculate at base; leaf blades linear; sheaths glabrous; ligules 2–4 mm long. Panicles pyramidal, 3–9 cm long, branches spreading, lower branches 1 or 2, scabrid. Spikelets wedge-shaped, 2.5–4 mm long, florets 2–3, callus glabrous. Lower glume longer than lowest lemmas, 3-nerved; upper glume 3-nerved. Lowest lemmas surface covered with ciliate hairs, keel ciliate on two thirds of length, intermediate nerves distinct, marginal nerves ciliate. Palea keels ciliate; anthers 0.6–1 mm long.

Flowering and Fruiting: August─November.

Habitat and Ecology: Rare, in dry alpine slopes or in glacial moraines, between 3500–4000 m elevation.

Distribution: Himalaya (Uttarakhand to Sikkim, Bhutan).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Gaumukh, 4000 m, 24 October 1994, *D.C. Nautiyal 13817* (GUH!).

Note: *Poa hirtiglumis* is an endemic species of the Himalaya. This species can be distinguished from other *Poa* species by presence of lower glumes being longer than the lowest lemmas, ciliate hairs on lemmas, ciliate palea keels and the small anthers.

17. ***Poa hylobates*** Bor, Bull. Bot. Surv. Ind.7:132. 1965.

Annual. Culms 38–42 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 3–4 mm long. Panicles pyramidal, 7–12 cm long, branches spreading, lower branches 2–4, scabrid. Spikelets elliptic, 3.5–4.1 mm long, florets 2–3, callus glabrous. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower part, intermediate nerves obscure, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 1.2–1.9 mm long.

Flowering and Fruiting: July─September.

Habitat and Ecology: Rare, in partly moist alpine meadows, between 3600–4000 m elevation.

Distribution: W. Himalaya (Nepal to Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Pithoragarh District, Panchachuli Base, 4000 m, 26 July 2004, *M. K. Kandwal 111796* (BSD!).

Note: *Poa hylobates* is rare species of the Himalaya. It was earlier reported from the W. Nepal. It is distinguished by its annual habit, scabrid lower panicle branches, 3-nerved lower glumes, scabrid palea keels and 1.2–1.9 mm long anthers.

18. ***Poa infirma*** Kunth, Nov. Gen. Sp. (H.B.K.) 1:158.1816.

Annual, tufted. Culms 3–7 cm tall; leaf blades linear; sheaths glabrous; ligules 1.2–2 mm long. Panicles oblong or pyramidal, 1–3 cm long, branches spreading, lower branches 2, smooth. Spikelets elliptic-oblong, 3.7–4 mm long, florets 3–5, callus glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on two-thirds or more its length, intermediate nerves distinct, marginal nerves ciliate. Paleas keels ciliate; anthers 0.3–0.4 mm long.

Flowering and Fruiting: May─August.

Habitat and Ecology: Rare, in sandy alpine slopes and in rock crevices, between 3000–3400 m elevation.

Distribution: S. America, S. Europe, Central Asia, introduced in the Himalaya.

Specimen examined: **INDIA**: Uttarakhand, Pithoragarh District, near Bogdyar, 3400 m, 19 Sep. 2004, *M.K. Kandwal 111560* (BSD!).

Note: *Poa infirma* is a widely distributed species in Europe and America. It is rare species in the Himalaya and earlier collected from the westernmost parts Bilaspur in Lahul District (Duthie, 1886). This species is close to *Poa annua* L. Both of these species are annual and have glabrous calluses and ciliate palea keels, but differ in the lengths of lemmas, paleas and anthers.

19. ***Poa jaunsarensis*** Bor, Kew Bull. 3 (1): 143.1948.

Perennial, rhizomatous. Culms 45–60 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 2.5–6 mm long. Panicles oblong, 10–16 cm long, branches spreading, lower branches 3–4, scabrid. Spikelets elliptic-oblong, 4.6–6.5 mm long, florets 2–5, callus with long ciliate hairs. Lower glume 1-nerved or rarely 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, intermediate nerves distinct, marginal nerves ciliate. Paleas keels scabrid; anthers 1.5–2 mm long.

Flowering and Fruiting: May─August.

Habitat and Ecology: Rare, in sub-alpine mixed coniferous forest floor or semi open forest slopes, between 3000–4000 m elevation.

Distribution: Himalaya (Pakistan to Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Gangotri, 3000 m, 19 June 1995, *D.C. Nautiyal 14907* (GUH!); Pithoragarh District, Kutti Yangti valley, Byans, 4000 m, 30 July 1886, *J.F. Duthie 6224* (DD!).

Note: *Poa jaunsarensis* is rare and an endemic species of the Himalaya and distributed from Pakistan to Uttarakhand. It resembles *Poa pratensis* L. in its rhizomatous habit and long ciliate callus, but differs in length of ligules and lemmas.

20. ***Poa kanaii*** Rajbh.,Acta Phytotax. Geobot.39 (1-3): 58. 1988.

Perennial, loosely tufted, with short creeping rhizome. Culms 10–15cm tall, erect; leaf blades linear or flat; sheaths glabrous; ligules 2–3 mm long. Panicles ovate or oblong, 1.5–4 cm long, branches ascending, lower branches 1 or 2, smooth. Spikelets proliferating, normal spikelets elliptic, 4.5–4.7 mm long, florets 2–3, callus glabrous. Lower glume 1 or 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower two-third, scabrid above, intermediate nerves obscure, marginal nerves glabrous. Paleas keels scabrid; anthers 1.2–1.8 mm long.

臺灣大學學術期刊資料庫

Flowering and Fruiting: June─August.

Habitat and Ecology: Rare, in sandy and dry glacial moraines or along stone boulders exposed to the sun, at an elevation of 4500 m.

Distribution: W. Himalaya (Nepal to Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, above Gaumukh, 4500 m, 26 June 1994, *D.C. Nautiyal 14915* (GUH!).

Note: *Poa kanaii* is an endemic species of the W. Himalaya. Earlier collected from the alpine zone of Central Nepal by Rajbahandari (1983). It resembles *P. pagophila* Bor in ligules and floral characters, but it differs in having ascending branches of panicles and the anthers 1.2–1.8 mm long. In *P. pagophila* panicle branches spreading or reflaxed and the anthers 2-3 mm long.

21. ***Poa khasiana*** Stapf, Fl. Brit India 7 (22): 343.1896.

Perennial, loosely tufted. Culms 20–50 cm tall, terete, geniculate at base; leaf blades flat; sheaths glabrous; ligules 0.8–2 mm long. Panicles pyramidal, 5–13 cm long, branches spreading, lower branches 3–5, scabrid. Spikelets elliptic-oblong, 4.3–5.3 mm long, florets 2–3, callus with ciliate hairs. Lower glume lanceolate, 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower part, intermediate nerves distinct, marginal nerves ciliate or glabrous. Paleas keels scabrid; anthers 0.7–1 mm long.

Flowering and Fruiting: May–August.

Habitat and Ecology: Rare, in shaded sandy sub-alpine forest floor and shaded rock crevices, at an elevation of 3900 m.

Distribution: Himalaya (Uttarakhand to Sikkim), Tibet, Yunnan.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Bhojbasa, 3900 m, 20 June 1995, *D.C. Nautiyal, 14908* (GUH!).

Note: *Poa khasiana* has been earlier reported from near the Singalela range of Sikkim Himalaya (Hajra and Verma, 1996). However, later it was rejected from the Sikkim and adjoining Darjeeling Himalaya by Noltie (2000). It resembles *P. himalayana* Nees ex Steudel in habit and lemma characters, but differs in the number of lower panicle branches and shape of the lower glume.

22. ***Poa koelzii*** Bor, Kew Bull. 3(1): 139. 1948.

Perennial, densely tufted. Culms 1.5–8 cm tall, terete; leaf blades linear, folded, glaucous; sheaths glabrous; ligules 1.2–2 mm long. Panicles oblong, 0.5–2.5 cm long, branches ascending, lower branches 1 or 2, scabrid. Spikelets elliptic-lanceolate, 3.4–4.3 mm long, florets 2–5, callus ciliate with short hairs. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas surface hairy on lower part, keel ciliate on lower half, intermediate nerves obscure, marginal nerves ciliate two-third or more. Paleas keels semipilose; anthers 1.2–1.5 mm long.

Flowering and Fruiting: August─October.

Habitat and Ecology: Rare, in sandy, dry alpine meadows and along stone boulders exposed to the sun, between 3500–4000 m elevation.

Distribution: W. Himalaya (Kashmir to Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, near Gaumukh, 4000 m, 23 Oct. 1994, *D.C. Nautiyal 14909* (GUH!).

Note: *Poa koelzii* is an endemic species of the western Himalaya. It is characterized by its perennial habit, dwarf or small plants, hairy surface of lemma and semipilose palea keels. It resembles *P. lahulensis* in densely tufted habit and floral characters, but differs in the height of culms and length of panicles and lemmas.

23. ***Poa lahulensis*** Bor, Kew Bull. 3 (1): 138. 1948.

Perennial tufted. Culms 7–18 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 1.2– 3 mm long. Panicles oblong, 2–4 cm long, branches ascending, lower branches 1 or 2, scabrid. Spikelets elliptic, 5–7.2 mm long, florets 2–7, callus glabrous. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, intermediate nerves obscure, marginal nerves ciliate on basal part. paleas keels semipilose; anthers 1.5–1.9 mm long.

Flowering and Fruiting: July–September.

Habitat and Ecology: Rare, in partly moist alpine grazing meadows, between 3000–4000 m elevation.

Distribution: W. Himalaya, Tibet.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Gangotri, 3000 m, 8 August 1992, *Uniyal et al. 109867* (BSD!).

Notes: *Poa lahulensis* resembles *P. alpina* L. in habit, callus, lemma surfaces and palea keels, but can be distinguished by the shape of spikelets. In *P. lahulensis* the shape of spikelet is elliptic, while ovate shape in *P. alpina.*

24. ***Poa mustangensis*** Rajb., Acta Phytotax. Geobot. 39 (1-3): 61.1988.

Perennial, densely tufted. Culms 5–16 cm tall, erect, scabrid; leaf blades linear; sheaths glabrous; ligules 2.5–3.5 mm long. Panicles linear, 2–4 cm long, branches ascending, lower branches 2, scabrid. Spikelets mostly proliferating; Normal spikelets elliptic, 3.5–5 mm long, florets 2–4, callus glabrous. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower one half to two thirds, scabrid above, intermediate nerves distinct, marginal nerves ciliate. Paleas keels scabrid; anthers 1.5–1.6 mm long.

Flowering and Fruiting: May–August.

Habitat and Ecology: Rare, in sandy glacial moraines and in stone crevices, between 4500–5000 m elevation.

Distribution: W. Himalaya (Central Nepal to Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand: Uttarkashi District, Gaumukh, 4500 m, 25 Jun. 1994, *D.C. Nautiyal14916* (GUH!).

Note: *Poa mustangensis* resembles to *P. poophagorum* Bor in habit, glabrous callus and anthers length, but differs in the size of lowest lemmas with distinct intermediate nerves and scabrid culms.

臺灣大學學術期刊資料庫

25. ***Poa nemoralis*** L., Sp. Pl. 1: 69. 1753.

Perennial, loosely tufted, sometimes short stolons. Culms 30–60 cm tall, erect, terete; leaf blades linear; sheaths glabrous; ligules 0.5–0.6 mm long. Panicles oblong, 8–15 cm long, branches spreading, lower branches 2–4, scabrid. Spikelets elliptic-lanceolate, 4–5.5 mm long, florets 2–4, callus ciliate. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, intermediate nerves obscure, marginal nerves ciliate. Paleas keels scabrid; anthers 1.1–1.7 mm long.

Flowering and Fruiting: May–August.

Habitat and Ecology: Not uncommon, in shaded temperate forest floor and in the high Himalaya, between 1900–3400 m elevation.

Distribution: Widespread in the temperate regions.

Specimen examined: **INDIA**: Uttarakhand, Garhwal District, Pauri, 1900 m, 8 January 1994, *D.C. Nautiyal 14902* (GUH!).

Note: *Poa nemoralis* is a common species of the northern Hemisphere. In the Himalaya, this species occurs in temperate zone of the westernmost part and is common in the Kashmir. This species confused with *P. polycolea* Stapf in having small ligules and shape of lower glume, but they differ in the number of nerves of lower glume (3 in *Poa nemoralis* versus 1 in *Poa polycolea*).

26. ***Poa nepalensis*** (Wall. ex Griseb) Duthie, List Grasses N-W India 40. 1883.

Perennial, tufted. Culms 20–50 cm tall, erect, terete; leaf blades linear; sheaths glabrous; ligules 1.1–1.5 mm long. Panicles oblong or pyramidal, 4–14 cm long, branches spreading, lower branches 1–2, scabrid. Spikelets elliptic, 3.5–4.6 mm long, florets 2–5, callus with long ciliate hairs. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, intermediate nerves obscure or distinct, marginal nerves ciliate. Palea keels ciliate; anthers 0.6–0.8 mm long.

Flowering and Fruiting: August–October.

Habitat and Ecology: Not uncommon, in shaded and damp sub-alpine forest floor, at an elevation of 3300 m.

Distribution: Himalaya (Pakistan to Uttarakhand, and Bhutan).

Specimen examined: **INDIA**: Uttrakhand, Uttarkashi District, Yamnotri, 3300 m, *D.C. Nautiyal 14945* (GUH!).

Note: *Poa nepalensis* is an endemic species to the Himalaya and found along its whole range. Stapf (1896) considered this species to be a variety of *P. annua* L. Though these species resemble each other in the length of anthers and palea keels, but they are quite distinct. These can be distinguished by habit, surface of the lower panicle branches and the callus.

27. ***Poa nephelophila*** Bor, Kew Bull.3(1): 140.1948.

Annual. Culms 25–38 cm tall, terete, erect or geniculate below; leaf blades linear, flat; sheaths glabrous; ligules 1.1–1.2 mm long. Panicles pyramidal, 10–12 cm long, branches spreading, lower branches 4, smooth. Spikelets oblong, 5.5–6.5 mm long, florets 4–6, callus glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half or more, intermediate nerves distinct, glabrous, marginal nerves ciliate. Paleas keels ciliate; anthers 0.6–0.9 mm long.

Flowering and Fruiting: August–October.

Habitat and Ecology: Rare, in shaded and moist semi open sub-alpine forest slopes, between 3300–3500 m elevation.

Distribution: Himalaya (Uttarakhand to Eastern Himalaya-Myanmar).

Specimen examined: **INDIA**: Uttrakhand, Uttarkashi District,Yamnotri, 3300 m, 10 September 1995, *D.C. Nautiyal, 14917* (GUH!).

Note: *Poa nephelophila* has been earlier reported from alpine zone of Myanmar. It is a rare species in the Western Himalaya. It resembles with *P. annua* in habit, length of anthers and spikelets characters, but differs in the number of lower panicle branches (4 in *P. nephelophila* versus 1or 2 in *P. annua*), the length of ligules (1.1–1.2 mm long in *P. nephelophila* vs. 1.5–3 mm in *P. annua*) and in the intermediate nerves of the lemma (glabrous in *P. nephelophila* vs. ciliate in *P. annua*).

28. ***Poa pagophila*** Bor, Kew Bull. 4 (2): 239.1949.

Perennial, loosely tufted. Culms 5–28 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 1.8–3.5 mm long. Panicles pyramidal, 4–10 cm long, branches spreading or reflexed, lower branches 2, smooth. Spikelets elliptic, 4.3–5.8 mm long, florets 2–4, callus ciliate. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower part, scabrid above, intermediate nerves distinct or obscure, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 2– 3 mm long.

Flowering and Fruiting: August–October.

Habitat and Ecology: Common, in sandy and partly moist alpine meadows, between 3500–4000 m elevation.

Distribution: Himalaya (Pakistan to Sikkim, Bhutan), Tibet.

Specimen examined: **INDIA**: Uttrakhand, Uttarkashi District, on way to Gaumukh, 4000 m, 28 June 1995, *D.C. Nautiyal 14905* (GUH!).

Note: *Poa pagophila* is a common species in the alpine zones of the Himalaya. It is characterized by long ligules (1.8–3.5 mm long), long anthers (2–3mm long), 1-nerved lower glume and hairy lemmas. This species resembles *P. kanaii* Rajbh. in ligules length and floral characters, but differs in length of anthers and reflaxed lower panicle branches.

29. ***Poa palustris*** L., Syst. Nat. ed. 10(2): 874. 1759.

Perennial, tufted. Culms 20–40 cm tall, terete; leaf blades linear, flat; sheaths glabrous; ligules 1.8–2 mm long. Panicles oblong or triangular, 12–18 cm long, branches spreading, lower branches 2–4, scabrid.

臺灣大學學術期刊資訊網

Spikelets elliptic-lanceolate, 4–4.5 mm long, florets 2–4, callus with long ciliate hairs. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower part, intermediate nerves obscure, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 1–1.2 mm long.

Flowering and Fruiting: July–September.

Habitat and Ecology: Common, in sandy and partly moist alpine meadows, between 3100–3300 m elevation.

Distribution: Temperate regions of the Northern Hemisphere; introduced in Himalaya.

Specimen examined: **INDIA**: Uttarakhand, Chamoli District, Badrinath, on way to Mana, 3100 m, 11 August 1995, *D.C. Nautiyal 14927* (GUH!).

Note: Previously this species was collected by Stewart (1947) from Kashmir which is morphologically similar to European specimens. It is characterized by a perennial tufted habit, 1.8–2 mm long ligules, obscure intermediate nerves of the lemmas and spreading panicle branches.

30. ***Poa polycolea*** Stapf, Fl. Brit. India 7 (22): 342. 1896.

Perennial, stoloniferous. Culms 10–30 cm tall, erect, terete; leaf blades linear; sheaths glabrous; ligules 0.6–0.8 mm long. Panicles pyramidal, 5–14 cm long, branches spreading, lower branches 2–5, smooth. Spikelets elliptic, 4.5–6 mm long, florets 3–4, callus glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate basally, intermediate nerves distinct, marginal nerves ciliate at base. Paleas keels scabrid; anthers 2–2.4 mm long.

Flowering and Fruiting: August–October.

Habitat and Ecology: Rare, in shaded forest slopes and moist alpine meadows, between 3000–3800 m elevation.

Distribution: Himalaya (Afganistan to Sikkim), Tibet.

Specimen examined: **INDIA**: Uttarakhand, Chamoli District, Bhyundar valley, 3000–3800 m, 10 August 1993, *D.C. Nautiyal 13723* (GUH!).

Note: *Poa poycolea* is a common species of the alpine zone in the Himalaya. This species is confused with *P. nemoralis* L. due to similarities in habit, length of ligules, shape of the lower glumes, but differs from it in surface of lower panicle branches, callus, number of nerves of the lower glumes and the length of the anthers.

31. ***Poa poophagorum*** Bor, Kew Bull. 1948: 143. 1948.

Perennial, densely tufted. Culms 4–40 cm tall, terete; leaf blades linear; sheaths glabrous; ligules 2.2–3 mm long. Panicles linear, 2–12 cm long, branches ascending, lower branches 2–4, scabrid. Spikelets elliptic, 3–4.1mm long, florets 2–3, callus glabrous. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower part, scabrid above, intermediate nerves obscure, marginal nerves glabrous. Paleas keels scabrid; anthers 1.2–1.7 mm long.

Flowering and Fruiting: July–September.

Habitat and Ecology: Uncommon, in sub-alpine mixed coniferous forest floor or semi open slopes, between 3100–3600 m elevation.

Distribution: Himalaya (Nepal to Sikkim and Bhutan), Tibet.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Gangotri National Park Area, Chirbasa to Bhojbasa, 3100–3600 m, 24 July 2003, *P.K. Pusalkar 104543*(BSD!).

Note: *Poa poophagorum* is a common species of the sub-alpine and alpine zones in the Himalaya. It resembles *P. mustangensis* Rajbh. in habit and floral characters, but differs from it in having smooth culms and obscure intermediate nerves of the lemma.

32. ***Poa pratensis*** L., Sp. Pl. 1: 67.1753.

Key to the subspecies

1a.Basal leaves setaceous, 0.5–1 mm wide. … subsp. ***angustifolia***
1b. Basal leaves flat, 1.5–4 mm wide ……subsp. ***pratensis***

32a. subsp.***pratensis*** Stapf, Fl. Brit. India 7: 339.1896.

Perennial, rhizomatous. Culms 6–75 cm tall, terete, erect; leaf blades linear; sheaths glabrous; ligules 2–2.3 mm long. Panicles oblong or ovate, 3–13 cm long, branches ascending, lower branches 2–5, scabrid. Spikelets elliptic-oblong, 4.8–5.7 mm long, florets 2–5, callus with long ciliate hairs. Lower glume 1 or 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower part, scabrid above, intermediate nerves distinct, marginal nerves ciliate on lower half. Paleas keels scabrid; anthers 1.5–2 mm long.

Flowering and Fruiting: July─September.

Habitat and Ecology: Rare, in moist sub-alpine and alpine meadows, between 3500–4000 m elevation.

Distribution: Europe and Asia including Himalaya (Afghanistan to Sikkim).

Specimen examined: **INDIA**: Uttarkhand, Pithoragarh District,Leptal, 3500–4000 m, 26 August 1995, *D.C. Nautiyal 13801* (GUH!).

32b. subsp.***angustifolia*** (L.) Gaud., Agrost. Helv.1: 214. 1811.
P. angustifolia L., Sp. Pl.1: 67.1753.

Perennial, rhizomatous. Culms 22–60 cm tall, erect; leaf blades folded, setaceously acuminate; sheaths glabrous; ligules 1.5–2 mm long. Panicles linear or pyramidal, 4–16 cm long, branches spreading, lower branches 2–5, scabrid. Spikelets elliptic-oblong, 3.7–5.3 mm long, florets 3–4, callus long ciliate. Lower glume 1 or 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, scabrid above, intermediate nerves distinct, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 1.2–2 mm long.

Flowering and Fruiting: June–September.

Habitat and Ecology: Rare, in partly moist alpine meadows, between 3300–4000 m elevation.

Distribution: Europe to Asia.

臺灣大學學術期刊論文授權

Specimen examined: **INDIA**: Uttarakhand, Pithoragarh District, above Sumna, 4000 m, 25 August 1995, *D.C. Nautiyal 13801*(GUH!); Uttarkashi District: Bhojbasa area, 3300–4000 m, 20 June 1995, *D.C. Nautiyal 13811* (GUH!).

33. ***Poa pseudamoena*** Bor, Kew Bull. 8(2): 276.1953

Annual, tufted. Culms 1–3 cm tall, erect, grooved; leaf blades linear; sheaths glabrous; ligules 0.5–1 mm long. Panicles linear, 1.5–2.5 cm long, branches ascending, lower branches 1–2, smooth. Spikelets elliptic, 5.5–6 mm long, florets 3–4, callus glabrous. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel glabrous or scabrid above, intermediate nerves distinct, marginal nerves glabrous. Paleas keels scabrid; anthers 0.7–1 mm long.

Flowering and Fruiting: August–November.

Habitat and Ecology: Rare, in sub-alpine and alpine meadows, between 3000–3800 m elevation.

Distribution: W. Himalaya (Kumaon), Tibet.

Specimen examined: **INDIA**: Uttarakhand, Pithoragarh District, Nagling to Bagling, 3000–3800 m, 26 July 2004, *M. K. Kandwal 111798* (BSD!).

Note: *Poa pseudamoeana* is a rare endemic species of western Himalaya having restricted distribution in Uttarakhand. It is distinct from other Himalayan *Poa* in having lemmas and paleas without ciliate hairs and ligule 0.5–1 mm long.

34. ***Poa rhadina*** Bor, Kew Bull.3(1): 138.1948.

Annual, loosely tufted. Culms 6–12 cm tall, erect; leaf blades linear, folded or flat; sheaths glabrous; ligules 2.5–3 mm long. Panicles elliptic or oblong, 2.5–6 cm long, branches spreading, lower branches 2, partly scabrid. Spikelets wedge-shaped, 2.5–3 mm long, florets 2–4, callus ciliate. Lower glume longer than lowest lemma, 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower two-thirds, intermediate nerves obscure, marginal nerves ciliate. Paleas keels scabrid; anthers 0.5–0.7 mm long.

Flowering and Fruiting: July─October.

Habitat and Ecology: Rare, in shaded and moist sub-alpine and alpine meadows, between 3500–4000 m elevation.

Distribution: W. Himalaya (Tehri).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Yamnotri, 3500 m, 14 September 1995, *D.C. Nautiyal 13821* (GUH!).

Note: *Poa rhadina* is a rare endemic species of western Himalaya having restricted distribution in Tehri Garhwal (Duthie, 1883). Earlier entire Uttarkashi District was a part of Tehri Garhwal in Britisher's time. This species is characterized by its annual habit, 2.5–3 mm long ligules, wedge-shaped spikelets, lower glumes longer than lowest lemmas and 0.5–0.7 mm long anthers.

35. ***Poa royleana*** Nees ex Steud., Syn. Plant. Glumac. 1(3): 256. 1854.

Perennial. Culms 60–87cm tall, terete, lower part compressed; leaf blades linear; sheaths glabrous; ligules 1 mm long. Panicles elliptic-oblong, up to 20 cm long, branches spreading, lower branches 2, scabrid. Spikelets ovate-elliptic, 3–4.5 mm long, florets 3–4, callus glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel glabrous on lower part, scabrid above, intermediate nerves distinct, marginal nerves glabrous. Paleas keels scabrid; anthers 1.2 mm long.

Flowering and Fruiting: August–October.

Habitat and Ecology: Rare, in temperate and sub-alpine forest slopes, between 3000–3330 m elevation.

Distribution: W. Himalaya (Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Dyara Bugyal, 3000–3300 m, August 2004, *M.K. Kandwal*, Not traced in BSD.

Note: *Poa royleana* is a rare endemic species of Western Himalaya. It was collected from Mussooree (W. Himalaya) by J.F. Royle more than 150 years ago. Earlier this species was treated as a synonym of *P. annua* by Stapf (1896), Bor (1952, 1960) and Cope (1982). Later when the type specimen was examined, the species was found to be quite different from *Poa annua* (Rajbhandari and Edmondson, 1990). It is characterized by perennial habit, more than 80 cm culms and spikelets have no trace of ciliate hairs on the callus. *Poa royleana* resembles *P. tibeticola* Bor in many similar characters, but differs in the habit and hight of the culm.

36. ***Poa setulosa*** Bor, Kew Bull. 3(1): 142. 1948.

Perennial, tufted. Culms 7–15 cm tall, erect or geniculate below; leaf blades linear; sheaths glabrous; ligules 2.5–3 mm long. Panicles linear, 4.5–7 cm long, branches spreading, lower branches 1–2, scabrid. Spikelets wedge-shaped, 3.1–4.5 mm long, florets 3–5, callus ciliate. Lower glume longer than lowest lemmas, 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, scabrid above, intermediate nerves obscure, marginal nerves ciliate. Paleas keels scabrid; anthers 0.6–0.8 mm long.

Flowering and Fruiting: July–October.

Habitat and Ecology: Rare, in partly moist and damp alpine meadows, between 3000–3500 m elevation.

Distribution: W. Himalaya.

Specimen examined: **INDIA**: Uttarakhand, Chamoli District, Badrinath, 3150 m, 11 August 1995, *D.C. Nautiyal 14925* (GUH!).

Note: *Poa setulosa* is an endemic species of the western Himalaya. It is characterized by perennial habit, 2.5–3 mm long ligules, wedge-shaped spikelets and anthers 0.6–0.8 mm long. This species resembles *P. eleanorae* in habit, shape of spikelets, the lower glumes longer than lowest lemma, but they can be distinguished by the length of spikelets. In *P. setulosa* they are 3.1–4.5 mm long and in *P. eleanorae* they are 5.5–6.7 mm long.

37. ***Poa sikkimensis*** (Stapf) Bor, Kew Bull.7(1): 130.1952.

P. annua L.,var. *sikkimensis* Stapf in Hook. f., Fl. Brit. India 7: 346.1896.

臺灣大學學術期刊資料庫

Perennial, tufted. Culms 4–20 cm tall, terete, geniculate at base; leaf blades linear; sheaths glabrous; ligules 1.5–4 mm long. Panicles oblong, 3.5–15 cm long, branches spreading, lower branches 2, smooth. Spikelets oblong, 3.8–4.7 mm long, florets 3–4, callus glabrous. Lower glume 1 or 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, scabrid above, intermediate nerves obscure, marginal nerves ciliate on lower part. Paleas keels semipilose; anthers 0.6–0.9 mm long.

Flowering and Fruiting: July–October.

Habitat and Ecology: Rare, in moist sub-alpine and alpine meadows, between 3100–3600 m elevation.

Distribution: Himalaya (Nepal to Bhutan).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Gangotri National Park area, near Rudragaria Khark, between Chirbasa and Deoghat, 3100–3600 m, July 2004, *M. K. Kandwal 111728* (BSD!).

Note: Earlier *Poa sikkimensis* was treated as a variety of *Poa annua* L. by Stapf (1896) due to the similarity of some of its characters to *P. annua* such as glabrous callus and anthers less than 1mm long. Bor (1952) treated it to be a distinct species from *P. annua* in having perennial habit, lower glumes 1-3 nerved (versus 1-nerved in *P. annua*), lemma with obscure intermediate nerves and semipilose palea keels.

38. ***Poa stapfiana*** Bor, Kew. Bull. 4(2): 239.1949.

Perennial, tufted. Culms 25–65 cm tall, erect or geniculate at base; leaf blades linear; sheaths glabrous; ligules 2–4 mm long. Panicles pyramidal, 12–15 cm long, branches ascending, reflaxed, lower branches 2–3, smooth. Spikelets elliptic-oblong, 3.6–6.6 mm long, florets 2–6, callus with long ciliate hairs. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas surface ciliate on lower half, keel ciliate on lower half, scabrid above, intermediate nerves distinct, marginal nerves ciliate. Palea keels semipilose; anthers 0.6–1.2 mm long.

Flowering and Fruiting: July–September.

Habitat and Ecology: Rare, in shaded and moist alpine meadows, in an elevation of 3500 m.

Distribution: W. Himalaya (Pakistan to Uttarakhand).

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Yamnotri, 3500 m, 14 September 1995, *D.C. Nautiyal 13818* (GUH!).

Note: *Poa stapfiana* is an endemic species of the Himalaya. It is characterized by the long ligules (2–4 mm), long ciliate callus, lemmas with hairy surfaces, palea keels semipilose and the small anthers.

39. ***Poa sterilis*** M. Bieb., Fl. Taur. Caucas.1: 62.1808.

Perennial, tufted. Culms 30–50 cm tall, erect, terete; leaf blades linear; sheaths glabrous or scabrid; ligules 2.5–3 mm long. Panicles oblong or lanceolate, 5–12 cm long, branches spreading, lower branches 2–3, scabrid. Spikelets elliptic, 4.9–5.5 mm long, florets 2–3, callus glabrous. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower part, scabrid above, intermediate nerves obscure, marginal nerves ciliate. Palea keels scabrid; anthers 1.7–2.2 mm long.

Flowering and Fruiting: May─September.

Habitat and Ecology: Uncommon, along the streams bank damp areas and moist mixed forest slopes, in an elevation of 3150 m.

Distribution: Caucasus, W. Himalaya.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Gangotri, 3150 m, 18 June 1995, *D.C. Nautiyal 14914* (GUH!).

Note: *Poa sterilis* is characterized by tufted perennial habit, long ligules (2.5–3 mm long), glabrous callus, intermediate nerves of the lemma obscure and palea keels scabrid.

40. ***Poa stewartiana*** Bor, Kew Bull. 6(2):185.1951

Annual. Culms 12–28 cm tall, terete, erect; leaf blades linear; sheaths glabrous; ligules 1.8–2.5 mm long. Panicles linear, 4.5–9 cm long, branches spreading, lower branches 2, scabrid. Spikelets elliptic, 3.5–6.5 mm long, florets 2–4, callus long ciliate. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, scabrid above, intermediate nerves distinct, marginal nerves ciliate on lower part. Palea keels semipilose; anthers 0.8–1 mm long.

Flowering and Fruiting: May–September.

Habitat and Ecology: Rare, in montane temperate to sub-alpine forest floor, between 2400–3000 m elevation.

Distribution: W. Himalaya.

Specimen examined: **INDIA**: Uttarakhand, Uttarkashi District, Jaunsar area (near Tons river), 3000 m, 5 May 1897, *J. F. Duthie 19777* (DD!).

Note: Bor (1960) mentioned *Poa stewartiana* as a common species in the Northwestern Himalaya. It was doubtfully recorded for Sikkim, but the cited specimen was redetermined by Rajbhandari (1991) as *P. himalayana*. However, *P. stewartiana* was also considered as superfluous one for *P. himalayana* (Noltie, 2000). This species resembles *P. himalayana* in appearance, but both species are quite different in habit and palea characteristics. *Poa stewartiana* is a rare annual grass species of the Northwestern Himalaya with a ligules 1.8–2.5 mm long and semipilose palea keels, whereas *P. himalayana* is a common perennial grass species in the Himalaya with a ligules 0.8–1.6 mm long and ciliate palea keels.

41. ***Poa supina*** Schrad., Fl. Germ. 1: 289. 1806.

Perennial, stoloniferous. Culms 3–12 cm tall, decumbent at the base; leaf blades linear; sheaths glabrous; ligules 1.1–1.5 mm long. Panicles ovate or triangular, 2–3 cm long, branches spreading, deflexed, lower branches 1–2, smooth. Spikelets elliptic-oblong, 5–6 mm long, florets 5–6, callus glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half to two thirds in length, scabrid above, intermediate nerves distinct, marginal nerves ciliate. Paleas keels ciliate; anthers 1.3–1.6 mm long.

臺灣大學學術期刊資料庫

Flowering and Fruiting: May–September.

Habitat and Ecology: Common, in sub-alpine and alpine grazing meadows, between 2800–3500 m elevation.

Distribution: Europe, Himalaya.

Specimen examined: **INDIA**: Uttarakhand, Chamoli District, Kuari Pass, 2800–3500 m, 28 May 1993, *D.C. Nautiyal 13726* (GUH!).

Note: *Poa supina* resembles *P. annua* L. in the smooth lower panicle branches, 1-nerved lower glumes, glabrous calluses and ciliate palea keels, but it differs in having the perennial habit and 1.3–1.6 mm long anthers.

42. ***Poa tibetica*** Munro ex Stapf. Fl. Brit. India 7(22): 339.1896.

Perennials, rhizomatous. Culms 14–50 cm tall, erect or geniculate at base; leaf blades linear, folded or flat; sheaths glabrous; ligules 2–3 mm long. Panicles oblong, 5–12 cm long, branches ascending, lower braches 2–4, smooth. Spikelets oblong-elliptic, 4.6–6 mm long, florets 2–4, callus glabrous. Lower glume 1 or 3-nerved; upper glumes 3-nerved, margins ciliate on lower half. Lowest lemmas keel ciliate on lower half, scabrid above, intermediate nerves obscure, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 2–2.9 mm long.

Flowering and Fruiting: July–October.

Habitat and Ecology: Rare, in alpine grazing meadows, between 3500–4800 m elevation.

Distribution: W. Himalaya, Tibet, Mongolia.

Specimen examined: **INDIA**: Uttarakhand, Chamoli District, Tibet border area adjoining Pithoragrh District, 4800 m, 16 August 2004, *M.K. Kandwal*, Not traced in BSD.

Note: *Poa tibetica* is distinguished from other Himalayan *Poa* in having the upper glumes which have ciliate margins on lower part.

43. ***Poa tibeticola*** Bor, Kew Bull. 3(1): 139. 1948.

Annual. Culms 1–25 cm tall, erect; leaf blades linear; sheaths scabrid; ligules 1.1–1.2 mm long. Panicles oblong, 0.8–11 cm long, branches spreading, lower branches 2–3, scabrid. Spikelets elliptic-oblong, 2.4–3.9 mm long, florets 2–3, callus glabrous. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel scabrid, intermediate nerves distinct, marginal nerves glabrous. Paleas keels scabrid; anthers 0.5–0.7 mm long.

Flowering and Fruiting: July–September.

Habitat and Ecology: Rare, in shaded and moist sub-alpine forest slopes, between 2800–3000 m elevation.

Distribution: Himalaya (Nepal to Sikkim), Tibet.

Specimen examined: **INDIA**: Uttarakhand, Pithoragarh District, Baling, 2800–3000 m, 25 July 2004, *M. K. Kandwal 111770* (BSD!).

Note: *Poa tibeticola* is an annual species characterized by the absence of ciliate hairs on the lemmas, paleas and calluses.

44. ***Poa trivialis*** L., Sp. Pl. 1: 67. 1753.

Perennial, stoloniferous. Culms 40–48 cm tall, erect, geniculate at the base; leaf blades linear; sheaths glabrous; ligules 4–6 mm long. Panicles ovate or pyramidal, 7–21 cm long, branches spreading, lower branches 4–5, scabrid. Spikelets oblong, 2.8–3 mm long, florets 2–3, callus with long ciliate hairs. Lower glume 1-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate to two-thirds to more, scabrid above, intermediate nerves distinct, marginal nerves ciliate on lower part. Paleas keels scabrid; anthers 1.5–1.6 mm long.

Flowering and Fruiting: July–September.

Habitat and Ecology: Rare, in temperate moist forest floor or semi open forest hill slope, between 1800–2200 m elevation.

Distribution: Widespread in Northern Hemisphere.

Specimen examined: **INDIA**: Uttarakhand, Pithoragarh District, Lohaghat area, 1800–2200 m, 14 August 2002, *M.K. Kandwal* 111421 (BSD!).

Note: *Poa trivialis* is a widely distributed species in the temperate northern Hemisphere. In the Himalaya, it has been collected from the far west Chitral and Kashmir and Darjeeling in the east. It is characterized by large ligules 4–6 mm long, ciliate calluses, distinct intermediate nerves of the lemmas and 1.5–1.6 mm long anthers.

45. ***Poa versicolor*** Besser Enum. Pl. 41. 1822 subsp. ***araratica***(Trautv.)Tzvelev in Nov. Sist. Vyssh. Rast. 1974: 31. 1974.

Poa araratica Trautv. in Acta Horti. Petrop. 2: 486. 1873.

Perennial, tufted, with stout rootstock. Culms 25–40 cm tall; leaf blades linear; sheaths glabrous; ligules 1.5–2.5 mm long. Panicles linear, 1.5–5 cm long, branches ascending, lower branches 2, scabrid. Spikelets elliptic, 4–4.2 mm long, florets 2–4, callus with few short ciliate hairs. Lower glume 3-nerved; upper glume 3-nerved. Lowest lemmas keel ciliate on lower half, scabrid above, intermediate nerves obscure, marginal nerves glabrous or short ciliate on lower part. Paleas keels scabrid; anthers 1.3–1.5 mm long.

Flowering and Fruiting: June–September.

Habitat and Ecology: Rare, in sandy sub-alpine and alpine meadows, between 3000–3500 m elevation.

Distribution: Middle East to W. Himalaya, Tibet.

Specimen examined: **INDIA**: Uttarakhand, Pithoragarh District, above Sumna Border area, 3000–3500 m, 25 August 1995, *D.C. Nautiyal 13802* (GUH!).

Note: *Poa versicolor* subsp. *araratica* is characterized by perennial tufted habit with stout rootstock, linear panicle, callus with short ciliate hairs and intermediate nerves of lemmas obscure.

DISCUSSION

Poa with more than 537 species (The Plant List, 2013) is native to the temperate regions of both hemispheres. It is the type genus of Poaceae subfamily Pooideae, supertribe Pooidae, tribe Poeae and subtribe Poinae (Bor, 1960; Soreng *et al.*, 2003, 2011; Soreng and Peterson, 2012).The genus includes both annual and perennial species and

臺灣大學學術期刊資訊網

leaves are linear, folded or flat, consists of open sheath and membranous ligules. The inflorescence terminates the culms and its branches consist of spikelets, formed by 2-7 florets and 2 glumes (Bor, 1960; Gibbs Rusell *et al.*, 1990; Cabi and Dogan, 2012).

New Records

Poa nephelophila, a very rare species earlier known from Myanmar; *P. kanaii, P. mustangensis, P. harae*, earlier known only from Nepal are reported new to India (Hooker, 1896; Bor, 1960; Naithani, 1985; Rajbhandari, 1991; Uniyal *et al.*, 1994).

Poa species known from far west Himalaya and earlier not recorded from Uttarakhand are *P. aitchisonii*, *P. bactriana*, *P. palustris*, *P. setulosa*, showing their eastward extension of distribution in the Himalaya (Hooker, 1896; Bor, 1960; Naithani, 1985; Rajbhandari, 1991; Uniyal *et al.*, 1994). Species of Central or Eastern Himalaya, not recorded earlier from this part of Himalaya are *Poa eleanorae*, *P. hirtiglumis*, *P. khasiana* are representing their westward extension of distribution (Hooker, 1896; Bor, 1960; Naithani, 1985; Rajbhandari, 1991; Uniyal *et al.*, 1994).

Floristic Comparison

The distribution of the genus *Poa* in the Himalaya is worthwhile to study being largest among the grasses in the area and its invariable presence throughout the range of the Himalaya. Rajbhandari (1991) in the revision of the genus reported 52 species of *Poa* in the entire Himalaya in which about 18 species are endemic from the western Himalaya including Garhwal and Kumaon. In the Himalaya, from east to west, countries/ state wise the species richness of *Poa* has been reported as 29 species in Bhutan (Noltie, 2000), 14 species in Sikkim (Hazra and Verma, 1996), 29 species in Nepal (Press *et al.*, 2000), 45 species in Uttarakhand (present study), 29 species in Himachal Pradesh (Chowdhery and Wadhwa, 1984) and 29 species in Pakistan (Cope, 1982). Complete estimates of *Poa* species for Jammu and Kashmir are yet not available. Murti (2001) reported 28 species of *Poa* in cold deserts of Western Himalaya which includes arid subalpine and alpine areas of Uttarakhand, Lahaul and Spiti districts of Himachal Pradesh and Ladakh area of Jammu and Kashmir state of India. Considering these numbers, Uttarakhand which constitutes a smaller area in the central part of the Himalayan arc, is highly rich in *Poa* species with 45 species (more than 86%) reported.

Ecological Distribution (Indicators)

On account of their frequent availability on specific locations, most of the Himalayan *Poa* species are restricted in distribution either on moist meadows, moraines, crevices, water courses or on dried glaciers in the high altitude zones. *Poa attenuata, P. hirtiglumis, P. infirma, P. koelzii, P. pagophila, P. pratensis*, etc form more or less restricted patches on dried meadows, between rock or stone crevices and on old deposited glacial moraines, whereas *Poa aitchisonii, P. falconeri, himalayana, P. khasiana, P. nepalensis, P. nephelophila, P. setulosa*, etc. are found in moist and damp sub-alpine and alpine meadows. Species collected above 4000 m elevation on glacier deposition are *Poa bulbosa, P. harae, P. kanaii*, and *P. mustangensis.* Some rare species like *Poa jaunsarensis* and *P. rhadina* are restricted only in shaded and moist forest floor.

Poa falconeri, Poa gammieana, Poa eleanorae, P. hirtiglumis, etc. are endemic to Himalaya, while *P. pseudamoena, P. rhadina* and *P. royleana* are native endemic species in a restricted range of Garhwal and Kumaon region in the west Himalaya.

Present study provides detailed information on collection sites and habitat characteristics of Himalayan *Poa*, floristic comparison, distribution of native endemic and rare species for conservation from this region of Himalaya.

Rare, Endemic and Threatened Species

Poa rhadina is one of the endemic species of western Himalaya having highly restricted distribution. It was earlier recorded from Tehri Garhwal (Duthie, 1883). The authors collected this species from a population comprising of 20-40 individuals with patchy distribution in less than one square kilometer area above Yamnotri shrine. This species was considered as rare species (Nayar, 1996; Uniyal *et al.*, 1994). In addition, we are giving account of other two reported endemic Poa species i.e. *P. pseudamoena* and *P. royleana* from the Uttarakhand (Garhwal and Kumaon Himalaya). We observed that the population sizes of many rare Himalayan endemic *Poa* species are so small and their habitats face severe pressure from various anthropogenic activities i.e. expansion of pilgrimage area, grazing, invasion of alien weeds, etc. In a recent work Pandit *et al*., 2007 have reported that large scale species extinction is likely to occur in Himalaya following deforestation and continuing land use changes.

ACKNOWLEDGEMENTS

We thank the authorities of Botanical Survey of India, Northern Regional Centre, Dehradun (BSD), Forest Research Institute (DD), Dehradun, Botanical Survey of India, Sikkim Circle, Gangtok (SHC) and Central National Herbarium (CAL), Kolkata for permission and help with the herbarium.

LITERATURE CITED

Babu, C.R. 1977. Herbaceous Flora of Dehradun. Council of Scientific and Industrial Reaserch (CSIR), New Delhi.

Bor, N.L. 1941. Some Common U.P. Grasses. Indian For. Rec. n.s. Bot. **2**: 1–220.

臺灣大學學術期刊資料庫

Bor, N.L. 1948. New species of Poa from India, Burma and Tibet. Kew Bull. **3(1)**: 138–144.

Bor, N.L. 1951. What Is Poa himalayana Nees? Kew Bull. **6** (2):181–186.

Bor, N.L. 1952. The genus *Poa* L. in India, Part I. J. Bomb. Nat. Hist. Soc. **50**: 787–838.

Bor, N.L. 1960. The Grasses of Burma, Ceylon, India and Pakistan (Excluding Bambuseae). Pergamon Press, London. 767 pp.

Bor, N.L. 1970. *Poa* L. In: Rechinger K.H. (ed.), Flora Iranica **70**: 20–46. Graz, Austria: Akademische Druck - u. Verlagsanstalt.

Cabi, E. and M. Doğan. 2012. Poaceae. In: Guner, A. *et al*. (eds.), Turkiye Bitkileri Listesi. Nezahat Gokyigit Botanik Bahcesi ve Flora Araştırmaları DernegiYayını, Istanbul.

Chen, S. *et al.* 2006. *Poa* L. In: www.eFloras.org Flora of China. Published on the Internet.
http://www.efloras.org/flora_page.aspx?flora_id=2 /accessed on 05.06. 2016.

Chowdhery, H.J. and B.M. Wadhwa. 1984. *Poa* L. Flora of Himachal Pradesh, 3:834–842. Botanical Survey of India (BSI), Howrah, India.

Chwedorzewska, K.J. 2008. *Poa annua* L. in Antarctic: searching for the source of introduction. Polar Biol. **31(3)**: 263–268.

Clausen, J. 1961. Introgression facilitated by apomixis in polyploidy Poas. Euphytica **10(1)**: 87–94.

Clayton, W.D. and S.A. Renvoize. 1986. Genera Graminum: Grasses of the World. London, UK. Kew Bulletin, Additional Series **13**: 1–389.

Clayton, W.D., M.S. Vorontsova, K.T. Harman and H. Williamson. 2006. Grass Base - The Online World Grass Flora. http://www.kew.org/data/grasses-db.html/ accessed on Dec 2011.

Cope, T.A. 1982. Flora of Pakistan. No. 143. Poaceae. Karachi.

Cope, T.A. 1982. *Poa* L. In: www.eFloras.org Flora of Pakistan. Herbarium Royal Botanic Garden, Kew. Published on the Internet.
http://www.efloras.org/flora_page.aspx?flora_id=5 /accessed on 05.06. 2016.

Duthie, J.F. 1883. A list of the grasses of North-western India. Indigenous and cultivated. Roorkee.

Duthie, J.F. 1906. Catalogue of the Plants of Kumaon and of the Adjacent Portions of Garhwal and Tibet, based on the collections of Strachey and Winterbottom during the years 1846-1849. London.

Gaur, R.D. 1987. A contribution to the flora of Srinagar Garhwal. J. Econ. Tax. Bot. **9**: 31–63.

Gaur, R.D. and D.C. Nautiyal. 1995. *Poa kanaii* Rajbh. And *P. mustangensis* Rajbh. New Record to India from Garhwal Himalaya. J. Econ. Tax.Bot.1**9**: 469–471.

Gaur, R.D. and D.C. Nautiyal. 1996. Some Little known and Rare High Altitude Species of *Poa* from Garhwal Himalaya. J. Bomb. Nat. Hist. Soc. **93**: 324–327.

Gaur, R.D. and D.C. Nautiyal. 1997. *Poa nephelophila* Bor-A new Record to India from Garhwal Himalaya. J. Bomb. Nat. Hist. Soc. **94**: 601–602.

Gaur, R.D. 1999. Flora of the District Garhwal North West Himalaya (With Ethnobotanical Notes). Trans Media, Srinagar (Garhwal), Uttarakhand, India.

Gibbs Russell, L.W., M. Koekermoer, L. Smook, N.P. Barker, H.M. Anderson, and M.J. Dallwitz. 1990. Grasses of Southern Africa, Memoirs of the Botanical Survey of South. Africa **58**:1–9.

Gillespie, L.J. and R. Soreng. 2005. A phylogenetic analysis of the bluegrass genus *Poa* based on cpDNA restriction site data. Syst. Bot. **30(1)**: 84–105.

Gillespie, L.J., A. Archambault, and R. Soreng. 2007. Phylogeny of *Poa* (Poaceae) based on *trn*T-*trn*F sequences data, major clades and basal relationships. Aliso **23(1)**: 420–434.

Guanghua, Z., L. Liang, R.J. Soreng and M.V. Olonova. 2006. *Poa* L. In: Flora of China. 22: 257–309.

Hajra, P.K. and D.M. Verma. 1996. *Poa* L. In Flora of Sikkim, 1: 300–303. Botanical Survey of India (BSI), Calcutta.

Hooker, J. D. 1896. *Poa* L. Flora of British India, **7**: 337-346. Reeve and Co., London, UK.

Hunziker, J.H. and G.L. Stebbins. 1987. Chromosomal evolution in the Gramineae. In: Soderstrom, T.R. *et al*. (eds.), Grass Systematic and Evolution, pp. 179–187. Smithsonian Institution Press, Washington DC, USA.

Jain, S. K. and R.R. Rao. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow, New Delhi.

Kala, S.P. and R.D. Gaur. 1982. A contribution to the flora of Gopeswar (Chamoli Garhawal), U.P. In: G.S. Paliwal (ed.), The vegetational Wealth of the Himalayas, pp. 347–413. Puja Publ., Delhi, India.

Kandwal, M. K., P. Richa and B.K. Gupta. 2003. *Poa arnoldii* Melderis - a new record from India. Ind. J. Forestry **26(3)**: 320–329.

Kandwal, M.K. and B.K. Gupta. 2009. An update of grass flora of Uttrakhand. Ind. J. Forestry **32**: 657–668.

Karthikeyan, S., S.K. Jain, M.P. Nayar, and M. Sanjappa. 1989. Florae Indicae Enumeratio: Monocotyledonae. Botanical Survey of India (BSI), Howrah, India. pp. 248–251.

Kavousi, M., M. Assadi, and T. Nejadsattari. 2015. Taxonomic revision of the genus *Poa* L. in Iran, new additions to Flora Iranica, and a new identification key. Tur. J. Bot. **39**: 105–127.

McNeill, J. *et al*. 2012. International Code of Nomenclature for algae, fungi, and plants (Melbourne Code). Regnum Vegetabile 154. A.R.G. Gantner Verlag KG, Ruggell, Liechtenstein. ISBN 978-3-87429-425-6. Available at http://www.iapt-taxon.org/nomen/main.php

Murti, S.K. 2001. *Poa* L. Flora of Cold Deserts of Western Himalaya. **1**: 367–388. Botanical Survey of India (BSI), Calcutta.

Naithani, B.D. 1985. *Poa* L. Flora of Chamoli, **2**: 748–750. Botanical Survey of India (BSI), Howrah, India.

Nautiyal, D.C. and R.D. Gaur. 1999a. A New Species of *Poa* L., Poaceae, from Garhwal Himalaya, India. J. Bomb. Nat. Hist. Soc. **96(2)**: 285–287.

Nautiyal, D. C. and R. D. Gaur. 1999b. *Poa harae* Rajbh. A new record to India from Garhwal Himalaya. J. Bomb. Nat. Hist. Soc. **92(2)**: 359–361.

Nayar, M.P. 1996. Hot Spots of Endemic plants of India, Nepal and Bhutan. Tropical Botanical Garden and Reseach Institute, Palode, Trivandrum.

Noltie, H.J. 2000. Flora of Bhutan: The Grasses of Bhutan, **3(2)**: 549–572. Royal Botanic Garden Edenburgh and Royal Government of Bhutan.

臺灣大學學術期刊資料庫

Pandit, M.K., N.S. Sodhi, L.P. Koh, A. Bhaskar and B.W. Brook. 2007. Unreported yet massive deforestation driving loss of endemic Biodiversity in Indian Himalaya. Biodiv. Conserv. **16(1)**: 153–163.

Pangtey, Y.P. S., S.S. Samant and G.S. Rawat. 1988. Contribution to the Flora of Pithoragarh District (Kumaon Himalaya). Himalayan Res., Dev. **7 (I and II)**: 24-26.

Press, J.R., K.K. Shrestha and D.A. Sutton. 2000. *Poa* L. In: www. Efloras. org**.** Annotated Checklist of the Flowering Plants of Nepal. Natural History Museum, London. Published on the Internet.
http://www.efloras.org/flora_page.aspx?flora_id=110/accessed on 05.06. 2016.

The Plant List. 2013. Version 1.1. Published on the Internet; http://www.theplantlist.org/ accessed on 23.05. 2016.

Raizada, M.B., S.K. Jain and K.N. Bahadur. 1983. Grasses of the Upper Gangetic Plain Part III (Pooideae). Jugal kishore and Co., Dehradun. pp.1–123.

Rajbhandari, K.R. and J.R. Edmondson. 1990. *Poa royleana* (Gramineae), a little-known species from western Himalaya. Kew Bull.**45 (2)**: 345–349.

Rajbhandari, K.R. 1991. A Revision of the genus Poa L. (Gramineae) in the Himalaya. In:Ohba and Malla (eds.), The Himalayan Plants, **2**:169–261. University of Tokyo Press.

Rau, M.A. 1961. Flowering Plants and Ferns of North Garhwal, U.P. India. Bull. Bot. Surv. Ind.**2**: 61–94.

Semwal, J.K. and R.D. Gaur. 1981. Alpine flora of Tungnath in Garhwal Himalaya. J. Bomb. Nat. Hist. Soc.**78**: 498-512.

Sharma, M.P. and R.D. Gaur. 1983. Contribution to the Flora of Pokhri block, Chamoli Garhwal. Ind. J. Forestry **6**: 149-153; **7**: 57–62.

Soreng, R.J., L.M. Giussani, and M.A. Negritto. 2003. *Poa* L. In: Soreng, R. J., Peterson, P. M., Davidse, G., Judziewicz, E. J., Zuloaga, F. O., Filgueiras, T. S., and Morrone, O. (eds.) Catalogue of New World grasses (Poaceae): IV. Subfamily Pooideae. **48**: 505−580. Contributions from the United States National Herbarium 48:1–730.

Soreng, R.J., L.J. Gillespie and S.W.L. Jacobs. 2009. *Saxipoa* and *Sylvipoa*- two new genera and a new classification for Australian *Poa* (Poaceae: Poinae). Austral Syst. Bot. **22(6)**: 401–412.

Soreng R.J., G. Davidse, P.M. Peterson, F.O. Zuloaga, E.J. Judziewicz, T.S. Filgueiras and O. Morrone. 2011. A World-wide Phylogenetic Classification of Poaceae (Gramineae).Published on the Internet.
http://www.tropicos.org/projectwebportal.aspx.

Soreng, R.J. and P.M. Peterson. 2012. Revision of *Poa* L. (Poaceae, Pooideae, Poeae, Poinae) in Mexico: new records, re-evaluation of *P. ruprechtii*, and two new species, *P. palmeri* and *P. wendtii*. PhytoKeys **15**: 1–104.

Stapf, O. 1896. *Poa*. In: Hooker, J.D. (ed.) Flora of British India. **7**: 337–346. L. Reeve and Co., London.

Stebbins, G.L. 1950. Variation and Evolution in Plants. Columbia University Press, New York, USA.

Stewart, R.R. 1945. The Grasses of North-west India. Brittonia **5(4)**: 404–468.

Tzvelev, N.N. 1983. *Poa* L. In: Tzvelev, (ed.), Grasses of the Soviet Union, **1**: 649–722 (translated from the Russian edition of 1976). Oxonian Press Pvt. Ltd., New Delhi.

Uniyal, B. P., B. Balodi and B. Nath. 1994. The Grasses of Uttar Pradesh A Checklist. Bishen Singh Mahendra Pal Singh, Dehradun.

Uniyal, B.P., J. R. Sharma, U. Choudhery and D.K. Singh. 2007. Flowering plants of Uttarakhand (a check list). Bishen Singh Mahendra Pal Singh, Dehradun. 404 pp.

臺灣大學學術期刊資料庫

Appendix 1. Distribution of ***Poa*** taxa in Uttarakhand region.

Sl. No.	Species Name	Distribution in Uttarakhand	Altitude (m)
1	*P. aitchisonii*	C-1	3300
2	*P. alpigena*	U-2	5000
3	*P. alpina*	P-3	3800-4500
4	*P. annua*	C- 4, G-4,U- 4	600-3500
5	*P. arnoldii*	R-5	5000-5600
6	*P. attenuata*	U-6	4000-5000
7	*P. bacterina*	U-7	4000-5000
8	*P. bulbosa*	U-8	5000
9	*P. burmanica*	R-9	3000
10	*P. eleanorae*	C-10	3000-3300
11	*P. falconeri*	C-11, U-11	3000-3500
12	*P. gammiena*	U-12	3600-4000
13	*P. garhwalensis*	C-13	4000
14	*P. harae*	U-14	4600-4800
15	*P. himalayana*	C-15, U-15	3000-3500
16	*P. hirtiglumis*	U-16	3500-4000
17	*P. hylobates*	P-17	3600-4000
18	*P. infirma*	U-18	3000-3400
19	*P. jaunsarensis*	U-19	3000-4000
20	*P. kanaii*	U-20	4500
21	*P. khasiana*	U-21	3900
22	*P. koelzii*	U-22	3500-4000
23	*P. lahulensis*	U-23	3000-4000
24	*P. mustangensis*	U-24	4500-5000
25	*P. nemoralis*	C-25, G-25, U-25	1900-3000
26	*P. nepalensis*	U-26	3300
27	*P. nephelophila*	U-27	3300-3500
28	*P. pagophila*	U-28	3500-4000
29	*P. palustris*	C-29	3100-3300
30	*P. polycolea*	C-30	3000-3800
31	*P. poophagorum*	P-31	3100-3600
32	*P. pratensis* ssp. *angustifolia*	C-32b, U-32b, P32b	3300-4000
32	*P. pratensis* ssp. *pratensis*	P-32a	3500-4000
33	*P. pseudoamoena*	P-33	3000-3800
34	*P. rhadina*	U-34	3500-4000
35	*P. royleana*	U-35	3000-3300
36	*P. setulosa*	C-36	3000-3500
37	*P. sikkimensis*	U-37	3100-3600
38	*P. stapfiana*	U-38	3500
39	*P. sterilis*	U-39	3150
40	*P. stewartiana*	U-40	2400-3000
41	*P. supina*	C-41	2800-3500
42	*P. tibetica*	C-42	3500-4800
43	*P. tibeticola*	P-43	2800-3000
44	*P. trivialis*	P-44	1800-2200
45	*P. versicolor* subsp.*araratica*	P-45	3000-3500

C= Chamoli District; **U**=Uttarkashi District; **P**=Pithoragarh District; **G**=Garhwal District; **R**=Rudrapryag District.

臺灣大學學術期刊資料庫